APPENDIX D

GEOTECHNICAL REPORT

Geotechnical Engineering Report

Proposed New Classroom and Administration Building
Los Alamitos High School
3591 W. Cerritos Avenue
Los Alamitos, California

December 28, 2018
Terracon Project No. 60185158

Prepared for:
Los Alamitos Unified School District
Los Alamitos, California

Prepared by:
Terracon Consultants, Inc.
Tustin, California

December 28, 2018

Terracon

Los Alamitos Unified School District
10652 Reagan Street
Los Alamitos, CA 90720

Attn: Mr. John Eclevia
Director of Facilities, Maintenance, Operations and Transportation
P: (562) 799-4592
E: jeclevia@losal.org

Re: Geotechnical Engineering Report
Proposed New Classroom and Administration Building
Los Alamitos High School
3591 W. Cerritos Avenue
Los Alamitos, California 90720
Terracon Project No. 60185158

Dear Mr. Eclevia,

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the above referenced project. These services were performed in general accordance with our proposal for engineering services, P60185158 dated August 24, 2018.

This geotechnical engineering report presents the results of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations, floor slabs, infiltration systems and pavements for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

REGISTERED PROFESSIONAL ENGINEER
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EXECUTIVE SUMMARY

A geotechnical exploration has been performed for the proposed new classroom and administration building to be located within the campus of Los Alamitos High School at 3591 West Cerritos Avenue, Los Alamitos, California. The proposed development will reside on the south side of the school near the northeast corner of West Cerritos Avenue and Norwalk Boulevard. Terracon's geotechnical scope of work included advancement of three (3) test borings to approximate depths of 21½ to 61½ feet below the ground surface (bgs), two (2) Cone Penetration Test (CPT) soundings to an approximate depth of 60 feet bgs and two (2) percolation testing to approximate depths of 5 and 10 feet bgs.

Based on the information obtained from our subsurface exploration, the site is considered suitable for development of the proposed project provided our geotechnical engineering recommendations are implemented in the design and construction phases of the project. The following geotechnical considerations were identified:

- The on-site subsurface materials consisted of predominantly lean clay with varying amounts of silt and sand extending to the maximum depth explored at 61½ feet bgs. Interbedded layers of sand with variable amounts of clay and silt, and sandy silt were encountered between the approximate depths of 35 and 55 feet bgs.
- Groundwater was encountered at a depth of 28 feet bgs during the field explorations for this project. Historic high groundwater depth is 7.3 feet bgs.
- Liquefaction potential analyses were performed from depths of 0 to 50 feet bgs using CPT soundings CPT-1 and CPT-2. Based on the subsurface conditions presented in the CPTs and our calculations, seismically-induced settlements of saturated and unsaturated sands are expected to be between 0.5 and 0.7 inch and seismically-induced differential settlements are expected to be less than of 0.5 inch in a 40-foot distance.
- The subsurface profile beneath the proposed building include a relatively thick soft clay layer that is expected to undergo significant settlement when loaded with typical foundation contact pressures. We have performed the settlement analysis of shallow foundation using Westergaard and Hough's method. Our analyses indicate foundation settlement values higher than 1 inch for foundation widths larger than 4 feet with a contact pressure of 1,500 psf.
- Due to the anticipated seismic induced settlement and static settlement, the proposed building should be supported by a drilled shaft foundation system. As an alternative to the drilled shaft foundation systems, we recommend that the subsurface soils be improved and densified by rammed aggregate pier (RAP) systems. The proposed building may be supported by shallow foundations in the event RAP systems are utilized.
- Due to their expansion potential, on-site clayey soils are not considered suitable to be used as engineered fill in structural areas. However, if the on-site clayey soils are blended with imported materials, these blended materials may be used as engineered fill provided the blended materials meet the low volume change materials specifications provided in this report.
- The 2016 California Building Code (CBC) seismic site classification for this site is E.
- Earthwork on the project should be observed and evaluated by Terracon. The evaluation of earthwork should include observation and testing of engineered fill, subgrade preparation, foundation bearing soils, and other geotechnical conditions exposed during construction.

This geotechnical executive summary should be used in conjunction with the entire report for design and/or construction purposes. It should be recognized that specific details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled General Comments should be read for an understanding of the report limitations.

GEOTECHNICAL ENGINEERING REPORT
PROPOSED NEW CLASSROOM AND ADMINISTRATION BUILDING
LOS ALAMITOS HIGH SCHOOL
3591 W. CERRITOS AVENUE
LOS ALAMITOS, CALIFORNIA

Terracon Project No. 60185158
December 28, 2018

1.0 INTRODUCTION

This report presents the results of our geotechnical engineering services performed for the proposed new classroom and administration building to be located within the campus of Los Alamitos High School at 3591 West Cerritos Avenue in Los Alamitos, Orange County, California. The Site Location Plan (Exhibit A-1) is included in Appendix A of this report. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- earthwork
- seismic considerations
- pavement design and construction
- groundwater conditions
- foundation design and construction
- floor slab design and construction
- Infiltration systems design and construction

Our geotechnical engineering scope of work for this project included the advancement of three (3) test borings to approximate depths of 21½ to 61½ feet bgs, two (2) CPT soundings to approximate depth of 60 feet bgs and two (2) percolation testing to approximate depths of 5 and 10 feet bgs.

Logs of the borings and CPT soundings along with a Boring Location Diagram (Site Geologic Map, Exhibit A-2) are included in Appendix A of this report. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included in Appendix B of this report. Descriptions of the field exploration and laboratory testing are included in their respective appendices.

2.0 PROJECT INFORMATION

2.1 Project Description

ITEM	DESCRIPTION
Site layout	Refer to the Boring Location Plan (Site Geologic Map, Exhibit A-2 in Appendix A).
Structures	The proposed project will include a new three-story classroom and administration building. The building will include a combination of offices, science classrooms, and standard classrooms. Based on the provided site layout, the building will have an approximate footprint area of 22,350 square feet.
Building Construction	We assume the superstructure will consist of steel frame and masonry walls supported on a shallow foundation system.
Maximum loads (assumed)	■ Columns: 200 to 400 kips ■ Walls: 1 - 3 kips per linear foot (klf) ■ Slabs: 150 pounds per square foot (psf)
Grading	Minimal cut/fill – assumed to be less than one foot
Paving	It is anticipated that new asphalt and portland cement concrete pavements will be associated with surrounding parking lots and driveways/lanes. Assumed Traffic Index (TI) for 20-year design life: Automobile Parking Areas………………………………..4.5 Driveways and Fire Lanes……………………….............6.0

2.2 Site Location and Description

Item	Description
Location	The project is located within the campus of Los Alamitos High School at 3591 W. Cerritos Avenue, Los Alamitos, California. The proposed development will reside on the south side of the school near the northeast corner of West Cerritos Avenue and Norwalk Boulevard.
Existing site features	The project site is an existing high school that consists of multiple one to two story buildings with associated parking areas, playgrounds, and landscape. The footprint of the proposed building is partially occupied by an existing office building.
Surrounding Developments	North: Coyote Creek South: West Cerritos Avenue East: Residential and Humbolt Street West: Norwalk Boulevard
Current ground cover	Pavements, landscape area and concrete sidewalks
Existing topography (from Google Earth)	The project site is relatively flat, with an approximate elevation ranging between 28 and 30 feet above mean sea level.

3.0 SUBSURFACE CONDITIONS

3.1 Site Geology

The site is situated within the Peninsular Ranges Geomorphic Province in Southern California. Geologic structures within this Province trend mostly northwest, in contrast to the prevailing east-west trend in the neighboring Transverse Ranges Geomorphic Province to the north. The Peninsular Ranges Province extends into Lower California and is bounded by the Colorado Desert to the east, the Pacific Ocean to the west and the San Gabriel and San Bernardino mountains to the north. [1,2] The surficial geologic unit mapped at the site is mapped as young alluvial fan deposits[3] (Exhibit A-2 and A-5) of Holocene to Late Pleistocene age. This unit is described as unconsolidated to slightly consolidated, undissected to slightly dissected boulder, cobble, gravel, sand, and silt deposits issued from a confined valley or canyon. This surficial geologic unit is also mapped as young alluvium, Unit 2[4], of Holocene to Late Pleistocene age described as poorly consolidated, poor sorted, permeable flood-plain deposits consisting of soft clay, silt and loose to moderately dense sand and silty sand.

3.2 Typical Subsurface Profile

Specific conditions encountered at the boring locations are indicated on the individual boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in-situ, the transition between materials may be gradual. Details for the borings can be found on the boring logs included in Appendix A. The on-site subsurface materials consisted of predominantly lean clay with varying amounts of silt and sand extending to the maximum depth explored at 61½ feet bgs. Interbedded layers of sand with variable amounts of clay and silt, and sandy silt were encountered between the approximate depths of 35 and 55 feet bgs. Geologic cross sections are presented on Exhibits A-3 and A-4.

Laboratory tests were conducted on selected soil samples and the test results are presented in Appendix B and on the boring logs. Atterberg limits test results indicated that near-surface clayey soils have low to medium plasticity. A direct shear test was performed on silty clay with sand materials encountered at an approximate depth of 5 feet bgs and resulted in an ultimate friction angle of 29 degrees and a corresponding cohesion value of 138 pounds per square foot (psf). An expansion index (EI) test on near surface sandy lean clay soils indicates an expansion index of 34.

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[1] Harden, D. R., "*California Geology, Second Edition*," Pearson Prentice Hall, 2004.

[2] Norris, R. M. and Webb, R. W., *"Geology of California, Second Edition,"* John Wiley & Sons, Inc., 1990.

[3] California Geological Survey*, Geologic Compilation of Quaternary Surficial Deposits in Southern California, Special Report 217, Plate 8-Long Beach 30' x 60' Quadrangle,* compiled by P.D. Roffers and T. L. Bedrossian, dated July 2010.

[4] California Geological Survey, Geologic Map of the Long Beach 30' x 60' Quadrangle, California, Version 2.0, compiled by G.J. Saucedo, H.G. Greene, M.P. Kennedy, and S.P. Bezore, dated 2016.

3.3 Groundwater

Groundwater was encountered at an approximate depth of 28 feet bgs in the borings during the field explorations for this project. These observations represent groundwater conditions at the time of the field exploration and may not be indicative of other times, or at other locations.

In clayey soils with low permeability, the accurate determination of groundwater level may not be possible without long-term observation. Long-term observation after drilling could not be performed, as borings were backfilled immediately upon completion due to safety concerns. Groundwater levels can best be determined by implementation of a groundwater monitoring plan. Such a plan would include installation of groundwater monitoring wells, and periodic measurement of groundwater levels over a sufficient period of time.

Based on the Seismic Hazard Zone Report, the historical high groundwater in the project area is about 14 feet bgs (Exhibit A-6).[5] Based on the nearby groundwater monitoring wells, the highest groundwater in the project area is 7.3 feet bgs[6].

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the improvements may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

3.4 Oil and Gas Exploration

Oil and gas well location maps were reviewed to locate any wells or test holes on the property or nearby. Well information can be used to evaluate the subsurface geology and estimate potential hazards associated with well operations, subsidence, or related environmental issues.

According to well field map W1-6, published by the California Division of Oil, Gas and Geothermal Resources (DOGGR, 2018), the subject property is not located within an oil or gas field production area. The DOGGR online mapping system depicts three dry hole (plugged and abandoned) wells within 2 miles of the subject property (see Exhibit A-7). There are no active oil or gas wells within 5 miles of the property. There are no gas fields that exist in the area approximately 2 to 5 miles away from the subject property. The closest oil field (Seal Beach) is located approximately 3 miles southwest of the property. There are approximately 15 abandoned oil or gas wells located within 5 miles of the site (California Division of Oil, Gas, and Geothermal Resources, 2018)[7].

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[5] Department of Conservation, Division of Mines and Geology, Seismic Hazard Zone Report 019 for the Los Alamitos 7.5-Minute Quadrangle, Los Angeles and Orange Counties, California, 1998.

[6] Groundwater monitoring well MW-16 is located at 3501 W. Cerritos Avenue, Los Alamitos, California at a distance of about 300 feet southwest of the project site (www. http://geotracker.waterboards.ca.gov).

[7] California Division of Oil, Gas & Geothermal Resources (DOGGR), 2018, Well Finder, website: http://maps.conservation.ca.gov/doggr/index.html#close, and Map W1-6, dated 2005

3.5 Seismic Considerations

3.5.1 Seismic Site Class and Parameters

DESCRIPTION	VALUE
2016 California Building Code Site Classification (CBC) [1]	E
Site Latitude	33.8109° N
Site Longitude	118.0701° W
S_s Spectral Acceleration for a Short Period	1.532g
S_1 Spectral Acceleration for a 1-Second Period	0.559g
F_a Site Coefficient for a Short Period	0.900
F_v Site Coefficient for a 1-Second Period	2.400

Note: The 2016 California Building Code (CBC) requires a site soil profile determination extending to a depth of 100 feet for seismic site classification. The current scope does not include the required 100-foot soil profile determination. Borings were extended to a maximum depth of 61½ feet, and this seismic site class definition considers that similar or denser soils continue below the maximum depth of the subsurface exploration. Additional exploration to deeper depths would be required to confirm the conditions below the current depth of exploration.

3.5.2 Faulting and Estimated Ground Motions

The site is located in Southern California, which is a seismically active area. The type and magnitude of seismic hazards affecting the site are dependent on the distance to causative faults, the intensity, and the magnitude of the seismic event. The table below indicates the distance of the fault zones and the associated maximum credible earthquake that can be produced by nearby seismic events. The Newport-Inglewood fault zone displays right-lateral strike-slip relative movement, a maximum credible earthquake magnitude of 7.43, a slip rate of 1.0 mm/yr., and the nearest strand lies approximately 6.64 kilometers southwest of the subject site. The surface trace of this fault zone is discontinuous in the Los Angeles Basin, but the fault zone can easily be noted there by the existence of a chain of low hills extending from Culver City to Signal Hill. South of Signal Hill, it roughly parallels the coastline until just south of Newport Bay, where it heads offshore, and becomes the Newport-Inglewood-Rose Canyon fault. The most significant recent movement of the Newport-Inglewood fault zone with no apparent surface rupture occurred during the March 10, 1933 Moment Magnitude 6.4 earthquake; the epicenter of this earthquake is located about 12 miles southeast of the site. The Newport-Inglewood fault, which is located approximately 6.64 kilometers from the site, is considered to have the most significant effect at the site from a design standpoint.

The table below indicates the distance of the fault zones and the associated maximum credible earthquake that can be produced by nearby seismic events, as calculated using the USGS Unified Hazard Tool (unless otherwise noted).

Characteristics and Estimated Earthquakes for Regional Faults		
Fault Name	**Approximate Distance to Site (kilometers)[8]**	**Maximum Credible Earthquake (MCE) Magnitude[9]**
Newport-Inglewood alt 2 (LA Basin)	6.64	7.43
Lower Elysian Park	7[10]	6.7[11]
Anaheim	7.53	7.10
Compton	8.70	7.31
Puente Hills (Coyote Hills)	12.39	7.28
Puente Hills (Santa Fe Springs)	14.38	6.98
Puente Hills (Santa Fe Springs)	14.45	7.71
San Joaquin Hills Thrust	15[12]	6.6[11]
Puente Hills	16.42	7.39
Palos Verdes	18.46 [13[13]]	7.39
Whittier alt 1	19.72	7.05
Puente Hills (LA)	20.67	7.16
Upper Elysian Park	27[10]	6.4[11]
Newport-Inglewood (Offshore)	28[13]	7.1[11]
Chino-Central Avenue	40[13]	6.7[11]
Elsinore (Glen Ivy)	45[13]	6.8[11]
San Andreas (Mojave S)	71.89	8.08

Based on the USGS Design Maps Summary Report, using the American Society of Civil Engineers (ASCE 7-10) standard, the peak ground acceleration (PGA_M) at the project site is expected to be 0.508g. Based on the USGS Unified Hazard Tool, the project site has a mode magnitude of 6.63.

[8] Fault distances calculated from the USGS Unified Hazard Tool (2018), unless otherwise noted.

[9] MCE magnitudes calculated from the USGS Unified Hazard Tool (2018), unless otherwise noted.

[10] Fault distances estimated from measurements using Puente Hills Blind-Thrust System, Los Angeles, California by Shaw and others (2002): Bulletin of the Seismological Society of America, vol. 92, no. 8, pp. 2946-2960, and from Bilodeau, W.L., Bilodeau, S.W., Gath, E.M. Oborne, M., and Proctor, R.J., 2007, Geology of Los Angeles, California, United States of America: Environmental & Engineering Geoscience, Vol. XIII, No. 2, May 2007, pp. 99–160.

[11] Maximum moment magnitude calculated from relationships (rupture area) derived from Wells and Coppersmith (1994; values listed in Appendix A of Cao, T., Bryant, W.A., Rowshandel, B., Branum, D., and Wills, C.J., 2003, The revised 2002 California probabilistic seismic hazard maps, June 2003: California Geological Survey, 12 p., Appendix A.

[12] Estimated fault distance from Coastal Uplift of the San Joaquin Hills, Southern Los Angeles Basin, California, by a Large Earthquake since A.D. 1635 by Lisa B. Grant, Leslie J. Ballenger, and Eric E. Runnerstrom: Bulletin of the Seismological Society of America, Vol. 92, No. 2, pp. 590–599, March 2002.

[13] Fault distances estimated from measurements using the Fault Activity Map of California (Jennings and Bryant, 2010).

The site is not located within an Alquist-Priolo Earthquake Fault Zone based on our review of the State Fault Hazard Maps[14]. The nearest zoned fault segment is in the Newport-Inglewood Fault Zone located approximately 6.64 kilometers southwest of the site (Exhibit A-8). The Quaternary age Los Alamitos fault strand and pre-Quaternary age unnamed fault strand of this fault zone are within about 2 kilometers southwest and ¼ kilometer northeast, respectively, of the site (Exhibits A-5 and A-9).

3.5.3 Historic Earthquakes

Historically, the San Andreas Fault Zone Complex has rendered many earthquakes of the magnitude range of 5.0Mw or greater ('Mw' is the Moment Magnitude as defined by the USGS) that may have affected the project site. These major quakes have been estimated to be in the range of 5.0Mw to 6.6Mw. Each of these major quakes has rendered light to moderate damage to buildings and roads. For reference purposes, a summary of the significant (≥5.0Mw) earthquakes that affected the site (within 50 km) is provided below using the SCEC and USGS earthquake catalogue websites.

Date	Latitude (Degrees N)	Longitude (Degrees W)	Moment Magnitude (Mw)	Depth (km)
3/11/1933	33.631	117.999	6.4	6.0
3/11/1933	33.767	117.985	5.0	6.0
3/11/1933	33.624	118.001	5.3	6.0
11/14/1941	33.791	118.264	5.1	6.0
10/1/1987	34.061	118.079	5.9	8.9
10/4/1987	34.074	118.098	5.3	7.7
12/3/1988	34.151	118.130	5.0	13.8
7/29/2008	33.949	117.766	5.4	15.5
3/29/2014	33.932	117.916	5.1	5.1

3.5.4 Liquefaction Potential

Liquefaction is a mode of ground failure that results from the generation of high pore-water pressures during earthquake ground shaking, causing loss of shear strength. Liquefaction is typically a hazard where loose sandy soils exist below groundwater. The California Geologic Survey (CGS), formerly known as the California Division of Mines and Geology (CDMG) prior to 2001 and hereafter referred to as the California Geological Survey (CGS), has designated certain areas within southern California as potential liquefaction hazard zones. These are areas

[14] California Department of Conservation Division of Mines and Geology (CDMG), *"Digital Images of Official Maps of Alquist-Priolo Earthquake Fault Zones of California, Southern Region"*, CDMG Compact Disc 2000-003, 2000.

considered at a risk of liquefaction-related ground failure during a seismic event, based upon mapped surficial deposits and the presence of a relatively shallow groundwater table.

The project site is located within a liquefaction potential zone as indicated by the CGS. Based on the materials encountered at the project site, subsurface conditions encountered on the project site are predominantly lean clay with varying amounts of silt and sand extending to the maximum depth explored at 61½ feet bgs. Interbedded layers of sand with variable amounts of clay and silt, and sandy silt were encountered between the approximate depths of 35 and 55 feet bgs. The historical high groundwater depth of 7.3 feet is considered for the liquefaction analysis.

Liquefaction analysis for the site was performed in general accordance with the DMG Special Publication 117. The liquefaction study utilized the software “LiquefyPro” by CivilTech Software. This analysis was based on the soils data from CPT-1 and CPT-2. Peak Ground Acceleration (PGA) of 0.508g was used. Calculations utilized a historically high groundwater depth of 7.3 feet. The CPT calculations were performed using the Robertson et al method which includes fine correction for liquefaction and settlement. Settlement analysis used the Tokimatsu, M-correction method. The liquefaction potential analysis was calculated from depths of 0 to 50 feet bgs. The liquefaction potential analysis is attached in Appendix D of this report.

Based on the subsurface conditions presented in the CPTs and based on the calculation results, seismically-induced settlements of saturated and unsaturated sands are expected to be between 0.5 and 0.7 inch and seismically-induced differential settlements are expected to be less than of 0.5 inch in a 40-foot distance.

3.6 Percolation Test Results

Two (2) in-situ percolation tests (using falling head borehole permeability) were performed to approximate depths of 5 and 10 feet below the ground surface (bgs). A 2-inch thick layer of gravel was placed at the bottom of each boring after the borings were drilled to investigate the soil profile. A 3-inch diameter perforated pipe was installed on top of the gravel layer in each boring. Gravel was used to backfill between the perforated pipes and the boring sidewall. The borings were then filled with water for a pre-soak period. Testing began after all the water had percolated through the test hole. At the beginning of each test, the pipes were refilled with water and readings were taken at ½-hour time intervals. Percolation rates are provided in the following table:

Test Location (depth, feet)	Soil Classification	Percolation Rate (in/hr.)	Correlated Infiltration Rate* (in/hr.)	Average Water Head (inches)
P-1 (5-10)	Lean Clay	0.5	< 0.1	65
P-2 (0-5)	Lean Clay	1.2	< 0.1	46

*If proposed infiltration system will mainly rely on vertical downward seepage, the correlated infiltration rates should be used. The correlated infiltration rates were calculated using the Porchet method.

Based on the correlated infiltration rates, it is our opinion that infiltration is not feasible onsite from a geotechnical standpoint.

The field test results are not intended to be design rates. They represent the result of our tests, at the depths and locations indicated, as described above. The design rate should be determined by the designer by applying an appropriate factor of safety. The designer should take into consideration the variability of the subsurface soils when selecting appropriate design rates. With time, the bottom of infiltration systems tend to plug with organics, sediments, and other debris. Long-term maintenance will likely be required to remove these deleterious materials to help reduce decreases in actual percolation rates.

The percolation test was performed with clear water, whereas the storm water will likely not be clear, but may contain organics, fines, and grease/oil. The presence of these deleterious materials will tend to decrease the rate that water percolates from the infiltration systems. Design of the storm water infiltration systems should account for the presence of these materials and should incorporate structures/devices to remove these deleterious materials.

Based on the soils encountered in our borings, we expect the percolation rates of the soils could be different than measured in the field due to variations in fines and gravel content. The design elevation and size of the proposed infiltration system should account for this expected variability in infiltration rates.

If infiltration systems are still planned for the site despite the very low infiltration rates, infiltration testing should be performed after construction of the infiltration system to verify the design infiltration rates. It should be noted that siltation and vegetation growth along with other factors may affect the infiltration rates of the infiltration areas. The actual infiltration rate may vary from the values reported here. Infiltration systems should be located at least 10 feet from any existing or proposed foundation system.

3.7 Inundation by Tsunami and Seiches

Tsunamis, often incorrectly called tidal waves, are long period waves of water usually caused by underwater seismic disturbances, volcanic eruptions, or submerged landslides. The site is not within a tsunami inundation area according to the State of California tsunami inundation map[15]. Therefore, tsunamis are not a potential hazard. A seiche is an oscillation of a body of water in an enclosed or semi-enclosed basin that varies in period. Seiches are often caused by tidal currents, landslides, earthquakes, and wind. There are no bodies of water adjacent to the site. Therefore, a seiche is not a potential inundation hazard.

[15] California Emergency Management Agency and California Geological Survey, 2009, Tsunami Inundation Map for Emergency Planning, State of California, County of Orange, Los Alamitos Quadrangle, Seal Beach Quadrangle, scale 1:24,000.

3.8 Flood Hazard

According the Federal Emergency Management Agency Flood Insurance Map (FIRM, 2009), the site is within a zone designated as “Other Flood Areas-Zone X: Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood” (Exhibit A-10). The site is approximately 1,250 feet south of a zone of Special Flood Hazard Areas Subject to Inundation by the 1% Annual Chance Flood (100-year flood), Zone A which is defined as “No Base Flood Elevations determined”.

3.9 Subsidence

Subsidence of the land surface, as a result of the activities of man, has been occurring in California for many years. Subsidence can be divided, on the basis of causative mechanisms, into four types: groundwater withdrawal subsidence, hydrocompaction subsidence, oil and gas withdrawal subsidence, and peat oxidation subsidence (CDMG, 1973[16]).

The United States Geological Survey (USGS Fact Sheet 165-00, Land Subsidence in the United States, 2000, and Areas of Land Subsidence in California, 2018[17]) indicates that the subject site lies within an area of groundwater withdrawal subsidence. The site is not within the area of any of the remaining three types of subsidence.

3.10 Corrosion Potential

Results of soluble sulfate testing indicate that ASTM Type I/II Portland cement may be used for all concrete on and below grade. Foundation concrete may be designed for expose Class S0 in accordance with the provisions of the ACI Design Manual, Section 318, Chapter 19.

Laboratory test results indicate the on-site soils have a pH value of 8.35, minimum resistivity of 3,104 ohm-cm, chloride content of 97 mg/kg, water soluble sulfate content of 0.01%, Red-Ox potential of +684 mV, and negligible sulfides, as shown on the attached Results of Corrosivity Analysis sheet in Appendix B.

Refer to the Results of Corrosivity Analysis in Appendix B for the complete results of the corrosivity testing conducted in conjunction with this geotechnical exploration.

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[16] California Division of Mines and Geology (CDMG), 1973, Urban Geology Master Plan for California, Bulletin 198, p. 43-48.
[17] U.S. Geological Survey (USGS), 2018, Areas of Land Subsidence in California, website: https://ca.water.usgs.gov/land_subsidence/california-subsidence-areas.html.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

The site appears suitable for the proposed construction based upon geotechnical conditions encountered in the test borings, provided our recommendations are implemented on the design and construction phases of the project.

The subsurface profile beneath the proposed building includes a relatively thick soft clay layer that is expected to undergo significant settlement when loaded with typical foundation contact pressures. We have performed the settlement analysis of shallow foundation using Westergaard and Hough's method. Our analyses indicate foundation settlement values higher than 1 inch for foundation widths larger than 4 feet with a contact pressure of 1,500 psf.

Due to the anticipated seismic induced settlement and static settlement, the proposed building may be supported by the following alternative foundation systems:

- drilled shaft foundation system.
- Shallow foundations supported on rammed aggregate pier (RAP) systems.

Due to their expansion potential, on-site clayey soils are not considered suitable to be used as engineered fill in structural areas. However, if the on-site clayey soils are blended with imported materials, these blended materials may be used as engineered fill provided the blended materials meet the low volume change materials specification presented in Section 4.2.3.

Expansive soils are present on this site. This report provides recommendations to help mitigate the effects of soil shrinkage and expansion; however, even if these procedures are followed, some movement and at least minor cracking in the structure should be anticipated. The severity of cracking and other cosmetic damage such as uneven floor slabs will probably increase if any modification of the site results in excessive wetting or drying of the expansive soils. Eliminating the risk of movement and cosmetic distress may not be feasible, but it may be possible to further reduce the risk of movement if significantly more expensive measures are used during construction. We would be pleased to discuss other construction alternatives with you upon request.

Estimated movements described in this report are based on effective drainage for the life of the structure and cannot be relied upon if effective drainage is not maintained. Exposed ground, extending at least 10 feet from the perimeter, should be sloped a minimum of 5% away from the building to provide positive drainage away from the structure. Grades around the structure should be periodically inspected and adjusted as part of the structure's maintenance program.

Geotechnical engineering recommendations for foundation systems and other earth-connected phases of the project are outlined below. The recommendations contained in this report are based upon the results of field and laboratory testing (which are presented in Appendices A and B), engineering analyses, and our current understanding of the proposed project.

4.2 Earthwork

The following presents recommendations for site preparation, excavation, subgrade preparation and placement of engineered fills on the project. The recommendations presented for the design and construction of earth supported elements including, foundations, slabs, and pavements, are contingent upon following the recommendations outlined in this section.

Earthwork on the project should be observed and evaluated by Terracon. The evaluation of earthwork should include observation and testing of engineered fill, subgrade preparation, foundation bearing soils, and other geotechnical conditions exposed during the construction of the project.

4.2.1 Site Preparation

Strip and remove existing demolition debris, pavements, vegetation, and other deleterious materials from the outline of the proposed buildings and pavement areas. This should include the removal of all existing asphalt concrete, buried concrete slabs, and buried footings that may exist within the area of the proposed construction. Exposed surfaces should be free of mounds and depressions, which could prevent uniform compaction.

Demolition of the existing buildings should include complete removal of all foundation systems and remaining underground utilities within the proposed construction area. This should include removal of any loose backfill found adjacent to existing foundations. All materials derived from the demolition of existing structures and pavements should be removed from the site and not be allowed for use as on-site fill. However, if the contractor desires to crush on-site pavements and concrete and use these materials as engineered fill, the crushed materials should be evaluated in accordance to section 4.2.3 of the report.

Although evidence of utilities or underground facilities was not observed during the site reconnaissance, such features could be encountered during construction. If encountered, abandoned underground utilities and facilities should be removed and the excavation thoroughly cleaned prior to backfill placement and/or construction.

4.2.2 Subgrade Preparation

Due to the anticipated seismic induced settlement and static settlement, the proposed building may be supported by drilled shaft foundation system or shallow foundation supported on RAP system. Grading for the proposed building should incorporate the limits of the building plus a lateral distance of 3 feet beyond the outside edge of the foundation perimeter, where possible.

If RAP alternative is selected, the upper 24 inches beneath the shallow foundations should be overexcavated and replaced with low volume change import materials. It is the contractor's responsibility to ensure that the excavation subgrade is firm and unyielding. If loose or yielding conditions are encountered, such areas should be properly cleared, scarified, moisture conditioned and compacted in accordance with the compaction requirements outlined in Section 4.2.3.

The upper 24 inches of materials below the proposed floor slabs on grade should be over-excavated and backfilled with low volume change imported materials. The floor slabs should be structurally independent of building footings or walls to reduce the possibility of slab cracking caused by differential movements between the drilled shafts or shallow foundations supported on RAP system and floor slabs on grade.

The over-excavation bottom, once properly cleared, should be scarified to a minimum depth of 10 inches, moisture conditioned, and compacted per the compaction requirements in Section 4.2.4. The over-excavation should then be backfilled up to the footing base elevation with engineered fill placed in lifts of 8 inches or less in loose thickness and should be moisture conditioned and compacted following the recommendations in section 4.2.4 of this report

Subgrade materials beneath exterior slabs, pavement, and flatwork should be scarified, moisture conditioned, and compacted to a minimum depth of 10 inches. The moisture content and compaction of subgrade soils should be maintained until flatwork construction.

4.2.3 Fill Materials and Placement

All fill materials should be inorganic soils free of vegetation, debris, and fragments larger than three inches in size. Pea gravel or other similar non-cementitious, poorly-graded materials should not be used as fill or backfill without the prior approval of the geotechnical engineer.

Onsite subsurface soils are comprised of clay soils. Due to their anticipated expansion potential, these near surface clay soils are not considered suitable for use as engineered fill in structural areas. However, if the on-site clayey soils are blended with imported materials, these blended materials may be used as engineered fill provided the blended materials meet the low volume change materials specification. Imported soils or blended soils meeting the low volume change materials specifications should only be used as engineered fill materials in the following areas:

- foundation support
- interior slab areas
- foundation backfill

Imported or blended or on-site soils (including clayey soils) may be used in the following areas:

- general site grading
- exterior slab areas
- pavement areas

Imported soils and blended soils should conform to low volume change materials as indicated in the following specifications:

Gradation	Percent Finer by Weight (ASTM C 136)
3”	100
No. 4 Sieve	50 to 100
No. 200 Sieve	10 to 40

- Liquid Limit .... 30 (max)
- Plasticity Index .... 15 (max)
- Maximum expansive index* .... 20 (max)

*ASTM D 4829

Engineered fill should be placed and compacted in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift. Fill lifts should not exceed ten inches loose thickness.

4.2.4 Compaction Requirements

Recommended compaction and moisture content criteria for engineered fill materials are as follows:

Material Type and Location	Per the Modified Proctor Test (ASTM D 1557)		
	Minimum Compaction Requirement	Range of Moisture Contents for Compaction Above Optimum	
		Minimum	Maximum
Imported or blended low volume change materials:			
Beneath shallow foundations:	90%	-1%	+4%
Foundation Backfill:	90%	-1%	+3%
Beneath slabs:	90%	-1%	+4%
On-site soils (including clayey soils) or imported materials:			
Utility trenches*:	90%	-1%	+4%
Beneath pavements:	95%	-1%	+4%
Bottom of excavation to receive fill:	90%	-1%	+4%
Miscellaneous backfill:	90%	-1%	+4%
Aggregate base (beneath pavements):	95%	-2%	+2%

* Upper 12 inches should be compacted to 95% within pavement areas. In structural areas, upper 24 inches should comprise of low volume change import materials compacted to 95%.

4.2.5 Grading and Drainage

Positive drainage should be provided during construction and maintained throughout the life of the development. Infiltration of water into utility trenches or foundation excavations should be prevented during construction. Planters and other surface features, which could retain water in areas adjacent to the building or flatwork should be sealed or eliminated. In areas where sidewalks or paving do not immediately adjoin the structure, we recommend that protective slopes be provided with a minimum grade of approximately 5 percent for at least 10 feet from perimeter walls.

Backfill against footings, exterior walls, and in utility and sprinkler line trenches should be well compacted and free of all construction debris to reduce the possibility of moisture infiltration. We recommend a minimum horizontal setback distance of 10 feet from the perimeter of any building and the high-water elevation of the nearest storm-water retention basin.

Roof drainage should discharge into splash blocks or extensions when the ground surface beneath such features is not protected by exterior slabs or paving. Sprinkler systems and landscaped irrigation should not be installed within 5 feet of foundation walls.

4.2.6 Exterior Slab Design and Construction

Exterior slabs-on-grade, exterior architectural features, and utilities founded on, or in backfill may experience some movement due to the volume change of the backfill. To reduce the potential for damage caused by movement, we recommend:

- exterior slabs should be supported directly on subgrade fill with no, or very low expansion potential;
- strict moisture-density control during placement of subgrade fills;
- maintain proper subgrade moisture until placement of slabs;
- placement of effective control joints on relatively close centers and isolation joints between slabs and other structural elements;
- provision for adequate drainage in areas adjoining the slabs;
- using of designs which allow vertical movement between the exterior slabs and adjoining structural elements

4.2.7 Utility Trenches

It is anticipated that the on-site soils will provide suitable support for underground utilities and piping that may be installed. Any soft and/or unsuitable material encountered at the bottom of excavations should be removed and be replaced with an adequate bedding material. A non-expansive granular material with a sand equivalent greater than 30 is recommended for bedding and shading of utilities, unless otherwise allowed by the utility manufacturer.

On-site materials are considered suitable for backfill of utility and pipe trenches in non-structural areas from one foot above the top of the pipe to the final ground surface, provided the material is free of organic matter and deleterious substances. Low volume change import materials should be used in structural areas.

Trench backfill should be mechanically placed and compacted as discussed earlier in this report. Compaction of initial lifts should be accomplished with hand-operated tampers or other lightweight compactors. Where trenches are placed beneath slabs or footings, the backfill should satisfy the gradation and expansion index requirements of engineered fill discussed in this report. Flooding or jetting for placement and compaction of backfill is not recommended.

4.2.8 Construction Considerations

It is anticipated that excavations for the proposed construction can be accomplished with conventional earthmoving equipment. On-site soils may pump or become unworkable at high water contents. The workability of the subgrade may be affected by precipitation, repetitive construction traffic or other factors. Workability may be improved by scarifying and drying. Lightweight excavation equipment may be required to reduce subgrade pumping. Should unstable subgrade conditions develop stabilization measures will need to be employed.

At the time of our study, moisture contents of the surface and near-surface native soils ranged from about 4 to 17 percent. Based on these moisture contents, some moisture conditioning may be needed for the project. The soils may need to be dried by aeration during dry weather conditions, or an additive, such as lime, cement, or kiln dust, may be needed to stabilize the soil. If the construction schedule does not allow for drying by aeration, clay soils may be stabilized using multiaxial geogrid and coarse aggregate materials.

Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content prior to construction of floor slabs and pavements. Construction traffic over the completed subgrade should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompacted prior to floor slab and pavement construction.

The geotechnical engineer should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation, proof-rolling, placement and compaction of controlled compacted fills, backfilling of excavations to the completed subgrade.

The exposed subgrade and each lift of compacted fill should be tested, evaluated, and reworked, as necessary, until approved by the geotechnical engineer's representative prior to placement of additional lifts. We recommend that each lift of fill be tested for density and moisture content at a frequency of one test for every 2,500 square feet of compacted fill in the building areas and 5,000 square feet in pavement areas. We recommend one density and moisture content test for every 50 linear feet of compacted utility trench backfill.

We recommend that the earthwork portion of this project be completed during extended periods of dry weather if possible. If earthwork is completed during the wet season (typically November through April) it may be necessary to take extra precautionary measures to protect subgrade soils. Wet season earthwork operations may require additional mitigation measures beyond that which would be expected during the drier summer and fall months. This could include diversion of surface runoff around exposed soils and draining of ponded water on the site. Once subgrades are established, it may be necessary to protect the exposed subgrade soils from construction traffic.

The individual contractor(s) is responsible for designing and constructing stable, temporary excavations as required to maintain stability of both the excavation sides and bottom. Excavations should be sloped or shored in the interest of safety following local, and federal regulations, including current OSHA excavation and trench safety standards.

4.3 Drilled Shaft Foundations

4.3.1 Design Recommendations

DESCRIPTION	VALUE
Structures	Proposed building foundations
Minimum Dimensions	Minimum drilled shaft diameter of 24 inches Straight sided shafts are recommended
Total Estimated Settlement	1 inch

The allowable axial shaft capacities were determined using side friction components of resistance. Allowable skin friction and estimated settlement charts are attached to Appendix E of this report. The allowable uplift capacities should only be based on the side friction of the shaft; however, the weight of the foundation should be added to these values to obtain the actual allowable uplift capacities for drilled shafts. The allowable skin friction capacity values are based on a minimum factor of safety of 2.5.

Recommended soil parameters for lateral analysis of drilled shaft foundations have been developed for use in LPILE 6.0 or GROUP 8.0 computer programs. Based on our review of the boring logs and the Standard Penetration Test (SPT) results, engineering properties have been estimated for the soil conditions as shown in the following table.

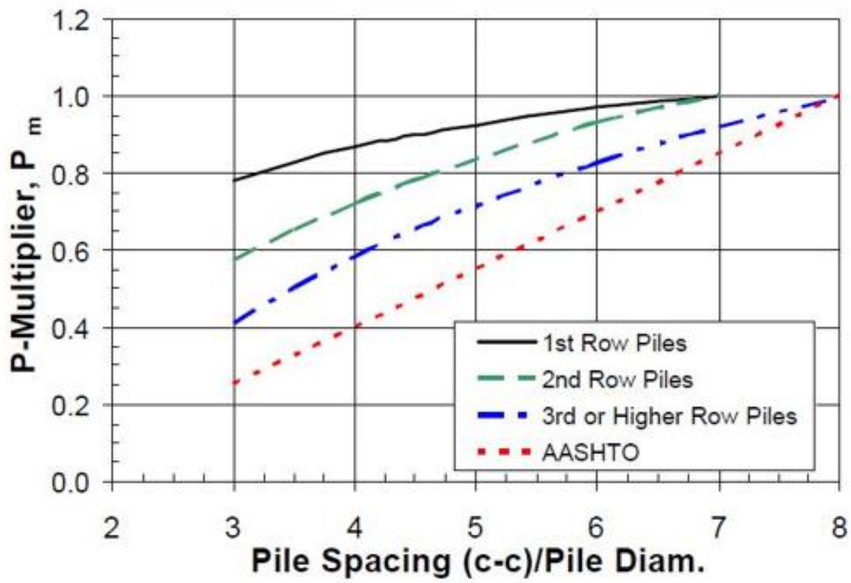
Lateral and Axial Compression Load Analysis Estimated Engineering Properties of Soils				
Depth (feet bgs)	**Effective Unit Weight (pcf)**	**L-Pile Soil Type**	**Undrained Shear Strength (psf) / Friction Angle (degrees)**	**Non-default Strain Factor ε_{50} / Soil-Modulus Parameter *k***
2 to 5	120	Stiff Clay	2,000	0.005
5 to 8	120	Stiff Clay	1,000	0.007
8 to 18	57	Soft Clay	250	0.020
18 to 25	57	Stiff Clay	1,000	0.007
25 to 40	57	Soft clay	500	0.010
40 to 50	57	Sand	34	70

The load capacities provided are based only on the stresses induced in the supporting soils; the structural capacity of the shafts should be checked to assure that they can safely accommodate the combined stresses induced by axial and lateral forces. The response of the drilled shaft foundations to lateral loads is dependent upon the soils/structure interaction as well as the shaft's actual diameter, length, stiffness, and "fixity" (fixed or free-head condition).

Lateral load design parameters are valid within the elastic range of the soil. The coefficient of subgrade reaction are ultimate values; therefore, appropriate factors of safety should be applied in the shaft design or deflection limits should be applied to the design.

Drilled shafts should have a minimum (center-to-center) spacing of three diameters. Closer spacing may require a reduction in axial load capacity. Axial capacity reduction can be determined by comparing the allowable axial capacity determined from the sum of individual shafts in a group versus the capacity calculated using the perimeter and base of the shaft group acting as a unit. The lesser of the two capacities should be used in design.

For lateral capacity of group piles, group efficiency factor for lateral loading may be determined using the following chart included in the published study "Response, Analysis, and Design of Pile Groups Subjected to Static & Dynamic lateral Load", June 2003, Report No. UT03.03.



We recommend that all drilled shaft installations be observed on a full-time basis by Terracon in order to confirm that soils encountered are consistent with the recommended design parameters.

4.3.2 Construction Considerations

Drilling to design depths should be possible with conventional single flight power augers. For drilled shaft depths above the depth of groundwater, temporary steel casing will likely be required to properly drill and clean shafts prior to concrete placement. For drilled shaft depths below groundwater level, we recommend the use of slurry drilling methods with polymers to keep the solids in suspension during the drilling.

Drilled shaft foundation concrete should be placed immediately after completion of drilling and cleaning. If foundation concrete cannot be placed in dry conditions, a tremie should be used for concrete placement. Due to potential sloughing and raveling, foundation concrete quantities may exceed calculated geometric volumes.

If casing is used for drilled shaft construction, it should be withdrawn in a slow continuous manner maintaining a sufficient head of concrete to prevent infiltration of water or the creation of voids in shaft concrete. Shaft concrete should have a relatively high fluidity when placed in cased shaft holes or through a tremie. Shaft concrete with slump in the range of 6 to 8 inches is recommended. Formation of mushrooms or enlargements at the tops of shafts should be avoided during shaft drilling. If mushrooms develop at the tops of the shafts during drilling, sono-tubes should be placed at the shaft tops to help isolate the shafts.

We recommend that all drilled shaft installations be observed on a full-time basis by Terracon in order to evaluate that the soils encountered are consistent with the recommended design parameters. If the subsurface soil conditions encountered differ significantly from those presented in this report, supplemental recommendations will be required.

The contractor should check for gas and/or oxygen deficiency prior to any workers entering the excavation for observation and manual cleanup. All necessary monitoring and safety precautions as required by OSHA, State or local codes should be strictly enforced.

4.4 Rammed Aggregate Pier (RAP) Recommendations

As an alternative to the mat foundations, we recommend that the subsurface soils be improved and densified by rammed aggregate pier (RAP) systems. The proposed building may be supported by shallow foundations bearing on the RAP improved soils. RAP elements provide an increase in bearing capacity, reduce seismic settlement potential, and enhance settlement control by delivering a composite stiffened bearing materials to reduce the matrix soil compressibility.

The construction process typically consists of utilizing pre-augered or displacement methods. The augered or displaced cavities are backfilled with aggregate that is compacted in place using static crowd pressure augmented with a high frequency, low amplitude, vibratory hammer. The impact hammer densifies aggregate vertically while the tamper foot forces aggregate laterally into cavity sidewalls resulting in stiff RAP elements and a stiffened matrix/soil. Constructed diameters may range from 20 to 30 inches depending on the method of installation.

In the event that RAP foundation systems are considered for the project, the proposed buildings can be supported on a shallow foundation system. RAP design is typically performed by a specialty design build ground improvement contractor who should be consulted to provide further analysis and recommendations. The design should result in a matrix of RAP systems and onsite soils that provides adequate support and bearing capacities for the proposed shallow foundation systems. The intent of the RAP system would be to provide increased bearing capacity and soil stiffness at the individual improvement locations. Furthermore, this will reduce the total and differential settlement.

The specialty contractor shall make their own interpretation of strength parameters and soil characteristics from the boring logs and laboratory testing presented in the Appendix A and B of this report.

4.5 Shallow Foundations for Secondary Structures

If the site has been prepared in accordance with recommendations presented in this report, the following design parameters are applicable for shallow foundations supporting secondary structures with no human occupancy such as fence walls, trash enclosures, generator pads, etc.

Item	Description
Structures	Secondary structures with no human occupancy such as fence walls, trash enclosures, generator pads, etc.
Foundation Type	Conventional Shallow Spread Footings
Allowable Bearing pressure [1, 2]	1,500 psf
Bearing Material [3]	Engineered fill extending to a minimum depth of 2 feet below the bottom of foundations
Approximate Foundation Dimensions	Less than 3 feet
Minimum Embedment below Finished Grade [4]	12 inches
Estimated Total Settlement from Structural Loads [2]	1 inch
Estimated Differential Settlement [2, 5]	0.5 inch over 40 feet

1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Values assume that exterior grades are no steeper than 20% within 10 feet of structure.
2. Settlement calculations were performed utilizing Westergaard and Hough's methods[10] to estimate the static settlement for various foundation widths.
3. Unsuitable or soft soils should be over-excavated and replaced per the recommendations presented in the earthwork section of the report.
4. Embedment necessary to minimize the effects of seasonal water content variations. For sloping ground, maintain depth below the lowest adjacent exterior grade within 5 horizontal feet of the structure.
5. Differential settlements are as measured over a span of 40 feet.

As noted in earthwork section of the report, the foundation excavations should be evaluated under the direction of the Geotechnical Engineer. The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

If the soil conditions encountered differ significantly from those presented in this report, supplemental recommendations will be required. Additional foundation movements could occur if water, from any source, saturates the foundation soils; therefore, proper drainage should be provided during construction and in the final design.

[10] FHWA Geotechnical Engineering Circular No. 6 – Shallow Foundations, FHWA-SA-02-054.

Foundations should be reinforced as necessary to reduce the potential for distress caused by differential foundation movement. The use of control joints at openings or other discontinuities in masonry walls is recommended.

Finished grade is defined as the lowest adjacent grade within five feet of the foundation for perimeter (or exterior) footings. The allowable foundation bearing pressures apply to dead loads plus design live load conditions. The design bearing pressure may be increased by one-third when considering total loads that include wind or seismic conditions. The weight of the foundation concrete below grade may be neglected in dead load computations.

4.6 Floor Slab

DESCRIPTION	RECOMMENDATION
Interior floor system	Slab-on-grade concrete
Floor slab support	A minimum of 24 inches of low volume change soils compacted as recommended in this report.
Subbase	Minimum 4-inches of Aggregate Base
Modulus of subgrade reaction	200 pounds per square inch per inch (psi/in) (The modulus was obtained based on estimates obtained from NAVFAC 7.1 design charts). This value is for a small loaded area (1 Sq. ft or less) such as for forklift wheel loads or point loads and should be adjusted for larger loaded areas.

In areas of exposed concrete, control joints should be saw cut into the slab after concrete placement in accordance with ACI Design Manual, Section 302.1R-37 8.3.12 (tooled control joints are not recommended). Additionally, dowels should be placed at the location of proposed construction joints. To control the width of cracking (should it occur) continuous slab reinforcement should be considered in exposed concrete slabs.

The use of a vapor retarder or barrier should be considered beneath concrete slabs on grade that will be covered with wood, tile, carpet or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer and slab contractor should refer to ACI 302 and ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder/barrier.

4.7 Lateral Earth Pressures

For engineered fill comprised of low volume change materials above any free water surface, recommended equivalent fluid pressures for unrestrained foundation elements are:

ITEM	VALUE[1]
Active Case	37 psf/ft
Passive Case	390 psf/ft[1]
At-Rest Case	56 psf/ft
Coefficient of Friction	0.35

[1]Note: The values are based on import materials used as backfill.

The lateral earth pressures herein do not include any factor of safety and are not applicable for submerged soils/hydrostatic loading. Additional recommendations may be necessary if such conditions are to be included in the design.

Fill against foundation should be compacted to densities specified in the Earthwork section of this report. Compaction of each lift adjacent to walls should be accomplished with hand-operated tampers or other lightweight compactors.

4.8 Pavements

4.8.1 Design Recommendations

Based on soil lithology and conditions, an estimated design R-Value was used to calculate the Asphalt Concrete (AC) pavement thickness sections and Portland Cement Concrete (PCC) pavement sections. R-value testing should be completed prior to pavement construction to verify the design R-value.

Assuming the pavement subgrades will be prepared as recommended within this report, the following pavement sections should be considered minimums for this project for the traffic indices assumed in the table below. As more specific traffic information becomes available, we should be contacted to reevaluate the pavement calculations.

	Recommended Pavement Section Thickness (inches)*	
	Light (Automobile) Parking Assumed Traffic Index (TI) = 4.5	**On-site Driveways and Delivery Areas Assumed TI = 6.0**
Section I Portland Cement Concrete (600 psi Flexural Strength)	5.0-inches PCC over 4-inches Class II Aggregate Base	6.0-inches PCC over 4-inches Class II Aggregate Base
Section II Asphaltic Concrete	3-inches AC over 5-inches Class II Aggregate Base	3-inches AC over 9-inches Class II Aggregate Base

* All materials should meet the CALTRANS Standard Specifications for Highway Construction.

All pavements should be supported on a minimum of 10 inches of scarified, moisture conditioned, and compacted materials. These pavement sections are considered minimal sections based upon the expected traffic and the existing subgrade conditions. However, they are expected to function with periodic maintenance and overlays if good drainage is provided and maintained.

Subsequent to clearing, grubbing, and removal of topsoil, subgrade soils beneath all pavements should be scarified, moisture conditioned, and compacted to a minimum depth of 10 inches. All materials should meet the CALTRANS Standard Specifications for Highway Construction. Aggregate base materials should meet the gradation and quality requirement of Class 2 Aggregate Base (¾ inch maximum) in Caltrans Standard Specifications, latest edition, Sections 25 through 29.

All concrete for rigid pavements should have a minimum flexural strength of 600 psi (4,250 psi Compressive Strength), and be placed with a maximum slump of four inches. Proper joint spacing will also be required to prevent excessive slab curling and shrinkage cracking. All joints should be sealed to prevent entry of foreign material and dowelled where necessary for load transfer.

Preventative maintenance should be planned and provided for through an on-going pavement management program in order to enhance future pavement performance. Preventative maintenance activities are intended to slow the rate of pavement deterioration, and to preserve the pavement investment.

Preventative maintenance consists of both localized maintenance (e.g. crack sealing and patching) and global maintenance (e.g. surface sealing). Preventative maintenance is usually the first priority when implementing a planned pavement maintenance program and provides the highest return on investment for pavements.

4.8.2 Construction Considerations

Materials and construction of pavements for the project should be in accordance with the requirements and specifications of the State of California Department of Transportation, or other approved local governing specifications.

Base course or pavement materials should not be placed when the surface is wet. Surface drainage should be provided away from the edge of paved areas to minimize lateral moisture transmission into the subgrade.

5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A

FIELD EXPLORATION

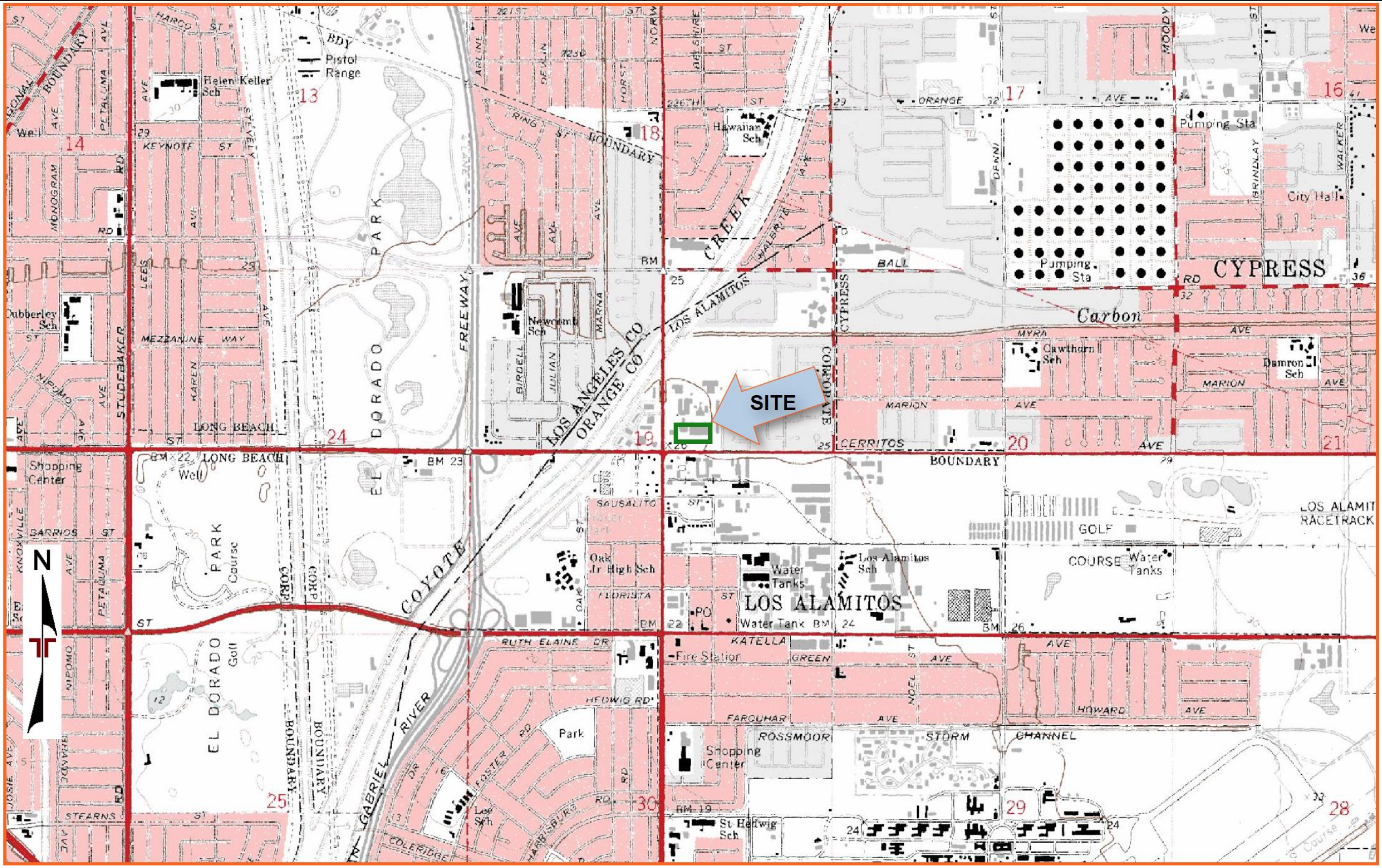


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY QUADRANGLES INCLUDE: LOS ALAMITOS, CA (1/1/1981).

Project Manager: SP	Project No. 60185158	Terracon Consulting Engineers & Scientists	SITE LOCATION PLAN
Drawn by: SJ	Scale: None	1421 Edinger Avenue, Ste C Tustin, CA 92780	**Proposed New Classroom and Admin. Building** **Los Alamitos High School** 3591 W Cerritos Ave. Los Alamitos, CA
Checked by: SP	File Name: A-1	PH. (949) 261-0051 FAX. (949) 261-6110	Exhibit
Approved by: FH	Date: 12/4/2018		A-1

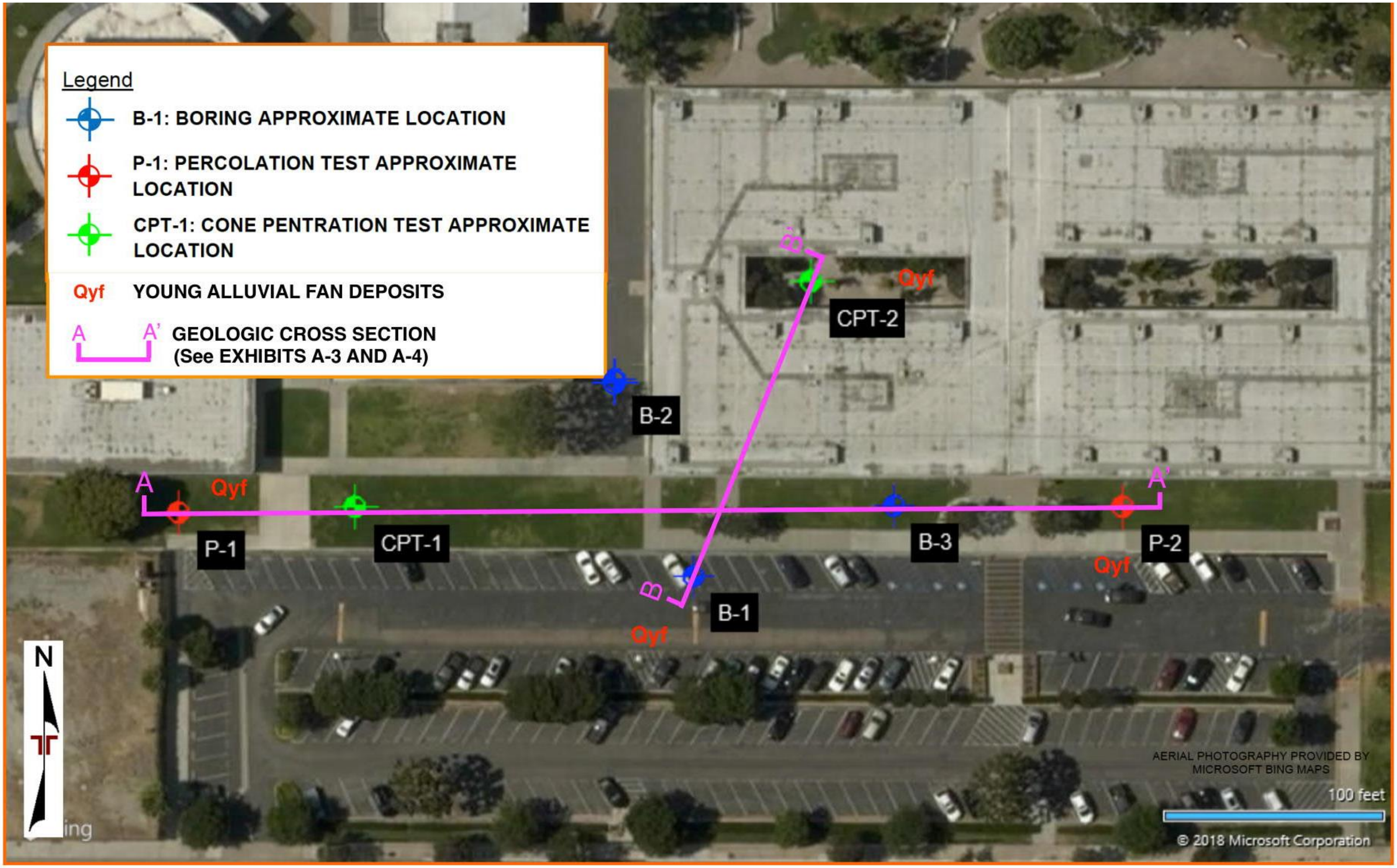


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: SP	Project No. 60185158	Terracon Consulting Engineers & Scientists	SITE GEOLOGIC MAP
Drawn by: SJ	Scale: As shown	1421 Edinger Avenue, Ste C Tustin, CA 92780	**Proposed New Classroom and Admin. Building**
Checked by: SP	File Name: A-2	PH. (949) 261-0051 FAX. (949) 261-6110	**Los Alamitos High School**
Approved by: FH	Date: 12/4/2018		3591 W Cerritos Ave. Los Alamitos, CA

Exhibit A-2

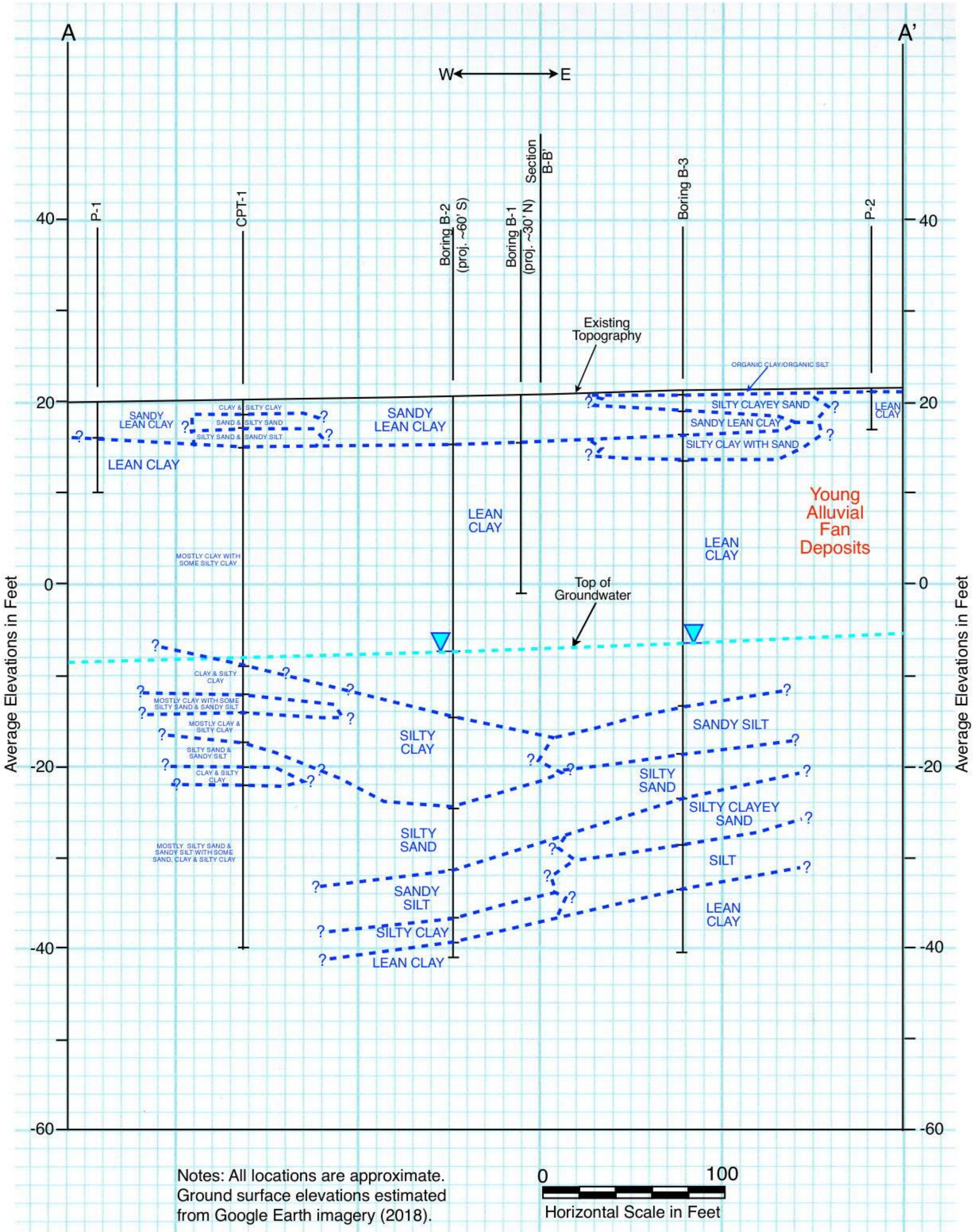
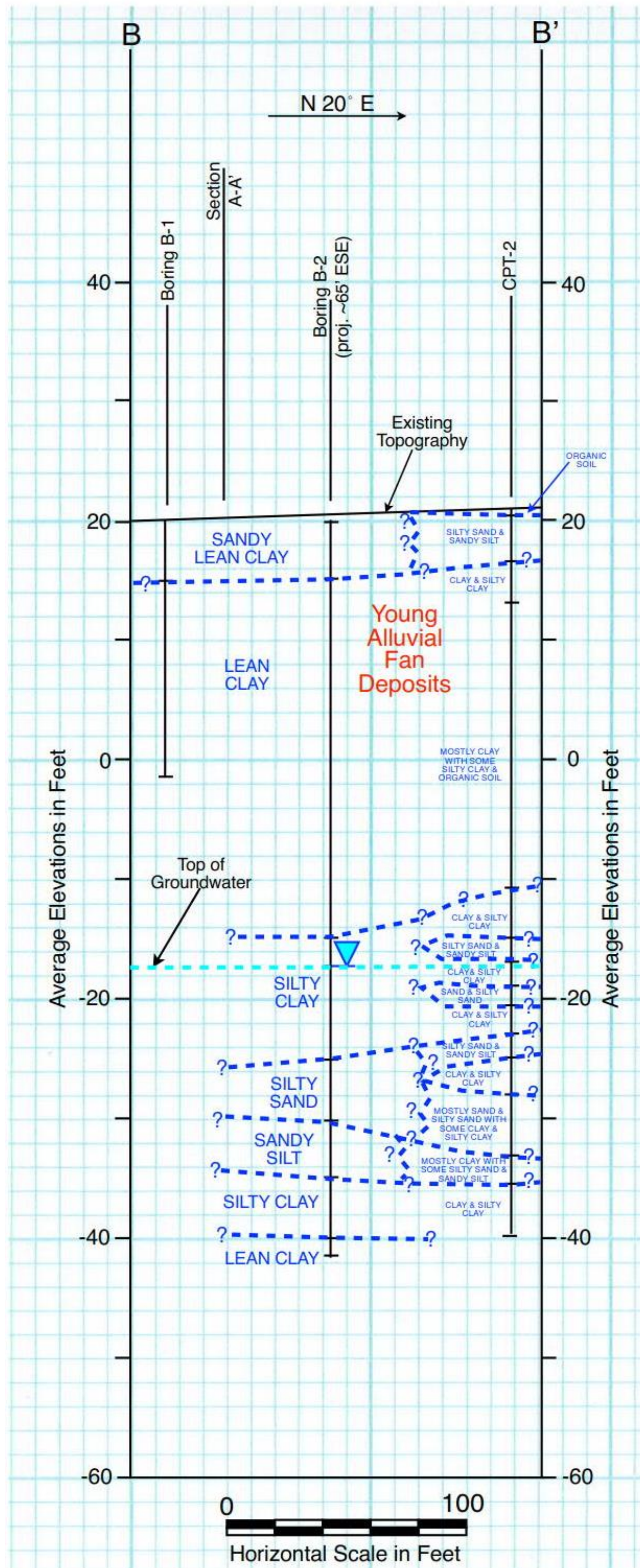


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: SP	**Project No.** 60185158	Terracon Consulting Engineers & Scientists	GEOLOGIC CROSS-SECTION A-A'	Exhibit
Drawn by: SJ	**Scale:** As shown	1421 Edinger Avenue Ste C, Tustin, California 92614	**Proposed New Classroom and Admin. Building**	A-3
Checked by: SP	**File Name:** A-3	PH. (949) 261-0051 FAX. (949) 261-6110	**Los Alamitos High School**	
Approved by: FH	**Date:** 12/26/2018		3591 W Cerritos Ave. Los Alamitos, CA	



Notes: All locations are approximate.
Ground surface elevations estimated
from Google Earth imagery (2018).

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: SP	Project No. 60185158		
Drawn by: SJ	Scale: As shown		
Checked by: SP	File Name: A-4		
Approved by: FH	Date: 12/26/2018		

Terracon
Consulting Engineers & Scientists

1421 Edinger Avenue Ste C Tustin, California 92614
PH. (949) 261-0051 FAX. (949) 261-6110

GEOLOGIC CROSS-SECTION B-B'

Proposed New Classroom and Admin. Building
Los Alamitos High School
3591 W Cerritos Ave.
Los Alamitos, CA

Exhibit
A-4

SCALE 1:100 000

LEGEND (Local Geologic Map Units):

Holocene to Late Pleistocene (Surficial Deposits)

Qyf **Young Alluvial Fan Deposits** - unconsolidated to slightly consolidated, undissected to slightly dissected boulder, cobble, gravel, sand, and silt deposits issued from a confined valley or canyon

Late to Middle Pleistocene (Surficial Deposits)

Qof **Old Alluvial Fan Deposits** - slightly to moderately consolidated, moderately dissected boulder, cobble, gravel, sand, and silt deposits issued from a confined valley or canyon

REFERENCE: Excerpt of *Geologic Compilations of Quaternary Surficial Deposits in Southern California, Long Beach 30' x 60' Quadrangle* by Peter D. Roffers and Trinda L. Bedrossian: CGS Special Report 217, Plate 8, dated July 2010

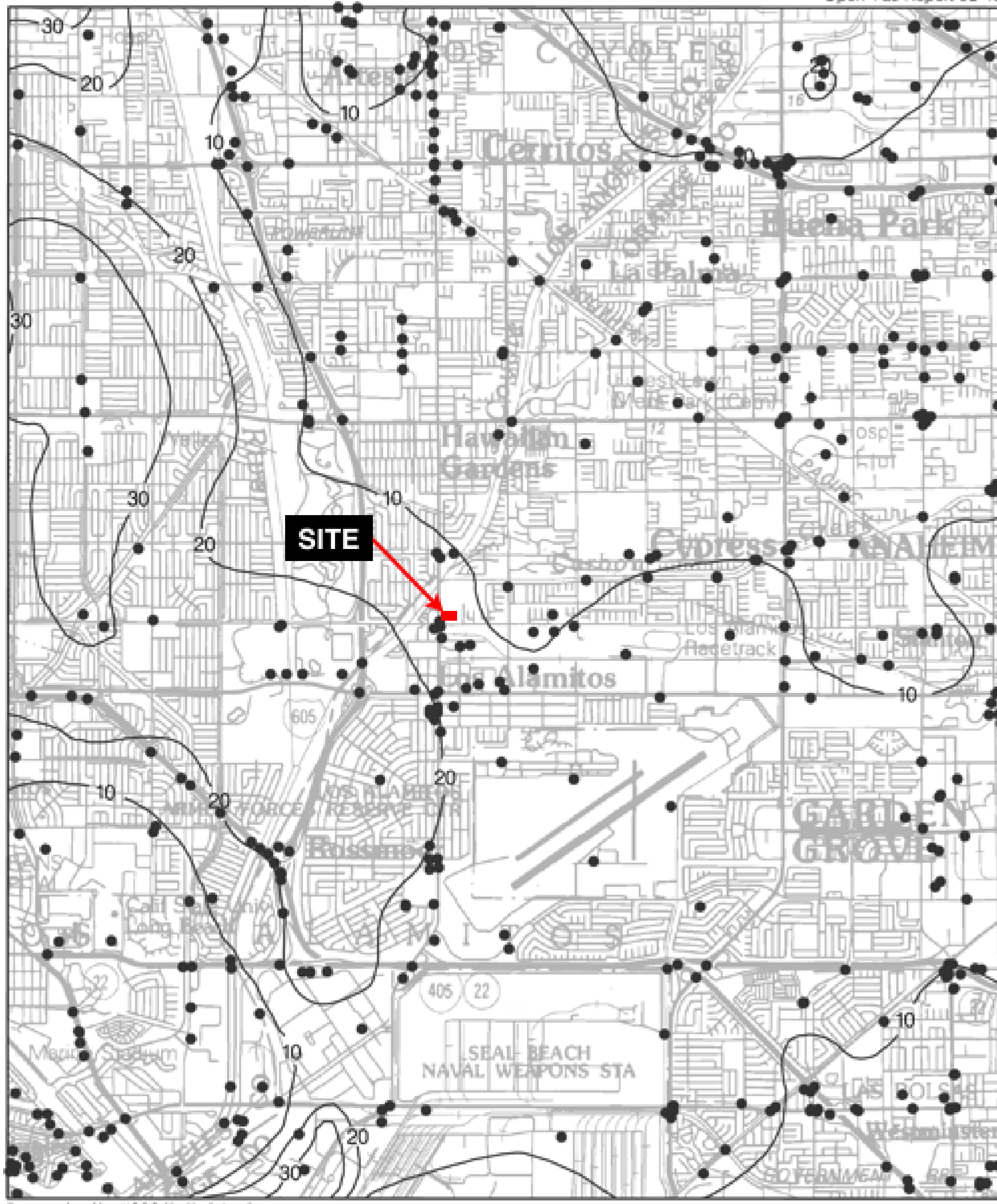
DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: SP	Project No. 60185158	Terracon Consulting Engineers & Scientists 1421 Edinger Avenue Ste C Tustin, California 92614 PH. (949) 261-0051 FAX. (949) 261-6110	REGIONAL GEOLOGIC MAP **Proposed New Classroom and Admin. Building** **Los Alamitos High School** 3591 W Cerritos Ave. Los Alamitos, CA
Drawn by: SJ	Scale: As shown		
Checked by: SP	File Name: A-5		
Approved by: FH	Date: 12/4/2018		

Exhibit

A-5

Open-File Report 98-10



Base map enlarged from U.S.G.S. 30 x 60-minute series

Plate 1.2 Historically Highest Ground Water Contours and Borehole Log Data Locations, Los Alamitos Quadrangle.

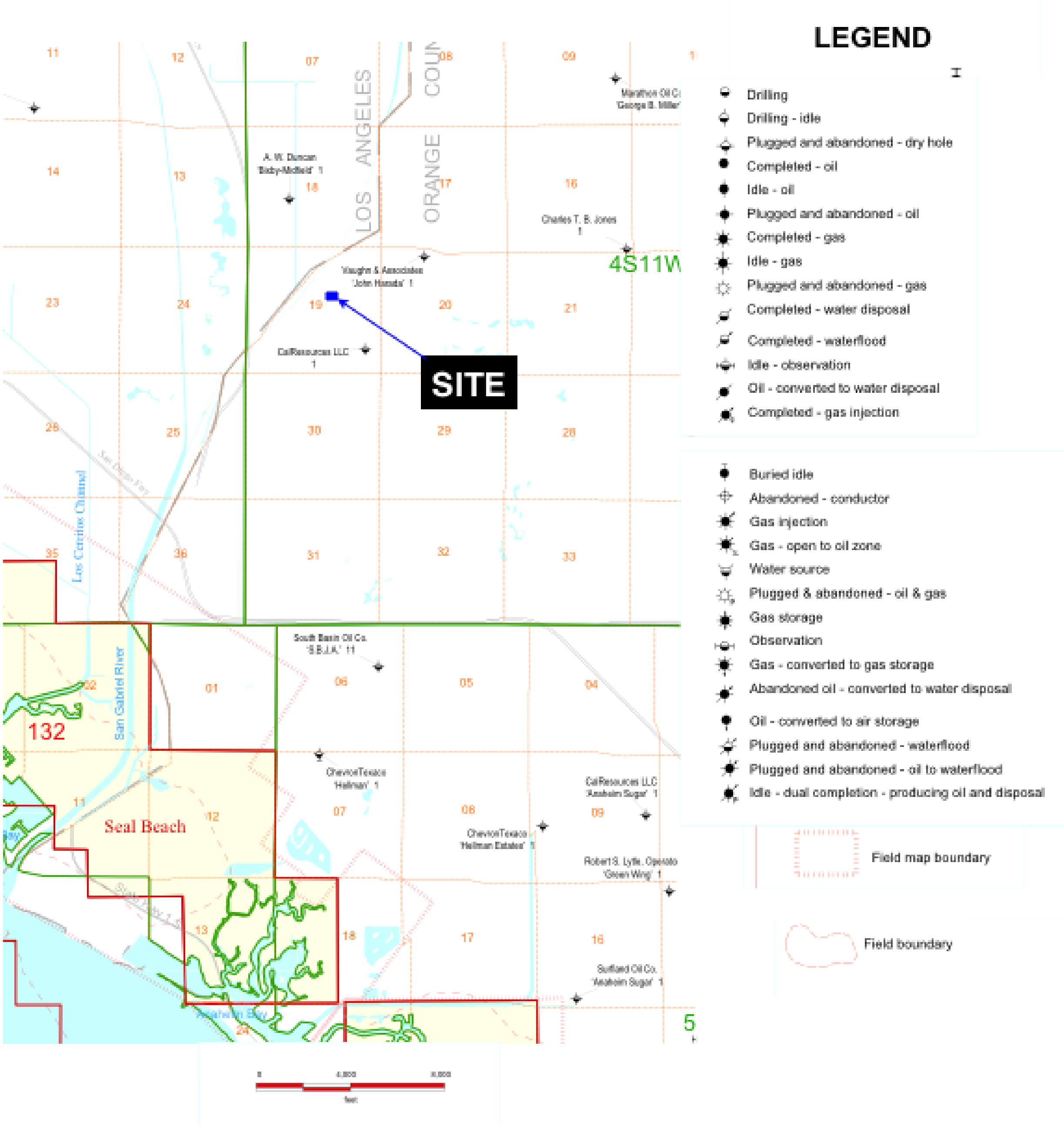
● Borehole Site — 30 — Depth to ground water in feet

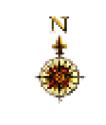
ONE MILE
SCALE

REFERENCE: Map of Historically Highest Ground Water Contours, Los Alamitos Quadrangle: *Seismic Hazard Zone Report for the Los Alamitos 7.5-Minute Quadrangle, Los Angeles and Orange Counties, California*, by the California Division of Mines and Geology (CDMG), Plate 1.2, dated 1998

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: SP	Project No. 60185158	Terracon Consulting Engineers & Scientists	GROUNDWATER MAP	Exhibit
Drawn by: SJ	Scale: As shown	1421 Edinger Avenue Ste C, Tustin, California 92614	**Proposed New Classroom and Admin. Building**	A-6
Checked by: SP	File Name: A-6	PH. (949) 261-0051 FAX. (949) 261-6110	**Los Alamitos High School**	
Approved by: FH	Date: 12/4/2018		3591 W Cerritos Ave. Los Alamitos, CA	





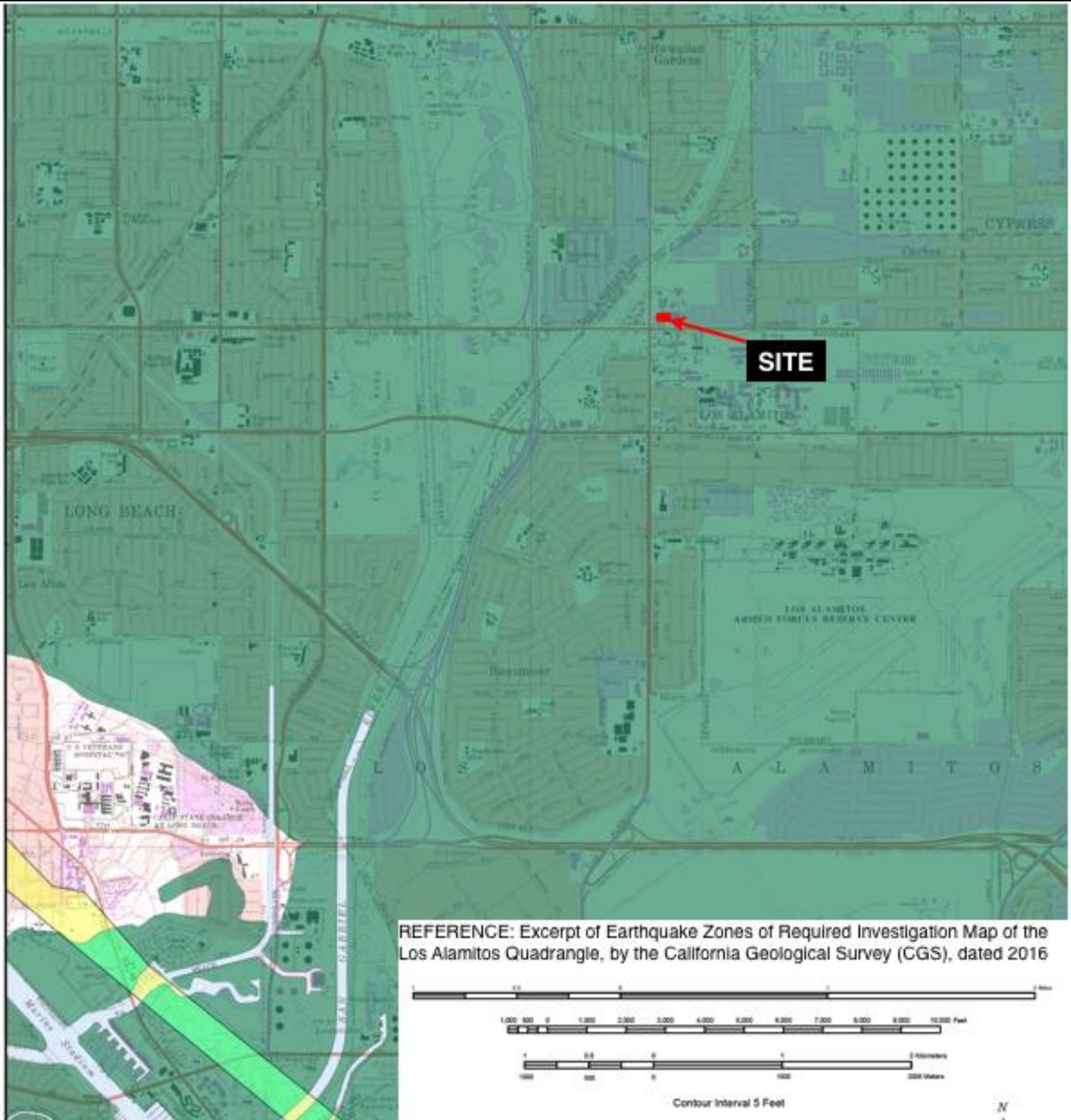
Reference: Excerpt of California Division of Oil, Gas & Geothermal Resources Map W1-6 (DOGGR, 2005)

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: SP	Project No. 60185158	Terracon Consulting Engineers & Scientists	OIL & GAS FIELDS & WELLS MAP
Drawn by: SJ	Scale: As shown	1421 Edinger Avenue Ste C, Tustin, California 92614	**Proposed New Classroom and Admin. Building**
Checked by: SP	File Name: A-7	PH. (949) 261-0051 FAX. (949) 261-6110	**Los Alamitos High School**
Approved by: FH	Date: 12/4/2018		3591 W Cerritos Ave. Los Alamitos, CA

Exhibit

A-7



REFERENCE: Excerpt of Earthquake Zones of Required Investigation Map of the Los Alamitos Quadrangle, by the California Geological Survey (CGS), dated 2016

Contour Interval 5 Feet

MAP EXPLANATION

EARTHQUAKE FAULT ZONES

Earthquake Fault Zones
Zone boundaries are delineated by straight-line segments; the boundaries define the zone encompassing active faults that constitute a potential hazard to structures from surface faulting or fault creep such that avoidance as described in Public Resources Code Section 2621.5(a) would be required.

Active Fault Traces
Faults considered to have been active during Holocene time and to have potential for surface rupture: Solid Line in Black or Red where Accurately Located; Long Dash in Black or Solid Line in Purple where Approximately Located; Short Dash in Black or Solid Line in Orange where Inferred; Dotted Line in Black or Solid Line in Rose where Concealed; Query (?) indicates additional uncertainty. Evidence of historic offset indicated by year of earthquake-associated event or C for displacement caused by fault creep.

SEISMIC HAZARD ZONES

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

OVERLAPPING EARTHQUAKE FAULT AND SEISMIC HAZARD ZONES

Overlap of Earthquake Fault Zone and Liquefaction Zone
Areas that are covered by both Earthquake Fault Zone and Liquefaction Zone.

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: SP	Project No. 60185158
Drawn by: SJ	Scale: As shown
Checked by: SP	File Name: A-8
Approved by: FH	Date: 12/4/2018

Terracon
Consulting Engineers & Scientists
1421 Edinger Avenue Ste C Tustin, California 92614
PH. (949) 261-0051 FAX. (949) 261-6110

SEISMIC HAZARD ZONES MAP

Proposed New Classroom and Admin. Building
Los Alamitos High School
3591 W Cerritos Ave.
Los Alamitos, CA

Exhibit
A-8

Reference: Excerpt of Jennings, C.W., and Bryant, W.A., 2010, Fault Activity Map of California: California Geological Survey, Geologic Data Map No. 6, scale 1:750,000.

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: SP	Project No. 60185158	Terracon Consulting Engineers & Scientists	REGIONAL FAULT ACTIVITY MAP	Exhibit
Drawn by: SJ	Scale: As shown		**Proposed New Classroom and Admin. Building**	A-9
Checked by: SP	File Name: A-9		**Los Alamitos High School**	
Approved by: FH	Date: 12/4/2018	1421 Edinger Avenue, Ste C Tustin, CA 92780 PH. (949) 261-0051 FAX. (949) 261-6110	3591 W Cerritos Ave. Los Alamitos, CA	

LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D — Areas in which flood hazards are undetermined, but possible.

Reference: Excerpts of Flood Insurance Rate Maps (FIRM) 06059C0104J (Panel 104 of 539) and 06059C0112J (Panel 112 of 539), Orange County, California and Incorporated Areas, dated December 9, 2009

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: SP	Project No. 60185158		
Drawn by: SJ	Scale: As shown		
Checked by: SP	File Name: A-10		
Approved by: FH	Date: 12/4/2018		

Terracon
Consulting Engineers & Scientists
1421 Edinger Avenue, Ste C Tustin, CA 92780
PH. (949) 261-0051 FAX. (949) 261-6110

FLOOD ZONE HAZARDS MAP

Proposed New Classroom and Admin. Building
Los Alamitos High School
3591 W Cerritos Ave.
Los Alamitos, CA

Exhibit
A-10

Field Exploration Description

A total of three (3) test borings and two (2) percolation testing were performed at the site on November 14 and two (2) Cone Penetration Tests (CPTs) were performed at the site on November 30 and December 3, 2018. The borings were drilled to approximate depths ranging between 21½ and 61½ feet bgs at the approximate locations shown on the attached Exhibit A-2. Test borings were advanced with a truck-mounted CME-75 drill rigs utilizing 8-inch diameter hollow-stem augers. The percolation testings were performed to the depth of 5 and 10 feet bgs.

The CPT soundings were performed to approximate depth of 60 feet bgs. The approximate locations of the CPT soundings are shown on the attached Exhibit A-2. CPT soundings were performed in accordance with ASTM Standards (D5778). The cone penetrometers were pushed using a 30-ton C

The borings were located in the field by using the proposed site plan, an aerial photograph of the site, and a handheld GPS unit. The accuracy of boring locations should only be assumed to the level implied by the method used.

Continuous lithologic logs of the borings were recorded by the field engineer during the drilling operations. At selected intervals, samples of the subsurface materials were taken by driving split-spoon or ring-barrel samplers. Bulk samples of subsurface materials were also obtained. Groundwater conditions were evaluated in the borings at the time of site exploration.

Penetration resistance measurements were obtained by driving the split-spoon and ring-barrel samplers into the subsurface materials with a 140-pound automatic hammer falling 30 inches. The penetration resistance value is a useful index in estimating the consistency or relative density of materials encountered.

An automatic hammer was used to advance the split-barrel sampler in the borings performed on this site. A significantly greater efficiency is achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. This higher efficiency has an appreciable effect on the SPT-N value. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

The samples were tagged for identification, sealed to reduce moisture loss, and taken to our laboratory for further examination, testing, and classification. Information provided on the boring logs attached to this report includes soil descriptions, consistency evaluations, boring depths, sampling intervals, and groundwater conditions. The borings were backfilled with auger cuttings prior to the drill crew leaving the site.

BORING LOG NO. B-1

PROJECT: Proposed New Classroom and Admin. Build.
Los Alamitos High School

CLIENT: Los Alamitos Unified School District
Los Alamitos, CA

SITE: 3591 W Cerritos Ave
Los Alamitos, CA

LOCATION See Exhibit A-2

Latitude: 33.8108° Longitude: -118.0704°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	EXPANSION INDEX	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.4	**ASPHALT**, 5" thickness												
	SANDY SILTY CLAY (CL-ML), brown, very stiff											24-18-6	53
					15-10-9					15	78		
5.0	**LEAN CLAY (CL)**, brown, stiff	5			3-5-7					17	104		
					3-6-8					29	89		
	soft	10			0-1-2 N=3							42-23-19	90
	medium stiff	15			1-2-3					37	83		
21.5	soft	20			0-1-2 N=3								
	Boring Terminated at 21.5 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with grout and capped with concrete.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.
Elevations estimated from Google Earth

Notes:

WATER LEVEL OBSERVATIONS
Not encountered

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

Boring Started: 11-14-2018	Boring Completed: 11-14-2018
Drill Rig: CME 75	Driller: Martini Drilling
Project No.: 60185158	Exhibit: A-12

BORING LOG NO. B-2

PROJECT: Proposed New Classroom and Admin. Build.
Los Alamitos High School

CLIENT: Los Alamitos Unified School District
Los Alamitos, CA

SITE: 3591 W Cerritos Ave
Los Alamitos, CA

LOCATION See Exhibit A-2

Latitude: 33.811° Longitude: -118.0708°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	EXPANSION INDEX	STRENGTH TEST: TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3	**ORGANIC SOIL**, dark brown to black												
	SANDY LEAN CLAY (CL), light brown, hard, some roots observed					34							
					11-24-30					10	114		
5.0	**LEAN CLAY (CL)**, brown very stiff	5			5-8-11					13	104		
	medium stiff				2-2-3 N=5								
	stiff	10			3-5-6					25	95		
	soft	15			0-0-2 N=2								
	trace sand, medium stiff	20			1-3-4					34	85		
		25											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with grout.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.
Elevations estimated from Google Earth

Notes:

WATER LEVEL OBSERVATIONS

While drilling

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

Boring Started: 11-14-2018	Boring Completed: 11-14-2018
Drill Rig: CME 75	Driller: Martini Drilling
Project No.: 60185158	Exhibit: A-13

BORING LOG NO. B-2

PROJECT: Proposed New Classroom and Admin. Build. Los Alamitos High School

CLIENT: Los Alamitos Unified School District Los Alamitos, CA

SITE: 3591 W Cerritos Ave Los Alamitos, CA

LOCATION See Exhibit A-2

Latitude: 33.811° Longitude: -118.0708°

GRAPHIC LOG / DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	EXPANISON INDEX	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	LEAN CLAY (CL), brown *(continued)* soft				1-1-3 N=4								
			▽										
	stiff	30			2-4-7					24	99		
35.0	**SILTY CLAY (CL-ML)**, brown, medium stiff to stiff	35			2-3-5 N=8								
	medium stiff	40			0-0-5								
45.0	**SILTY SAND (SM)**, brown, medium dense	45			5-13-11 N=24							NP	21
50.0		50											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with grout.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.
Elevations estimated from Google Earth

Notes:

WATER LEVEL OBSERVATIONS

▽ *While drilling*

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

Boring Started: 11-14-2018	Boring Completed: 11-14-2018
Drill Rig: CME 75	Driller: Martini Drilling
Project No.: 60185158	Exhibit: A-13

BORING LOG NO. B-2

PROJECT: Proposed New Classroom and Admin. Build.
Los Alamitos High School

CLIENT: Los Alamitos Unified School District
Los Alamitos, CA

SITE: 3591 W Cerritos Ave
Los Alamitos, CA

LOCATION See Exhibit A-2
Latitude: 33.811° Longitude: -118.0708°

GRAPHIC LOG / DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	EXPANISON INDEX	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDY SILT (ML), brown, very stiff				8-17-19					26	99	NP	59
55.0	**SILTY CLAY (CL-ML)**, trace sand, brown, stiff	55			3-6-7 N=13								
60.0	**LEAN CLAY (CL)**, gray, very stiff	60			7-11-13					28	96		
61.5	***Boring Terminated at 61.5 Feet***												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with grout.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.
Elevations estimated from Google Earth

Notes:

WATER LEVEL OBSERVATIONS
∇ *While drilling*

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

Boring Started: 11-14-2018	Boring Completed: 11-14-2018
Drill Rig: CME 75	Driller: Martini Drilling
Project No.: 60185158	Exhibit: A-13

BORING LOG NO. B-3

PROJECT: Proposed New Classroom and Admin. Build.
Los Alamitos High School

CLIENT: Los Alamitos Unified School District
Los Alamitos, CA

SITE: 3591 W Cerritos Ave
Los Alamitos, CA

LOCATION See Exhibit A-2

Latitude: 33.8109° Longitude: -118.0701°

DEPTH	Material Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	EXPANISON INDEX	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3	**ORGANIC SOIL**, dark brown to black												
2.5	**SILTY CLAYEY SAND (SC-SM)**, brown											23-19-4	43
5.0	**SANDY LEAN CLAY (CL)**, light brown, hard				15-29-28					4	108		
7.5	**SILTY CLAY WITH SAND (CL-ML)**, brown, stiff	5			3-5-7					9	94		
	LEAN CLAY (CL), brown soft				1-1-2 N=3								
	soft to medium stiff	10			1-2-2 N=4								
	soft	15			0-1-1 N=2								
	trace silt, medium stiff	20			1-3-4 N=7								
		25											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with grout.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.
Elevations estimated from Google Earth

Notes:

WATER LEVEL OBSERVATIONS
While drilling

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

Boring Started: 11-14-2018	Boring Completed: 11-14-2018
Drill Rig: CME 75	Driller: Martini Drilling
Project No.: 60185158	Exhibit: A-14

BORING LOG NO. B-3

**PROJECT: Proposed New Classroom and Admin. Build.
Los Alamitos High School**

**CLIENT: Los Alamitos Unified School District
Los Alamitos, CA**

**SITE: 3591 W Cerritos Ave
Los Alamitos, CA**

LOCATION See Exhibit A-2

Latitude: 33.8109° Longitude: -118.0701°

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	EXPANSION INDEX	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	LEAN CLAY (CL), brown *(continued)* soft			X	1-2-2 N=4								
			▽										
	medium stiff	30		X	9-2-3 N=5								
	35.0												
	SANDY SILT (ML), brown, soft to medium stiff	35		X	1-1-3 N=4								
	40.0												
	SILTY SAND (SM), brown, medium dense	40		X	3-7-11 N=18								
	45.0												
	SILTY CLAYEY SAND (SC-SM), brown, medium dense	45		X	3-9-13 N=22								
	50.0	50											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with grout.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.
Elevations estimated from Google Earth

Notes:

WATER LEVEL OBSERVATIONS

▽ *While drilling*

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

Boring Started: 11-14-2018	Boring Completed: 11-14-2018
Drill Rig: CME 75	Driller: Martini Drilling
Project No.: 60185158	Exhibit: A-14

BORING LOG NO. B-3

PROJECT: Proposed New Classroom and Admin. Build. Los Alamitos High School

CLIENT: Los Alamitos Unified School District Los Alamitos, CA

SITE: 3591 W Cerritos Ave Los Alamitos, CA

LOCATION See Exhibit A-2

Latitude: 33.8109° Longitude: -118.0701°

DEPTH	Material Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	EXPANSION INDEX	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SILT (ML), brown, very stiff			X	3-8-14 N=22								
55.0	**LEAN CLAY (CL)**, trace sand, brown, stiff	55		X	3-4-5 N=9								
	stiff to very stiff	60		X	3-6-9 N=15								
61.5	***Boring Terminated at 61.5 Feet***												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with grout.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.
Elevations estimated from Google Earth

Notes:

WATER LEVEL OBSERVATIONS

While drilling

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

Boring Started: 11-14-2018	Boring Completed: 11-14-2018
Drill Rig: CME 75	Driller: Martini Drilling
Project No.: 60185158	Exhibit: A-14

BORING LOG NO. Perc-1

PROJECT: Proposed New Classroom and Admin. Build.
Los Alamitos High School

CLIENT: Los Alamitos Unified School District
Los Alamitos, CA

SITE: 3591 W Cerritos Ave
Los Alamitos, CA

LOCATION See Exhibit A-2

Latitude: 33.8109° Longitude: -118.0712°

GRAPHIC LOG	DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	EXPANISON INDEX	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	0.4	**ORGANIC SOIL**, dark brown to black												
	4.0	**SANDY LEAN CLAY (CL)**, light brown												
	10.0	**LEAN CLAY (CL)**, brown	5											
		Boring Terminated at 10 Feet	10											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.
Elevations estimated from Google Earth

Notes:

WATER LEVEL OBSERVATIONS
Not encountered

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

Boring Started: 11-14-2018	Boring Completed: 11-14-2018
Drill Rig: CME 75	Driller: Martini Drilling
Project No.: 60185158	Exhibit: A-15

BORING LOG NO. Perc-2

PROJECT: Proposed New Classroom and Admin. Build.
Los Alamitos High School

CLIENT: Los Alamitos Unified School District
Los Alamitos, CA

SITE: 3591 W Cerritos Ave
Los Alamitos, CA

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 33.8109° Longitude: -118.0698° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	EXPANISON INDEX	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	0.2 **ORGANIC SOIL**, dark brown to black												
	LEAN CLAY (CL), trace sand, brown												
	5.0	5											
	Boring Terminated at 5 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.
Elevations estimated from Google Earth

Notes:

WATER LEVEL OBSERVATIONS

Not encountered

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

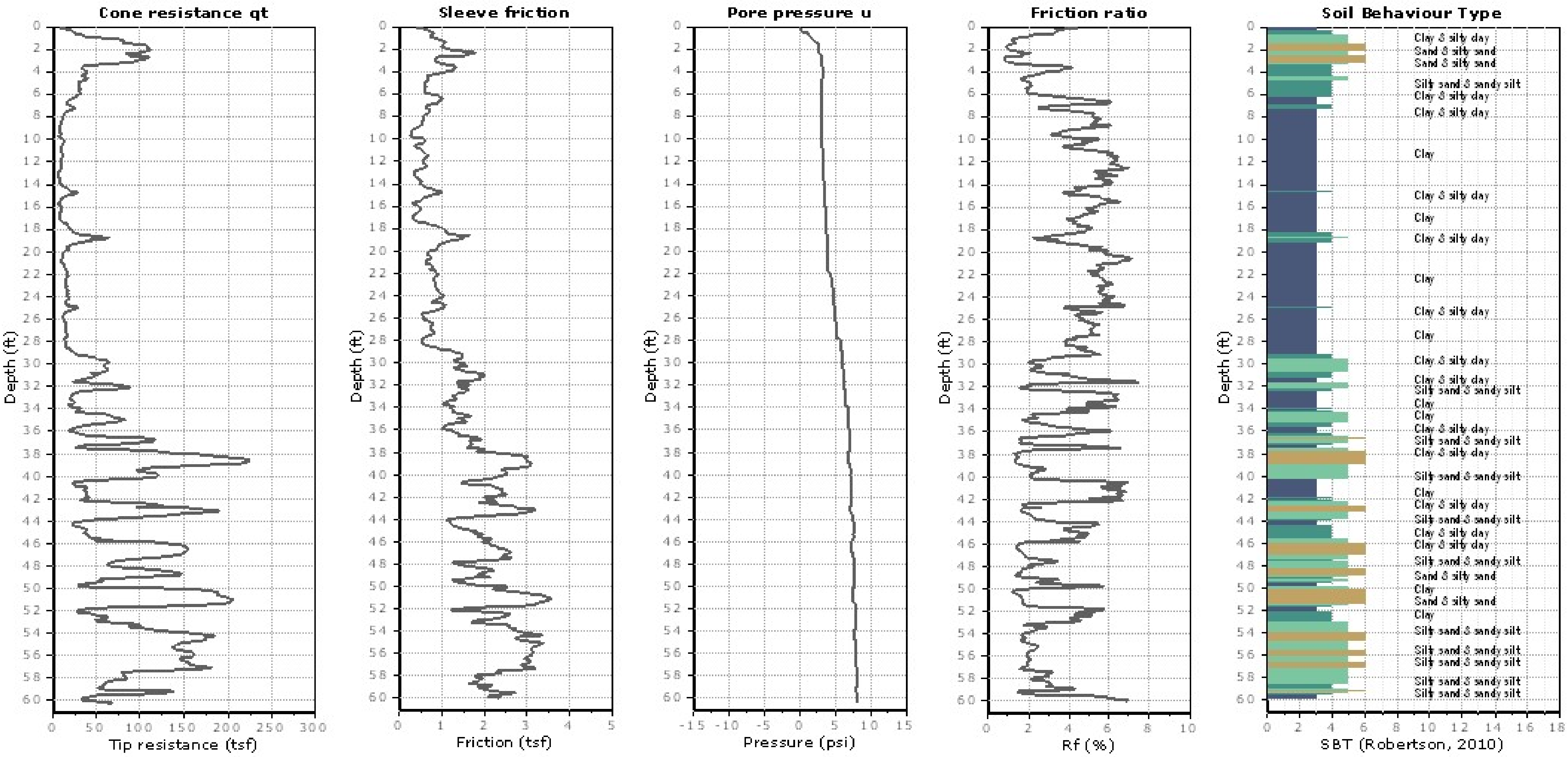
Boring Started: 11-14-2018	Boring Completed: 11-14-2018
Drill Rig: CME 75	Driller: Martini Drilling
Project No.: 60185158	Exhibit: A-16

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

CPT-1

Project: **Terracon Consultants / Los Alamitos High School**
Location: **Los Alamitos, CA**

Total depth: 60.24 ft, Date: 11/30/2018
Cone Type: Vertek

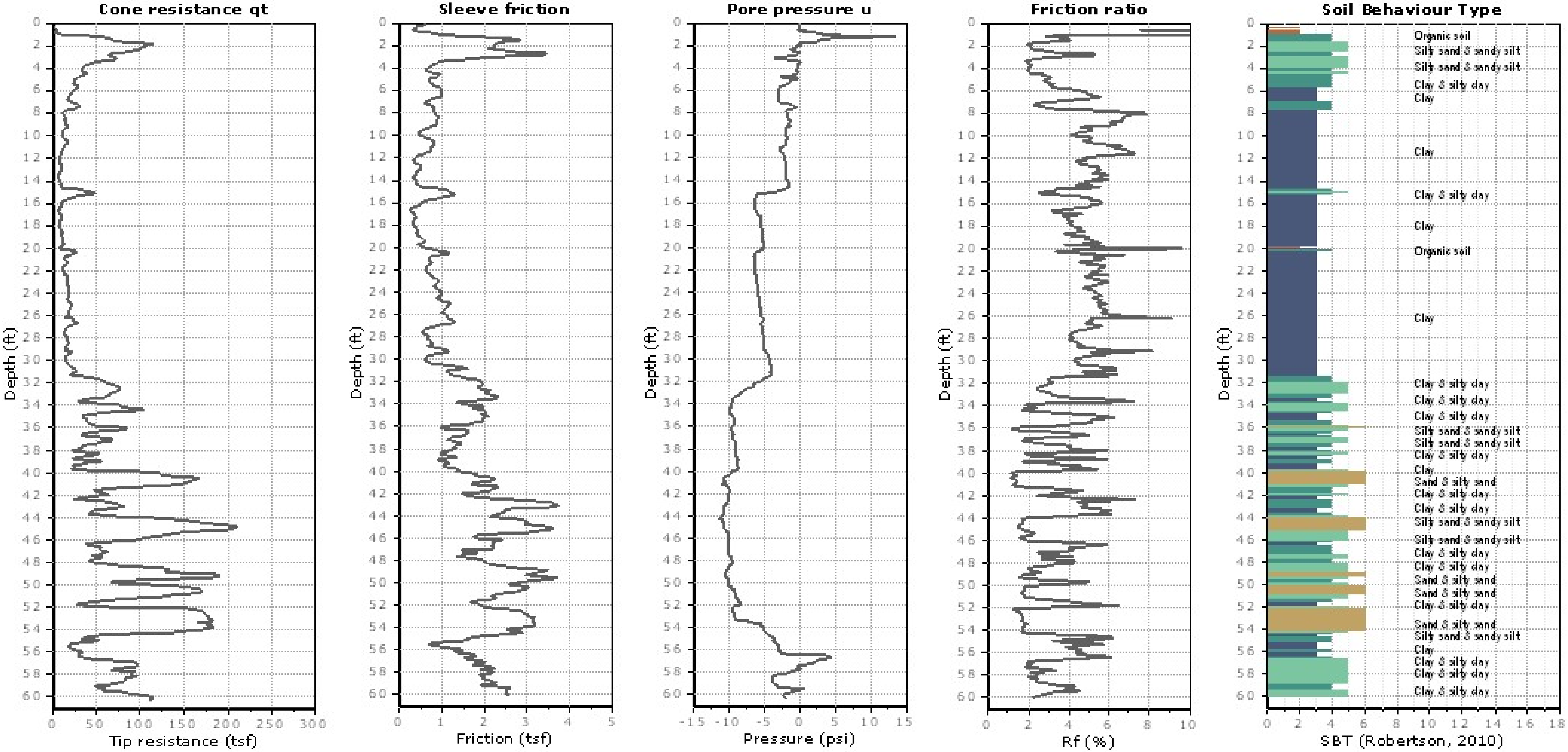


Kehoe Testing and Engineering
714-901-7270
steve@kehoetesting.com
www.kehoetesting.com

CPT-2

Project: **Terracon Consultants / Los Alamitos High School**
Location: **Los Alamitos, CA**

Total depth: 60.33 ft, Date: 12/3/2018
Cone Type: Vertek



APPENDIX B

LABORATORY TESTING

Laboratory Testing

Samples retrieved during the field exploration were taken to the laboratory for further observation by the project geotechnical engineer and were classified in accordance with the Unified Soil Classification System (USCS) described in Appendix C. At that time, the field descriptions were confirmed or modified as necessary and an applicable laboratory testing program was formulated to determine engineering properties of the subsurface materials.

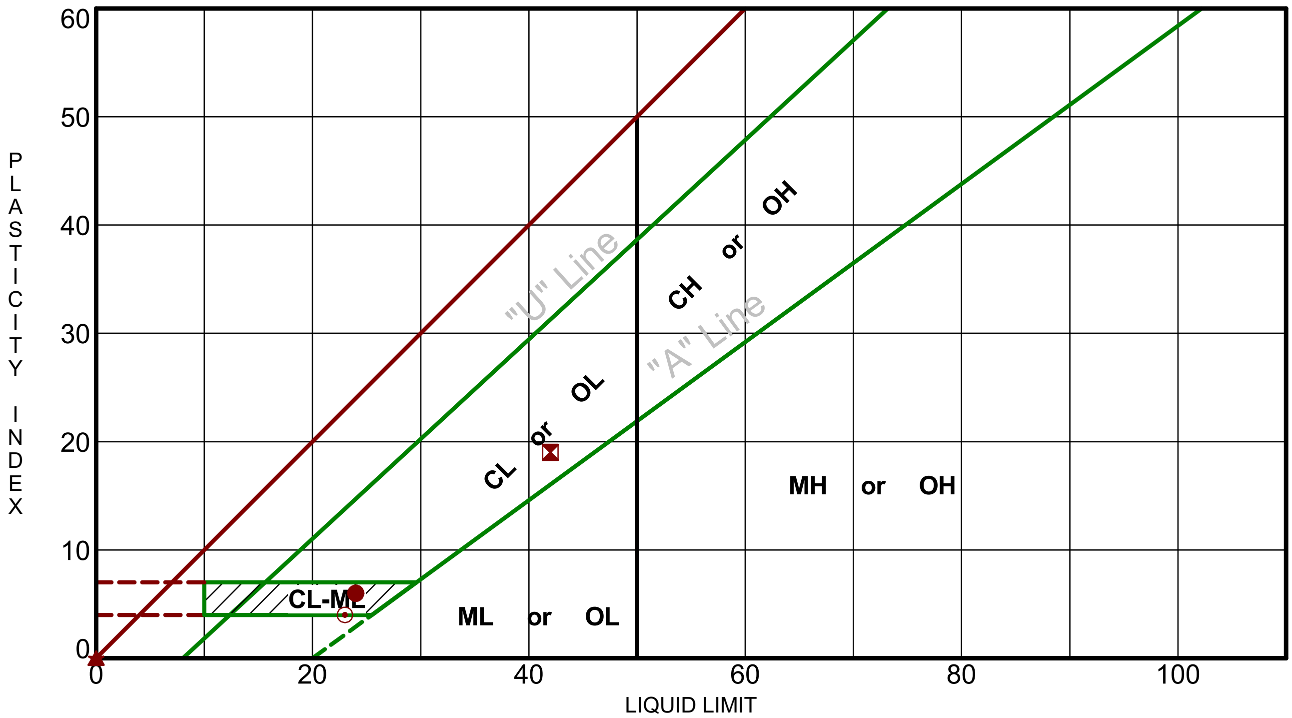
Laboratory tests were conducted on selected soil samples and the test results are presented in this appendix. The laboratory test results were used for the geotechnical engineering analyses, and the development of foundation and earthwork recommendations. Laboratory tests were performed in general accordance with the applicable ASTM, local or other accepted standards.

- ASTM D7263 Dry Density
- CT422 Chloride Content
- CT643 pH
- ASTM C136 Grain Size Distribution
- ASTM D4318 Atterberg Limits
- ASTM D4829 Expansion Index
- ASTM D2216 Moisture Content
- CT417 Soluble Sulfates
- CT643 Minimum Resistivity
- ASTM D4546 Consolidation
- ASTM D3080 Direct Shear

Procedural standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

ATTERBERG LIMITS RESULTS

ASTM D4318



	Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
●	B-1	0.4 - 2.5	24	18	6	53	CL-ML	SANDY SILTY CLAY
⊠	B-1	10 - 11.5	42	23	19	90	CL	LEAN CLAY
▲	B-2	45 - 46.5	NP	NP	NP	21	SM	SILTY SAND
★	B-2	50 - 51.5	NP	NP	NP	59	ML	SANDY SILT
⊙	B-3	0.3 - 2.5	23	19	4	43	SC-SM	SILTY, CLAYEY SAND

PROJECT: Proposed New Classroom and Admin. Build. Los Alamitos High School

SITE: 3591 W Cerritos Ave
Los Alamitos, CA

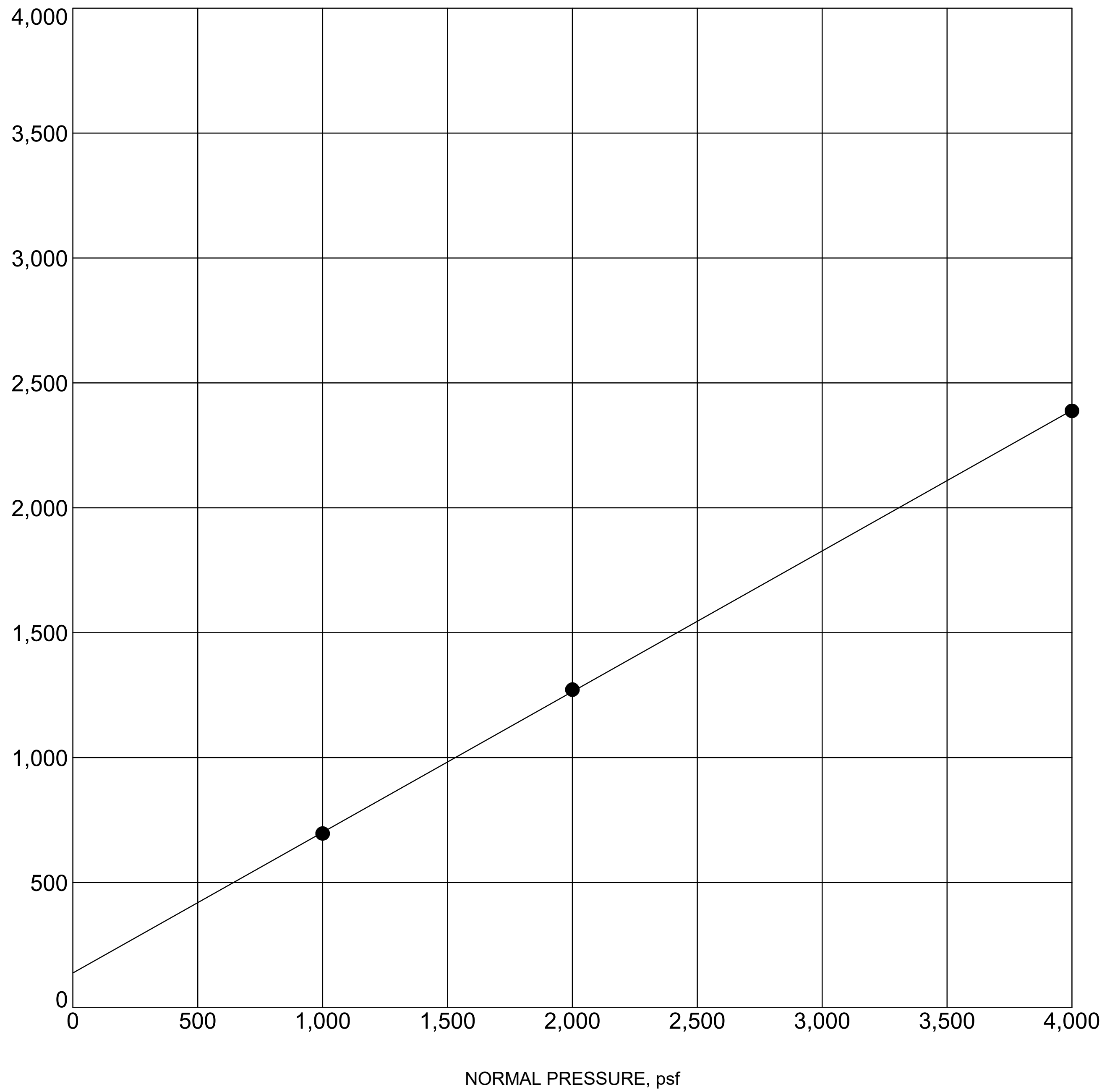
Terracon
1421 Edinger Ave, Ste C
Tustin, CA

PROJECT NUMBER: 60185158

CLIENT: Los Alamitos Unified School District
Los Alamitos, CA

EXHIBIT: B-2

DIRECT SHEAR TEST ASTM D3080



	Specimen Identification		Classification	γ_d, pcf	WC,%	c, psf	ϕ°
●	**B-3**	**5 - 6.5**	**SILTY CLAY WITH SAND CL-ML**	**94**	**9**	**138**	**29**

PROJECT: Proposed New Classroom and Admin. Build. Los Alamitos High School

SITE: 3591 W Cerritos Ave
Los Alamitos, CA

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

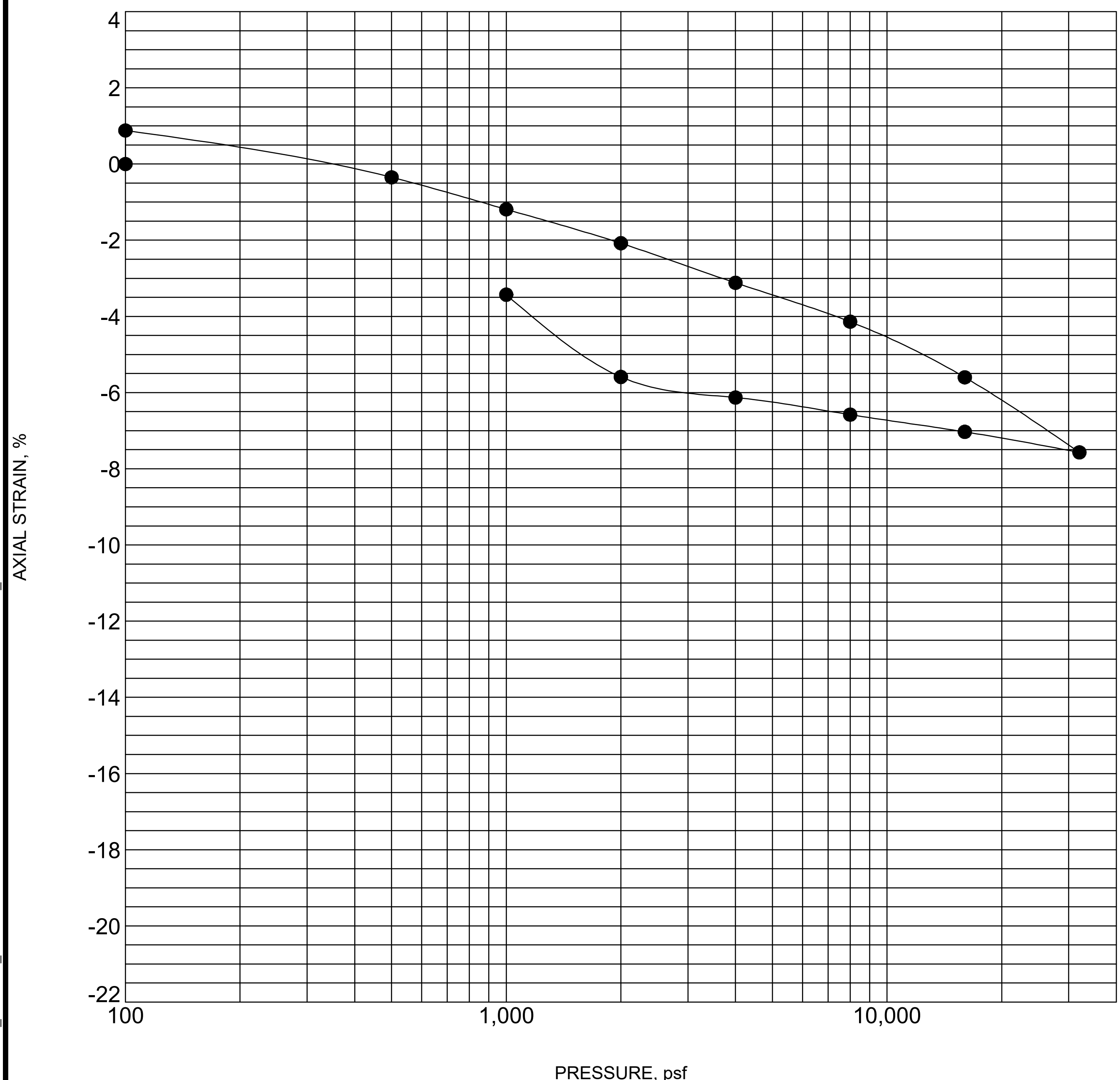
PROJECT NUMBER: 60185158

CLIENT: Los Alamitos Unified School District
Los Alamitos, CA

EXHIBIT: B-3

SWELL CONSOLIDATION TEST

ASTM D4546

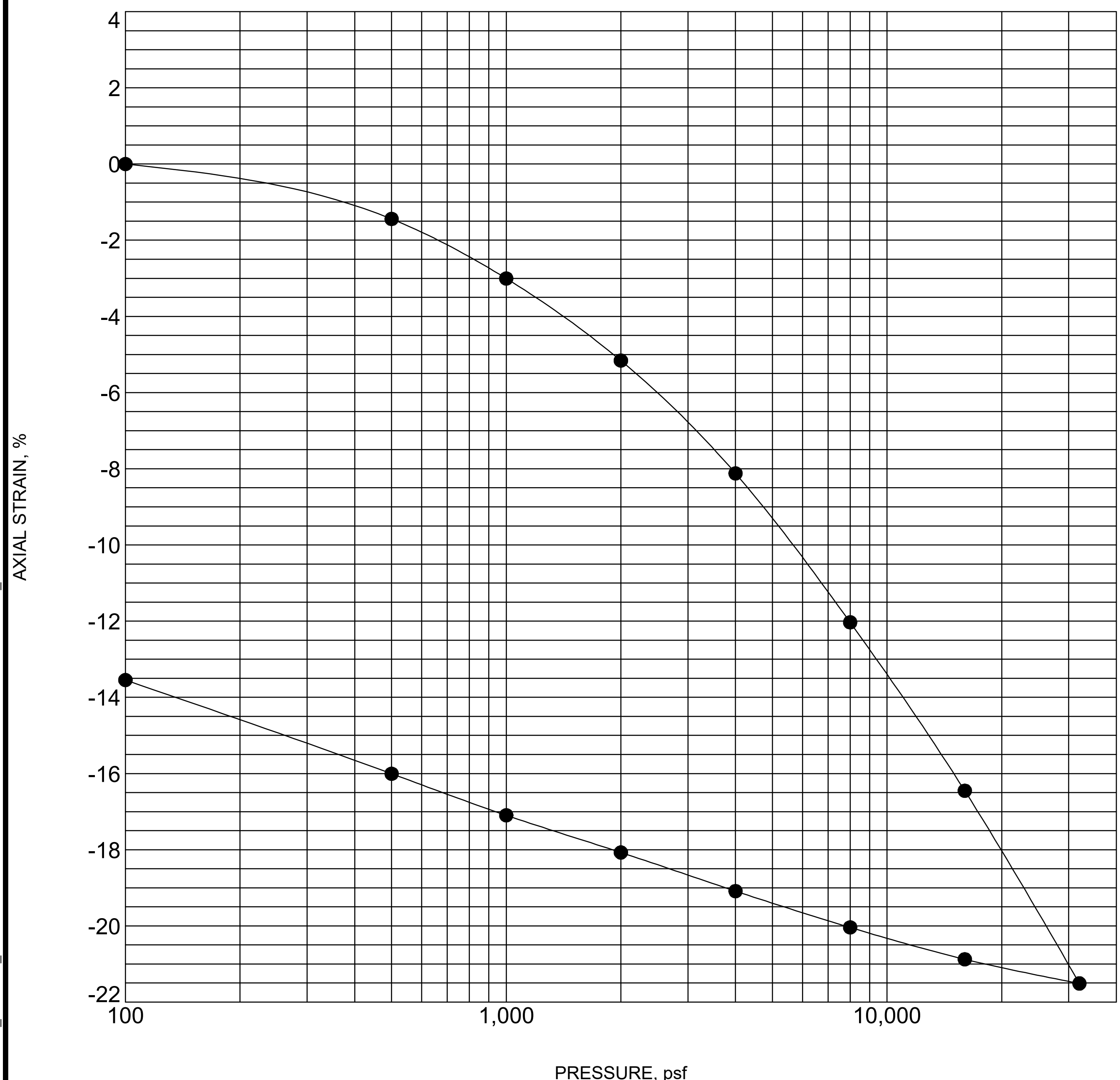


Specimen Identification		Classification	γ_d, pcf	WC, %
●	B-1 5 - 6.5 ft	LEAN CLAY	101	18

NOTES: Water added at 100 psf.

PROJECT: Proposed New Classroom and Admin. Build. Los Alamitos High School	Terracon 1421 Edinger Ave, Ste C Tustin, CA	PROJECT NUMBER: 60185158
SITE: 3591 W. Cerritos Ave Los Alamitos, CA		CLIENT: Los Alamitos Unified School District Los Alamitos, CA
		EXHIBIT: B-4

SWELL CONSOLIDATION TEST
ASTM D2435



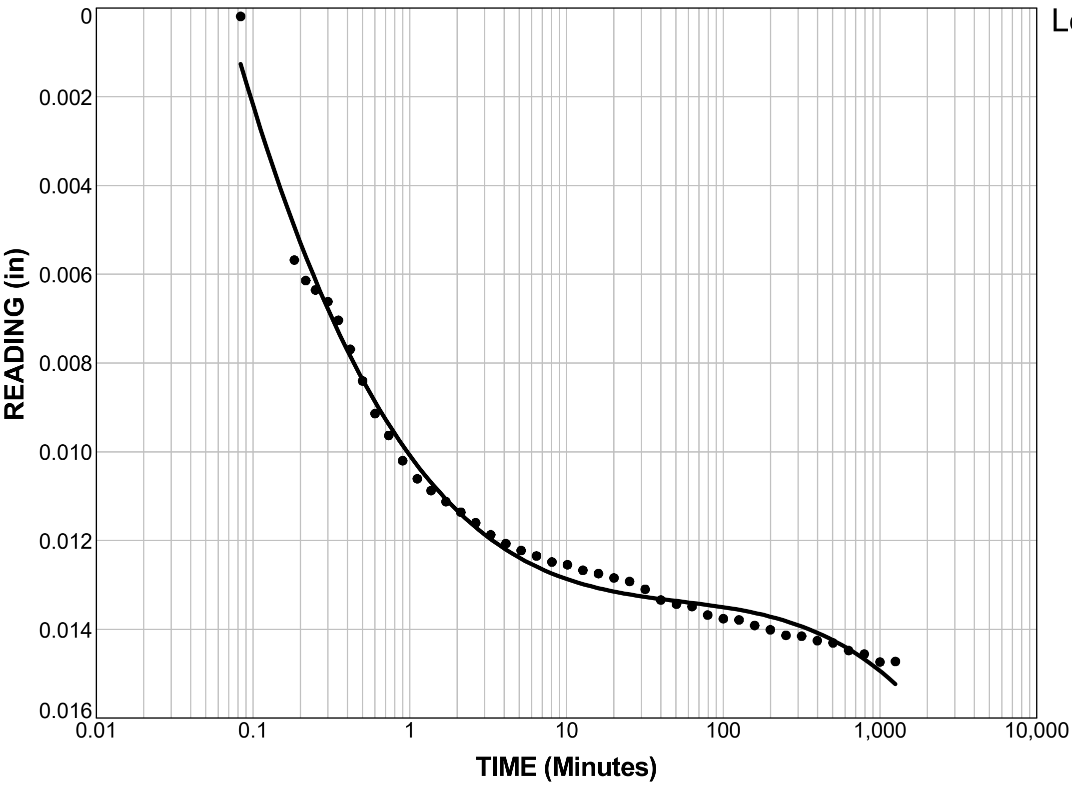
Specimen Identification		Classification	γ_d, pcf	WC, %
●	B-1 15 - 16.5 ft	LEAN CLAY	83	37

NOTES: Water added at 100 psf.

PROJECT: Proposed New Classroom and Admin. Build. Los Alamitos High School	Terracon 1421 Edinger Ave, Ste C Tustin, CA	PROJECT NUMBER: 60185158
SITE: 3591 W. Cerritos Ave Los Alamitos, CA		CLIENT: Los Alamitos Unified School District Los Alamitos, CA
		EXHIBIT: B-5

Per ASTM D2435/D2435M, Fig. 1

Borehole: B-1 Depth: 15

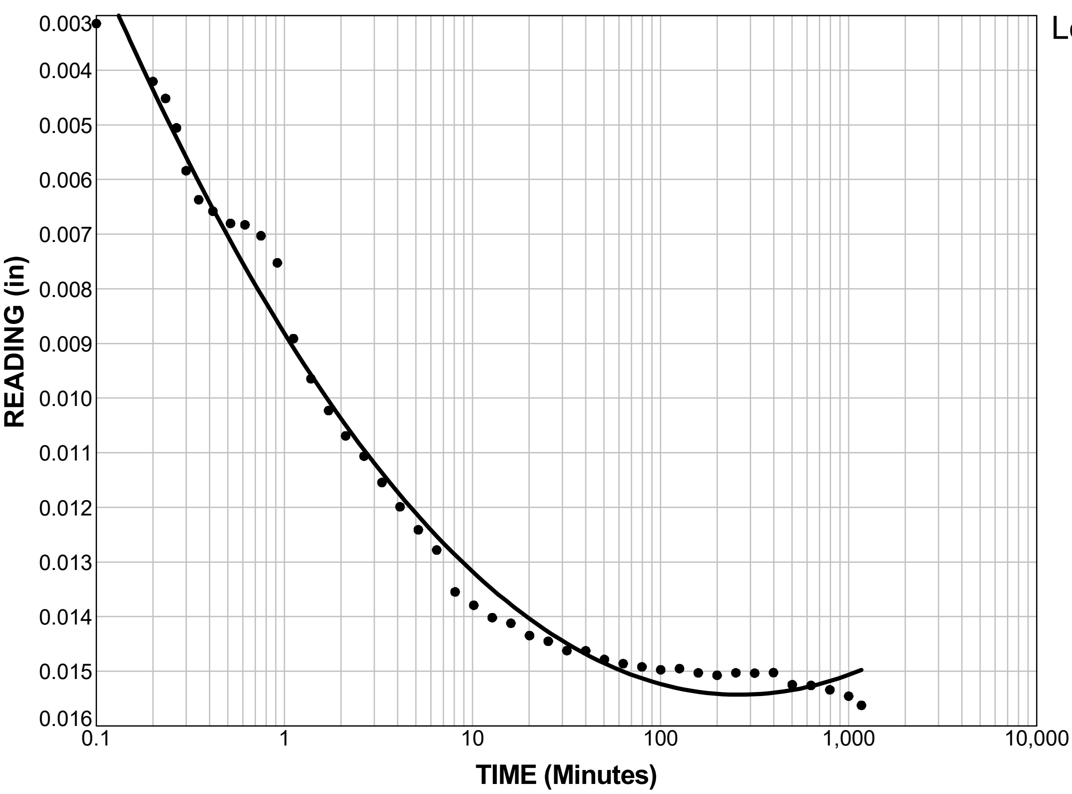


Load No. = 2
Load = 500 psf
D_0 = -0.0046
D_{50} = 0.0050
D_{100} = 0.0145
t_{50} = 0.19 min.

C_V @ t_{50}
2.477 ft^2/day

2ndary Compression Slope (c_α)
0.00095 in/log time

Borehole: B-1 Depth: 15



Load No. = 3
Load = 1000 psf
D_0 = -0.0023
D_{50} = 0.0055
D_{100} = 0.0132
t_{50} = 0.29 min.

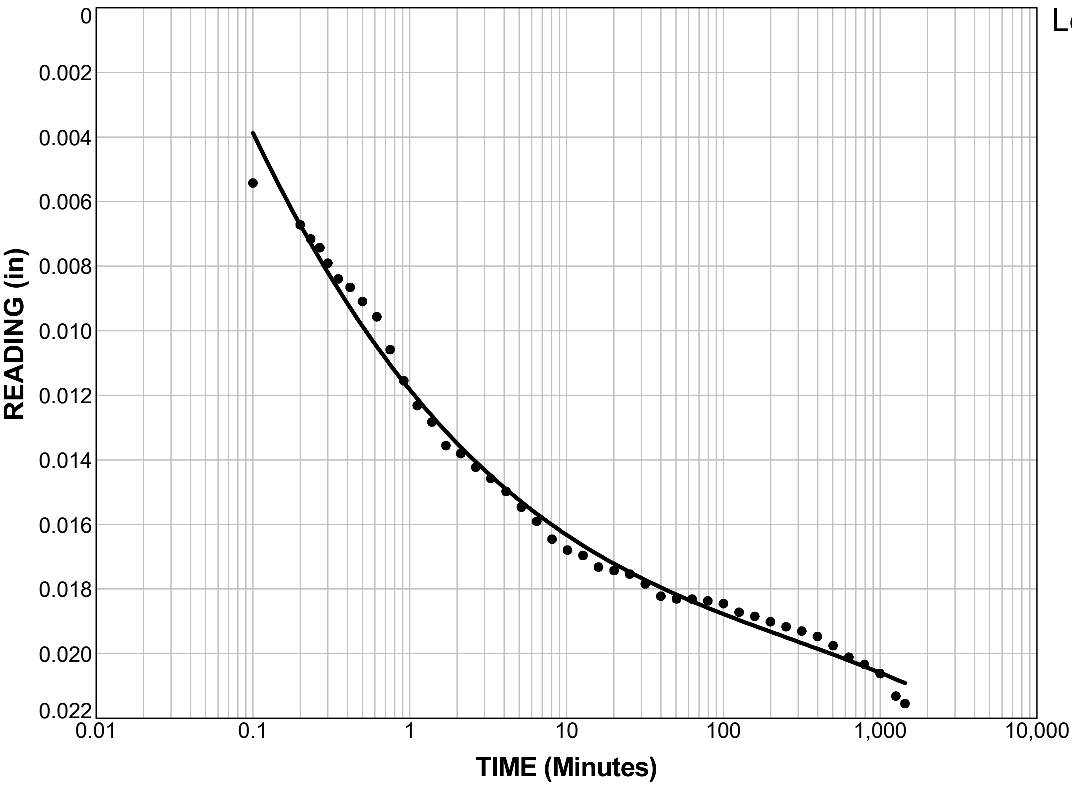
C_V @ t_{50}
1.596 ft^2/day

2ndary Compression Slope (c_α)
0.00100 in/log time

PROJECT: Proposed New Classroom and Admin. Build. Los Alamitos High School	Terracon 1421 Edinger Ave, Ste C Tustin, CA	PROJECT NUMBER: 60185158
SITE: 3591 W Cerritos Ave Los Alamitos, CA		CLIENT: Los Alamitos Unified School District Los Alamitos, CA
		EXHIBIT: B-6

Per ASTM D2435/D2435M, Fig. 1

Borehole: B-1 Depth: 15

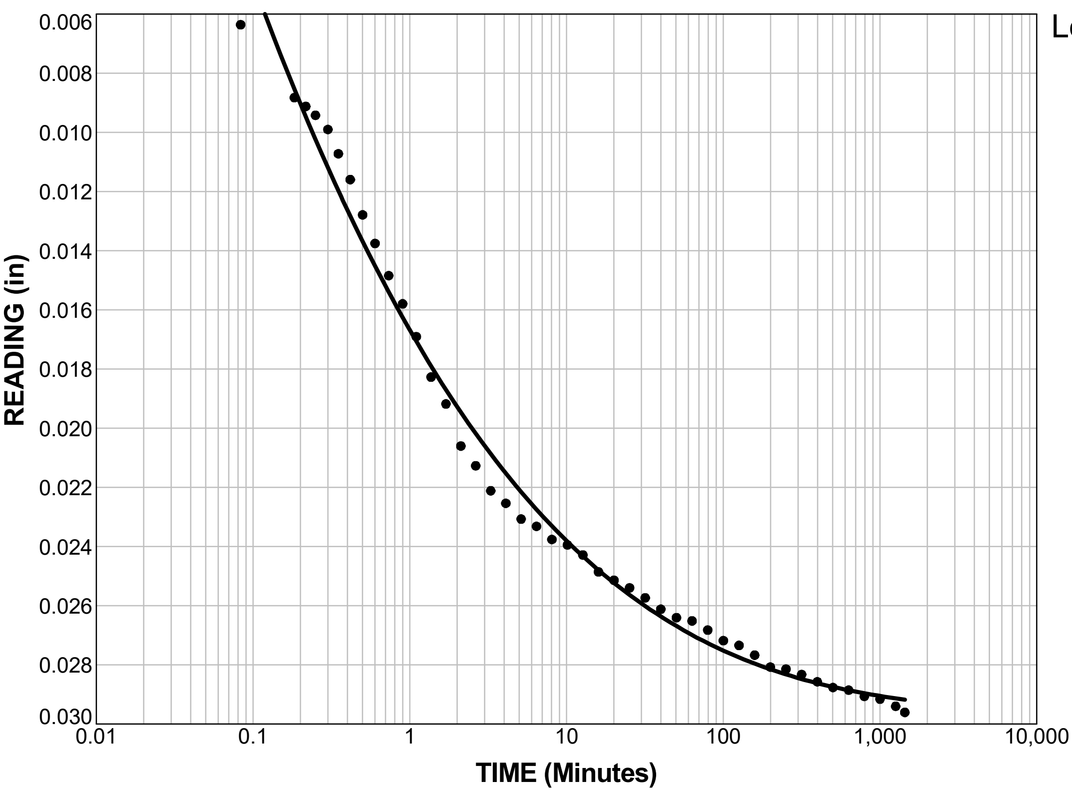


Load No. = 4
Load = 2000 psf
D_0 = -0.0014
D_{50} = 0.0094
D_{100} = 0.0203
t_{50} = 0.43 min.

C_V @ t_{50}
1.045 ft^2/day

2ndary Compression Slope (c_α)
0.00367 in/log time

Borehole: B-1 Depth: 15



Load No. = 5
Load = 4000 psf
D_0 = -0.0042
D_{50} = 0.0105
D_{100} = 0.0253
t_{50} = 0.26 min.

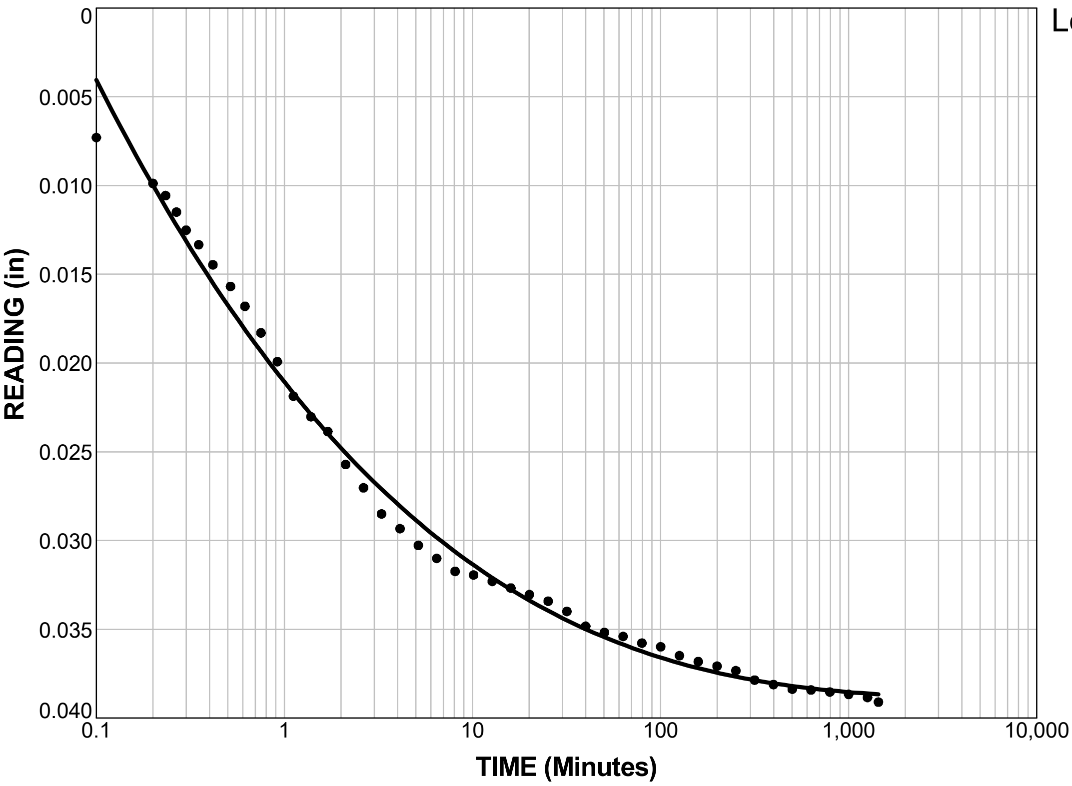
C_V @ t_{50}
1.713 ft^2/day

2ndary Compression Slope (c_α)
0.00180 in/log time

PROJECT: Proposed New Classroom and Admin. Build. Los Alamitos High School	Terracon 1421 Edinger Ave, Ste C Tustin, CA	PROJECT NUMBER: 60185158
SITE: 3591 W Cerritos Ave Los Alamitos, CA		CLIENT: Los Alamitos Unified School District Los Alamitos, CA
		EXHIBIT: B-7

Per ASTM D2435/D2435M, Fig. 1

Borehole: B-1 Depth: 15

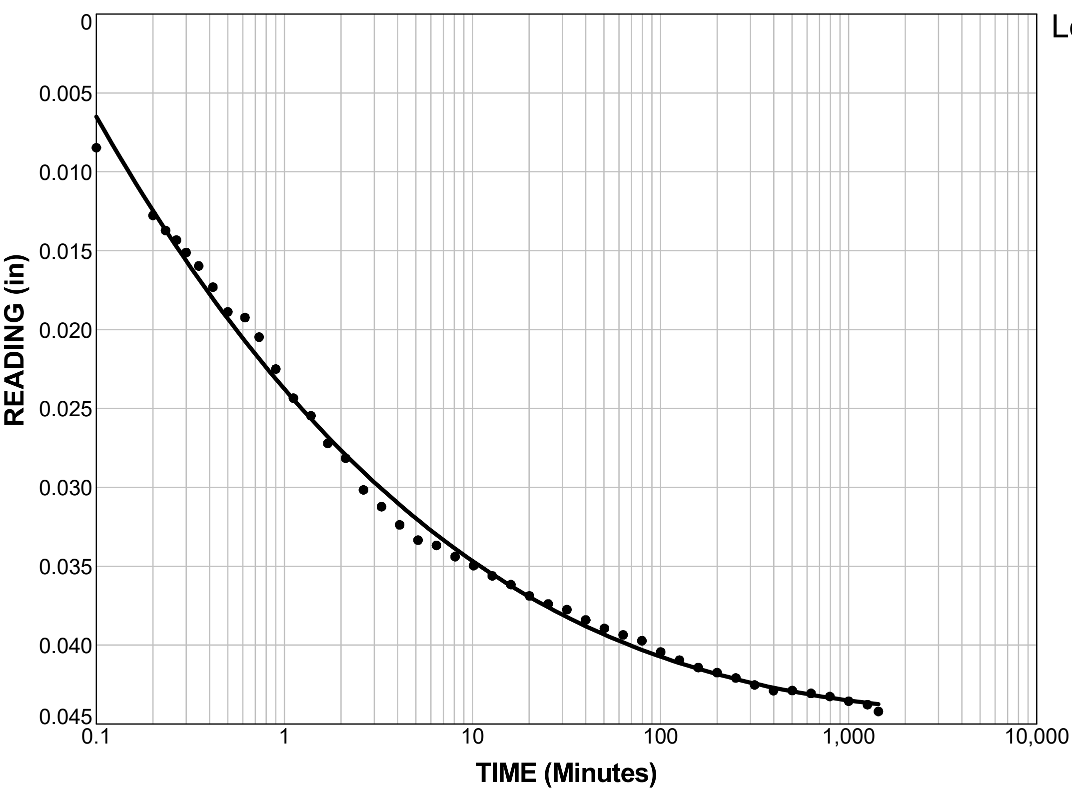


Load No. = 6
Load = 8000 psf
D_0 = -0.0071
D_{50} = 0.0142
D_{100} = 0.0355
t_{50} = 0.35 min.

C_V @ t_{50}
1.298 ft^2/day

2ndary Compression
Slope (c_α)
0.00163 in/log time

Borehole: B-1 Depth: 15



Load No. = 7
Load = 16000 psf
D_0 = -0.0047
D_{50} = 0.0171
D_{100} = 0.0389
t_{50} = 0.36 min.

C_V @ t_{50}
1.226 ft^2/day

2ndary Compression
Slope (c_α)
0.00237 in/log time

PROJECT: Proposed New Classroom and Admin. Build. Los Alamitos High School

SITE: 3591 W Cerritos Ave
Los Alamitos, CA

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

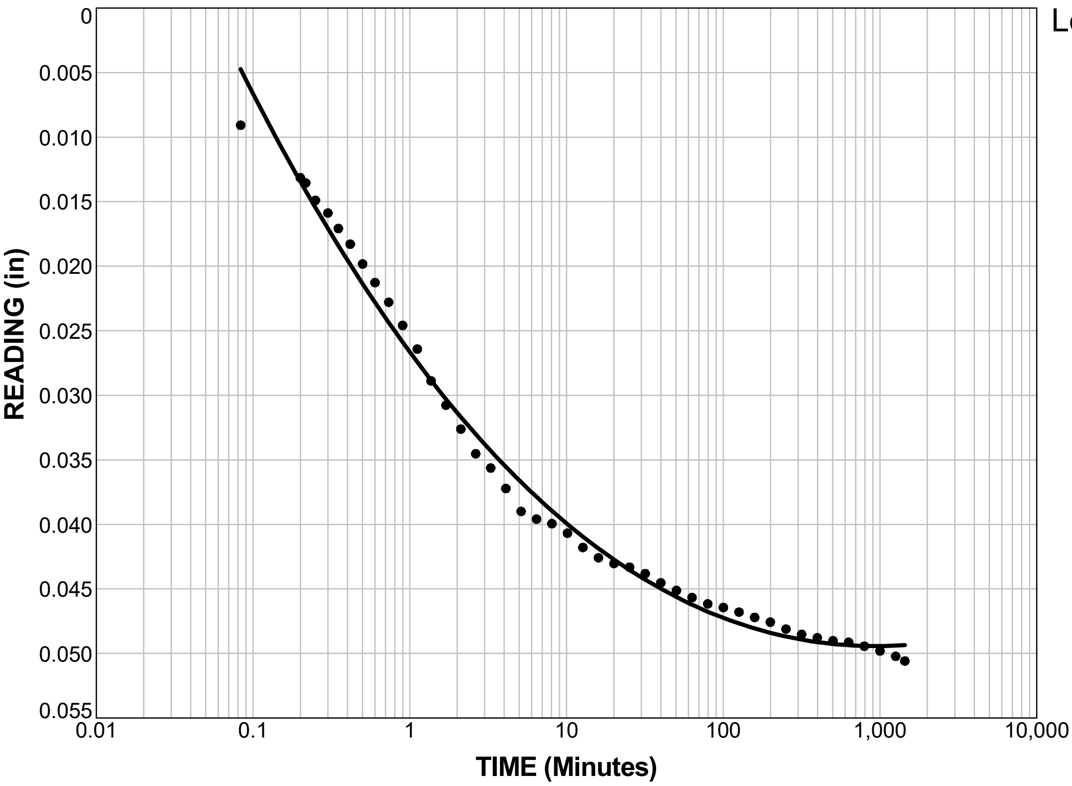
PROJECT NUMBER: 60185158

CLIENT: Los Alamitos Unified School District
Los Alamitos, CA

EXHIBIT: B-8

Borehole: B-1 Depth: 15

Per ASTM D2435/D2435M, Fig. 1



Load No. = 8

Load = 32000 psf

D_0 = -0.0085

D_{50} = 0.0163

D_{100} = 0.0410

t_{50} = 0.27 min.

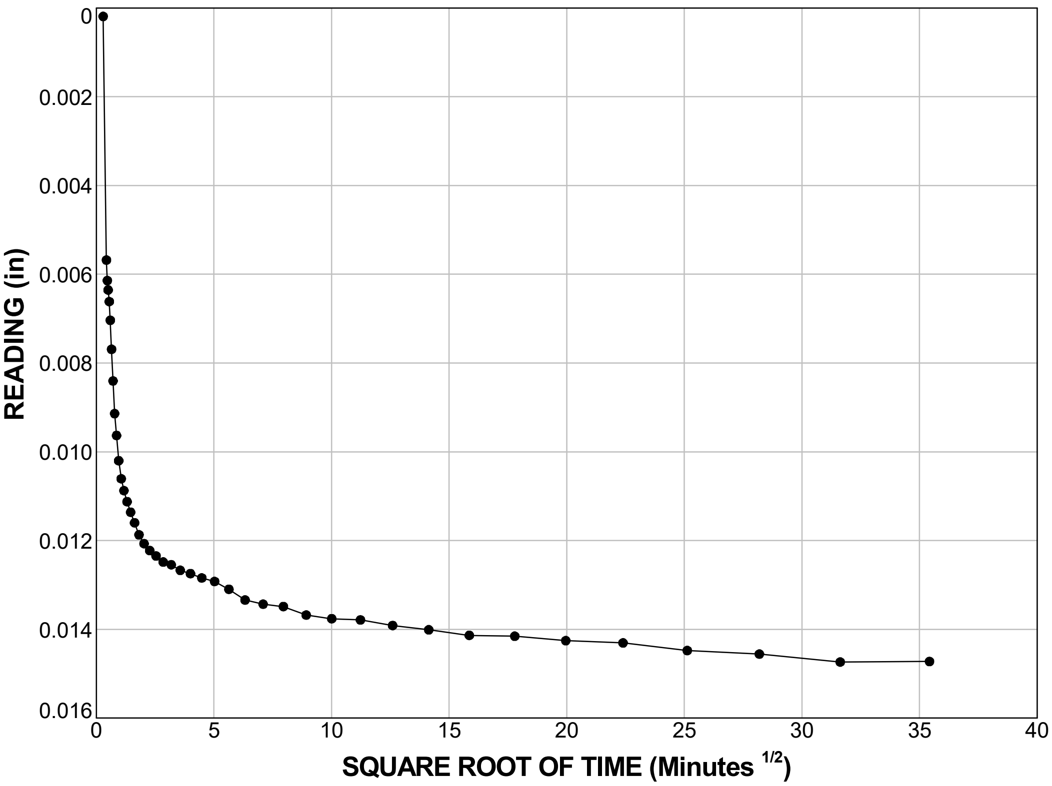
C_V @ t_{50}
1.637 ft^2/day

2ndary Compression Slope (c_α)
0.00399 in/log time

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. CONS_TIME-DEF_PROP_LOG-TIME 60185158 BORING LOGS.GPJ TERRACON_DATATEMPLATE.GDT 12/27/18

PROJECT: Proposed New Classroom and Admin. Build. Los Alamitos High School	Terracon 1421 Edinger Ave, Ste C Tustin, CA	PROJECT NUMBER: 60185158
SITE: 3591 W Cerritos Ave Los Alamitos, CA		CLIENT: Los Alamitos Unified School District Los Alamitos, CA
		EXHIBIT: B-9

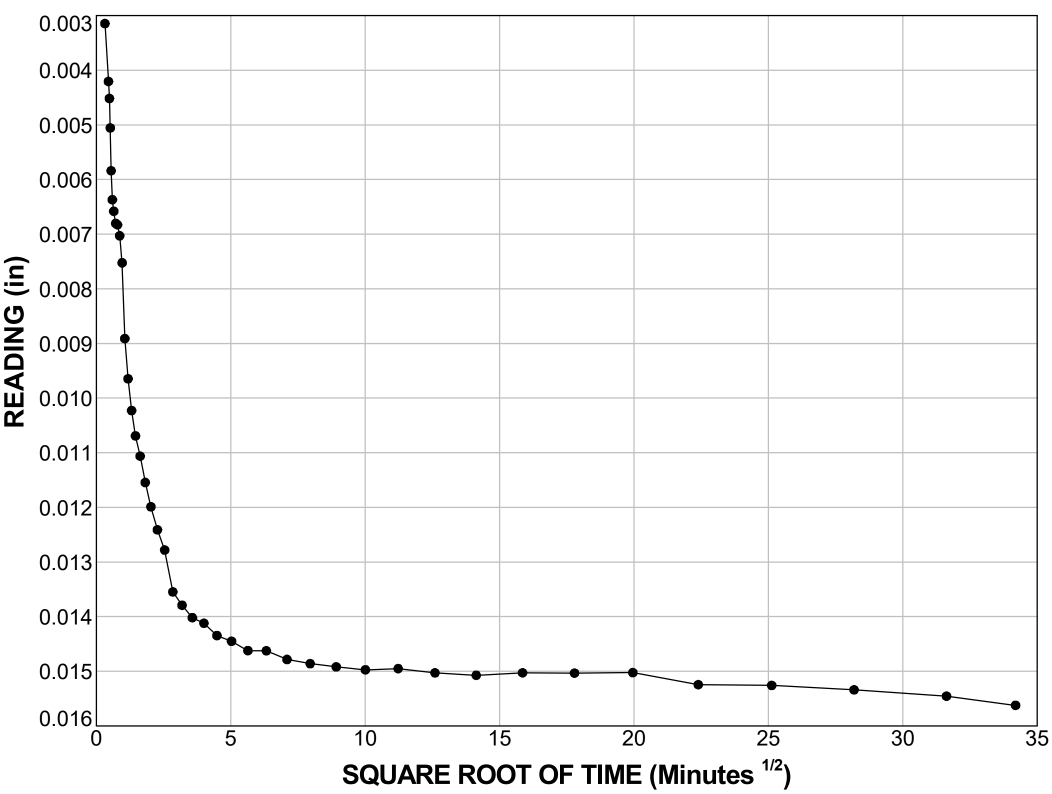
Borehole: B-1 Depth: 15



Load No. = 2
Load = 500 psf
D_0 = -0.0084
D_{90} = 0.0068
D_{100} = 0.0085
t_{90} = 0.32 min.

C_V @ t_{90}
6.249 ft^2/day

Borehole: B-1 Depth: 15



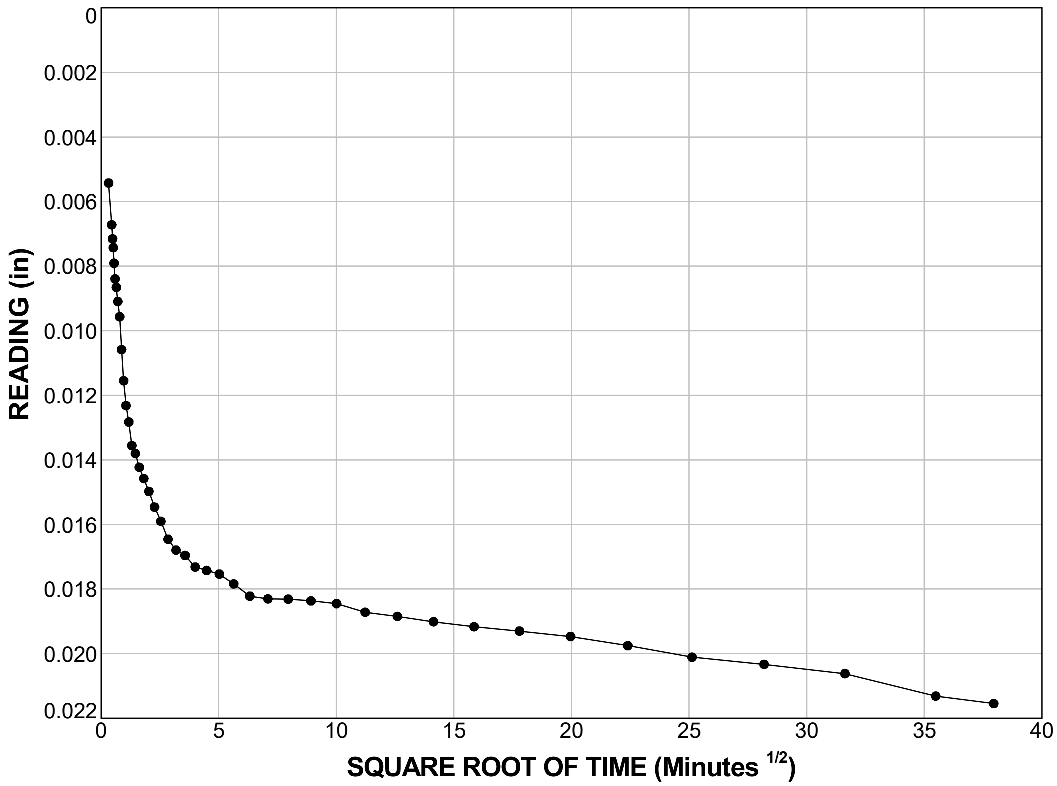
Load No. = 3
Load = 1000 psf
D_0 = -0.0040
D_{90} = 0.0067
D_{100} = 0.0079
t_{90} = 0.49 min.

C_V @ t_{90}
4.056 ft^2/day

PROJECT: Proposed New Classroom and Admin. Build. Los Alamitos High School	Terracon 1421 Edinger Ave, Ste C Tustin, CA	PROJECT NUMBER: 60185158
SITE: 3591 W Cerritos Ave Los Alamitos, CA		CLIENT: Los Alamitos Unified School District Los Alamitos, CA
		EXHIBIT: B-10

Per ASTM D2435/D2435M, Fig. 2

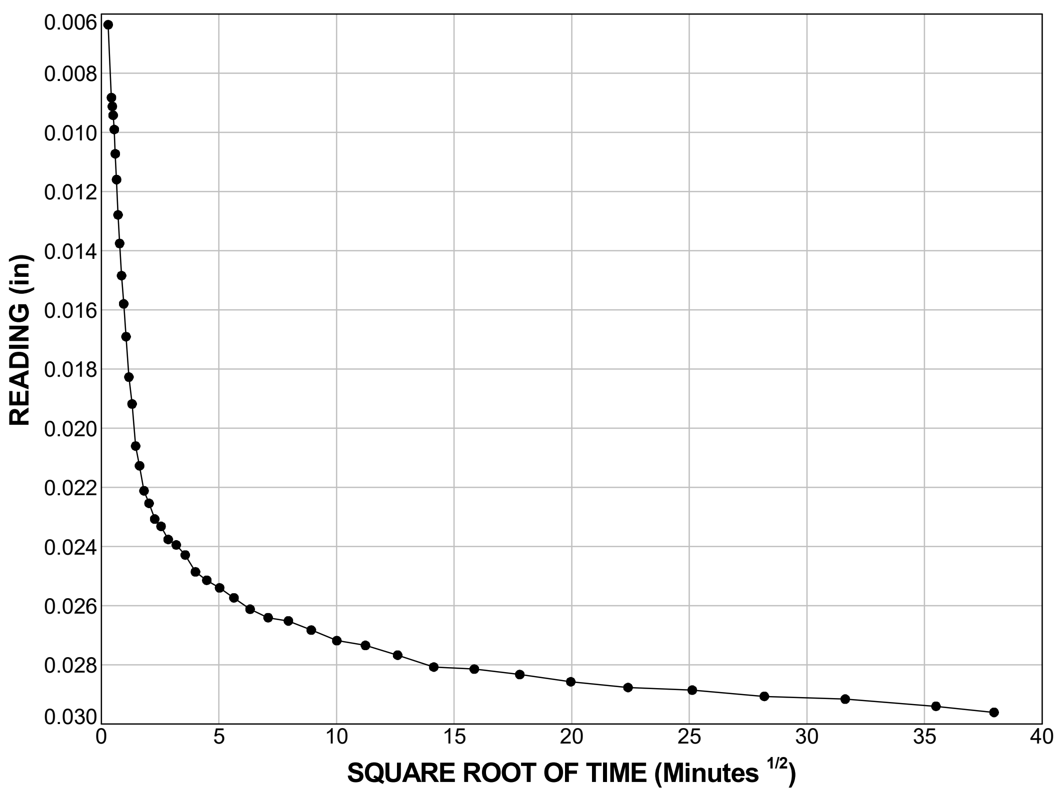
Borehole: B-1   Depth: 15



Load No. = 4
Load = 2000 psf
D_0 = 0.0014
D_{90} = 0.0124
D_{100} = 0.0136
t_{90} = 1.14 min.

C_V @ t_{90}
1.716 ft^2/day

Borehole: B-1   Depth: 15



Load No. = 5
Load = 4000 psf
D_0 = 0.0001
D_{90} = 0.0182
D_{100} = 0.0202
t_{90} = 1.35 min.

C_V @ t_{90}
1.451 ft^2/day

PROJECT: Proposed New Classroom and Admin. Build. Los Alamitos High School

SITE: 3591 W Cerritos Ave
Los Alamitos, CA

1421 Edinger Ave, Ste C
Tustin, CA

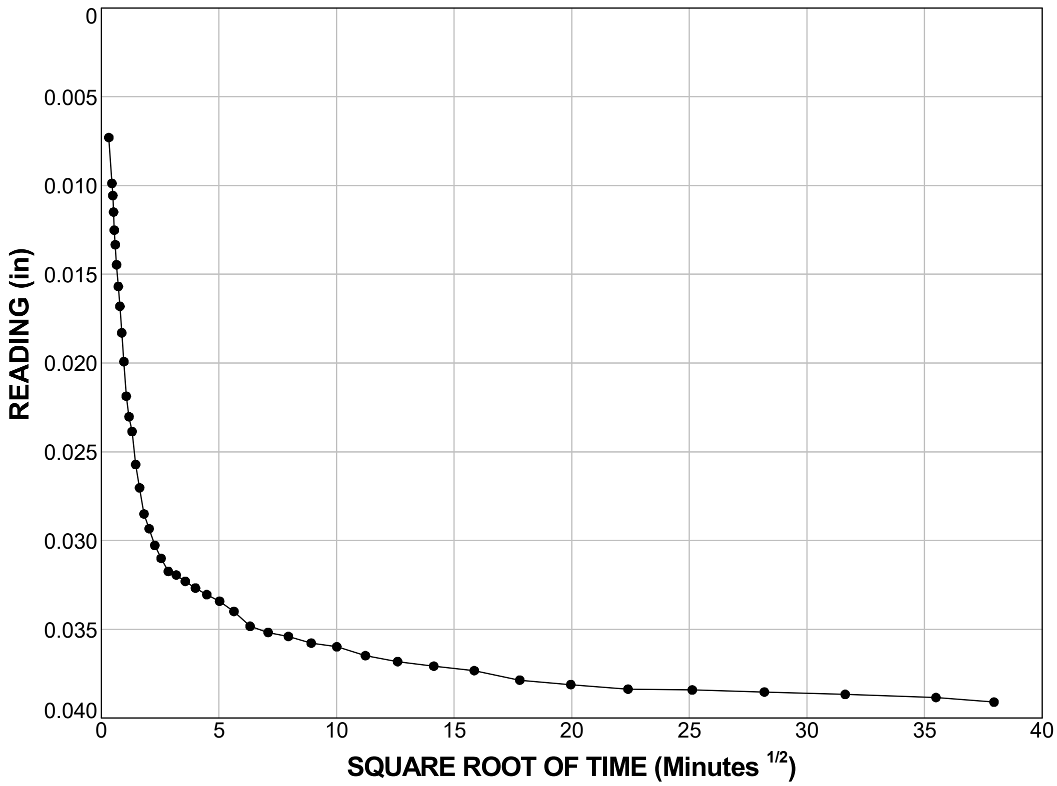
PROJECT NUMBER: 60185158

CLIENT: Los Alamitos Unified School District
Los Alamitos, CA

EXHIBIT: B-11

Per ASTM D2435/D2435M, Fig. 2

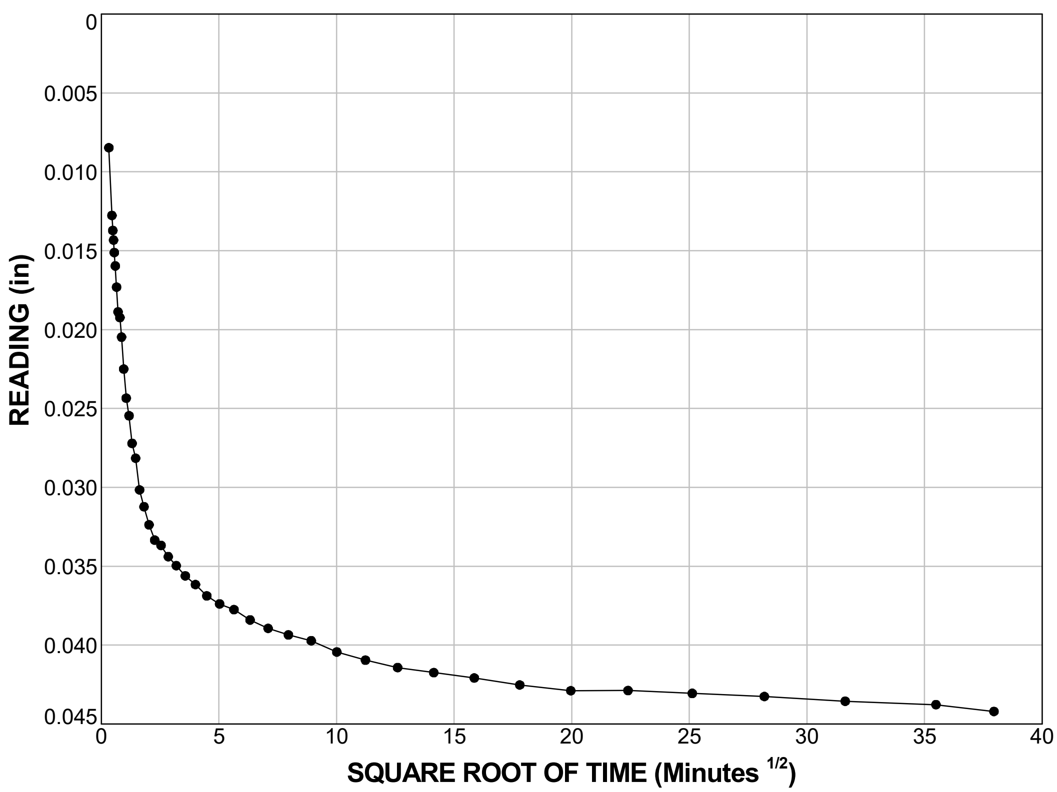
Borehole: B-1 Depth: 15



Load No. = 6
Load = 8000 psf
D_0 = -0.0020
D_{90} = 0.0202
D_{100} = 0.0226
t_{90} = 0.94 min.

C_V @ t_{90}
2.074 ft^2/day

Borehole: B-1 Depth: 15



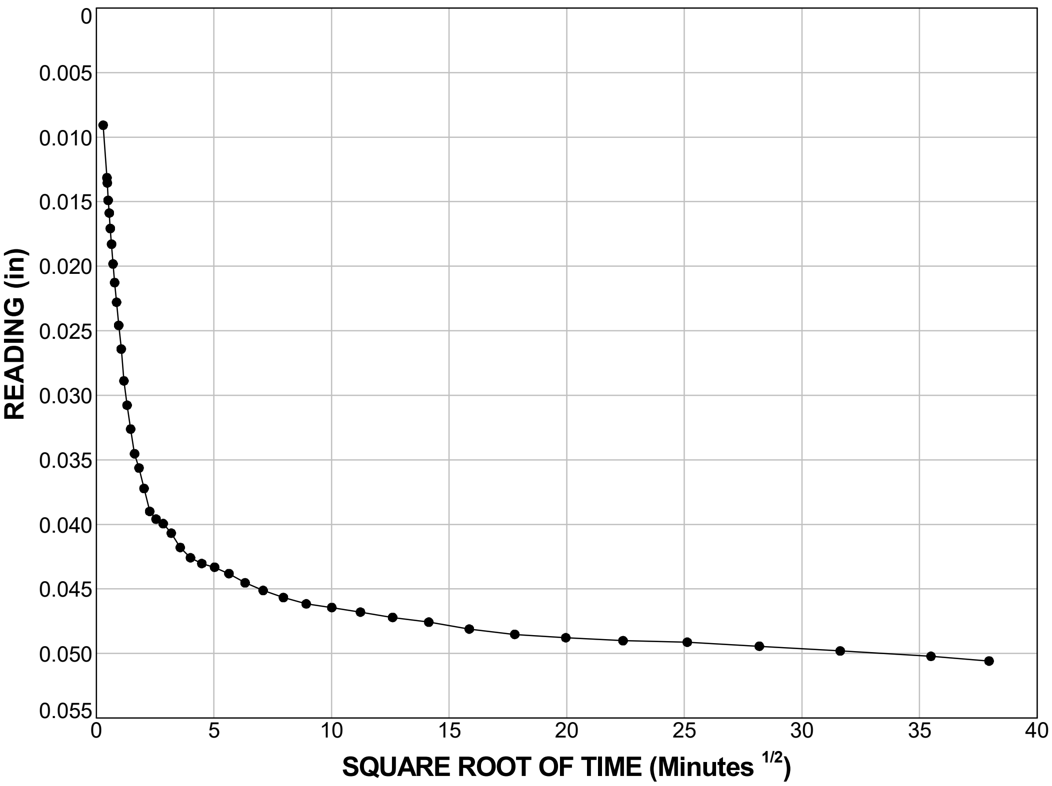
Load No. = 7
Load = 16000 psf
D_0 = -0.0009
D_{90} = 0.0192
D_{100} = 0.0214
t_{90} = 0.59 min.

C_V @ t_{90}
3.306 ft^2/day

PROJECT: Proposed New Classroom and Admin. Build. Los Alamitos High School	Terracon 1421 Edinger Ave, Ste C Tustin, CA	PROJECT NUMBER: 60185158
SITE: 3591 W Cerritos Ave Los Alamitos, CA		CLIENT: Los Alamitos Unified School District Los Alamitos, CA
		EXHIBIT: B-12

Borehole: B-1 Depth: 15

Per ASTM D2435/D2435M, Fig. 2



Load No. = 8
Load = 32000 psf
D_0 = 0.0006
D_{90} = 0.0264
D_{100} = 0.0292
t_{90} = 1.11 min.

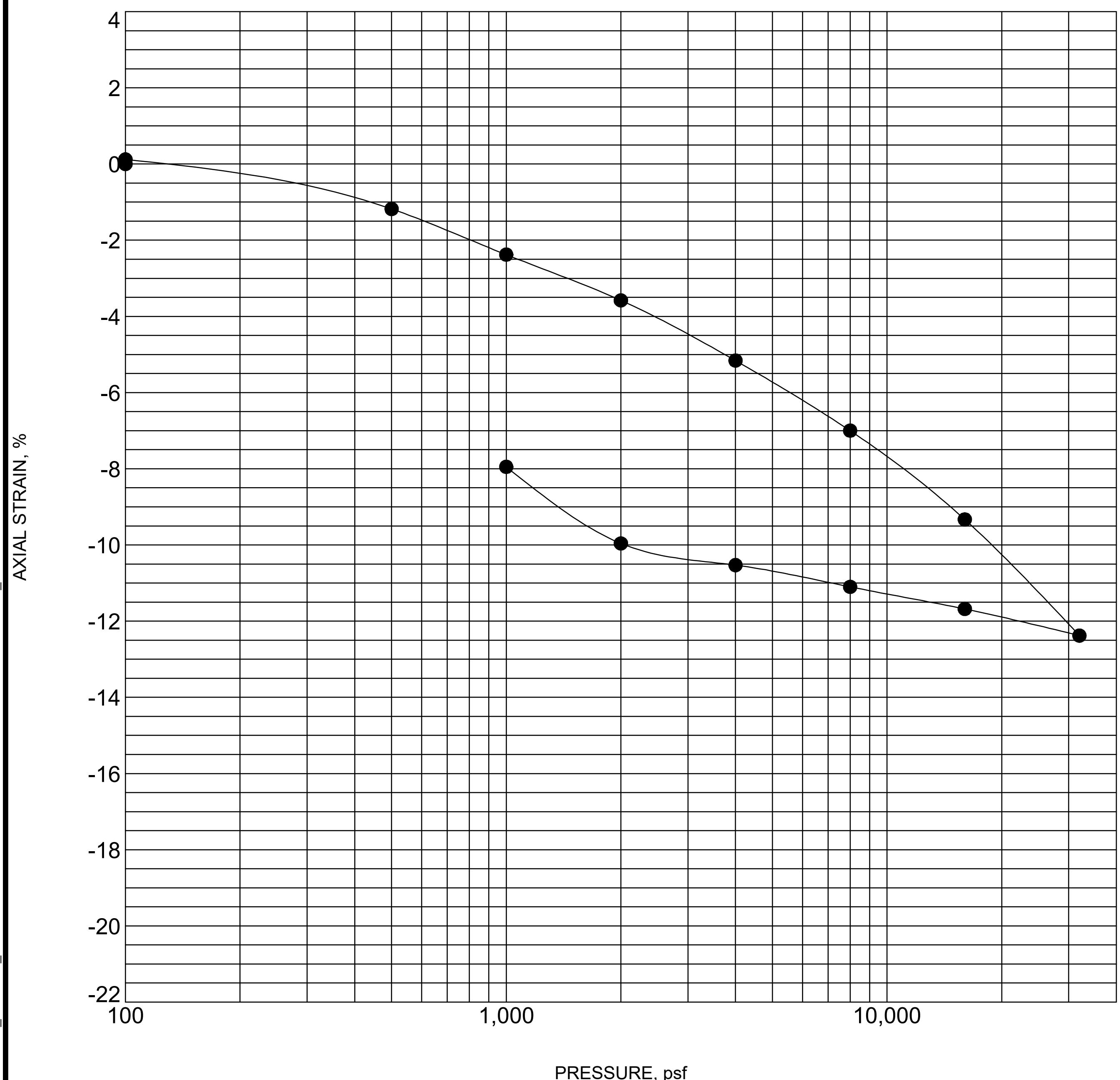
C_V @ t_{90}
1.739 ft^2/day

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. CONS_TIME-DEF_PROP_SQRT-TIME 60185158 BORING LOGS.GPJ TERRACON_DATATEMPLATE.GDT 12/27/18

PROJECT: Proposed New Classroom and Admin. Build. Los Alamitos High School	Terracon 1421 Edinger Ave, Ste C Tustin, CA	PROJECT NUMBER: 60185158
SITE: 3591 W Cerritos Ave Los Alamitos, CA		CLIENT: Los Alamitos Unified School District Los Alamitos, CA
		EXHIBIT: B-13

SWELL CONSOLIDATION TEST

ASTM D4546



Specimen Identification		Classification	γ_d, pcf	WC, %
●	B-2 20 - 21.5 ft	LEAN CLAY	86	34

NOTES: Water added at 100 psf.

PROJECT: Proposed New Classroom and Admin. Build. Los Alamitos High School

SITE: 3591 W. Cerritos Ave
Los Alamitos, CA

Terracon
1421 Edinger Ave, Ste C
Tustin, CA

PROJECT NUMBER: 60185158

CLIENT: Los Alamitos Unified School District
Los Alamitos, CA

EXHIBIT: B-14

CHEMICAL LABORATORY TEST REPORT

Project Number: 60185158
Service Date: 12/06/18
Report Date: 12/10/18
Task:

750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client

Los Alamitos Unified School District

Project

Los Alamito High School Classroom Building

Sample Submitted By: Terracon (60) **Date Received:** 12/4/2018 **Lab No.: 18-1479**

Results of Corrosion Analysis

Sample Number	
Sample Location	B-3
Sample Depth (ft.)	Bulk
pH Analysis, AWWA 4500 H	8.35
Water Soluble Sulfate (SO4), AWWA 4500 E (percent %)	0.01
Sulfides, AWWA 4500-S D, (mg/kg)	Nil
Chlorides, ASTM D 512, (mg/kg)	97
Red-Ox, AWWA 2580, (mV)	+684
Total Salts, AWWA 2520 B, (mg/kg)	778
Resistivity, ASTM G 57, (ohm-cm)	3104

Analyzed By: Trisha Campo

Trisha Campo
Chemist

APPENDIX C

SUPPORTING DOCUMENTS

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING

Auger	Shelby Tube	Split Spoon
Rock Core	Macro Core	Modified California Ring Sampler
Grab Sample	No Recovery	Modified Dames & Moore Ring Sampler

WATER LEVEL

- Water Initially Encountered
- Water Level After a Specified Period of Time
- Water Level After a Specified Period of Time

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	Hand Penetrometer
(T)	Torvane
(b/f)	Standard Penetration Test (blows per foot)
N	N value
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer
(WOH)	Weight of Hammer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels and sands.			**CONSISTENCY OF FINE-GRAINED SOILS** (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance Includes silts and clays.			
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength, Qu, psf**	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42
			Hard	> 8,000	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification: Group Symbol	Soil Classification: Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]	GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F,G,H]
			Fines classify as CL or CH	GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]	SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G,H,I]
			Fines classify as CL or CH	SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	$PI > 7$ and plots on or above "A" line [J]	CL	Lean clay [K,L,M]
			$PI < 4$ or plots below "A" line [J]	ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OL	Organic clay [K,L,M,N]
					Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line	CH	Fat clay [K,L,M]
			PI plots below "A" line	MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OH	Organic clay [K,L,M,P]
					Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10} \qquad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains $\geq$ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains $\geq$ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains $\geq$ 30% plus No. 200 predominantly sand, add "sandy" to group name.

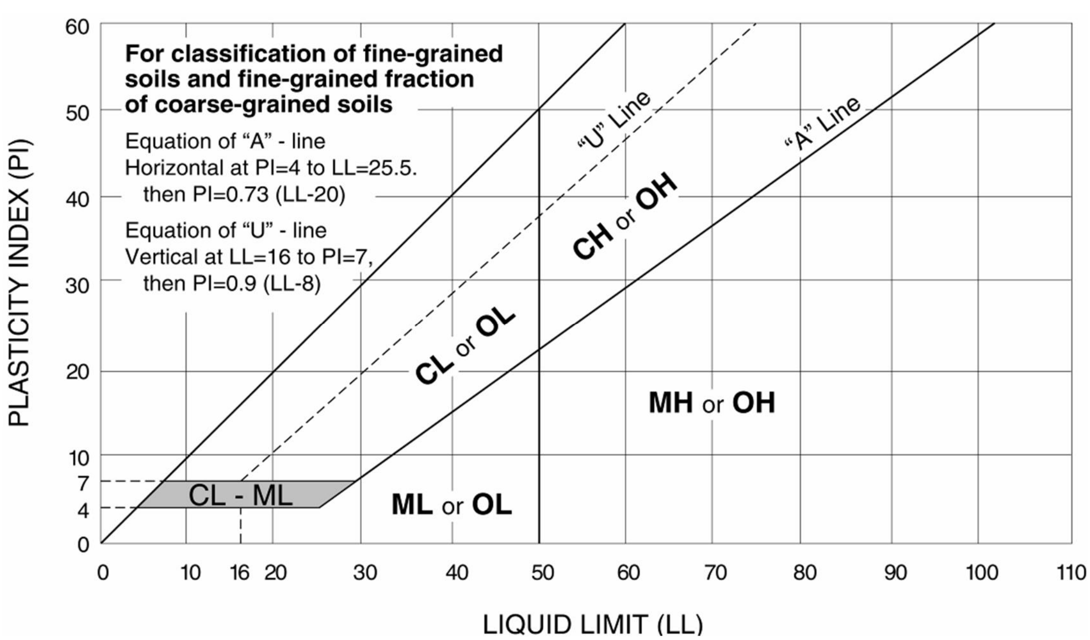
[M] If soil contains $\geq$ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] $PI \geq 4$ and plots on or above "A" line.

[O] $PI < 4$ or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



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APPENDIX D

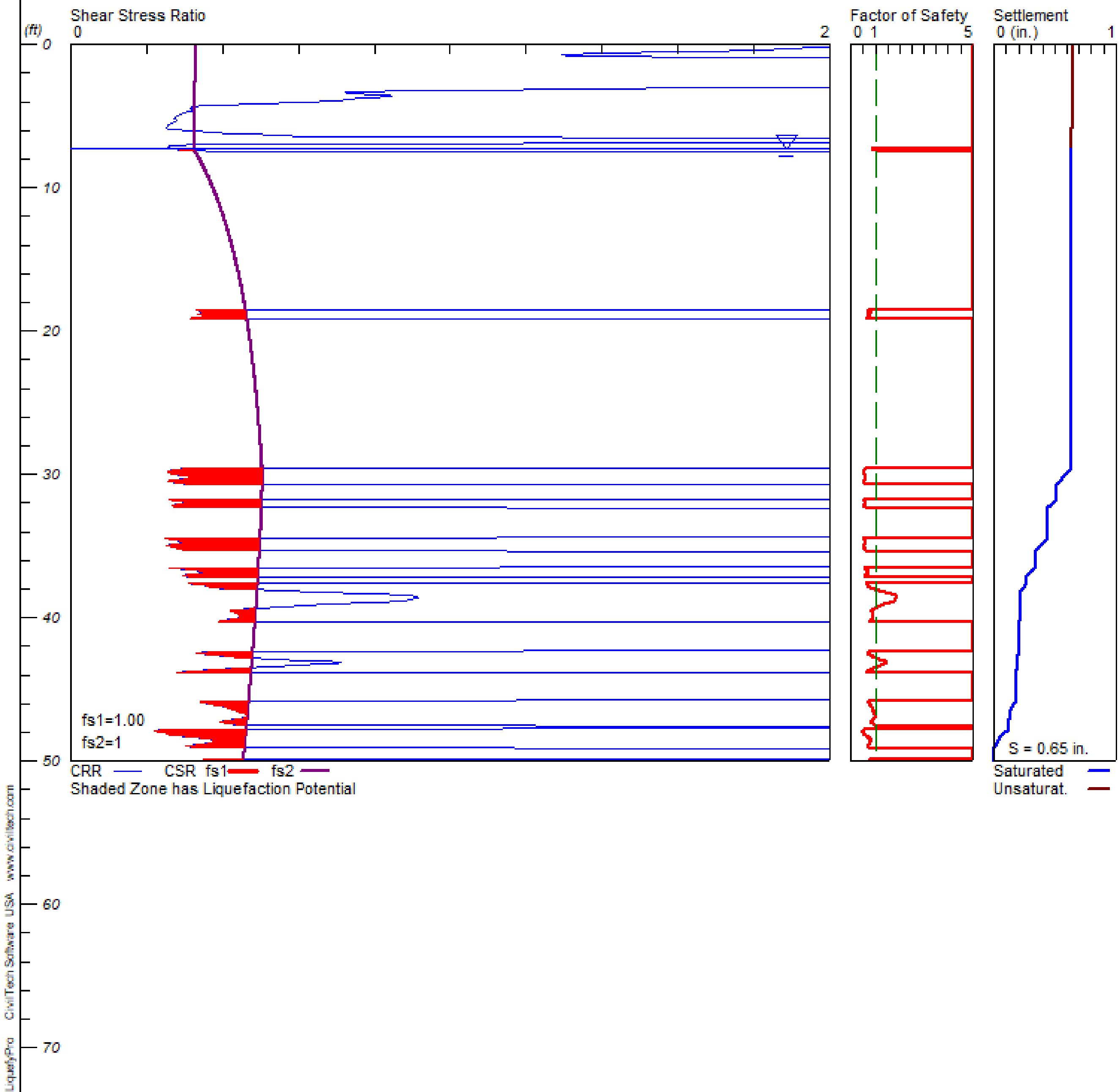
CALCULATIONS

LIQUEFACTION ANALYSIS

Proposed New Classroom and Administration Building

Hole No.=CPT-1 Water Depth=7.3 ft

Magnitude=6.63
Acceleration=0.508g



CivilTech Corporation   Los Alamitos High School (Project No. 60185158)   Exhibit D-1

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LIQUEFACTION ANALYSIS SUMMARY

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Input File Name: N:\Projects\2018\60185158\Working Files\Calculations-Analyses\CPT-1.liq
Title: Proposed New Classroom and Administration Building
Subtitle: Los Alamitos High School (Project No. 60185158)

Surface Elev.=
Hole No.=CPT-1
Depth of Hole= 50.00 ft
Water Table during Earthquake= 7.30 ft
Water Table during In-Situ Testing= 28.00 ft
Max. Acceleration= 0.51 g
Earthquake Magnitude= 6.63

Input Data:
Surface Elev.=
Hole No.=CPT-1
Depth of Hole=50.00 ft
Water Table during Earthquake= 7.30 ft
Water Table during In-Situ Testing= 28.00 ft
Max. Acceleration=0.51 g
Earthquake Magnitude=6.63
No-Liquefiable Soils: CL, OL are Non-Liq. Soil

1. CPT Calculation Method: Robertson et al.
2. Settlement Analysis Method: Tokimatsu, M-correction
3. Fines Correction for Liquefaction: Stark/Olson et al.*
4. Fine Correction for Settlement: During Liquefaction*
5. Settlement Calculation in: All zones*
9. User request factor of safety (apply to CSR) , User= 1.
   Plot two CSR (fs1=User, fs2=1)
10. Use Curve Smoothing: Yes*
* Recommended Options

In-Situ Test Data:

Depth	qc	fs	Rf	gamma	Fines	D50

ft	atm	atm	pcf	%	mm	
0.00	0.00	0.23	100.00	120.00	0.00	0.50
1.25	79.82	1.02	1.28	120.00	0.00	0.50
2.53	87.61	1.50	1.72	120.00	0.00	0.50
3.75	33.64	1.26	3.76	120.00	0.00	0.50
5.02	29.02	0.60	2.07	120.00	0.00	0.50
6.29	22.81	0.99	4.33	120.00	0.00	0.50
7.51	16.60	0.71	4.26	120.00	0.00	0.50
8.99	8.24	0.42	5.15	120.00	0.00	0.50
10.05	10.73	0.58	5.38	120.00	0.00	0.50
11.31	10.39	0.63	6.02	120.00	0.00	0.50
12.55	8.81	0.61	6.95	120.00	0.00	0.50
13.81	8.47	0.51	5.97	120.00	0.00	0.50
15.04	15.69	0.78	4.96	120.00	0.00	0.50
16.29	9.48	0.49	5.15	120.00	0.00	0.50
17.54	14.79	0.65	4.42	120.00	0.00	0.50
18.77	63.68	1.40	2.20	120.00	0.00	0.50
20.02	12.87	0.73	5.69	120.00	0.00	0.50
21.34	13.32	0.75	5.66	120.00	0.00	0.50
22.52	14.11	0.82	5.82	120.00	0.00	0.50
23.76	16.60	0.96	5.80	120.00	0.00	0.50
25.01	27.77	1.05	3.78	120.00	0.00	0.50
26.28	12.98	0.64	4.95	120.00	0.00	0.50
27.51	15.35	0.71	4.65	120.00	0.00	0.50
28.75	19.64	0.95	4.82	120.00	0.00	0.50
30.00	61.19	1.39	2.27	120.00	0.00	0.50
31.27	43.81	1.98	4.52	120.00	0.00	0.50
32.48	33.87	1.59	4.71	120.00	0.00	0.50
33.76	18.29	1.16	6.33	120.00	0.00	0.50
35.00	79.26	1.36	1.72	120.00	0.00	0.50
36.23	28.79	1.26	4.36	120.00	0.00	0.50
37.47	25.52	1.62	6.36	120.00	0.00	0.50
38.74	221.51	3.00	1.36	120.00	0.00	0.50
39.97	119.79	2.55	2.13	120.00	0.00	0.50
41.23	35.79	2.34	6.54	120.00	0.00	0.50
42.46	112.22	1.87	1.67	120.00	0.00	0.50
43.70	85.58	2.03	2.37	120.00	0.00	0.50
44.98	36.69	1.65	4.49	120.00	0.00	0.50
46.22	149.59	2.13	1.42	120.00	0.00	0.50
47.44	87.84	2.62	2.98	120.00	0.00	0.50
48.70	147.33	2.00	1.36	120.00	0.00	0.50
49.94	90.55	2.32	2.56	120.00	0.00	0.50

Output Results:

Settlement of Saturated Sands=0.64 in.
Settlement of Unsaturated Sands=0.01 in.
Total Settlement of Saturated and Unsaturated Sands=0.65 in.

Differential Settlement=0.326 to 0.430 in.

Depth ft	CRRm	CSRfs	F.S.	S_sat. in.	S_dry in.	S_all in.
0.00	2.00	0.33	5.00	0.64	0.01	0.65
1.00	2.85	0.33	5.00	0.64	0.01	0.65
2.00	2.85	0.33	5.00	0.64	0.01	0.65
3.00	1.84	0.33	5.00	0.64	0.01	0.65
4.00	0.63	0.33	5.00	0.64	0.01	0.65
5.00	0.28	0.33	5.00	0.64	0.01	0.64
6.00	0.30	0.33	5.00	0.64	0.00	0.64
7.00	0.34	0.32	5.00	0.64	0.00	0.64
8.00	2.00	0.34	5.00	0.64	0.00	0.64
9.00	2.00	0.36	5.00	0.64	0.00	0.64
10.00	2.00	0.38	5.00	0.64	0.00	0.64
11.00	2.00	0.39	5.00	0.64	0.00	0.64
12.00	2.00	0.40	5.00	0.64	0.00	0.64
13.00	2.00	0.41	5.00	0.64	0.00	0.64
14.00	2.00	0.43	5.00	0.64	0.00	0.64
15.00	2.00	0.43	5.00	0.64	0.00	0.64
16.00	2.00	0.44	5.00	0.64	0.00	0.64
17.00	2.00	0.45	5.00	0.64	0.00	0.64
18.00	2.00	0.46	5.00	0.64	0.00	0.64
19.00	0.35	0.46	0.76*	0.63	0.00	0.63
20.00	2.00	0.47	5.00	0.63	0.00	0.63
21.00	2.00	0.48	5.00	0.63	0.00	0.63
22.00	2.00	0.48	5.00	0.63	0.00	0.63
23.00	2.00	0.48	5.00	0.63	0.00	0.63
24.00	2.00	0.49	5.00	0.63	0.00	0.63
25.00	2.00	0.49	5.00	0.63	0.00	0.63
26.00	2.00	0.50	5.00	0.63	0.00	0.63
27.00	2.00	0.50	5.00	0.63	0.00	0.63
28.00	2.00	0.50	5.00	0.63	0.00	0.63
29.00	2.00	0.50	5.00	0.63	0.00	0.63
30.00	0.27	0.51	0.54*	0.58	0.00	0.58
31.00	2.00	0.51	5.00	0.51	0.00	0.51
32.00	0.30	0.50	0.59*	0.48	0.00	0.48
33.00	2.00	0.50	5.00	0.44	0.00	0.44
34.00	2.00	0.50	5.00	0.44	0.00	0.44
35.00	0.25	0.50	0.51*	0.38	0.00	0.38
36.00	2.00	0.50	5.00	0.34	0.00	0.34
37.00	0.31	0.49	0.62*	0.28	0.00	0.28
38.00	0.44	0.49	0.89*	0.23	0.00	0.23
39.00	0.71	0.49	1.44	0.22	0.00	0.22
40.00	0.45	0.49	0.92*	0.22	0.00	0.22
41.00	2.00	0.48	5.00	0.21	0.00	0.21
42.00	2.00	0.48	5.00	0.21	0.00	0.21
43.00	0.65	0.48	1.35	0.19	0.00	0.19

44.00	2.00	0.48	5.00	0.18	0.00	0.18
45.00	2.00	0.47	5.00	0.18	0.00	0.18
46.00	0.36	0.47	0.77*	0.16	0.00	0.16
47.00	0.46	0.47	0.98*	0.13	0.00	0.13
48.00	0.24	0.46	0.52*	0.09	0.00	0.09
49.00	0.32	0.46	0.69*	0.00	0.00	0.00
50.00	0.37	0.46	0.81*	0.00	0.00	0.00

* F.S.<1, Liquefaction Potential Zone
(F.S. is limited to 5, CRR is limited to 2,   CSR is limited to 2)

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

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1 atm (atmosphere) = 1 tsf (ton/ft2)

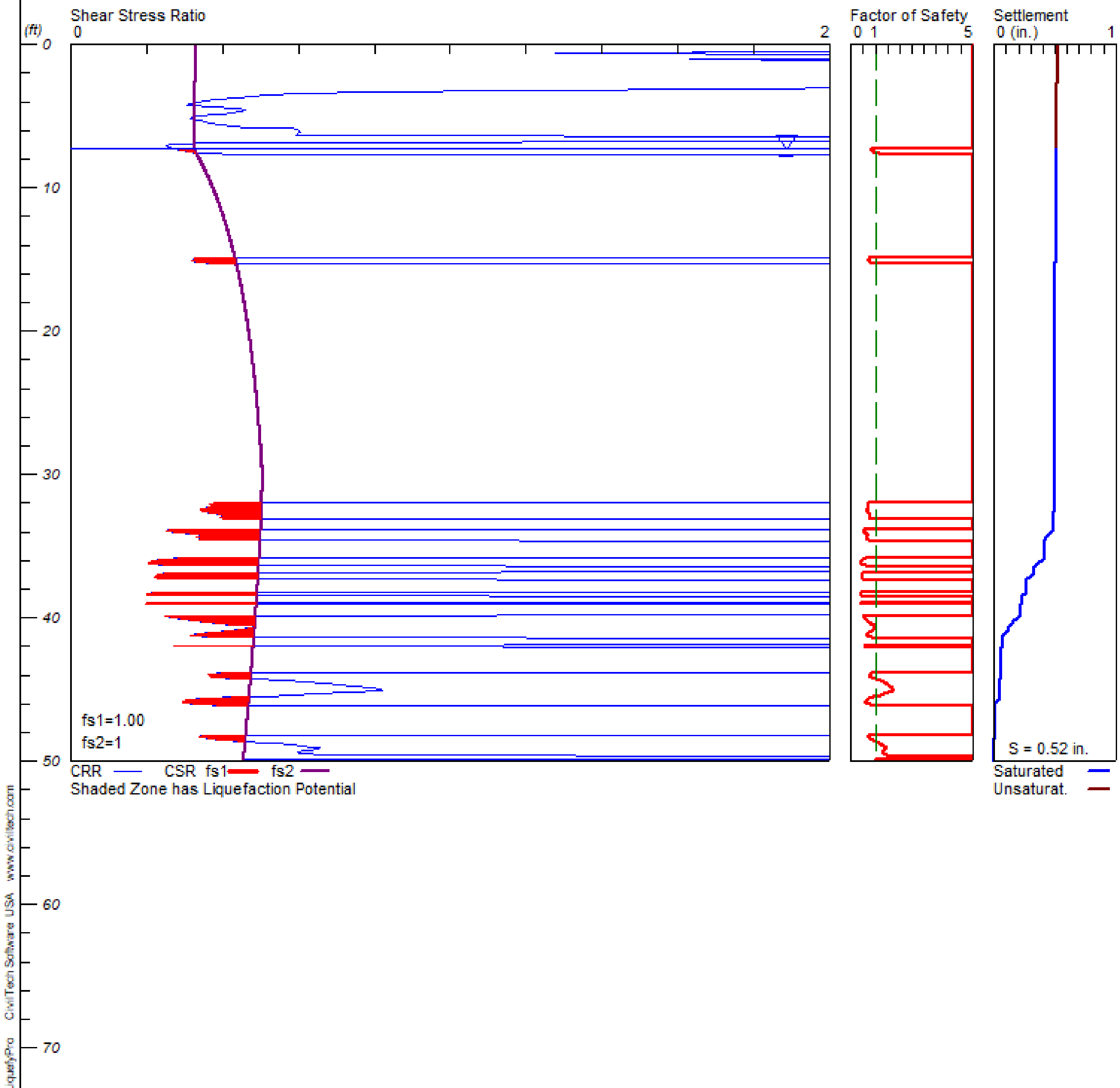
CRRm	Cyclic resistance ratio from soils
CSRsf	Cyclic stress ratio induced by a given earthquake (with user request factor of safety)
F.S.	Factor of Safety against liquefaction, F.S.=CRRm/CSRsf
S_sat	Settlement from saturated sands
S_dry	Settlement from Unsaturated Sands
S_all	Total Settlement from Saturated and Unsaturated Sands
NoLiq	No-Liquefy Soils

LIQUEFACTION ANALYSIS

Los Alamitos New Classroom and Administration Building

Hole No.=CPT-2 ***Water Depth=7.3 ft***

Magnitude=6.63
Acceleration=0.508g



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LIQUEFACTION ANALYSIS SUMMARY

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Input File Name: N:\Projects\2018\60185158\Working Files\Calculations-Analyses\CPT-2.liq
Title: Los Alamitos New Classroom and Administration Building
Subtitle: Los Alamitos High School (Project No. 60185158)

Surface Elev.=
Hole No.=CPT-2
Depth of Hole= 50.00 ft
Water Table during Earthquake= 7.30 ft
Water Table during In-Situ Testing= 28.00 ft
Max. Acceleration= 0.51 g
Earthquake Magnitude= 6.63

Input Data:
Surface Elev.=
Hole No.=CPT-2
Depth of Hole=50.00 ft
Water Table during Earthquake= 7.30 ft
Water Table during In-Situ Testing= 28.00 ft
Max. Acceleration=0.51 g
Earthquake Magnitude=6.63
No-Liquefiable Soils: CL, OL are Non-Liq. Soil

1. CPT Calculation Method: Robertson et al.
2. Settlement Analysis Method: Tokimatsu, M-correction
3. Fines Correction for Liquefaction: Stark/Olson et al.*
4. Fine Correction for Settlement: During Liquefaction*
5. Settlement Calculation in: All zones*
9. User request factor of safety (apply to CSR) , User= 1.
   Plot two CSR (fs1=User, fs2=1)
10. Use Curve Smoothing: Yes*
* Recommended Options

In-Situ Test Data:
Depth qc fs Rf gamma Fines D50

ft	atm	atm	pcf	%	mm	
0.00	0.00	0.09	100.00	120.00	0.00	0.50
1.58	70.68	2.74	3.88	120.00	0.00	0.50
3.15	72.03	1.70	2.36	120.00	0.00	0.50
4.75	29.92	0.90	3.00	120.00	0.00	0.50
6.32	19.98	0.99	4.96	120.00	0.00	0.50
7.90	12.87	0.81	6.32	120.00	0.00	0.50
9.45	11.52	0.59	5.12	120.00	0.00	0.50
11.03	12.31	0.75	6.09	120.00	0.00	0.50
12.61	9.03	0.45	4.98	120.00	0.00	0.50
14.18	8.02	0.40	5.02	120.00	0.00	0.50
15.76	13.44	0.72	5.34	120.00	0.00	0.50
17.36	9.14	0.36	3.97	120.00	0.00	0.50
18.93	9.37	0.41	4.42	120.00	0.00	0.50
20.50	24.16	1.14	4.72	120.00	0.00	0.50
22.07	11.74	0.62	5.25	120.00	0.00	0.50
23.65	17.73	0.85	4.82	120.00	0.00	0.50
25.22	20.89	1.13	5.39	120.00	0.00	0.50
26.78	23.14	1.21	5.25	120.00	0.00	0.50
28.36	16.71	0.74	4.42	120.00	0.00	0.50
29.92	14.34	0.61	4.25	120.00	0.00	0.50
31.50	44.93	1.37	3.05	120.00	0.00	0.50
33.08	63.56	2.04	3.21	120.00	0.00	0.50
34.66	59.27	2.01	3.40	120.00	0.00	0.50
36.22	78.24	0.97	1.24	120.00	0.00	0.50
37.84	29.13	1.30	4.45	120.00	0.00	0.50
39.40	23.26	1.05	4.52	120.00	0.00	0.50
40.97	149.37	1.88	1.26	120.00	0.00	0.50
42.52	52.05	2.51	4.83	120.00	0.00	0.50
44.10	122.38	2.13	1.74	120.00	0.00	0.50
45.69	115.38	1.87	1.62	120.00	0.00	0.50
47.28	52.72	1.80	3.42	120.00	0.00	0.50
48.86	137.51	3.50	2.54	120.00	0.00	0.50

Output Results:

Settlement of Saturated Sands=0.51 in.
Settlement of Unsaturated Sands=0.01 in.
Total Settlement of Saturated and Unsaturated Sands=0.52 in.
Differential Settlement=0.260 to 0.343 in.

Depth ft	CRRm	CSRfs	F.S.	S_sat. in.	S_dry in.	S_all in.
0.00	2.00	0.33	5.00	0.51	0.01	0.52
1.00	2.85	0.33	5.00	0.51	0.01	0.52
2.00	2.85	0.33	5.00	0.51	0.01	0.52
3.00	2.52	0.33	5.00	0.51	0.01	0.52

4.00	0.34	0.33	5.00	0.51	0.01	0.52
5.00	0.33	0.33	5.00	0.51	0.01	0.51
6.00	0.60	0.33	5.00	0.51	0.00	0.51
7.00	0.26	0.32	5.00	0.51	0.00	0.51
8.00	2.00	0.34	5.00	0.51	0.00	0.51
9.00	2.00	0.36	5.00	0.51	0.00	0.51
10.00	2.00	0.38	5.00	0.51	0.00	0.51
11.00	2.00	0.39	5.00	0.51	0.00	0.51
12.00	2.00	0.40	5.00	0.51	0.00	0.51
13.00	2.00	0.41	5.00	0.51	0.00	0.51
14.00	2.00	0.43	5.00	0.51	0.00	0.51
15.00	0.33	0.43	0.75*	0.51	0.00	0.51
16.00	2.00	0.44	5.00	0.51	0.00	0.51
17.00	2.00	0.45	5.00	0.51	0.00	0.51
18.00	2.00	0.46	5.00	0.51	0.00	0.51
19.00	2.00	0.46	5.00	0.51	0.00	0.51
20.00	2.00	0.47	5.00	0.51	0.00	0.51
21.00	2.00	0.48	5.00	0.51	0.00	0.51
22.00	2.00	0.48	5.00	0.51	0.00	0.51
23.00	2.00	0.48	5.00	0.51	0.00	0.51
24.00	2.00	0.49	5.00	0.51	0.00	0.51
25.00	2.00	0.49	5.00	0.51	0.00	0.51
26.00	2.00	0.50	5.00	0.51	0.00	0.51
27.00	2.00	0.50	5.00	0.51	0.00	0.51
28.00	2.00	0.50	5.00	0.51	0.00	0.51
29.00	2.00	0.50	5.00	0.51	0.00	0.51
30.00	2.00	0.51	5.00	0.51	0.00	0.51
31.00	2.00	0.51	5.00	0.51	0.00	0.51
32.00	0.38	0.50	0.75*	0.51	0.00	0.51
33.00	0.39	0.50	0.78*	0.49	0.00	0.49
34.00	0.27	0.50	0.54*	0.47	0.00	0.47
35.00	2.00	0.50	5.00	0.41	0.00	0.41
36.00	0.22	0.50	0.44*	0.39	0.00	0.39
37.00	0.23	0.49	0.46*	0.32	0.00	0.32
38.00	2.00	0.49	5.00	0.27	0.00	0.27
39.00	0.20	0.49	0.40*	0.22	0.00	0.22
40.00	0.27	0.49	0.56*	0.19	0.00	0.19
41.00	0.38	0.48	0.79*	0.11	0.00	0.11
42.00	0.27	0.48	0.56*	0.07	0.00	0.07
43.00	2.00	0.48	5.00	0.06	0.00	0.06
44.00	0.37	0.48	0.77*	0.06	0.00	0.06
45.00	0.82	0.47	1.73	0.05	0.00	0.05
46.00	0.32	0.47	0.69*	0.01	0.00	0.01
47.00	2.00	0.47	5.00	0.01	0.00	0.01
48.00	2.00	0.46	5.00	0.01	0.00	0.01
49.00	0.63	0.46	1.38	0.00	0.00	0.00
50.00	0.44	0.46	0.97*	0.00	0.00	0.00

* F.S.<1, Liquefaction Potential Zone

(F.S. is limited to 5, CRR is limited to 2,   CSR is limited to 2)

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

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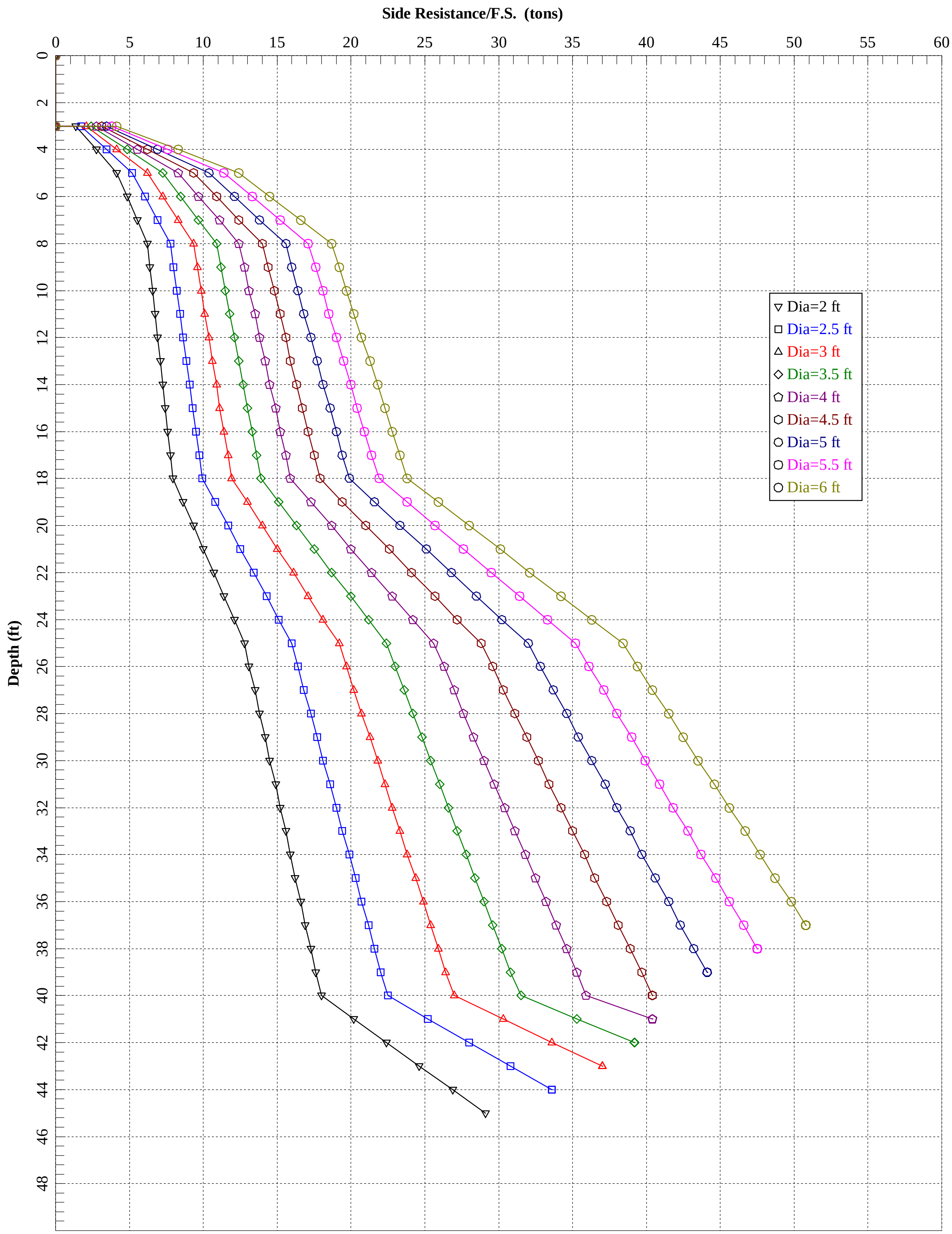
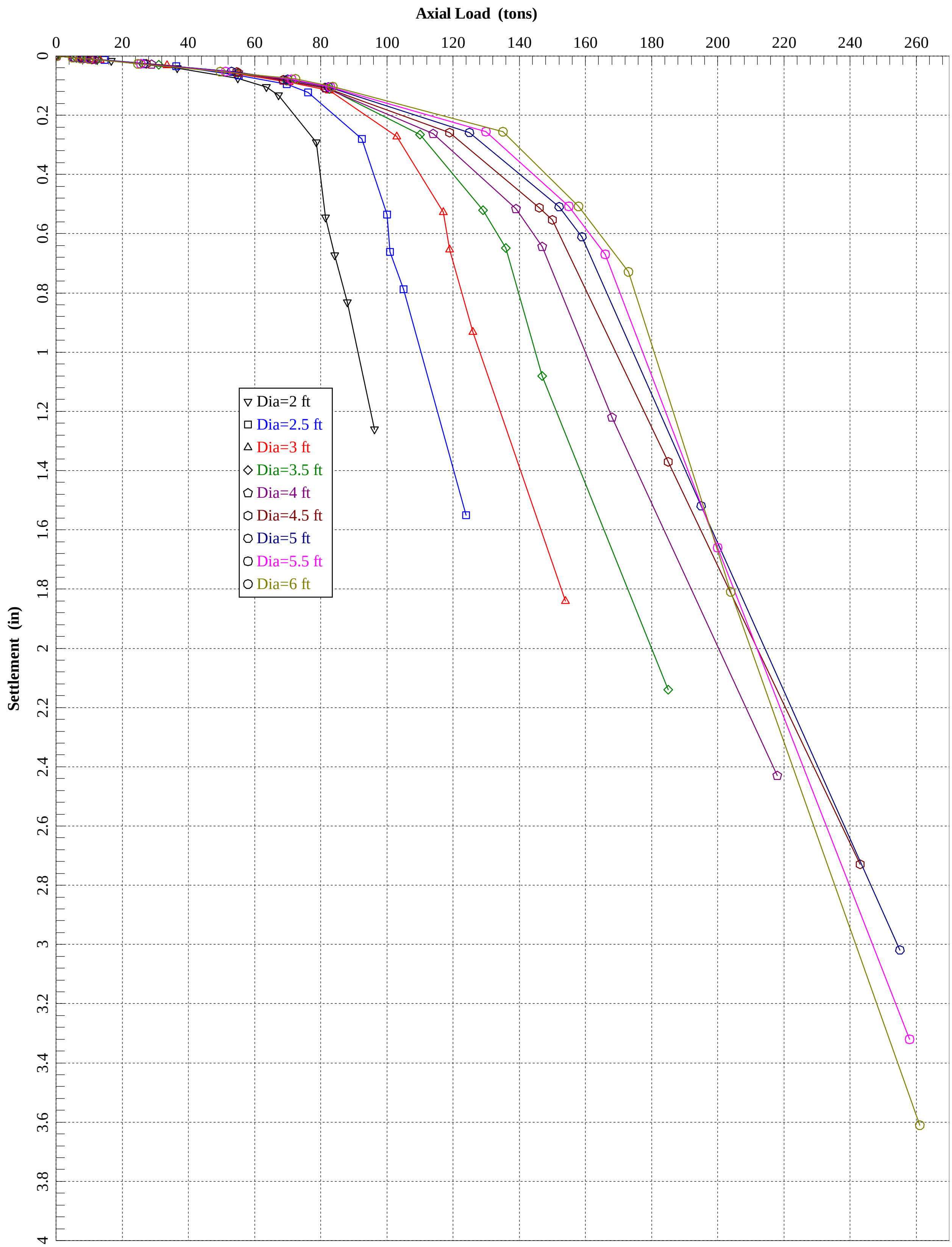
1 atm (atmosphere) = 1 tsf (ton/ft2)

CRRm	Cyclic resistance ratio from soils
CSRsf	Cyclic stress ratio induced by a given earthquake (with user request factor of safety)
F.S.	Factor of Safety against liquefaction, F.S.=CRRm/CSRsf
S_sat	Settlement from saturated sands
S_dry	Settlement from Unsaturated Sands
S_all	Total Settlement from Saturated and Unsaturated Sands
NoLiq	No-Liquefy Soils



Proposed Classroom and Administration Building: Los Alamitos High School



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