August 11, 2017
Revised August 30, 2017

RSCCD Facility Planning, District
Construction and Support Services
2323 N. Broadway, Suite 112
Santa Ana, CA 92706

Attn: Ms. Allison Coburn
Facilities Project Manager
P: (714) 480-7530
E: Coburn_allison@rsccd.edu

Re: Revised Addendum 2 to Geotechnical Engineering Report
Proposed Johnson Student Center - Santa Ana College
1530 West 17th Street, Santa Ana, California
Terracon Project No. 60145100

References: Terracon, "Geotechnical Engineering Report – Proposed Johnson Student Center", Terracon Project No. 60145100, dated November 21, 2016

Terracon, "Addendum 1 to Geotechnical Engineering Report – Proposed Johnson Student Center – Santa Ana College", Terracon Project No. 60145100, dated March 24, 2017

Dear Ms. Coburn,

Terracon Consultants, Inc. (Terracon) is providing this second addendum to the above referenced report. This addendum provides the results of our supplemental geotechnical engineering services for the project. These supplemental services were performed in general accordance with the Supplement to Agreement for Services between Terracon and Rancho Santiago Community College District dated May 2, 2017. The recommendations presented in the above referenced report and addendum are still valid and remain applicable for the development of the site, except as specifically addressed in this letter.

Project Information

It is our understanding that a shade/serving structure will be developed to the west of the proposed Johnson Building at 1530 West 17th Street in Santa Ana, California. The Site Location Plan (Exhibit A-1) is included in the attachments to this addendum. Terracon's geotechnical scope of work included the advancement of six borings, designated as 17B-1, 17B-2, 17P-1, 17P-2, 17Perc-1, and 17Perc-2, to approximate depths ranging between 5 and 51½ feet below the ground surface (bgs). Two (2) of the borings were utilized for percolation testing (17Perc-1 and 17Perc-2). Logs of the borings (Exhibits A-3 through A-8) along with a Boring and Test Location Plan (Exhibit A-2) are included in the attachments.

Subsurface Profile

The subsurface materials generally consisted of soft to very stiff lean clay with variable amounts of sand, except in borings 17B-1 and 17B-2 which encountered loose silty clayey sand and clayey sand within the upper 5½ to 10 feet bgs. Laboratory tests were conducted on selected soil samples, and the test results are presented on the boring logs and Exhibits B-1 and B-2. Atterberg limits test results indicated that near-surface soils exhibit low to medium plasticity. A one-dimensional consolidation test was performed on boring 17B-2 at an approximate depth of 2½ feet bgs. The results indicate the material has a slight collapse potential and moderate compressibility when saturated with water at a confining pressure of 2,000 psf. Expansion Index (EI) testing was performed on near-surface soils in boring B-1 which indicates these soils have an EI of 10. R-value testing was performed on a combined sample of the near-surface materials in borings 17P-1 and 17P-2. The results indicate these soils have an R-value of 9.

Groundwater was observed in boring B-1 at a depth of approximately 20 feet bgs, at the time of field exploration and at an approximate depth of 34 feet bgs in boring 17B-1 after the boring was completed. These observations represent groundwater conditions at the time of the field exploration and may not be indicative of other times, or at other locations. Based on historical high groundwater level maps published by the California Geological Survey (CGS), the groundwater level in the project vicinity is approximately 35 feet bgs.[1]

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.

Percolation Test Results

Two (2) in-situ percolation tests (using falling head borehole permeability) were performed to approximate depths of 5 and 10 feet 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 was percolated through the test hole. At the beginning of each test, the pipes were refilled with water, and readings were taken at designated time intervals. Percolation rates are provided in the following table:

[1] Seismic Hazard Zone Report for the Anaheim 7.5-Minute Quadrangle, Orange County, California, by California Division of Mines and Geology (CDMG), dated 1998.

TEST RESULTS				
Test Location (depth in feet bgs)	**Soil Classification**	**Percolation Rate (in/hr)**	**Correlated Infiltration Rate* (in/hr)**	**Average Water Head, (inches)**
17Perc-1 (5)	Lean Clay (CL)	6.0	0.26	38
17Perc-2 (10)	Lean Clay (CL)	3.0	0.11	48

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

The field test results are not intended to be design rates. They represent the results 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. With time, the bottoms 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.

The percolation rates of the soils could be different than measured in the field due to variations in soil type. The design elevation and size of the proposed infiltration system should account for variability in infiltration rates based on encountered soils during construction should they differ from our field test results.

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 a minimum of 10 feet from any existing or proposed foundation system.

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 low sulfate exposure in accordance with the provisions of the ACI Design Manual, Section 318, Chapter 4.

Laboratory test results indicate the on-site soils have a pH of 7.78, a water soluble sulfate content of 0.02-percent, a negligible sulfides content, a chlorides content of 68 ppm, a Red-Ox potential of 697 mV, a total salts content of 695 ppm, and a minimum resistivity of 2,474 ohm-cm, as shown on the attached Results of Corrosion Analysis sheet (Exhibit B-2). These values should be used to evaluate corrosive potential of the on-site soils to underground ferrous metals.

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.

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, but may also occur with low plasticity silt or sensitive soft clay below groundwater. The California Geological Survey (CGS) has designated certain areas as potential liquefaction hazard zones. These are areas 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 water table.

The project site is located within a liquefaction potential zone as indicated by the CGS.[2] Based on the materials encountered at the project site, subsurface conditions encountered on the project site is predominantly soft to medium stiff lean clay with variable amounts of sand with an occasional loose silty clayey sand or clayey sand layer near the surface.

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 soil data from Boring 17B-1. A PGA_M of 0.528 g and a mean magnitude of 6.6 were used. In addition, the historical high groundwater of 34 feet was used for Water Table During Earthquake[3], and for Water Table during In-Situ Testing. Settlement analysis used the Tokimatsu, M-correction method. Fines were corrected for liquefaction using Modify Stark/Olson. Liquefaction potential analysis was performed from depths ranging from 0 to 51½ feet bgs. The liquefaction potential analysis is attached in Appendix D of this report.

Based on the subsurface conditions presented in boring 17B-1, lab test results, and calculation results, seismically-induced total settlement of saturated and dry sands is expected to be less than ¼ inch and seismically-induced saturated, and dry sand differential settlements are expected to be less than ¼ inch. The liquefaction potential analysis is attached as Appendix D of this report.

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. Based on the geotechnical engineering analyses, subsurface exploration, and laboratory test results, we recommend that the proposed buildings be supported on a spread footing foundation system bearing on engineered fill. The proposed trellis structures may be supported on cast in drilled hole (CIDH) foundations.

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[2] *CGS, "Earthquake Zones of Required Investigation – Anaheim Quadrangle", http://gmw.conservation.ca.gov/SHP/EZRIM/Maps/ANAHEIM_EZRIM.pdf*

[3] *Seismic Hazard Zone Report for the Anaheim 7.5-Minute Quadrangle, Orange County, California, by California Division of Mines and Geology (CDMG), dated 1998.*

Due to the low bearing capacity of the near-surface soils, the proposed foundations and floor slabs should be supported on a minimum of 3 feet of engineered fill or engineered fill which extends to 5 feet below existing grade whichever is greater. Foundations and slabs prepared as recommended in this letter may be designed using the parameters provided in section 4.3, 4.4, and 4.5 of the original geotechnical report.

Only the on-site sandy materials are considered suitable for use as engineered fill, provided that the materials are processed, and oversized particles, debris, organic materials and other unsuitable materials are removed. On-site clayey soils may be used for general site grading in non-structural areas. Imported soils for use as fill material within proposed building and structure areas should conform to low volume change materials as indicated in section 4.2.3 of the original geotechnical engineering report.

Subgrade Preparation

Due to the low bearing capacity of the near-surface soils, the proposed foundations and floor slabs should be supported on a minimum of 3 feet of engineered fill or engineered fill which extends to 5 feet below existing grade whichever is greater. All grading for each structure should incorporate the limits of the proposed structure plus a lateral distance of 2 feet beyond the edges.

Exposed areas which will receive fill, 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.

Subgrade materials beneath exterior slabs 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.

Trellis Foundations

It is our understanding that the design team is planning to utilize CIDH foundations for trellis foundations within the existing courtyard of the Johnson Building and the serving structure site. We understand that these additions will be structurally separated from the proposed structures.

Description	Recommendation
Structures	Proposed trellis canopy columns
Minimum Dimensions	Minimum shaft diameter of 12 inches. Straight sided shafts are recommended.

The allowable axial shaft capacities were determined using both end bearing and side friction components of resistance. Allowable skin friction, axial capacity, and estimated settlement charts are attached to 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 end bearing capacities and skin friction values are based on a minimum factor of safety of 3.0.

Recommended soil parameters for lateral analysis of drilled shaft foundations have been developed for use in LPILE 8.0 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 Load Analysis
Estimated Engineering Properties of Soils

Depth (feet bgs)	Effective Unit Weight (pcf)	L-Pile Soil Type	Friction Angle/Cohesion (psf)	Coefficient of Static Horizontal Subgrade Reaction K_s (pci)	ε_{50}
2 to 8	120	Sand	30°	25[a]	--
8 to 20	120	Stiff Clay without free water	1,000	--	0.007

a. Note: The soil modulus increases linearly with depth by an amount equal to the coefficient of horizontal subgrade reaction and is independent of the shaft diameter.

The above parameters assume the groundwater level is below the maximum depth of the drilled shaft. 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). When designing to resist uplift forces, the effective weight of the shaft and structure (divided by an appropriate factor of safety) and the allowable skin-friction values provided above should be used.

Lateral load design parameters are valid within the elastic range of the soil. The coefficients 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.

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

Drilled Shaft Construction Considerations:

Due to the presence of loose sandy soils that may slough during the drilling of the proposed shafts, temporary steel casing will likely be required to properly drill and clean shafts prior to concrete placement. If groundwater is encountered during the construction of the drilled shafts, we recommend the use of slurry drilling methods with polymers to keep the solids in suspension during the drilling.

Shaft concrete should be placed immediately after completion of drilling and cleaning. Water, if encountered, should be removed from the shaft excavation prior to concrete placement. If shaft concrete cannot be placed in dry conditions, a tremie should be used for concrete placement. Shaft concrete should have a relatively high fluidity when placed in cased holes or through a tremie; concrete with slump in the range of 6 to 8 inches is recommended. Temporary casing should be withdrawn in a slow continuous manner maintaining a sufficient head of concrete inside the casing to counteract earth and any hydrostatic pressures outside the casing. An insufficient head of concrete inside the case can cause "necking" of the shaft, resulting in a reduced shaft capacity. Due to potential sloughing and raveling, foundation concrete quantities may exceed calculated geometric volumes.

We recommend that all drilled shaft installations be observed on a full-time basis by an experienced geotechnical engineer in order to confirm that soil materials encountered are consistent with the recommended design parameters.

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
Approved on-site granular soils or imported materials:			
Beneath foundations and slabs:	90%	-1%	+3%
Utility Trenches in structural areas*:	90%	-1%	+3%
On-site soils			
Bottom of excavations to receive fill:	90%	0%	+4%
Pavement areas:	95%	0%	+4%
Miscellaneous backfill:	90%	0%	+4%
Aggregate base (beneath pavements and flatwork):	95%	-2%	+2%

* The upper 12 inches beneath flatwork and structural elements should be compacted to a minimum of 95%.

Pavement Design Recommendations and Construction Considerations

Based on laboratory testing, a design R-Value of 9 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) = 4.0	Loading Dock and Truck Areas Assumed TI = 7.0
Section I Portland Cement Concrete (600 psi Flexural Strength)	5-inches Plain jointed PCC over 4-inches Class II Aggregate Base (AB) over 10-inches of scarified, moisture conditioned, and compacted materials	6.5-inches Plain jointed PCC over 4-inches Class II AB over 10-inches of scarified, moisture conditioned, and compacted materials
Section II Asphaltic Concrete	3-inches AC over 6-inches Class II AB over 10-inches of scarified, moisture conditioned, and compacted materials	4-inches AC over 15-inches Class II AB over 10-inches of scarified, moisture conditioned, and compacted materials

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

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.

All concrete for rigid pavements should have a minimum flexural strength of 600 psi, and be placed with a maximum slump of four inches. Based on ACI 330 standard, a flexural strength of 600 psi roughly correlates to a compressive strength of 4,250 psi. 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.

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.

Closure

To ensure that foundation construction is carried out in accordance with the geotechnical recommendations prepared for this project, we recommend that Terracon be retained to provide the construction quality assurance services during foundation construction and other earth-related construction phases of the project.

Our professional services were performed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical engineers practicing in this or similar localities. No warranties, either express or implied, are intended or made. Should you have any questions, please do not hesitate to call.

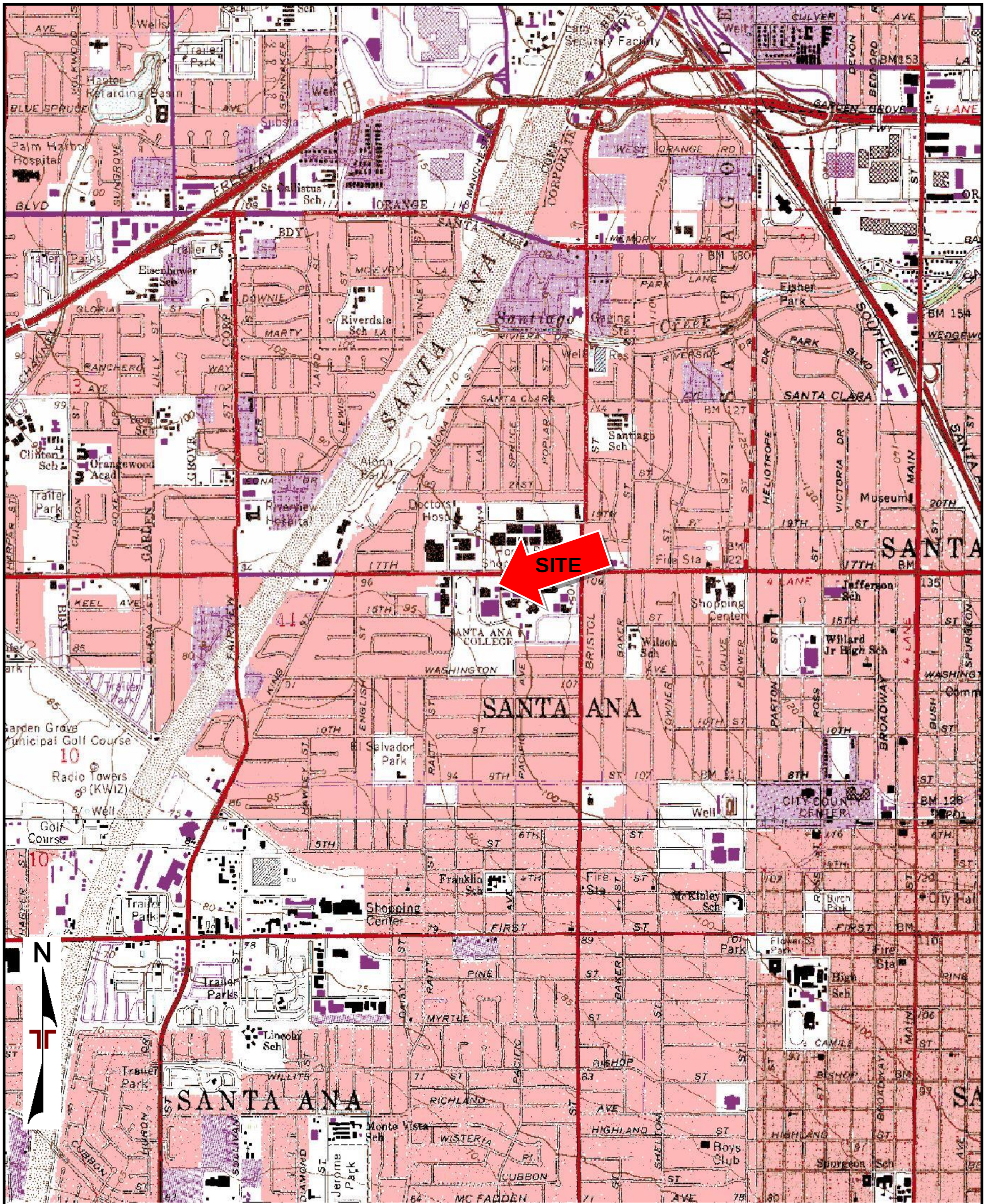
Sincerely,
Terracon Consultants, Inc.

Joshua R. Morgan, P.E.
Project Engineer

Michael W. Laney, P.E., G.E.
Senior Geotechnical Engineer

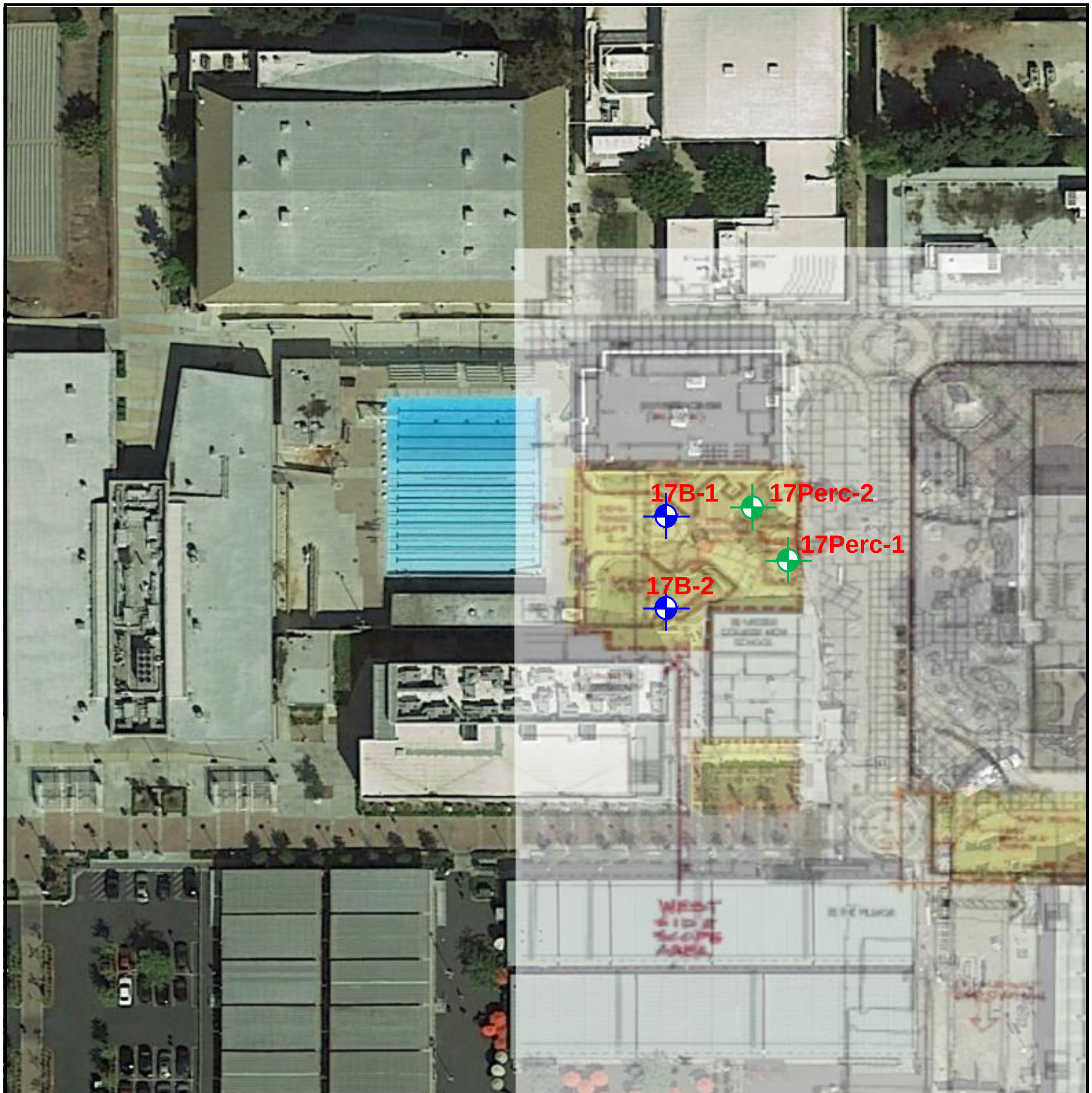
Stephen Jacobs, PG, CEG
Senior Engineering Geologist

Attachments:
- Exhibit A-1: Site Location Plan
- Exhibit A-2: Boring and Test Location Plan
- Exhibits A-3 through A-8: Boring Logs
- Exhibit B-1: Atterberg Limits Results
- Exhibit B-2: Swell Consolidation Test
- Exhibit B-3: Results of Corrosion Analysis
- Exhibit B-4: R-value Test Results
- Exhibit C-1: General Notes
- Exhibit C-2: Unified Soil Classification System
- Exhibit D-1: Liquefaction Analysis Chart
- Exhibit D-2: Liquefaction Analysis Summary



TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY
QUADRANGLES INCLUDE: ANAHEIM, CA (1/1/1981), ORANGE, CA (1/1/1981), NEWPORT BEACH, CA (1/1/1981) and TUSTIN, CA (1/1/1981).

Project Manager: J.M	Project No. 60145100	Terracon	SITE LOCATION	Exhibit
Drawn by: A.L	Scale: 1"=2,000'	1421 Edinger Ave Ste C	RSCCD: Johnson Student Center	A-1
Checked by: ?	File Name: 60145100	Tustin, CA 92780-6287	1530 West 17th Street	
Approved by: ?	Date: JULY 2017		Santa Ana, CA	



N

Source: Google Earth Pro, Accessed on July 27, 2017.

LEGEND:

17B-1 **APPROXIMATE BORING LOCATION AND DESIGNATION**

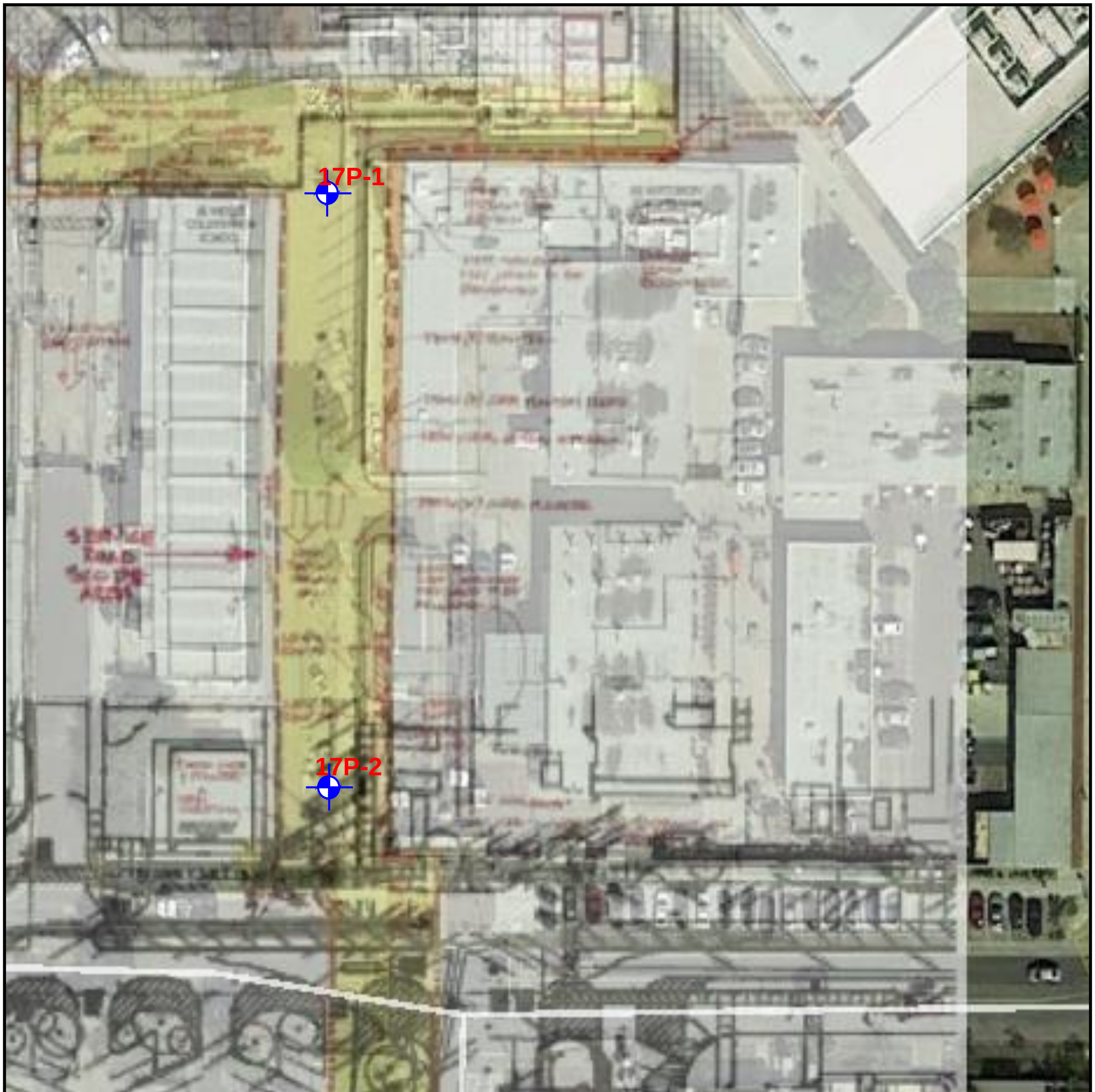
17Perc-1 **APPROXIMATE PERCOLATION TESTING LOCATION AND DESIGNATION**

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

Project Manager: JM	Project No. 60145100	Terracon Consulting Engineers & Scientists	BORING LOCATION PLAN
Drawn by: AL	Scale: 1"=108'	1421 Edinger Ave, Suite C Tustin, California 82780	**Johnson Student Center**
Checked by:	File Name: A-2	PH. (949) 261-0051 FAX. (949) 261-6110	1530 West 17th Street
Approved by:	Date: July 2017		Santa Ana, California

Exhibit

A-2a



Source: Google Earth Pro, Accessed on July 27, 2017.

LEGEND:

17P-1 APPROXIMATE BORING LOCATION AND DESIGNATION

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

Project Manager: JM	Project No. 60145100	Terracon Consulting Engineers & Scientists	BORING LOCATION PLAN
Drawn by: AL	Scale: 1"=145'	1421 Edinger Ave, Suite C Tustin, California 82780	**Johnson Student Center**
Checked by:	File Name: A-2	PH. (949) 261-0051 FAX. (949) 261-6110	1530 West 17th Street
Approved by:	Date: July 2017		Santa Ana, California

Exhibit A-2b

BORING LOG NO. 17B-1

PROJECT: Proposed Johnson Student Center

CLIENT: RSCCD Facility Planning, District Santa Ana, California

SITE: 1530 West 17th Street Santa Ana, California

LOCATION See Exhibit A-2

Latitude: 33.75867° Longitude: -117.88952°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Expansion Index	STRENGTH TEST: TEST TYPE	COMPRESSIVE STRENGTH (psf)	STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SILTY CLAYEY SAND (SC-SM), brown												
				bulk		10						22-17-5	39
	loose				3-2-2 N=4								
5.5		5			2-2-5 N=7								
	LEAN CLAY (CL), brown, medium stiff												
					3-4-4 N=8								
		10			2-2-4 N=6								
		15			2-3-4 N=7								
	soft	20	∇		2-2-2 N=4								

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

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil 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.

Notes:

WATER LEVEL OBSERVATIONS

∇ *Groundwater encountered at 20' while drilling*

∇ *Groundwater encountered at 34' after drilling*

Terracon
1421 Edinger Ave Ste C
Tustin, CA

Boring Started: 6/23/2017	Boring Completed: 6/23/2017
Drill Rig: CME-75	Driller: Cal Pac Drilling
Project No.: 60145100	Exhibit: A-3

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 60145100 BORING LOGS.GPJ TERRACON_DATATEMPLATE.GDT 7/28/17

BORING LOG NO. 17B-1

PROJECT: Proposed Johnson Student Center

CLIENT: RSCCD Facility Planning, District Santa Ana, California

SITE: 1530 West 17th Street Santa Ana, California

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 33.75867° Longitude: -117.88952° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Expansion Index	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	LEAN CLAY (CL), brown, medium stiff *(continued)*												
	stiff	25		X	5-6-6 N=12								
	medium stiff	30		X	2-3-4 N=7								
			▽ (34')										
	35.0												
	SANDY LEAN CLAY (CL), brown, medium stiff	35		X	2-2-4 N=6								
	stiff	40		X	4-6-8 N=14								

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

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil 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.

Notes:

WATER LEVEL OBSERVATIONS

▽ *Groundwater encountered at 20' while drilling*
▽ *Groundwater encountered at 34' after drilling*

Terracon
1421 Edinger Ave Ste C
Tustin, CA

Boring Started: 6/23/2017	Boring Completed: 6/23/2017
Drill Rig: CME-75	Driller: Cal Pac Drilling
Project No.: 60145100	Exhibit: A-3

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 60145100 BORING LOGS.GPJ TERRACON_DATATEMPLATE.GDT 7/28/17

BORING LOG NO. 17B-1

PROJECT: Proposed Johnson Student Center

CLIENT: RSCCD Facility Planning, District Santa Ana, California

SITE: 1530 West 17th Street Santa Ana, California

LOCATION See Exhibit A-2

Latitude: 33.75867° Longitude: -117.88952°

GRAPHIC LOG	DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Expansion Index	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	45.0	**SANDY LEAN CLAY (CL)**, brown, medium stiff *(continued)*												
		LEAN CLAY (CL), brown, stiff	45		X	5-6-9 N=15								
	51.5	very stiff	50		X	4-7-10 N=17								
		Boring Terminated at 51.5 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 soil 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.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater encountered at 20' while drilling

Groundwater encountered at 34' after drilling

Terracon
1421 Edinger Ave Ste C
Tustin, CA

Boring Started: 6/23/2017	Boring Completed: 6/23/2017
Drill Rig: CME-75	Driller: Cal Pac Drilling
Project No.: 60145100	Exhibit: A-3

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 60145100 BORING LOGS.GPJ TERRACON_DATATEMPLATE.GDT 7/28/17

BORING LOG NO. 17B-2

PROJECT: Proposed Johnson Student Center

CLIENT: RSCCD Facility Planning, District Santa Ana, California

SITE: 1530 West 17th Street Santa Ana, California

LOCATION See Exhibit A-2

Latitude: 33.75856° Longitude: -117.88952°

DEPTH	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Expansion Index	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	CLAYEY SAND (SC), brown, loose												
				Hand									
				Ring	8-4-6					26	94		
		5		Ring	3-7-11								
				Ring	3-6-8					25	99		
10.0	**LEAN CLAY (CL)**, brown, medium stiff	10		SPT	1-2-3 N=5								
	stiff	15		SPT	2-4-5 N=9								
20.0	**SANDY LEAN CLAY (CL)**, brown, medium stiff	20		SPT	2-3-3 N=6								

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

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil 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.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1421 Edinger Ave Ste C
Tustin, CA

Boring Started: 6/23/2017	Boring Completed: 6/23/2017
Drill Rig: CME-75	Driller: Cal Pac Drilling
Project No.: 60145100	Exhibit: A-4

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 60145100 BORING LOGS.GPJ TERRACON_DATATEMPLATE.GDT 7/28/17

BORING LOG NO. 17B-2

PROJECT: Proposed Johnson Student Center

CLIENT: RSCCD Facility Planning, District Santa Ana, California

SITE: 1530 West 17th Street Santa Ana, California

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 33.75856° Longitude: -117.88952° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Expansion Index	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDY LEAN CLAY (CL), brown, medium stiff *(continued)*	25											
	26.5												
	Boring Terminated at 26.5 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 soil 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.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1421 Edinger Ave Ste C
Tustin, CA

Boring Started: 6/23/2017	Boring Completed: 6/23/2017
Drill Rig: CME-75	Driller: Cal Pac Drilling
Project No.: 60145100	Exhibit: A-4

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 60145100 BORING LOGS.GPJ TERRACON_DATATEMPLATE.GDT 7/28/17

BORING LOG NO. 17P-1

PROJECT: Proposed Johnson Student Center

CLIENT: RSCCD Facility Planning, District Santa Ana, California

SITE: 1530 West 17th Street Santa Ana, California

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 33.75808° Longitude: -117.88863° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Expansion Index	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	0.3 **ASPHALT**, 4 inches												
	0.7 **AGGREGATE BASE COURSE**, 4 inches												
	LEAN CLAY WITH SAND (CL), 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 soil cuttings upon completion.
Sealed with bituminous cold patch at surface.

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.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1421 Edinger Ave Ste C
Tustin, CA

Boring Started: 6/23/2017	Boring Completed: 6/23/2017
Drill Rig: CME-75	Driller: Cal Pac Drilling
Project No.: 60145100	Exhibit: A-5

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 60145100 BORING LOGS.GPJ TERRACON_DATATEMPLATE.GDT 7/28/17

BORING LOG NO. 17P-2

PROJECT: Proposed Johnson Student Center

CLIENT: RSCCD Facility Planning, District Santa Ana, California

SITE: 1530 West 17th Street Santa Ana, California

LOCATION See Exhibit A-2

Latitude: 33.75736° Longitude: -117.88864°

GRAPHIC LOG	DEPTH	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Expansion Index	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	0.3	**ASPHALT**, 4 inches												
	0.7	**AGGREGATE BASE COURSE**, 4 inches												
	5.0	**LEAN CLAY WITH SAND (CL)**, brown	5		bulk (0.7–5 ft)								43-20-23	78
		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 soil cuttings upon completion.
Sealed with bituminous cold patch at surface.

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.

Notes:

WATER LEVEL OBSERVATIONS
Groundwater not encountered

Terracon
1421 Edinger Ave Ste C
Tustin, CA

Boring Started: 6/23/2017 | Boring Completed: 6/23/2017
Drill Rig: CME-75 | Driller: Cal Pac Drilling
Project No.: 60145100 | Exhibit: A-6

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 60145100 BORING LOGS.GPJ TERRACON_DATATEMPLATE.GDT 7/28/17

BORING LOG NO. 17Perc-1

PROJECT: Proposed Johnson Student Center

CLIENT: RSCCD Facility Planning, District Santa Ana, California

SITE: 1530 West 17th Street Santa Ana, California

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 33.7586° Longitude: -117.88933° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Expansion Index	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	LEAN CLAY (CL), 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 soil 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.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

Terracon
1421 Edinger Ave Ste C
Tustin, CA

Boring Started: 6/23/2017	Boring Completed: 6/23/2017
Drill Rig: CME-75	Driller: Cal Pac Drilling
Project No.: 60145100	Exhibit: A-7

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 60145100 BORING LOGS.GPJ TERRACON_DATATEMPLATE.GDT 7/28/17

BORING LOG NO. 17Perc-2

PROJECT: Proposed Johnson Student Center

CLIENT: RSCCD Facility Planning, District Santa Ana, California

SITE: 1530 West 17th Street Santa Ana, California

LOCATION See Exhibit A-2

Latitude: 33.7587° Longitude: -117.88939°

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Expansion Index	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (psf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	LEAN CLAY (CL), brown, medium stiff												
				X	1-2-3 N=5								
		5											
				X	2-4-4 N=8								
	10.0	10											
	Boring Terminated at 10 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 soil 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.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not encountered

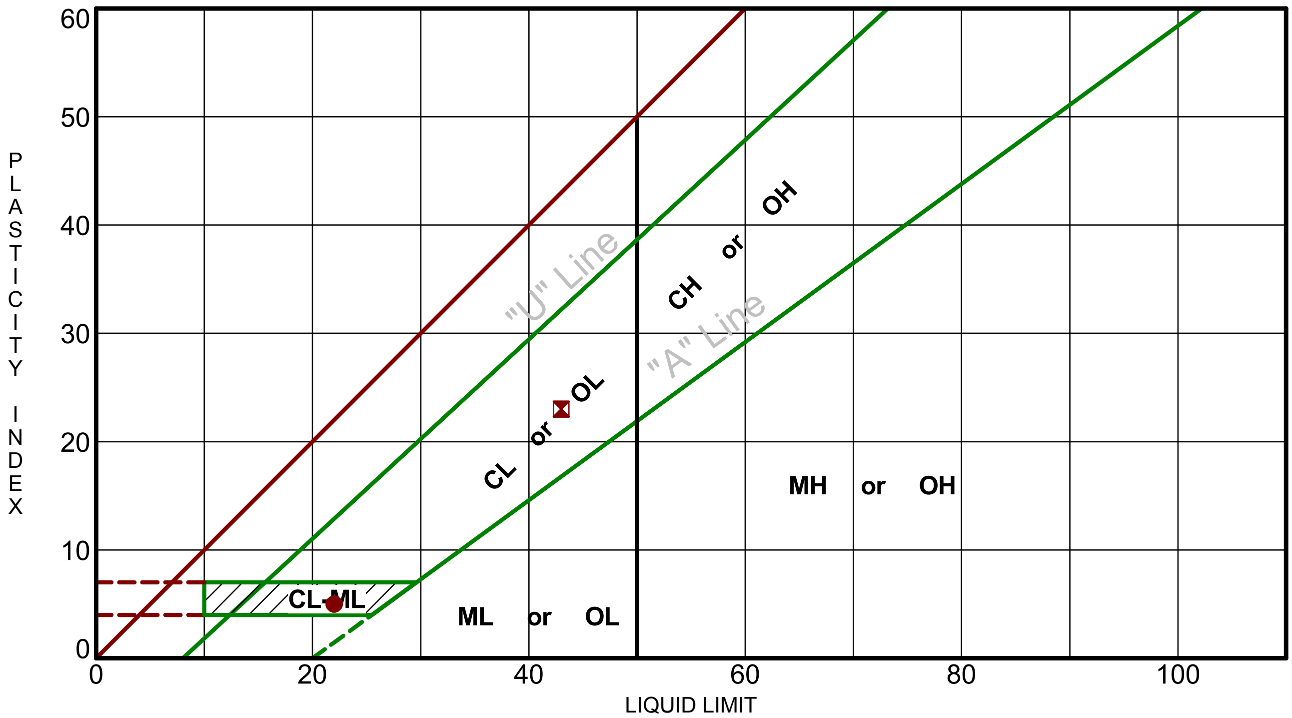
Terracon
1421 Edinger Ave Ste C
Tustin, CA

Boring Started: 6/23/2017	Boring Completed: 6/23/2017
Drill Rig: CME-75	Driller: Cal Pac Drilling
Project No.: 60145100	Exhibit: A-8

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL 60145100 BORING LOGS.GPJ TERRACON_DATATEMPLATE.GDT 7/28/17

ATTERBERG LIMITS RESULTS

ASTM D4318



	Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
●	**17B-1**	**0 - 2.5**	**22**	**17**	**5**	**39**	**SC-SM**	**SILTY, CLAYEY SAND**
⊠	**17P-2**	**0.67 - 5**	**43**	**20**	**23**	**78**	**CL**	**LEAN CLAY with SAND**

PROJECT: Proposed Johnson Student Center

SITE: 1530 West 17th Street
Santa Ana, California

Terracon
1421 Edinger Ave Ste C
Tustin, CA

PROJECT NUMBER: 60145100

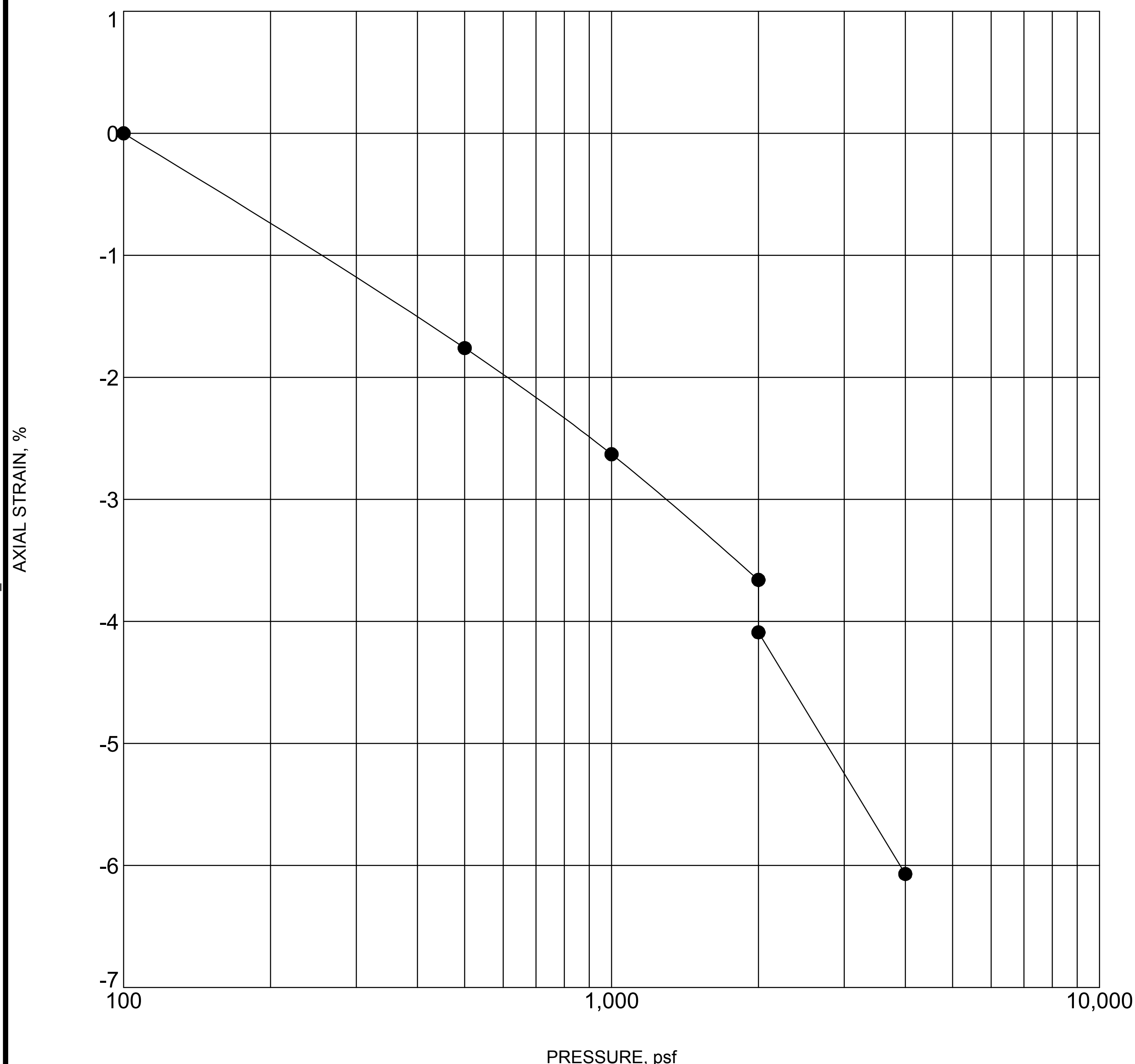
CLIENT: RSCCD Facility Planning, District
Santa Ana, California

EXHIBIT: B-1

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. ATTERBERG LIMITS 60145100 BORING LOGS.GPJ TERRACON_DATATEMPLATE.GDT 7/28/17

SWELL CONSOLIDATION TEST

ASTM D2435



Specimen Identification		Classification	γ_d, pcf	WC, %
●	17B-2 2.5 - 4 ft	CLAYEY SAND (SC)	94	26

NOTES: Water added at 2,000 psf.

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. 65155045-SWELL/CONSOL 60145100 BORING LOGS.GPJ TERRACON_DATATEMPLATE.GDT 7/28/17

PROJECT: Proposed Johnson Student Center	Terracon 1421 Edinger Ave Ste C Tustin, CA	PROJECT NUMBER: 60145100
SITE: 1530 West 17th Street Santa Ana, California		CLIENT: RSCCD Facility Planning, District Santa Ana, California
		EXHIBIT: B-2

CHEMICAL LABORATORY TEST REPORT

Project Number: 60145100
Service Date: 07/07/17
Report Date: 07/08/17
Task:

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

Client

Project

RSCCD: Johnson Student Center

Sample Submitted By: Terracon (60) **Date Received:** 6/30/2017 **Lab No: 17-0653**

Results of Corrosion Analysis

Sample Number	
Sample Location	B-1
Sample Depth (ft.)	0
pH Analysis, AWWA 4500 H	7.78
Water Soluble Sulfate (SO4), AWWA 4500 E (percent %)	0.02
Sulfides, AWWA 4500-S D (mg/kg)	Nil
Chlorides, ASTM D 512 (mg/kg)	68
Red-Ox, AWWA 2580 (mV)	+697
Total Salts, AWWA 2540 (mg/kg)	695
Resistivity, ASTM G 57 (ohm-cm)	2474

Analyzed By: [signature]
Trisha Campo
Chemist

The tests were performed in general accordance with applicable ASTM, AASHTO, or DOT test methods. This report is exclusively for the use of the client indicated above and shall not be reproduced except in full without the written consent of our company. Test results transmitted herein are only applicable to the actual samples tested at the location(s) referenced and are not necessarily indicative of the properties of other apparently similar or identical materials.

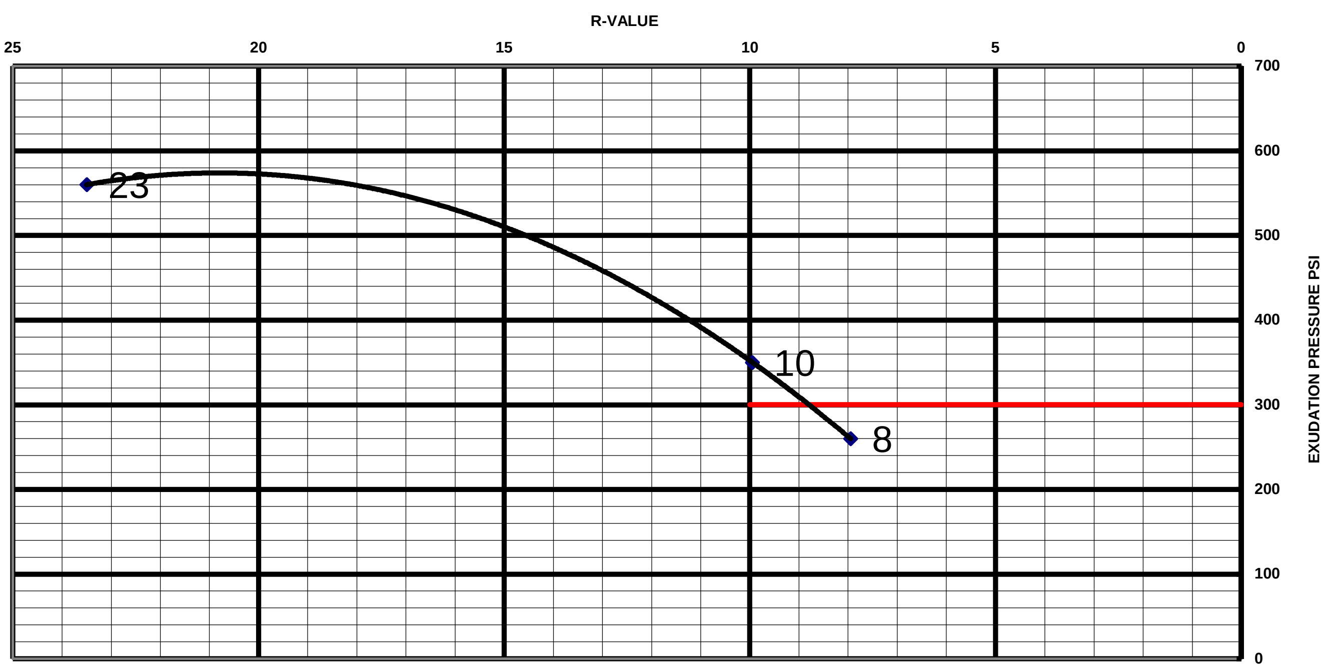
Job No. 60145100
Date. 8/4/2017

LAB0RATORY RECORD OF TESTS MADE ON BASE, SUBBASE, AND BASEMENT SOILS

CLIENT: **RSCED**
PROJECT LOCATION: **P1/P2 (0-5')**
R-VALUE # : **P1/P2 (0-5')**
T.I. :

	A	B	C	D
COMPACTOR AIR PRESSURE P.S.I.	100	175	250	
INITIAL MOISTURE %	13.4	13.4	13.4	
WATER ADDED, ML	45	35	25	
WATER ADDED %	4.6	3.6	2.6	
MOISTURE AT COMPACTION %	18.0	17.0	16.0	
HEIGHT OF BRIQUETTE	2.55	2.50	2.52	
WET WEIGHT OF BRIQUETTE	1113	1095	1097	
DENSITY LB. PER CU.FT.	112.1	113.4	113.7	
STABILOMETER PH AT 1000 LBS.	62	59	45	
2000 LBS.	141	137	110	
DISPLACEMENT	3.90	3.80	3.70	
R-VALUE	8	10	23	
EXUDATION PRESSURE	260	350	560	
THICK. INDICATED BY STAB.	0.00	0.00	0.00	
EXPANSION PRESSURE	3	8	30	
THICK. INDICATED BY E.P.	0.10	0.27	1.00	

EXUDATION CHART



R-Value: **9**

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, sands and silts.			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			
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

Terracon

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 ≥ 4 and 1 ≤ Cc ≤ 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 ≥ 6 and 1 ≤ Cc ≤ 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] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 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 ≥ 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 ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

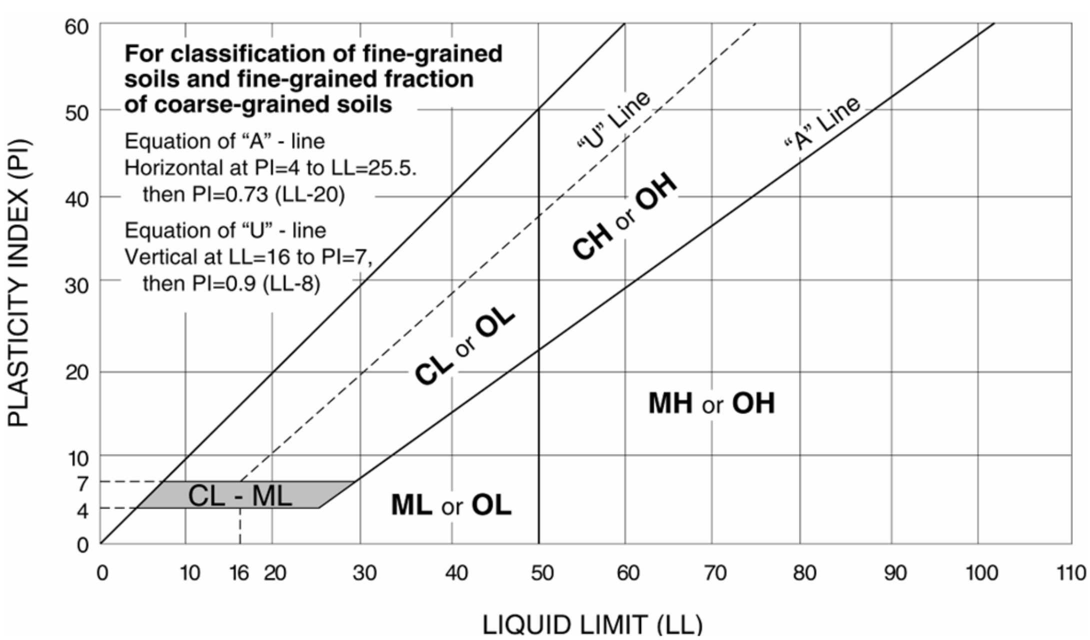
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 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.



Terracon

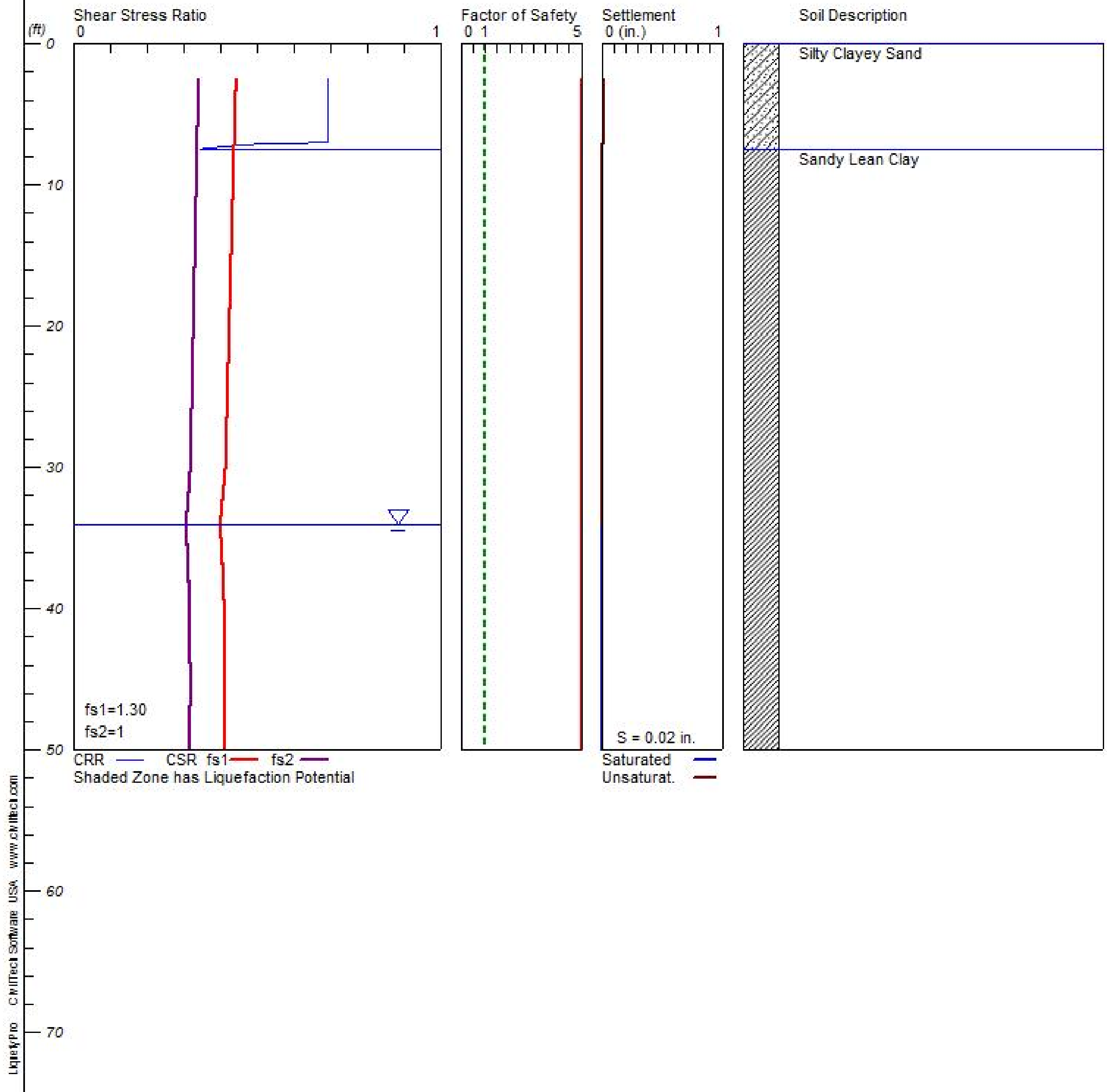
Exhibit C-2

LIQUEFACTION ANALYSIS

Johnson

Hole No.=B-1 Water Depth=34 ft Surface Elev.=103

Magnitude=6.6
Acceleration=0.528g



LIQUEFACTION ANALYSIS SUMMARY

Surface Elev.=101
Hole No.=17B-1
Depth of Hole= 51.50 ft
Water Table during Earthquake= 34.00 ft
Water Table during In-Situ Testing= 20.00 ft
Max. Acceleration= 0.53 g
Earthquake Magnitude= 6.60

Input Data:

Surface Elev.=101
Hole No.=17B-1
Depth of Hole=51.50 ft
Water Table during Earthquake= 34.00 ft
Water Table during In-Situ Testing= 34.00 ft
Max. Acceleration=0.53 g
Earthquake Magnitude=6.60
No-Liquefiable Soils: CL, OL are Non-Liq. Soil

1. SPT or BPT Calculation.
2. Settlement Analysis Method: Tokimatsu, M-correction
3. Fines Correction for Liquefaction: No
4. Fine Correction for Settlement: During Liquefaction*
5. Settlement Calculation in: All zones*
6. Hammer Energy Ratio, Ce = 1.25
7. Borehole Diameter, Cb= 1.05
8. Sampling Method, Cs= 1.2
9. User request factor of safety (apply to CSR) , User= 1.3
   Plot two CSR (fs1=User, fs2=1)
10. Use Curve Smoothing: Yes*

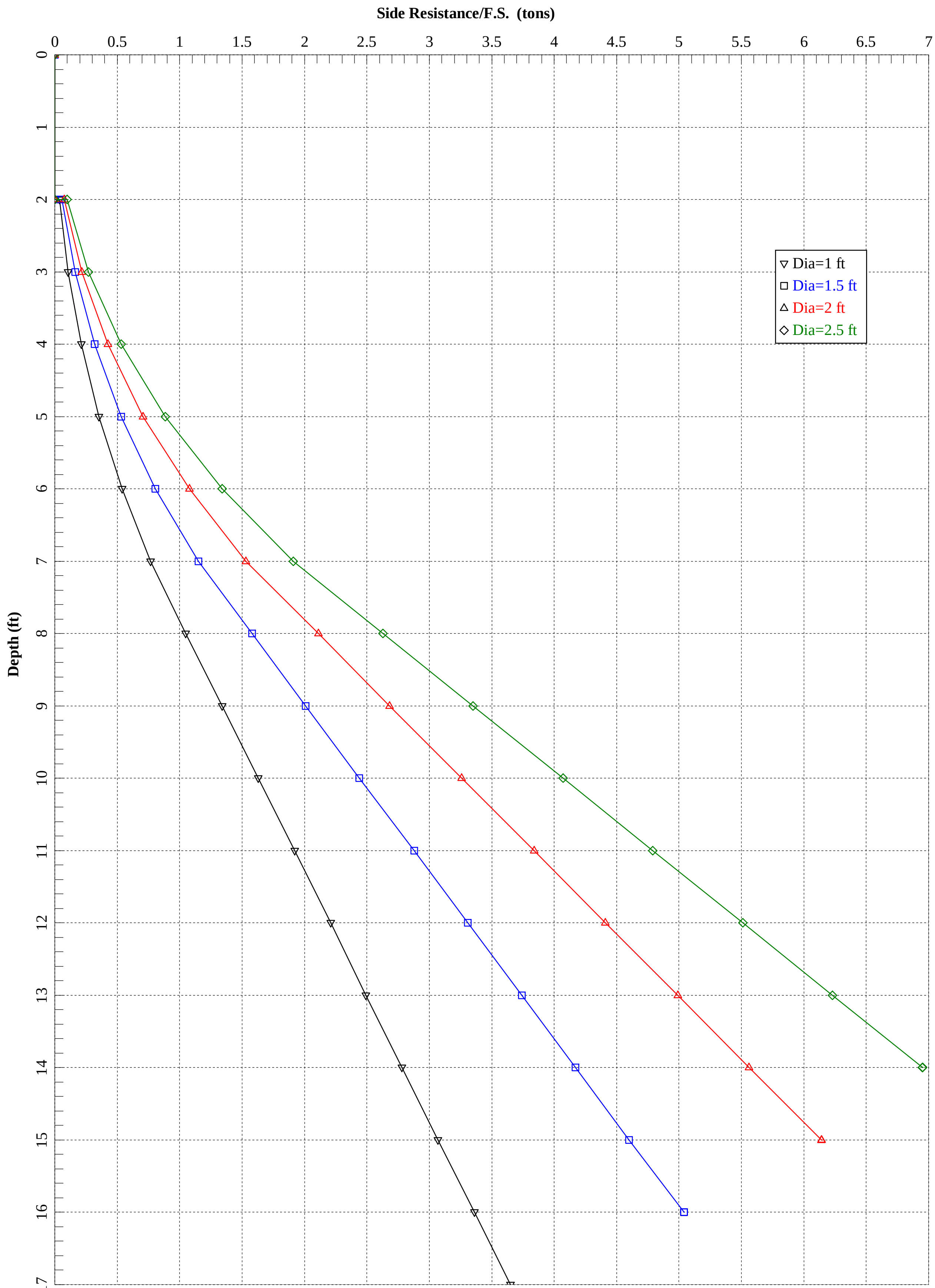
* Recommended Options

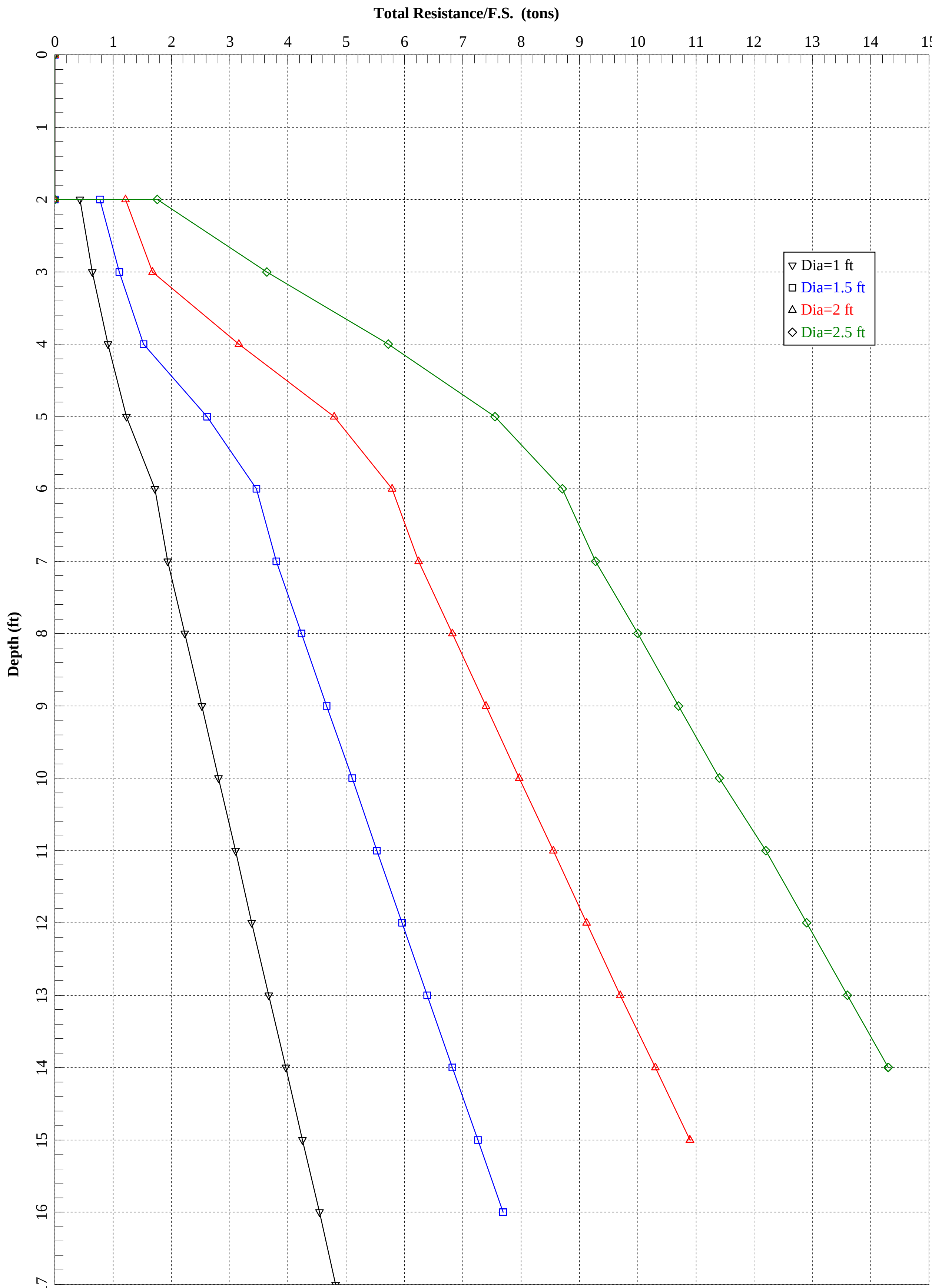
In-Situ Test Data:

Depth ft	SPT	gamma pcf	Fines %
2.50	30.00	118.00	39.00
5.00	30.00	118.00	39.00
7.50	8.00	115.00	NoLiq
10.00	6.00	115.00	NoLiq
15.00	7.00	115.00	NoLiq
20.00	4.00	115.00	NoLiq
25.00	12.00	120.00	NoLiq
30.00	7.00	115.00	NoLiq
35.00	6.00	115.00	NoLiq
40.00	14.00	120.00	NoLiq
45.00	15.00	120.00	NoLiq
50.00	17.00	120.00	NoLiq

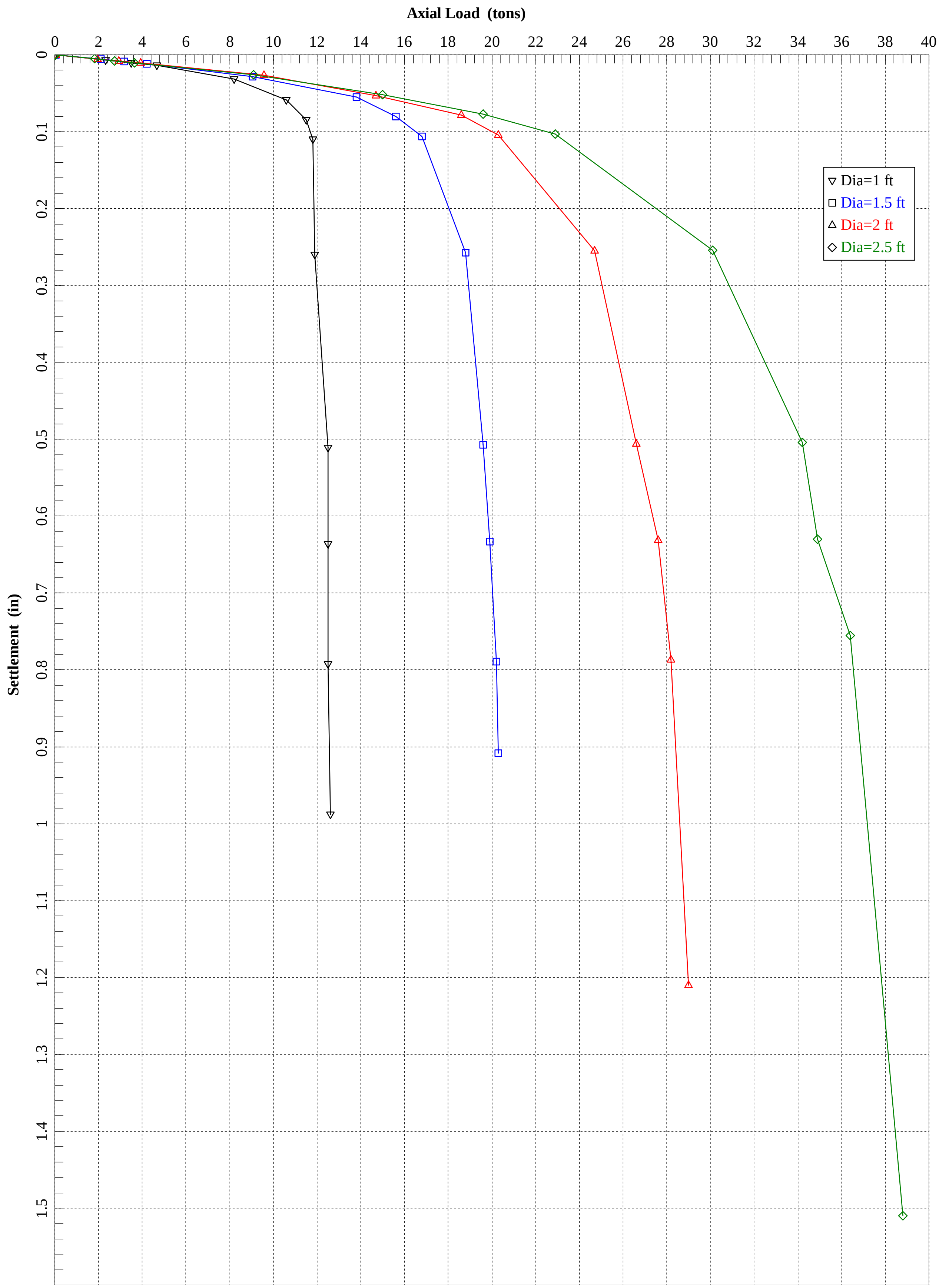
Output Results:

Total Settlement of Saturated and Unsaturated Sands=0.02 in.


Side Resistance/F.S. (tons)
Depth (ft)
Dia=1 ft
Dia=1.5 ft
Dia=2 ft
Dia=2.5 ft



Total Resistance/F.S. (tons)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Depth (ft)
16
17
Dia=1 ft
Dia=1.5 ft
Dia=2 ft
Dia=2.5 ft



Axial Load (tons)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
Settlement (in)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
Dia=1 ft
Dia=1.5 ft
Dia=2 ft
Dia=2.5 ft