GEOTECHNICAL ENGINEERING REPORT

For Proposed Six Story Burn Tower at

Joint Public Safety Training Campus Phase II

4301 W. Chicago Avenue

Chicago, Illinois

Prepared for:

WOOD GROUP PLC.
Environment & Infrastructure Solutions
8745 W Higgins Road
Chicago, IL 60631

Prepared by:

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JOB NO. 21016

April 30th, 2021

Geo Services, Inc.
Geotechnical, Environmental and Civil Engineering
An MBE - DBE Firm

April 30th, 2021

Wood Group Plc.
Environmental & Infrastructure Solutions
8745 W. Higgins Road
Chicago, IL 60631

Attn: Ms. Mary Jank, PG
Email: mary.jank@Woodplc.com

GSI Project No. 21016

Re: Geotechnical Engineering Report for
Proposed Six (6) Story Live Fire Class-A Burn Tower at
Joint Public Safety Training Campus Phase II
4301 W. Chicago Avenue, Chicago, Illinois

Dear Ms. Jank:

The following report presents the geotechnical analysis and recommendations for the Proposed six (6) story Live Fire Class-A Burn Tower at Joint Public Safety Training Campus (JPSTC) Phase II Project, located at the 4301 W. Chicago Avenue in Chicago, Cook County, Illinois.

The scope of services was conducted in general accordance with GSI proposal No. 21534 dated February 25th, 2021. This geotechnical engineering report has been prepared based upon information obtained in two (2) soil borings with in-situ pressuremeter testing (PMT) performed at the site by Geo Services, Inc. (GSI) on April 5th, 2021. Copies of the soil boring logs along with a location diagram, lab test results are included in this report.

If there are any questions regarding the information submitted herein, please do not hesitate to contact us.

Very truly yours,

GEO SERVICES, Inc.

Alexandra Weatherwax	Arun Tailor	Andrew J. Ptak, P.E.
Project Engineer	Project Manager	Principal

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expires 11/30/21

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EXECUTIVE SUMMARY OF FINDINGS AND RECOMMENDATIONS

A geotechnical exploration has been performed for the Proposed six (6) story Live Fire Class-A Burn Tower at Joint Public Safety Training Campus (JPSTC) Phase II Project located at the 4301 W. Chicago Avenue in Chicago, Cook County, Illinois.

Geo Services, Inc. (GSI) geotechnical scope of work included the advancement of two (2) soil borings were advanced to approximately 50.0-ft below grade surface with in-situ pressuremeter testing (PMT). A total of six pressuremeter test were performed at 20, 30, 35 -ft. depth at soil boring labeled as 2B-1 and 30, 35, 40 -ft. depth at soil boring labeled as 2B-2.

Based upon geotechnical conditions encountered in the borings and our understanding of the proposed development the following geotechnical consideration were identified.

- The subgrade soils encountered at the boring locations consist of existing uncontrolled, non-engineered fill above +22.0 to +26.00 CCD. Underlying the fill materials, the soil stratigraphy followed by stiff clay/very stiff clay/hard clay layer up to an elevation of - 1.0 to -2.0 CCD with some exceptional intermediate layer of very dense silt layer at an elevation of +12.0 to +19.00 CCD. The soil stratigraphy then continues with strata of very dense clayey gravel/silt/clayey silt/sandy silt to termination of borings at approximate 50-ft below grade surface at an elevation of -13.0 to -15.0 CCD.

- Perched groundwater was encountered in the fill during drilling at an approximate depth of 9.0-ft to 10.0-ft. below grade surface. Based on sample moisture conditions and color of clay sample, we estimate the ground water for design purposes at 10-ft to 15-ft below the current grade surface. We anticipate groundwater seepage in open excavation would be controlled by means of sumps and pump, if encountered.

- The project site is considered to be in a low seismic area and is considered to be design using Seismic Site Class B for Soil Site Class D.

- Due to the variable loose to dense uncontrolled non-engineered fill materials encountered in both soil borings and extending up to 13 -ft. depth, the use of shallow spread footings is not recommended for support of the proposed building foundations without ground improvement due to risk of settlement. Shallow foundations can be considered for support on the existing soil, if existing fill soils improved by Rammed Aggregate Pier. For the ground improvement, we recommend a 24-inch diameter aggregate pier at 5 ft. spacing at desired 5 ft into natural clay at +/-20 ft. below grade surface. With the Rammed Aggregate Pier installation, shallow foundations can be designed with allowable net pressure of 5 kips per square -ft. (ksf). Actual design of rammed aggregate pier ground improvement should be done by the specialty geotechnical contractor and submitted for review/approval by the Engineer.

- Based on the provided loading conditions, we recommend Deep Foundation drilled-shafts for the proposed building. A deep foundation may be designed for a maximum net allowable soil bearing pressure not to exceed 25 kips per square foot. (ksf) bearing on hard clay at an anticipated 30 to 35-ft. below the existing grade elevation (approximately below +5.0 CCD). We predict a total settlement on the order of 1.4 inch or less for the drilled shaft.

SECTION 01: INTRODUCTION

This report presents the results of the geotechnical investigation performed for the Joint Public Safety Training Campus (JPSTC) Project Phase II located at the 4301 W. Chicago Avenue in Chicago, Cook County, Illinois. This report has been prepared based upon information obtained in two (2) soil borings performed at the site by GSI on April 5th, 2021 for JPSTC within the proposed "footprint" for the six (6) - story Burn Tower Live Fire Class-A building. Three (3) in-situ pressuremeter testing (PMT) were also performed on each soil borings at predetermined depths, within the "hardpan" bearing strata – this stratum was estimated using previously GSI drilled soil borings for JPSTC phase 1 project, which is located west of the proposed development. These in-situ PMT testing results will be used for a significantly greater bearing pressures as oppose to the City Code allowable values, resulting in foundation cost savings.

The purposes of this report are to describe the subsurface conditions encountered in the soil borings, to analyze and evaluate the data obtained, and to submit recommendations relating to the design and construction of foundations support to a 6-story Burn Tower Live Fire Class-A building.

Site Description

The project is located in City of Chicago, Cook County, Illinois with the following range/township information: T39N R13E, Section 10. Figure 1 shows the project location map. The project site location map included in the Appendix B.

Figure 1: Project Location, from Google Earth

As shown in above image the site is a roughly triangular shaped property that lies south of W. Chicago Avenue, between Kilbourn Avenue and CTA Access Road, in the Garfield Park/Humboldt Park neighborhood in Chicago. The site dimensions are roughly 2,300-ft east to west and 740-ft north to south in the middle. The property is a former railyard currently overgrown with vegetation/shrubs/trees and berms of soil fill located along a good portion of the north line and to about the west half of the south line. Previously, the site had railroad spur tracks that led into the site at W. Chicago Street and Kilbourn Avenue, and then dead ended on the east side of the site. The tracks have been removed with occasional Wood ties and ballast exposed at the ground surface. The west end of the site is elevated above street level and contained by retaining wall structures.

TABLE 1
SOIL BORING LOCATION INFORMATION

Boring No.	Boring Location	Northing	Easting	Surface Elevation (CCD, ft)
2B-1	NW Corner of Proposed 6-story Burn Tower	1904421.2	1146751.6	+36.3
2B-2	SE Corner of Proposed 6-story Burn Tower	1904395.8	1146800.9	+34.8

A description of soil and groundwater conditions, general construction considerations for the site, along with general notes in Appendix A, site location map found in Appendix B, boring location diagram in Appendix C, Soil boring logs in Appendix D, Lab Test Results found in Appendix E, In-situ Pressuremeter (PMT) Test results found in Appendix F and Design Drawing found in Appendix G.

SECTION 02: PROJECT DESCRIPTION

The scope of the phase II project is to design multiple smaller design build tactical village structures, which allows the first responders to conduct scenario-based training in a realistic, context- based environment. The structures can also be utilized by CFD to conduct EMS scenario training as well as for low visibility search and rescue instruction. As shown in latest phase II concept drawings, the proposed development includes the two & three story mixed used tactical building; two/three flat residential tactical building, six-story burn tower or live fire tower building, two to four story burn building or live fire building and two-story technical rescue prop building. In addition, site improvements include surrounding roadway pavement.

This geotechnical report is prepared only for the construction of the six (6)-story Burn Tower, designed for active scenario training. The Burn Tower and other primary buildings and ancillary unoccupied outdoor training facilities will be constructed on a 30-acre city owned site located at 4301 W. Chicago Avenue, Chicago, Illinois. The six (6)-story Burn Tower will be a live-fire commercial training tower in the JPSTC. The total square footage (sq. ft) for the building is approximately 12,000-sq. ft to 15,265-sq.ft.

Based on information provided to us by Wood and Structural engineer from DLR Group. We have Table 2 below summarizes - type of structure, approximate sq. ft size, proposed finished floor elevation with estimated foundation load and type of foundations. For economical design, heavy loaded stair tower area will be designed to be supported on a pile cap with multiple caissons approximately four (4) caissons in group, which will result in ~500 kips per caisson. Estimated total load at each stairwell is approximately 2000 kips.

TABLE 2
SUMMARY OF PROPOSED PHASE II STRUCTURE

Type of Structure	Approx. Sq. Ft.	Anticipated F.F.* Elevation (CCD, ft)	Max. Unfactored Column Load (Kips)	Wall Load (Kips/ft)
Six-Story Burn Tower Live-Fire Building (R.C.C.* framed) Supported on drilled shaft foundation	15,265	+40.60	500 (60 % D.L+ 40% L.L)	4.0

Note: R.C.C is reinforced cement concrete.
F.F is finished floor.
D.L Dead Load L.L Live Load

SECTION 03: SUBSURFACE INVESTIGATION PROCEDURES

Boring locations were selected by Wood and were provided to GSI. Boring locations were laid out in the field by GSI personnel at the proposed locations. All locations in field were verified by GSI personnel using a handheld GPS device before and after the borings were completed. Elevations at the boring locations were estimated based on the topographic survey provided by Wood Group Plc. The approximate ground surface elevations at the borings are indicated on the boring logs. The as-drilled locations are illustrated on the boring location diagram in the Appendix.

The soil borings and in-situ testing were performed on April 7th thru April 12th,2021. The soil borings were performed with a truck-mounted drilling equipped with a CME automatic hammer, advanced by continuous flight hollow stem augers to a depth of 10-ft and then switching to rotary drilling in accordance with ASTM D-6151 to a full depth of 50-ft from the surface to the completion of the borings.

Representative soil samples were obtained employing split spoon sampling procedures in accordance with ASTM specifications D-1586, “Standard Test Method for Standard Penetration Test and Split Barrel Sampling of Soils”. Soil samples were obtained with the use of a split spoon sampler, at interval of 2.5-ft to a depth of 15-ft and then at 5-ft intervals thereafter. Split-spoon sampling involves driving a 2-inch diameter split-barrel sampler into the soil with a 140-pound weight falling freely through a distance of 30-in. Blow counts are recorded at 6-in intervals and the blow counts are shown on the boring logs. The number of blows required to advance the sampler the last 12-in is termed the Standard Penetration Resistance (N). The N-value is an indication of the relative density of the soil.

GSI field representative visually classified and logged the soil samples during the subsurface exploration activities and performed unconfined compressive strength tests on cohesive soil samples using a calibrated Rimac compression tester or a hand penetrometer. Samples obtained in the field were brought to our laboratory for further examination and testing.

In addition, our geotechnical services included performing a total of six (06) in-situ pressuremeter testing (PMT) (three (03) in each soil boring) at selected discreet intervals by GSI to ascertain bearing pressure and lateral modulus values for design. In the pressuremeter test (PMT), an inflatable probe is lowered into the soil boring hole during the sampling operations. At the desired depth, the probe is expanded against the soils forming the walls of the borehole with pressurized liquid and gas and the pressure required to expand the probe and corresponding volume changes are recorded incrementally and this information is plotted on a volume vs pressure curve.

Water levels observations were taken while drilling and after completion of drilling at each soil boring and are summarized in Section 6, Table 4, of this report.

Upon completion, the borings were backfilled with soil cuttings.

SECTION 04: LAB TESTING PROGRAM

The laboratory-testing program consisted of performing water content tests per ASTM D-2216, unconfined compression testing with a Rimac test device, and/or a hand penetrometer tests on the cohesive samples recovered. Water content tests were performed on non-cohesive samples recovered. These tests were performed upon representative portions of the samples obtained in the field. The results of all testing performed, along with a visual classification of the material are based upon both a textural analysis and the Unified Soil Classification System, and are indicated on the boring logs in Appendix E.

In addition to the regular lab testing program, Atterberg Limits (ASTM D 4318) and Particle Size Analysis (ASTM D 422) or Grain Size Analysis (ASTM D 6913) tests were performed on select samples from the borings. The tests were performed upon representative portions of the samples obtained in the field. Graphs for the particle size or grain size can be found in Appendix E.

SECTION 05: SUBSURFACE CONDITIONS

The subsurface soil conditions described in this section were developed based on the results of both the site investigation and laboratory results. Detailed descriptions of the subsurface soils, as well as the approximate ground surface elevations and laboratory test results are provided on the soil boring logs. Variations in the general subsurface soil profile were noted during the drilling activities. The stratifications shown on the boring logs represent the conditions only at the actual boring locations and represent the approximate boundary between subsurface materials; however, the actual transition may be gradual.

Specific soil conditions encountered in the borings are indicated on the soil boring logs included in the Appendix E. General descriptions of the soil profile encountered are provided below.

Phase II Proposed 6-Story Burn Tower Building

Soil borings 2B-1 and 2B-2 were completed at the location shown for “footprint” of the proposed the 6-story Burn Tower structure. (Current plans show this structure between the multi-story mixed-use Block 1 and the HAZ-MAT/Transportation Training Area and adjacent to the multi-use missed Block 2. Soil boring 2B-1 is in the northwest corner of the proposed Burn Tower “footprint”. Soil boring 2B-2 is located in the southeast corner of the “footprint”.

The soil conditions encountered at boring 2B-1 consisted of approximately 10-ft of loose to medium dense non-cohesive granular, uncontrolled non engineered fill material classified as silty sand with gravel/cinder sand and gravel/silty sand with gravel. Below the fill materials, the soil stratigraphy continues with strata of stiff to very stiff to hard silty clay/lean clay with sand to approximately 37-ft below grade surface with the exception of 5 ft. thick layer of dense silt layer encountered at 22 to 27 ft. below the grade surface. The soil stratigraphy then continues with strata of very dense clayey gravel/poorly graded gravel to termination of boring at approximate 50 -ft. below the grade surface.

The soil conditions encountered at boring 2B-2 consisted topsoil/sandy topsoil from the ground surface to approximately 1-ft. to 2-ft.depth. Underlying the sandy topsoil, approximately 11-ft. of loose to medium dense non-cohesive granular, uncontrolled non engineered fill material classified as poorly graded sand and gravel/cinder sand and gravel/silty gravel. Below the fill materials, the soil stratigraphy continues with strata of stiff to very stiff to hard lean clay with sand to approximately 37-ft. below grade surface with the exception of 5-ft. thick layer of dense silt with sand layer encountered at 17 to 22 ft. below the grade surface. The soil stratigraphy then continues with strata of very dense silt with sand / sandy silt to termination of boring at approximate 50 -ft. below the grade surface.

In general, above listed borings, the soil samples above 13-ft., predominately has uncontrolled non-engineered non-cohesive granular material has a moisture content typically ranged from 4% to 19% with an average of 11%. Similarly, moisture content of cohesive soils sampled in above listed boring ranged from 12% to 30% with an average of 18%. The representative soil samples collected from the borings were tested and had unconfined compressive strengths (Qu) ranging from 1.1 to 8.5 tons per square foot (tsf) with an average of 4.0 tons per square foot (tsf).

A total of six (6) pressuremeter testing (PMT) were performed in these two soil borings at the depths of 20-ft, 30-ft, and 35-ft for 2B-1 and depths 30-ft, 35-ft, and 40-ft for 2B-2. Results of the tests and the pressures and modulus of deformation is summarized below in Table 3.

TABLE 3
PRESSUREMETER TEST SUMMARY

Boring No.	Depth (ft)	Elevation (CCD, ft)	P_o (tsf)	P_f (tsf)	P_l (tsf)	E_d (tsf)
2B-1	20	16.3	1.4	a	a	a
	30	6.3	1.4	13.2	27.4	166.5
	35	1.3	1.7	13.3	31.3	155.1
2B-2	30	4.8	3.0	13.8	33.4	132.0
	35	-0.2	3.1	15.9	45.3	223.0
	40	-5.2	3.0	15.5	39.5	140.0

Note: P_o = "At Rest" Earth Pressure
P_f = Creep Pressure
P_l = Limited Pressure
E_d = Initial Loading Modulus of the soil
a = PMT test inconclusive; likely borehole disturbance.

SECTION 06: WATER TABLE CONDITIONS

Water was encountered in borings 2B-1 and 2B-2 between approximate elevations +25.8 CCD and +26.3 CCD (approximate depths 9-ft to 10-ft. below ground surface) at the time borings were drilled. Fluctuations in the amount of water accumulated and in the hydrostatic water table can be anticipated depending on variations in precipitation and surface runoff. We estimate the long-term positions of ground water by observe the change of the color from brown to gray and samples moistures. We estimate the long-term groundwater level to be 12-ft. to 15-ft. (elevations +22.0 CCD to +20.0 CCD) below from top of existing grade at borings. The brown color of the soil is typically caused by oxidation that occurs above the long-term water level. This color transition did not occur at a consistent elevation in all of the borings, which may indicate seasonal fluctuations from the above average rainfall and climatic conditions or impacts from the drainage of the surrounding area.

TABLE 4
GROUND WATER OBSERVATIONS

Boring No.	Approximate Ground Surface Elevation (CCD, ft)	Ground Water Observations While Drilling / Upon Completion	
		Depth below Ground Surface (ft.)	Elevations (CCD, ft.)
2B-1	+36.3	10.5/ n/a	+25.8
2B-2	+34.8	8.5/ n/a	+26.3

- n/a= Not Available
- Delayed water level reading unable to obtained as bore hole cave in.

SECTION 07: ANALYSIS AND RECOMMENDATIONS

General

This section provides recommendations regarding foundation design and construction for the proposed six-story burn tower or live fire tower building at Joint Public Safety Training Campus (JPSTC) Phase II Project.

The recommendations were developed based on the project information provided by Wood, DLR Group and the results of the site investigation. If there are any significant changes to the project characteristics or if significantly different subsurface conditions are encountered during construction, Geo Services, Inc. (GSI) should be consulted so that the recommendations of this report can be reviewed.

The approximate proposed finish floor elevations and estimated substructure loads for the proposed structures provided by DLR Group are shown in Table 2 of this report.

7.1 Seismic Consideration

Based on site soil properties, the project site is classified as soil site class D in accordance with the chapter 20 of the ASCE 7. The project site has a horizontal Response Spectral Acceleration

(S_1) of 0.063 at a period of 1.0 second and 5% critical dampening. The site also has a horizontal Response Spectral Acceleration (S_s) of 0.118 at a period of 0.2 seconds and 5% critical dampening. The following table shows recommended seismic design data in accordance to the Chicago Building Code (CBC) 2019.

TABLE 5
SEISMIC DESIGN (APPROXIMATELY 1000-YEAR RETURN PERIOD)

Seismic Performance Zone (SPZ)	1
Horizontal Response Spectral Acceleration (S_1) 1.0 second and 5%	0.063
Horizontal Response Spectral Acceleration (S_s) 0.2 seconds and 5%	0.118
Spectral Acceleration at 1 second (S_{D1})	0.101
Design Spectral Acceleration at 0.2 seconds (S_{Ds})	0.126
Peak ground acceleration coefficient (PGA)	0.059g
Soil Site Class	D
Site Seismic Design Category (SDC)	B

The project site is considered to be in a low seismic area and is considered a non-extreme event. Liquefiable layers are not expected to impact the design of the proposed new building.

7.2 Expansive Soil

Based on our soil investigation and visual inspection of soils for this project there is no expansive soil encountered at any of the soil borings. We have performed soil laboratory analysis and test results of cohesive materials LL < 30 and PI < 12 which indicate low probability of swelling soils.

7.3 Potential Effect of Excavations on Existing Structures and Utilities

Based on our review of site and Google Earth® aerial imagery, the existing site is far away from the nearest existing structure currently. Based on utility locate there were no existing utility observed or marked at the site near the proposed structure.

SECTION 08: FOUNDATION RECOMMENDATIONS

Soil 2B-1 and 2B-2 were drilled in and around the “footprint” of the proposed Burn Tower building which includes six (6) story portions.

Based on the existing soil conditions and the provided site development information, feasible foundation systems include a deep foundation system on drilled-shaft or a shallow foundation system with ground improvement of rammed aggregate pier foundations.

While shallow footing foundations are typically the most economical system for buildings such as those proposed for the JPSTC development, the presence of variable material types and thickness of non-engineered fills such as found in the borings will require significant undercuts and replacement with engineered fill, or other ground improvement methods, such as rammed aggregate pier to provide more uniform support conditions.

A deep foundations system such as concrete-filled drilled shafts (caissons) is considered feasible. Caissons extending to bear on the hard clay strata for foundation support and would reduce potential for differential settlements that could occur for footings supported above variable fill thickness.

We recommend that an economic analysis for each foundation option presented below be considered before choosing a foundation system for the structure.

8.1 Shallow Foundation General Overview

Due to deeper fill materials were present at borings drilled in and around the proposed building "footprints". The fill was variable in consistency with poorly graded sand with gravel/silty, sand/clayey sand and gravel materials. An apparent "perched" water table was also present in the fill layer. The existing fill is considered to be suitable for support of pavements and floor slabs, but not suitable for supporting the foundation loads using conventional shallow depth wall and column footings.

There are some options for dealing with the existing fill. One is to completely remove and replace/re-compact the in-place fill materials as part of building pad construction. This would be most applicable if heavy floor slab loads and/or relative low floor slab settlement/flatness tolerances were anticipated. The other option is to leave existing fill in-place under the floor slab and extend the footings through it to bear on underlying very stiff to hard native silty clay soils or on new engineered fill or shallow spread footings bearing over a system of rammed aggregate piers in lieu of complete over-excavation and replacement of unsuitable soils. A discussion regarding these two types of foundation support is discussed in the following sections.

8.2 Shallow Foundations supported on natural Clay Layer

As discussed above, foundation undercuts are anticipated if existing fill is left in-place at footing locations. The base of the undercuts should exceed footing dimensions by at least 12-in along each side, 6-in for every foot of over dig where the undercut exceeds 2-ft in depth. Replacement materials in foundation excavations should consist of crushed stone or crushed gravel between ¼-in to 3-in in size and containing no fines (typically comprising 3-in rock). This "structural" fill should be spread in 8-in layers loose thickness, each lift to be densified using vibratory compaction equipment or approved method. Footings constructed on the crushed stone or crushed gravel backfill may also be proportioned for 3,000-psf bearing.

For frost considerations, all exterior footings should be constructed at least 3.5-ft below outside finished grade and 4-ft for foundations located outside of heated building limits. Interior footings may be constructed at higher elevations as long as they are protected against frost heave in the event of winter construction.

The 3,000-psf bearing value may be increased by up to 33% for intermittent loads such as wind and seismic loading. The 33% increase may also be applied to the toe pressure of eccentrically loaded footings as long as the average bearing pressure does not exceed 3,000-psf. The above recommendations should otherwise result in total foundation settlements of less than 1-in. Differential settlement is typically ½” to ¾” the total settlement.

Summarized in the following table are the depth/elevations at which in-situ native soils are considered capable of supporting a net allowable bearing pressure of 3,000 pounds per square foot (psf).

TABLE 6
ESTIMATED ELEVATION OF SUITABLE FOOTING FOUNDATION BEARING MATERIAL

Boring ID	**Existing Grade***	**Existing Fill Depth (ft)**	**3,000 PSF Native Bearing**		**Depth of Undercut for Proposed Shallow Footing**
			DEPTH (ft)	**ELEVATION (CCD, ft)**	**UNDERCUT (ft)**
2B-1	36.3	10.5	11.0	24.7	11.0
2B-2	34.8	13.0	15.0	16.8	15.0

- Note: 1. verify in field
- Chicago City datum (CCD)

8.3 Shallow Foundations Supported on Rammed Aggregate Pier

Rammed Aggregate piers are an intermediate design-build soil reinforcement system that is commonly used to support structures as an alternative to soil over-excavation. The system allows the use of conventional spread footings and slabs cast on-grade, and typically provides settlement control to within 1-inch or less.

Aggregate piers are installed by densifying lifts of aggregate into a cavity that is created by either drilling or displacement methods. Densification takes place with a high-energy beveled tamper or vibratory probe that both densifies the aggregate and forces the aggregate laterally into the sidewalls of the hole. This action increases the lateral stress in surrounding soil, thereby further stiffening the stabilized composite soil mass. The result of aggregate pier installation is a significant strengthening and stiffening of subsurface soils that then support slabs and conventional shallow spread footings, we recommend that the 24-inch diameter individual aggregate pier elements spaced at 5-ft. apart and extend through the deep fill soils encountered in the upper 11 to 13 -ft. of the soil profile and terminate in the underlying native clay layer classified as very stiff to hard Lean clay / silty clay. The use of the displacement or drilling method is at the discretion of a design-build aggregate pier contractor.

Aggregate pier designs are based on a two-layer settlement analysis. Settlements within the “upper zone” (zone of soil that is reinforced with aggregate pier elements) are computed using a weighted modulus method that accounts for the stiffness of the aggregate pier elements, the stiffness of the matrix soil, and the area coverage of aggregate pier elements below supported footings. Settlements within the "lower zone" (zone of soils beneath the upper zone which receives lower intensity footing stresses) are computed using conventional geotechnical settlement methods.

After reinforcement with the aggregate pier system, the building foundations may be designed as a conventional spread footing, sized for an allowable bearing pressure on the order of 5 kips per square -ft. (ksf). The above estimate should be considered preliminary and is based on our past experience with aggregate pier systems in similar soils. The allowable bearing pressure will vary depending on the size, installation methods and spacing of the individual piers. Thus, the actual allowable bearing pressure used in footing design should be developed by an experienced design-build aggregate pier contractor based on the actual pier geometry to be used for construction. We are able to provide a list of qualified aggregate pier design-build contractors at your request.

Based on City of Chicago Department of Building April 4th, 2016 Memorandum:

For buildings two stories or greater in height the design soil bearing capacity achieved by the soil improvement system shall be established by the Load Test Method described as below.

- The Load Test Method: After the installation of the soil improvement system, the load test(s) shall be performed to verify soil bearing capacity.

- The kind of load test to be performed such as Compression or Tension load test shall be decided by the project structural engineer in consultation with the Department of Buildings (DOB) Structural Bureau.

- The protocol for the load tests shall be prepared and signed and stamped by the Licensed Structural Engineer of record. The load test protocol shall be submitted to the DOB Structural Bureau for review and electronically uploaded as a permanent record document to the building permit file.

The Load Test requirements are:

- A continuous foundation supported on a minimum of three Goopiers/Stone Columns shall be load tested.

- One load test shall be performed for the most critically loaded completed footing in the area of the most critical soil.
- Individual Geopiers or Stone Columns shall be load tested as required by the DOB Structural Bureau.
- The Service test load used for the load test shall be calculated based on the allowable soil bearing capacity and footing dimensions.
- The Field Load test method shall comply with Section 18(13-132-070) Sub-sections (b) 3, 4 and 5 of the Chicago Municipal Code.

The findings from the load test(s) shall be reviewed with the DOB Structural Bureau before the installation of foundations. If the soil bearing capacity is found to be insufficient for the test load then the foundation system must be re-designed or additional soil improvement provided to achieve the required soil bearing capacity. Verify with the conditions of acceptance for the load test with Code Section 18(13-132- 070) (c)(1)(2) of the Chicago Municipal Code. Revised structural calculations and plans for these structural changes shall be submitted and uploaded to the Department of Buildings as a permanent record document to the building permit file.

The Department of Buildings reserves the right to limit the height in stories or feet for buildings or structures seeking to use of Geopiers or Stone Columns in lieu of using deep foundations or a mat foundation.

8.4 Deep Foundation Caisson Foundation Recommendations

A deep foundation system consisting of drilled shafts (caisson) may be considered for the support of the proposed 6-story Burn Tower structure. Due to the variable loose to dense fill materials encountered in a majority of soil borings and extending up to 13-ft depth, the use of shallow spread footings may be not economical for support of the building foundations.

Based on our understanding proposed foundation for the six (6) story burn tower will be design to be supported on drilled shaft foundation extending into the hardpan soil situated at 30 -ft. below the grade surface. The foundation may be constructed using a foundation system of straight shaft or belled caissons bearing at or below a depth of 30-ft below existing grade (approx. +5.00 CCD), in the hard clay stratum encountered at this depth, based on review of the in-situ pressuremeter (PMT) testing conducted at the site (results in Appendix F). A maximum allowable bearing pressure of 25.0-kips per square foot (ksf) may be used for design using Service Load Design Method, SLD, (also known as Allowable Stress Design, ASD).The maximum net allowable soil bearing pressure is that pressure which may be transmitted to the foundation soils in excess of the final minimum surrounding overburden pressure.

If necessary, the bases of the foundations should be enlarged by belling to achieve the required bearing area. Belling should be feasible in the very stiff clay soils that overlie the recommended soil bearing layer.

TABLE 7
ESTIMATED ELEVATION OF
SUITABLE DRILLED SHAFT BEARING MATERIAL

Boring No.	Existing Grade* (CCD, ft)	Drilled Shafts Bearing 25 ksf	
		Depth (ft)	Elevation* (CCD, FT)
2B-1	+36.3	30	+6.3
2B-2	+34.8	30	+4.8

- Note: 1 verify in field
- * Elevations in -ft., Chicago City Datum (CCD)

Because the proposed 25 ksf design bearing pressure on hardpan is the higher than is currently used from standard City Code limits, it should be emphasized that performance of the foundation bearing requires proper interpolation of field-testing during construction as it correlates with the in-situ pressuremeter and laboratory testing that was performed during our subsurface exploration and on communication with our geotechnical engineering staff. Therefore, it is important that this interpretation be performed in the field by a representative of GSI as the geotechnical engineer of the record.

Based on the estimated bearing pressures, the consistency of the soils encountered, and the magnitude of the loads expected, we estimate a maximum settlement of 1.4 inches or less. It should be noted that these settlement values are for soil compression only and that elastic compression of the caisson concrete should be added to these values.

There were no soft soils encountered at any of the borings and squeeze potential, the potential for the shaft squeeze should be evaluated once the shaft sizes are determined. Based on soil strength data collected from in-situ Qp test, laboratory Rimac test, water content of the cohesive soil, we estimate there is low squeeze potential of the drilled shafts during construction.

To prevent groundwater, as well as, upper fill materials and silt, sand and gravel soil granular fill present in the borings from sloughing/caving into the caisson boreholes during construction, we recommend that a temporary steel casing be employed at the surface during construction. Potential use for temporary casing will be required to a depth of approximate elevation of +16.00 CCD to +10.00 CCD below the ground surface; the temporary casing should be extended through the granular fill and at least 2-ft into the underlying cohesive soils to provide a seal.

If casing is used for drilled shaft construction, it should be withdrawn in a slow continuous manner maintaining a sufficient head of concrete above the bottom of the casing at all times to prevent infiltration of water or the creation of voids in shaft concrete. The caisson bell should have a base angle of at least 60˚ (from horizontal) and the bell diameter should not exceed 3 times the shaft diameter.

Care should be taken to assure that soils do not slough into the caisson shaft and that voids do not occur during concrete placement. After the bearing materials have been reached, belling (if used on hard clay soils), cleaning, testing and concrete placement should occur as quickly as possible. Because the caisson technician will likely not be lowered into the excavation to observe the base of the caisson excavation directly due to safety concerns, it will be necessary to oversize the bell area by 15% or 1-ft diameter, whichever is smaller, and any loose spoils be back bladed to the outside edge prior to placing concrete. As an alternative, a camera can be used to inspect the bottom of the bell.

A minimum caisson shaft diameter of 30 inches with varying diameter bells at the base is recommended for drilled shafts. The concrete slump should be in the range of 5-in to 7-in. The recommended minimum 28-day compression strength of the concrete should be a minimum of 4,000-psi. Caisson concrete may be placed by the free fall method into the clean and dry shaft excavations as long as concrete does not hit the sides of the shaft or the rebar cage during placement. The caissons should be excavated and backfilled with concrete in one work-day shifts.

8.5 Floor Slabs Supports and Design Parameters

As discussed in earlier section, the existing site grades are to be raised, prior to start fill all surface vegetation, railroad debris, or unsuitable support materials should be removed at the start of fill operations. After the removal of unsuitable surface materials and prior to placement of any new fill, the exposed subgrade should be thoroughly proof-rolled to detect areas of unstable yielding soils. Any such areas detected should be over-excavated or improved by appropriate preparation and compaction techniques. Assuming the proofroll passes, the excavated area can then be backfilled with newly placed engineered fill to within 8-inches of the proposed floor slab bearing elevation.

After completion of newly fill raised over the existing fill, the construction of the floor slabs should be delayed several weeks to allow consolidation of the underlying soft, wet fills under the weight of the newly placed fills. It may be advisable to implement a settlement monitoring program to determine the magnitude and time rate of consolidation of the existing fills. Construction of the floor slabs can then commence once it has been determined that at least 90 percent consolidation of the fill has occurred.

Note: The site is a former rail yard and the existing fill is expected to have some debris throughout, including slag and cinders. Larger items such as clay and concrete pipe, and/or concrete slabs should not be incorporated in the fill unless crushed to 3 inches or less. Wood railroad ties should be removed from the site. Other debris, exposed in the site grading, may occur that should not be allowed in the structural fill.

It is recommended that fill materials used for pavement support consist of well-graded granular soils or low plasticity lean clays. Fill should be placed on firm subgrades, in layers of not more than 8-in in loose thickness and be compacted to at least 90% of the maximum dry density as determined by ASTM D 1557 (Modified Proctor) method of test.

Specific attention should be given to positive drainage away from the structure and positive drainage of the aggregate base out from beneath the floor slab. Additional floor slab recommendations are provided below.

Floor slabs are typically provided with an aggregate base for load distribution and as a leveling course and capillary break. Typical base course materials include IDOT gradations CA-6 (well-graded sand and gravel with fines) or CA-7 (¼" to ¾" chips). The CA-6 material should be compacted using vibratory equipment to 95 percent Modified Proctor density, the CA-7 until a dense and stable state is achieved. The CA-7 material is considered free-draining, providing a superior capillary break.

Concrete floors should be isolated from foundation elements, i.e. jointed around columns and foundation walls, to permit minor differential settlement to occur without causing undue cracking or other distress. They should also be provided with adequate reinforcement and jointing to minimize the effects of any slab movement and control minor cracking. In this regard, slab-on-grade construction and jointing should be in accordance with ACI 360-10 (Guide to Design of Slabs-on-Ground). A subgrade modulus of up to 150-pci is recommended for concrete floor slab design, with a higher value possible if the upper subgrade is lime stabilized.

8.6 Deep *Foundation Lateral Soil Properties*

The following Table 6 contains a tabulation of soil parameters to be used design for deep foundation lateral resistance.

TABLE 8
LATERAL SOIL PARAMETERS

Material (Elevation, ft.)	Unit Weight (pcf)	Drained Friction Angle (°)	Undrained Cohesion (psf)	Lateral Modulus of Subgrade Reaction k (pci)[1]	Strain ε_{50}
Loose to Medium Dense Poorly Graded Sand / Sand and Gravel / Clayey Sand and Gravel (Fill)	120	28	-	60	-
Stiff Lean Clay / Silty Clay (CL)	125	28	1,500	650	0.005
Very Stiff to Hard Lean Clay (CL)	125	28	4,000	2,000	0.004
Very Dense Clayey Silt / Silt (ML)	125	30	-	90	-

Note: 1. Values recommended for use in design from L-Pile software manual.

8.7 Site Preparation

The site has been filled to raise the grade for the former rail yard, and fill was used to form berms along the north and a portion of the south property lines. This fill is mostly granular, sands to sand and gravel with varying amounts of silt and clay and cinders or slag.

In all building and pavement areas, all surface vegetation, railroad debris, or unsuitable support materials should be removed at the start of fill operations. Depending on site design grades, the large fill berms along portions of the north and south property lines will be removed or used as site fill. The site is a former rail yard and the existing fill is expected to have some debris throughout, including slag and cinders. Larger items such as clay and concrete pipe, and/or concrete slabs should not be incorporated in the fill unless crushed to 3 inches or less. Wood railroad ties should be removed from the site. Other debris, exposed in the site grading, may occur that should not be allowed in the structural fill.

Depending on proposed new pavement grades, the existing fill layer can be considered to remain in place if stable for proof-roll inspection of subgrade. A new berm area along the eastern and northeastern portions of the property is shown on the latest concept plan. We would anticipate that most of the on-site fill materials could be used to construct the new berms provided proper moisture conditioning and compaction criteria are maintained.
Surface preparation in the building and new pavement area should include the removal of existing pavement material, organic topsoil and vegetation. After the removal of unsuitable surface materials and prior to placement of any new fill, the exposed subgrade should be thoroughly proof-rolled to detect areas of unstable yielding soils. Any such areas detected should be over-excavated or improved by appropriate preparation and compaction techniques.

It is recommended that fill materials used for pavement support consist of well-graded granular soils or low plasticity lean clays. Fill should be placed on firm subgrades, in layers of not more than 8-in in loose thickness and be compacted to at least 95% of the maximum dry density as determined by ASTM D 1557 (Modified Proctor) method of test.

8.8 *Pavement Design and Construction*

Pavement subgrade preparation should include stripping of any surficial topsoil or root zone materials. Existing fill may be left in-place subject to proof-rolling. The exposed subgrade and any new fill should then be compacted to 95% Modified Proctor density.

Based on the predominately cohesive fill anticipated at subgrade level, an Illinois Bearing Ratio (IBR) value of 3.0 could be used in the design of pavements. This value considers that any soft or unstable areas will be remediated during subgrade preparation.

Base course and subbase materials should otherwise conform to IDOT gradation CA-6 and be compacted to 95% Modified Proctor density or 100% of the Standard Proctor (ASTM D 698) maximum density value. Bituminous materials should be an approved IDOT Superpave minimum design, with N30 or N50 typical for light-duty parking lots and N50 or N70 for heavy-duty pavements. Standard Specifications for Road and Bridge Construction, Sections 406 and 1032 should also be referenced. They should be compacted to between 93% and 97% of their theoretical maximum density, as determined by the supplier.

Portland Cement Concrete (PCC) or heavy-duty bituminous concrete is recommended for pavements with heavy truck traffic and high traffic load areas such as garbage truck dumpster loading areas. Standard Specifications for Road and Bridge Construction should be followed.

SECTION 09: GENERAL CONSTRUCTION CONSIDERATIONS

All excavations that extend greater than 4-ft in depth should be designed in accordance with Occupational Safety and Health Administration (OSHA) regulations with properly sloped or braced sides to prevent excavation instability. Excavation safety is the responsibility of the contractor; however, we recommend that excavation sides be sloped at 1-1/2H:1V or flatter above the water table for this purpose. Stockpiles of material or equipment should not be placed near the top of excavation slopes.

All soils which become softened or loosened at the base of foundation excavation areas or subgrade areas should be carefully re-compacted or removed prior to placement of foundation concrete or fill material. No foundation concrete or structural fill should be placed in areas of ponded water or frozen soil.

It is recommended that all foundation subgrade soils be observed by an experienced geotechnical engineer or his field representative prior to placement of concrete or fill, in order to confirm that the subgrade conditions are consistent with the design assumptions and recommendations contained in this report. Periodic density testing should be performed on any fill in order to document that density requirements have been met.

During excavation for the proposed improvements, movement of adjacent soils into the excavation should be prevented. All excavations should be performed in accordance with the latest Occupational Safety and Health Administration (OSHA) requirements.

SECTION 10: GENERAL QUALIFICATIONS

The analysis and recommendations presented in this report are based upon the data obtained from soil borings performed at the indicated locations and from any other information discussed in this report. This report does not reflect any variations that may occur between borings across the site. In addition, it is recommended that Geo Services, Inc. be retained to perform construction observation and thereby provide a complete professional geotechnical engineering service through the observational method.

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. In the event that any 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 the changes are reviewed and the conclusions of this report modified or verified in writing by the geotechnical engineer. Also note that Geo Services, Inc. is not responsible for any claims, damages, or liability associated with any other party's interpretation of this report's subsurface data or reuse of the report's' subsurface data or engineering analyses without the express written authorization of Geo Services, Inc.

If there are any questions regarding the information submitted herein, please do not hesitate to contact us.

APPENDIX A

GENERAL NOTES

GENERAL NOTES

CLASSIFICATION

American Association of State Highway & Transportation Officials (AASHTO) System used for soil classification.

Cohesionless Soils

Relative Density	No. of Blows per foot N
Very Loose	0 to 4
Loose	4 to 10
Medium Dense	10 to 30
Dense	30 to 50
Very Dense	Over 50

TERMINOLOGY

Streaks are considered to be paper thick. **Lenses** are considered to be less than 2 inches thick. **Layers** are considered to be less than 6 inches thick. **Stratum** are considered to be greater than 6 inches thick.

Cohesive Soils

Consistency	Unconfined Compressive Strength - qu (tsf)
Very Soft	Less than 0.25
Soft	0.25 - 0.5
Medium Stiff	0.5 - 1.0
Stiff	1.0 - 2.0
Very Stiff	2.0 - 4.0
Hard	Over 4.0

DRILLING AND SAMPLING SYMBOLS

SS: Split Spoon 1-3/8" I.D., 2" O.D.
ST: Shelby Tube 2" O.D., except where noted
AS: Auger Sample
DB: Diamond Bit - NX: BX: AX
CB: Carboloy Bit - NX: BX: AX
OS: Osterberg Sampler
HS: Housel Sampler
WS: Wash Sample
FT: Fish Tail
RB: Rock Bit
WO: Wash Out

Standard "N" Penetration: Blows per foot of a 140 lb. hammer falling 30" on a 2" O.D. Split Spoon

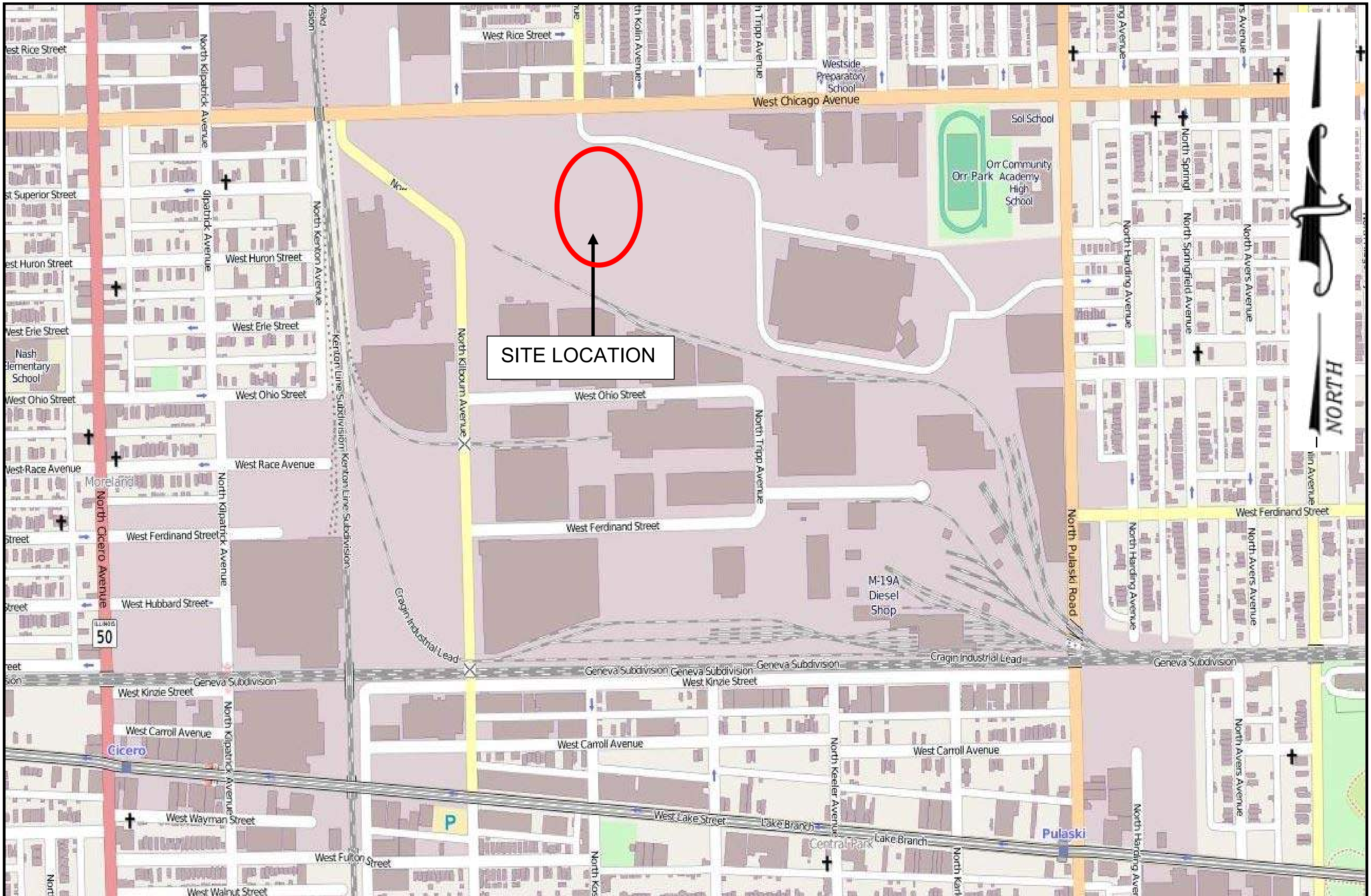
WATER LEVEL MEASUREMENT SYMBOLS

WL: Water
WCI: Wet Cave In
DCI: Dry Cave In
WS: While sampling
WD: While Drilling
BCR: Before Casing Removal
ACR: After Casing Removal
AB: After Boring

Water levels indicated on the boring logs are the levels measured in the boring at the times indicated. In pervious soils, the indicated elevations are considered reliable ground water levels. In impervious soils, the accurate determination of ground water elevations is not possible in even several days observation, and additional evidence on ground water elevations must be sought.

APPENDIX B

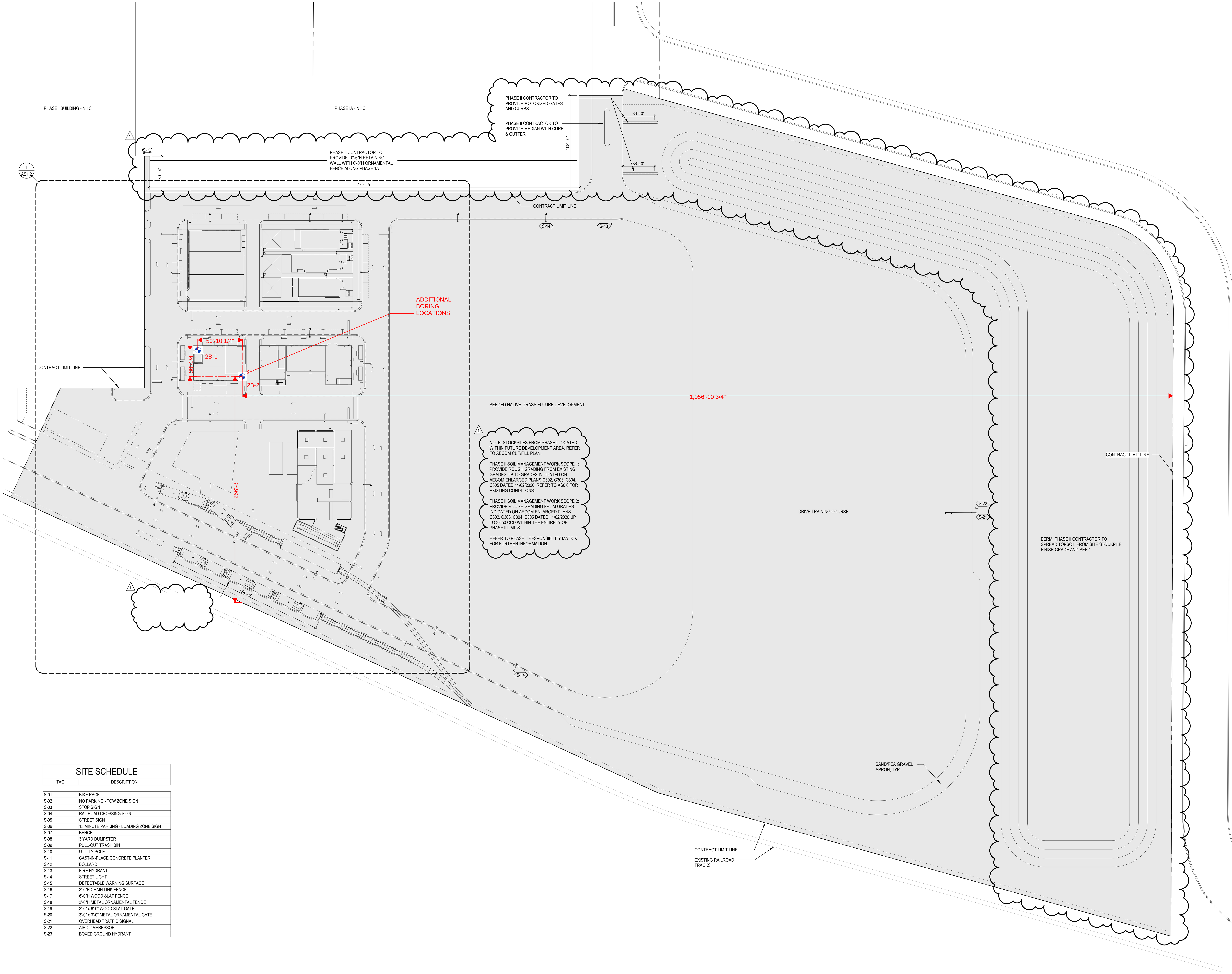
SITE MAP



SITE LOCATION MAP		DRAWN BY	AT
GEOTECHNICAL RECOMMENDATION **For Six (6)-Story Burn Tower Project at** **Joint Public Safety Training Campus Phase II** **4443 W. Chicago Avenue,** **Cook County, Chicago, IL**	***Geo Services, Inc.*** Geotechnical, Environmental & Civil Engineering 805 Amherst Court, Suite 204 Naperville, Illinois 60565 (630) 355-2838	APPROVED BY	AJP
		DATE	April 18, 2021
		GSI JOB No.	21016
		SCALE	NTS

APPENDIX C

SOIL BORING LOCATION DRAWING



SITE SCHEDULE	
TAG	DESCRIPTION
S-01	BIKE RACK
S-02	NO PARKING - TOW ZONE SIGN
S-03	STOP SIGN
S-04	RAILROAD CROSSING SIGN
S-05	STREET SIGN
S-06	15 MINUTE PARKING - LOADING ZONE SIGN
S-07	BENCH
S-08	3 YARD DUMPSTER
S-09	PULL-OUT TRASH BIN
S-10	UTILITY POLE
S-11	CAST-IN-PLACE CONCRETE PLANTER
S-12	BOLLARD
S-13	FIRE HYDRANT
S-14	STREET LIGHT
S-15	DETECTABLE WARNING SURFACE
S-16	3'-0"H CHAIN LINK FENCE
S-17	6'-0"H WOOD SLAT FENCE
S-18	3'-0"H METAL ORNAMENTAL FENCE
S-19	3'-0" x 6'-0" WOOD SLAT GATE
S-20	3'-0" x 3'-0" METAL ORNAMENTAL GATE
S-21	OVERHEAD TRAFFIC SIGNAL
S-22	AIR COMPRESSOR
S-23	BOXED GROUND HYDRANT

ARCHITECTURAL SITE PLAN - PHASE II

SCALE: 1" = 40'-0"

BIM 360://22-21105-00 JPS Training Campus - Phase 2/22-21105-00_JPSTC_AR_2020.rvt
1/14/2021 3:33:14 PM

DLR Group
© DLR Group

- NOT FOR CONSTRUCTION -

Chicago Joint Public Safety Training Campus - Phase II

4443 W Chicago Avenue, Chicago IL60651

50% SCHEMATIC DESIGN
12/21/2020

REVISIONS
1 PHASE 1 SCOPE TRANSFER 01/14/2021

22-21105-00

ARCHITECTURAL SITE PLAN - PHASE II

AS1.1

APPENDIX D

SOIL BORING LOGS

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

STRUCTURE FOUNDATION BORING LOG

DATE 4/7/2021

LOGGED BY AW

GSI JOB No. 21016

Project: Geotechnical Investigation For Joint Public Safety Training Campus (JPSTC) Phase 2

Location: 4301 W. Chicago Avenue, Chicago, Illinois

County: Cook   Drilling Method: Hollow Stem Auger/Rotary   Hammer Type: CME Automatic

Client: WOOD

BORING No.: **2B-01**

Northing: 1904421.2

Easting: 1146751.6

Ground Surface Elev. *+36.3 CCD*

Surface Water Elev. *n/a*

Stream Bed Elev. *n/a*

Groundwater Elevation:

First Encounter *+25.8 CCD*

Upon Completion *n/a*

After ______ Hrs.

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SILTY SAND with Gravel–black–medium dense (Fill)		AS		14
		4		
		8		
+33.3 CCD		12		16
CINDERS, SAND & GRAVEL–brown–medium dense (SP) Fill		7		
		9		
	–5	7		6
		4		
		5		
+28.3 CCD		6		6
SILTY SAND with Gravel–gray–loose (GM) Fill		3		
		4		
+25.8 CCD	–10	5		16
FAT SILTY CLAY–dark brown & gray–stiff (CL)		2		
		2		
		4	1.5P	30
		1		
		4		
+19.3 CCD	–15	5	1.75P	28
SANDY LEAN CLAY with Gravel–gray–stiff (CL)		2		
		3		
	–20	6	1.5P	12

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SANDY LEAN CLAY with Gravel–gray–stiff (CL) *+14.3 CCD*				
SILT–gray–dense (ML)		12		
		15		
+9.3 CCD	–25	19		21
LEAN CLAY with Sand–gray–hard (CL)		10		
Pressuremeter at –30.0 ft.		14		
Pf=13.2 tsf, Ed=166.5 tsf	–30	14	4.5+P	12
		11		*124*
Pressuremeter at –35.0 ft.		14		
Pf=13.3 tsf, Ed=155.1 tsf *–0.7 CCD*	–35	21	8.8B	12
CLAYEY GRAVEL–gray–very dense (GP)		50/5"		
	–40			15

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B–Bulge, S–Shear, P–Penetrometer)   ST–Shelby Tube Sample   VS=Vane Shear Test
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)   The Unit Dry Weight (pcf) is noted in italics above moist (%)
NR–No Recovery   NP–Nonplastic

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

STRUCTURE FOUNDATION BORING LOG

DATE 4/7/2021

LOGGED BY AW

GSI JOB No. 21016

Project: Geotechnical Investigation For Joint Public Safety Training Campus (JPSTC) Phase 2

Location: 4301 W. Chicago Avenue, Chicago, Illinois

County: Cook

Drilling Method: Hollow Stem Auger/Rotary

Hammer Type: CME Automatic

Client: WOOD

BORING No.: **2B-01**

Northing: 1904421.2

Easting: 1146751.6

Ground Surface Elev. *+36.3 CCD*

Surface Water Elev. *n/a*

Stream Bed Elev. *n/a*

Groundwater Elevation:

First Encounter *+25.8 CCD*

Upon Completion *n/a*

After ____ Hrs. ____

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
CLAYEY GRAVEL–gray–very dense (GP) *-5.7 CCD*				
POORLY GRADED GRAVEL & FRACTURED ROCK–gray–very dense (GP)		24		
		50		
	-45			7
		5		
		38		
-13.7 CCD	-50	49		6
End Of Boring @ -50.0' Hollow Stem Augers To -10.0' Rotary Drilling To Completion 10.0' Of 4.0"ø Casing Used CME Automatic Hammer				
	-55			
	-60			

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
-65			
-70			
-75			
-80			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B–Bulge, S–Shear, P–Penetrometer) ST–Shelby Tube Sample VS=Vane Shear Test
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206) The Unit Dry Weight (pcf) is noted in italics above moist (%)
NR–No Recovery NP–Nonplastic

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STRUCTURE FOUNDATION BORING LOG

DATE 4/7/2021

LOGGED BY AW

GSI JOB No. 21016

Project: Geotechnical Investigation For Joint Public Safety Training Campus (JPSTC) Phase 2

Location: 4301 W. Chicago Avenue, Chicago, Illinois

County: Cook

Drilling Method: Hollow Stem Auger/Rotary

Hammer Type: CME Automatic

Client: WOOD

BORING No.: **2B-02**

Northing: 1904395.8

Easting: 1146800.9

Ground Surface Elev. *+34.8 CCD*

Surface Water Elev. *n/a*

Stream Bed Elev. *n/a*

Groundwater Elevation:

First Encounter *+25.9 CCD*

Upon Completion *n/a*

After ____ Hrs. ____

Description	Bottom Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SANDY TOPSOIL-black	*+33.3 CCD*		AS		14
POORLY GRADED SILTY CLAYEY SAND & GRAVEL-brown-medium dense to dense (SC-SM)) Fill			6 8 9		4
		-5	14 22 16		7
			6 5 6		5
	+25.8 CCD				
CINDERS, SAND & GRAVEL-black-dense (Fill)	*+24.3 CCD*	-10	2 15 18		19
SILTY GRAVEL-black-loose (GM) Fill	*+21.8 CCD*		3 2 3		11
LEAN CLAY with Sand-dark brown & gray-stiff (CL)		-15	3 5 7	1.1B	***103*** 24
	+17.8 CCD				
SILT with Sand-gray-very dense (ML)		-20	3 8 7		16

Description	Bottom Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SILT with Sand-gray-very dense (ML)	*+12.8 CCD*				
SANDY LEAN CLAY with Sand-gray-hard (CL)		-25	15 14 8	4.4B	***120*** 15
Pressuremeter at -30.0 ft. Pf=13.8 tsf, Ed=132.0 tsf		-30	9 12 15	7.2B	***124*** 13
Pressuremeter at -35.0 ft. Pf=15.9 tsf, Ed=223.0 tsf	*-2.2 CCD*	-35	12 25 42	4.5+P	13
SILT with Sand-gray-very dense (ML) Pressuremeter at -40.0 ft. Pf=15.5 tsf, Ed=140.0 tsf		-40	50/4"		12

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer) ST-Shelby Tube Sample VS=Vane Shear Test
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206) The Unit Dry Weight (pcf) is noted in italics above moist (%)
NR-No Recovery NP-Nonplastic

Geo Services, Inc.
Geotechnical, Environmental & Civil Engineering
805 Amherst Court, Suite 204
Naperville, Illinois 60565
(630) 355-2838

STRUCTURE FOUNDATION BORING LOG

DATE 4/7/2021

LOGGED BY AW

GSI JOB No. 21016

Project: Geotechnical Investigation For Joint Public Safety Training Campus (JPSTC) Phase 2

Location: 4301 W. Chicago Avenue, Chicago, Illinois

County: Cook | Drilling Method: Hollow Stem Auger/Rotary | Hammer Type: CME Automatic

Client: WOOD

BORING No.: **2B-02**

Northing: 1904395.8

Easting: 1146800.9

Ground Surface Elev. *+34.8 CCD*

Surface Water Elev. *n/a*

Stream Bed Elev. *n/a*

Groundwater Elevation:

First Encounter *+25.9 CCD*

Upon Completion *n/a*

After ____ Hrs.

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SILT with Sand-gray-very dense (ML)				
-7.2 CCD				
SANDY SILT-gray-very dense (ML)		31		
		22		
	-45	31		16
		35		
		50/5"		
-15.2 CCD	-50			16
End Of Boring @ -50.0' Hollow Stem Augers To -10.0' Rotary Drilling To Completion 10.0' Of 4.0"ø Casing Used CME Automatic Hammer				
	-55			
	-60			

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
-65			
-70			
-75			
-80			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer) ST-Shelby Tube Sample VS=Vane Shear Test
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206) The Unit Dry Weight (pcf) is noted in italics above moist (%)
NR-No Recovery NP-Nonplastic

APPENDIX E

LAB TEST RESULTS

Geo Services, Inc.
Geotechnical, Environmental and Civil Engineering
An MBE - DBE Firm

1235 East Davis Street, Suite 101
Arlington Heights, IL 60005
(847) 253-3845

Liquid Limit, Plastic Limit, and Plasticity Index of Soils
AASHTO T89/T90

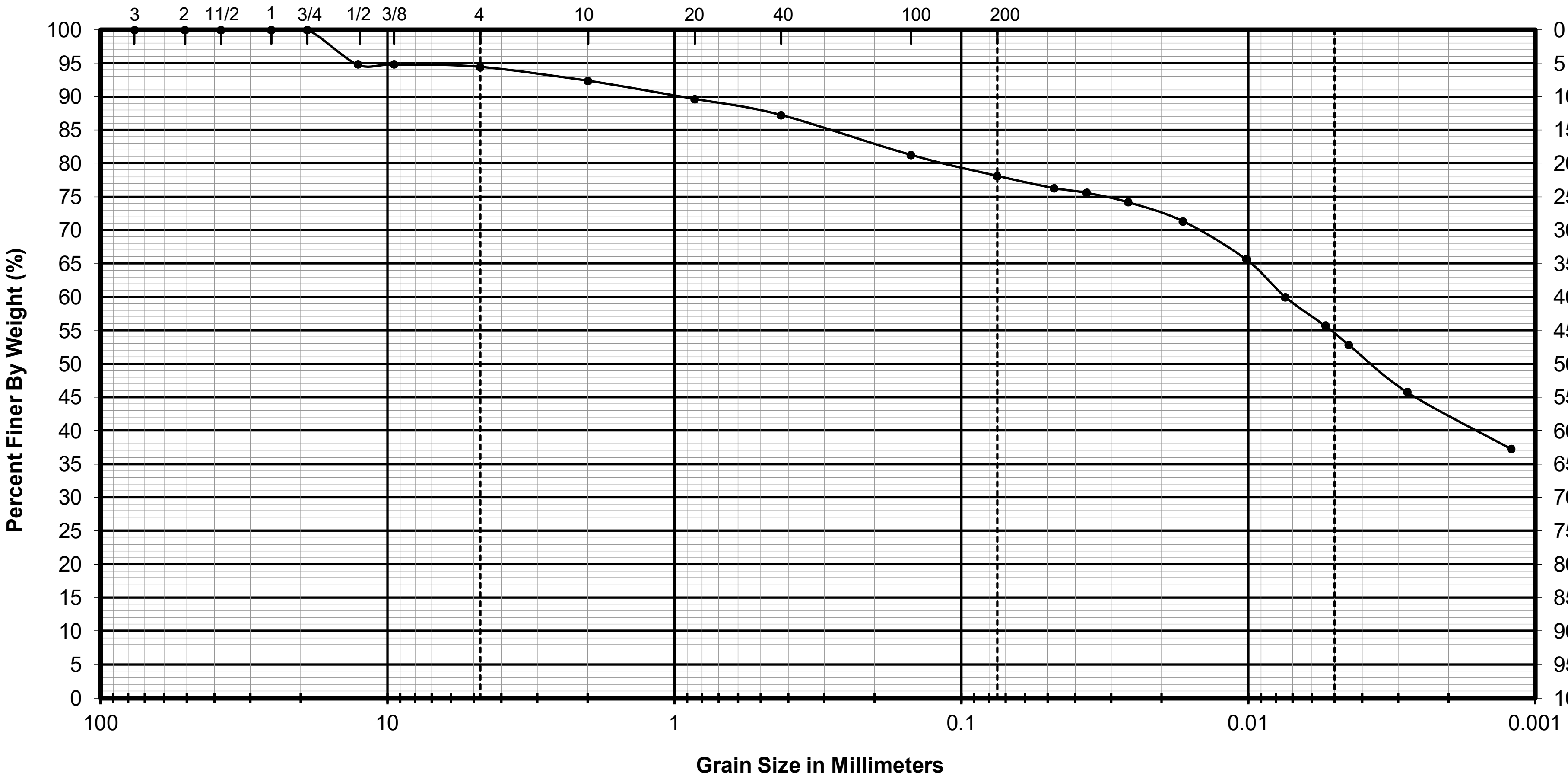
Project Name Joint Public Safety Training Campus (JPSTC) Phase 2 Job No 21016

Location 4301 W. Chicago Avenue Date 3/10/21

Client Wood Group Plc.

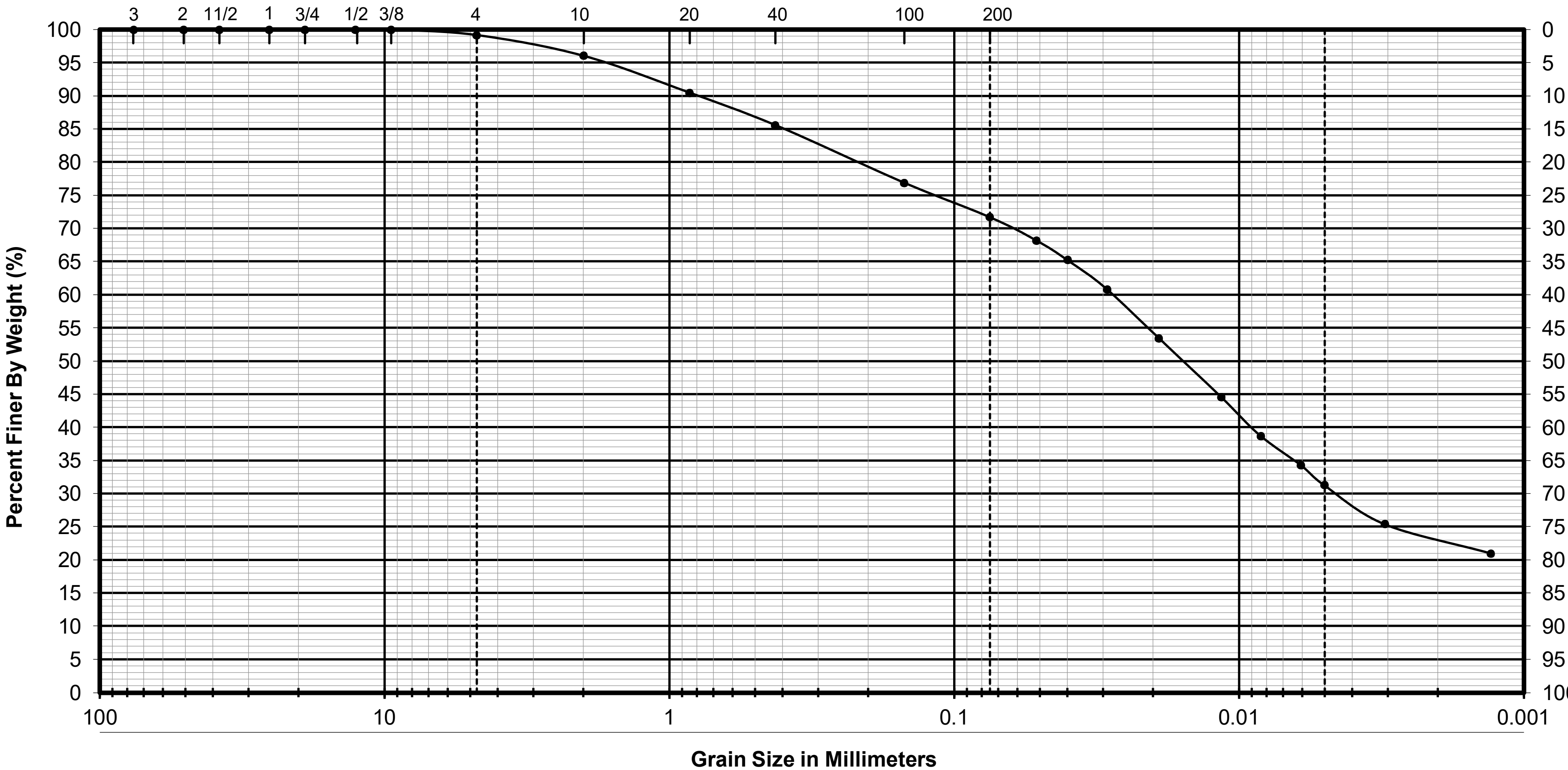
Boring No.	2B-01	2B-01	2B-02					
Sample No.	6	10	11					
Depth	11.0'-12.5'	28.5'-30.0'	33.5'-35.0'					
LIQUID LIMIT (LL)	52	26	29					
PLASTIC LIMIT (PL)	21	16	16					
PLASTICITY INDEX (PI)	31	10	13					

Tested by MT



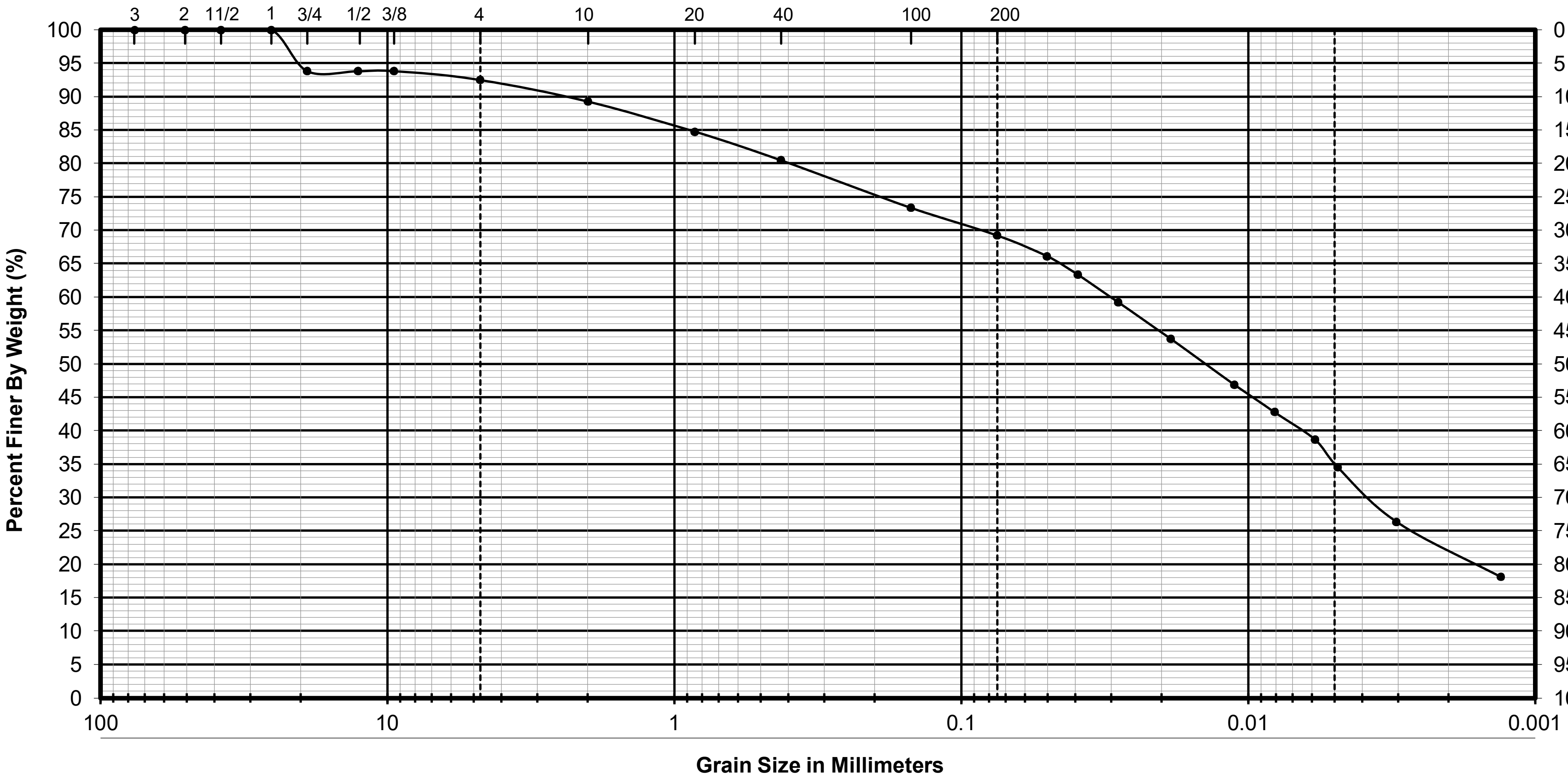
GRAVEL	SAND			SILT	CLAY
	COARSE	MEDIUM	FINE		

Boring No.	2B-01	CLASSIFICATION-ASTM D 2487		PARTICLE SIZE ANALYSIS-ASTM D 422
Sample No.	6	FAT CLAY with SAND (CH)		Joint Public Safety Training Campus (JPSTC) II
Depth	11.0'-12.5'	black/gray		4301 W. Chicago Avenue
Liquid Limit	52			Chicago, Illinois
Plastic Limit	21			
Plasticity Index	31			Geo Services, Inc. Geotechnical, Environmental and Civil Engineering An MBE - DBE Firm
Test By	MT	% Gravel	5.5	
Date	4/9/21	% Sand	16.3	
Reviewed By	AT	% Silt	22.4	1235 E. Davis St., Arlington Heights, IL 60005
Job No	21016	% Clay	55.7	Phone 847-253-3845 ● Fax 847-253-0482



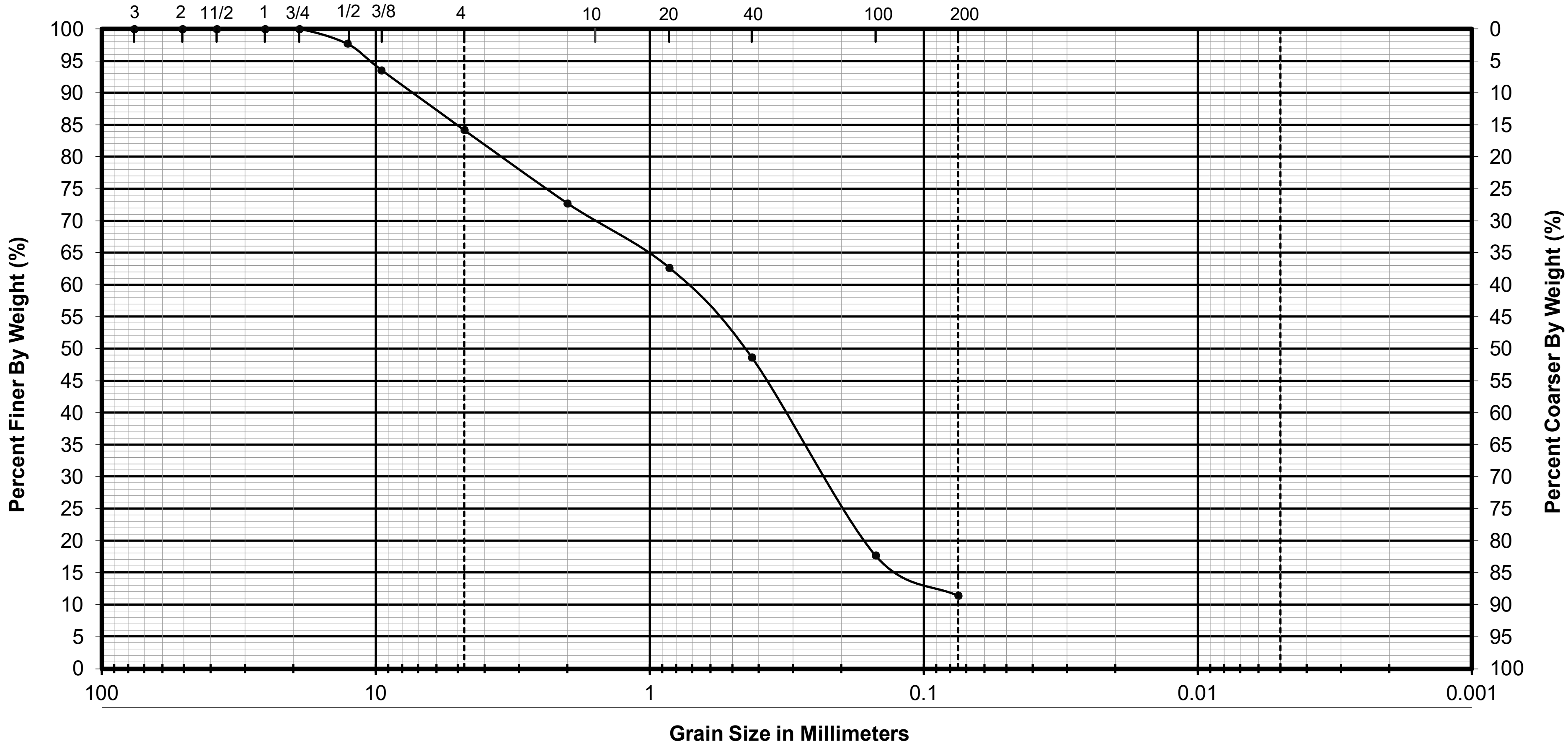
GRAVEL	SAND			SILT	CLAY
	COARSE	MEDIUM	FINE		

Boring No.	2B-01	CLASSIFICATION-ASTM D 2487		PARTICLE SIZE ANALYSIS-ASTM D 422
Sample No.	10	LEAN CLAY with SAND (CL)		
Depth	28.5'-30.0'			Joint Public Safety Training Campus (JPSTC) II
Liquid Limit	26	gray		4301 W. Chicago Avenue
Plastic Limit	16			Chicago, Illinois
Plasticity Index	10			
Test By	MT	% Gravel	0.8	Geo Services, Inc. Geotechnical, Environmental and Civil Engineering An MBE - DBE Firm
Date	4/9/21	% Sand	27.4	
Reviewed By	AT	% Silt	37.5	1235 E. Davis St., Arlington Heights, IL 60005
Job No	21016	% Clay	34.3	Phone 847-253-3845 • Fax 847-253-0482



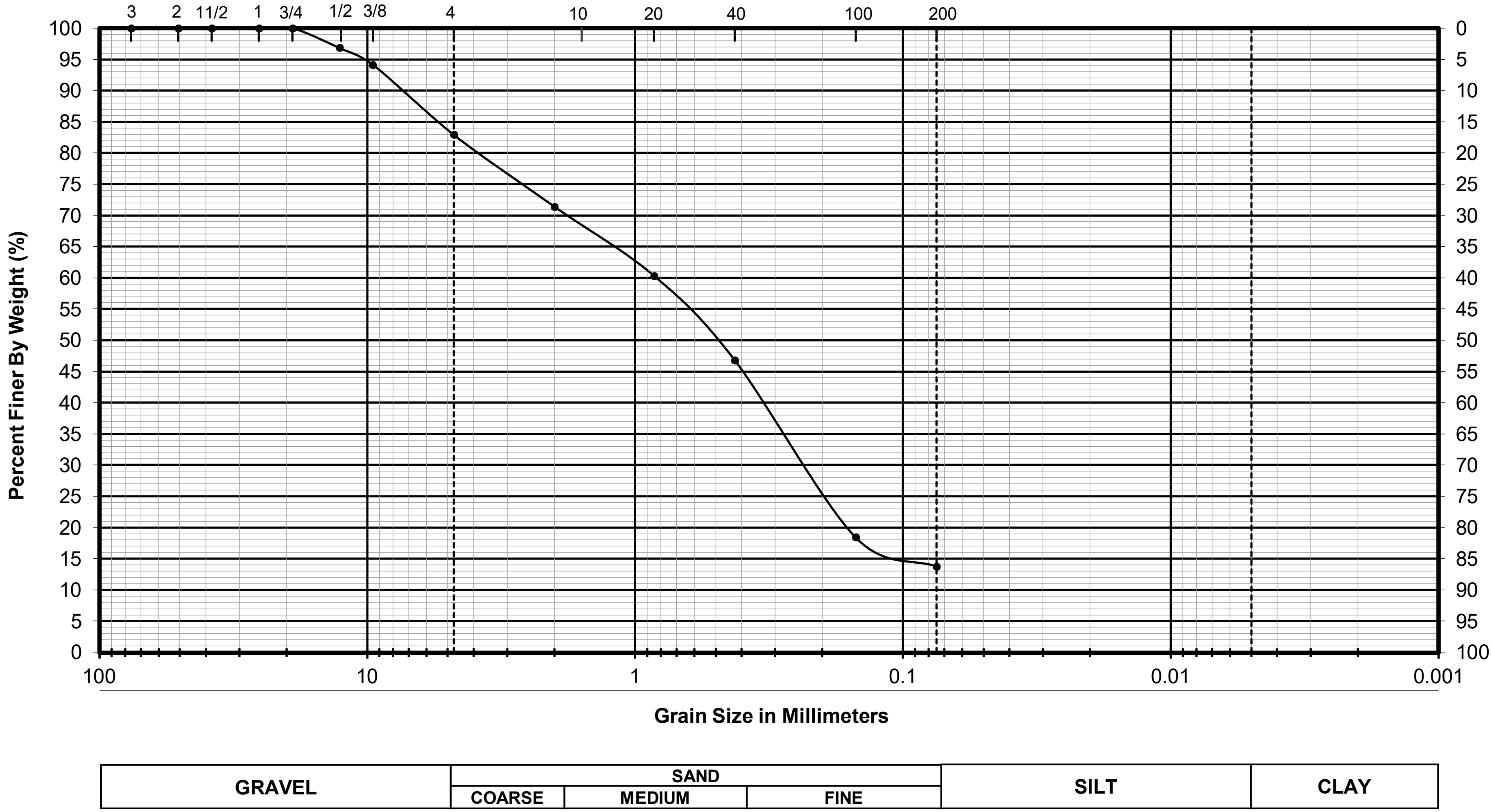
GRAVEL	SAND			SILT	CLAY
	COARSE	MEDIUM	FINE		

Boring No.	2B-02	CLASSIFICATION-ASTM D 2487		PARTICLE SIZE ANALYSIS-ASTM D 422
Sample No.	11	SANDY LEAN CLAY (CL)		Joint Public Safety Training Campus (JPSTC) II
Depth	33.5'-35.0'			4301 W. Chicago Avenue
Liquid Limit	29	gray		Chicago, Illinois
Plastic Limit	16			
Plasticity Index	13			Geo Services, Inc. Geotechnical, Environmental and Civil Engineering An MBE - DBE Firm
Test By	MT	% Gravel	7.5	
Date	4/9/21	% Sand	23.3	
Reviewed By	AT	% Silt	30.6	1235 E. Davis St., Arlington Heights, IL 60005
Job No	21016	% Clay	38.7	Phone 847-253-3845 • Fax 847-253-0482



GRAVEL	SAND			SILT	CLAY
	COARSE	MEDIUM	FINE		

Boring No.	2B-01	CLASSIFICATION-ASTM D 2487	GRAIN SIZE ANALYSIS-ASTM C117/C136
Sample No.	3,4 & 5	WELL-GRADED SAND with SILTY CLAY and GRAVEL (SW-SC)	Joint Public Safety Training Campus (JPSTC) II
		brown	4301 W. Chicago Avenue
Depth	3.5'-10.0'	Cu 12	Chicago, Illinois
		Cc 1	
Test By	MT	% Gravel 15.8	Geo Services, Inc. Geotechnical, Environmental and Civil Engineering An MBE - DBE Firm
Date	4/9/21	% Sand 72.8	
Reviewed By	AT	% Silt/Clay 11.4	1235 E. Davis St., Arlington Heights, IL 60005
Job No	21016		Phone 847-253-3845 ● Fax 847-253-0482



Boring No.	2B-02	CLASSIFICATION-ASTM D 2487	GRAIN SIZE ANALYSIS-ASTM C117/C136
Sample No.	2 & 3	SILTY CLAYEY SAND with GRAVEL (SC-SM) brown	Joint Public Safety Training Campus (JPSTC) II 4301 W. Chicago Avenue Chicago, Illinois
Depth	1.0'-5.0'	Cu 19 Cc 2	
Test By	MT	% Gravel 17.0	Geo Services, Inc. Geotechnical, Environmental and Civil Engineering An MBE - DBE Firm
Date	4/9/21	% Sand 69.2	
Reviewed By	AT	% Silt/Clay 13.8	1235 E. Davis St., Arlington Heights, IL 60005
Job No	21016		Phone 847-253-3845 ● Fax 847-253-0482

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Arlington Heights, IL 60005
Phone (847) 253-3845
Fax (847) 253-0482

ORGANIC MATTER of SOILS
ASTM D2974

Project Name Joint Public Safety Training Campus (JPSTC) Phase 2 **Date** 04/08/21

Location 4301 W. Chicago Avenue, Chicago, IL **Job No** 21016

Boring No. 2B-01 **Sample No.** 6 **Depth** 11.0'-12.5'

Sample Description Silty Clay- (CL)-Dark Brown & Gray **Furnace Temp ^{0}C.:** 440

Mosture Content	Wet Soil+Tare (g)	Dry Soil+Tare	Tare Mass (g)	w (%)
Oven-Dry Method	88.45	79.69	52.38	32.1

Ash Content	Dry Soil+Tare (g)	Ash+Tare (g)	Tare Mass (g)	Ash content (%)
Loss on Ignition	79.69	78.34	52.38	95.1

Organic Content (%) = 4.9

Notes:

Test By MT

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ORGANIC MATTER of SOILS
ASTM D2974

Project Name Joint Public Safety Training Campus (JPSTC) Phase 2 **Date** 04/08/21

Location 4301 W. Chicago Avenue, Chicago, IL **Job No** 21016

Boring No. SB-02 **Sample No.** 5 **Depth** 8.5'-10.0'

Sample Description CINDERS, SAND & GRAVEL-black **Furnace Temp ^{0}C.:** 440

Mosture Content	Wet Soil+Tare (g)	Dry Soil+Tare	Tare Mass (g)	w (%)
Oven-Dry Method	123.72	114.24	48.27	14.4

Ash Content	Dry Soil+Tare (g)	Ash+Tare (g)	Tare Mass (g)	Ash content (%)
Loss on Ignition	114.24	111.32	48.27	95.6

Organic Content (%) = 4.4

Notes:

Test By MT

APPENDIX F

In-Situ Pressuremeter (PMT)Testing Results

PROJECT: JPSTC Phase II
PROJECT NO: 21016
PREPARED BY: AGW
LAST UPDATED: 4/15/2021

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PRESSUREMETER TEST RESULTS

BORING NUMBER	DEPTH (ft)	P_o (tsf)	P_f (tsf)	P_l (tsf)	E_d (tsf)	E^+ (tsf)	E_d/E^+	E_d/P_l	P_l/P_f
2B-01	20.0	1.40	a	a	a	a	a	a	a
	30.0	1.4	13.2	27.4	165.5	2203.2	0.08	6.0	2.1
	35.0	1.7	13.3	31.3	155.1	443.1	0.35	5.0	2.4
					AVERAGE		0.21	5.50	2.21
2B-02	30.0	3.0	13.8	33.4	132.0	930.0	0.14	4.0	2.4
	35.0	3.1	15.9	45.3	223.0	856.0	0.26	4.9	2.8
	40.0	3.0	15.5	39.5	140.0	925.0	0.15	3.5	2.5
					AVERAGE		0.18	4.14	2.61

Notes: a) PMT test inconclusive; likely borehole disturbance.

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G-AM Pressuremeter Test

Project name:	21016 JPSTC Phase II	Material	Stiff Sandy Clay
Date of test:	4/12/2021	Manometer height above ground:	1.6 ft
Type of pressuremeter:	G-AM II	SPT N	9
Borehole name:	2B-01	Poisson's coefficient:	0.33
Test Depth	20 ft	Fluid density:	1.0

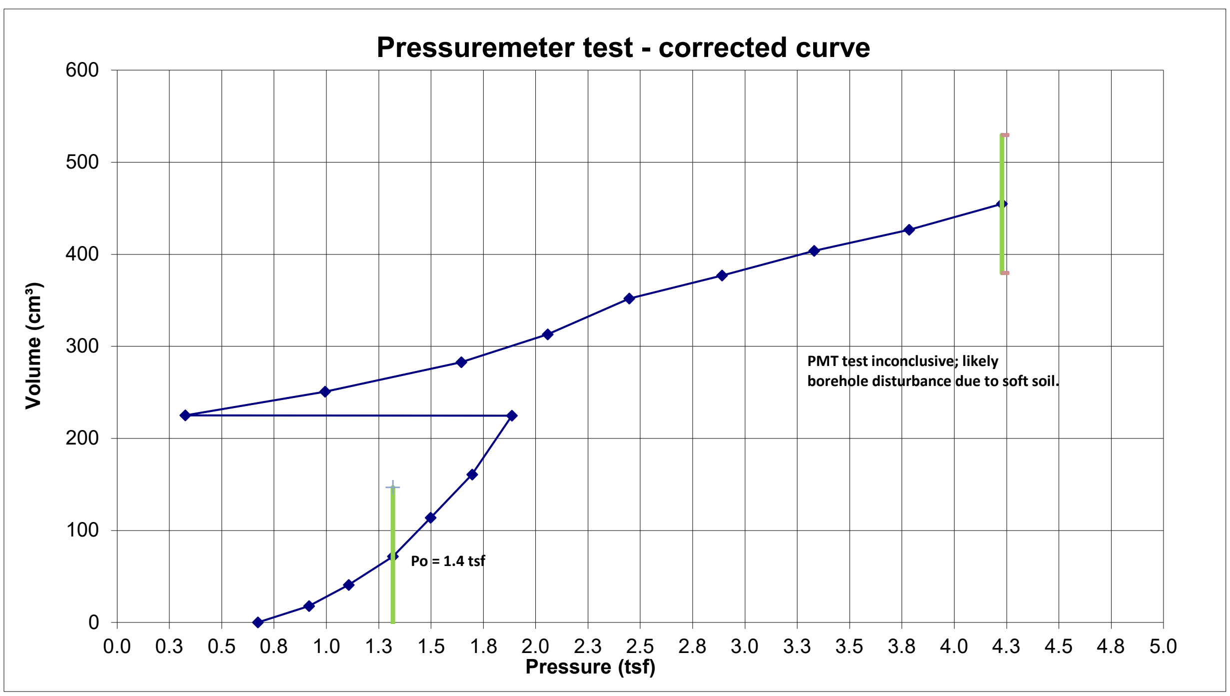
Raw Readings		Corrected Readings		
Pressure tsf	Volume cm³	Pressure tsf	Volume cm³	$\Delta R/R_0$ %
0.00	0.0	0.67	0.0	0.00
0.52	18.0	0.92	18.0	1.13
1.04	41.0	1.11	40.9	2.56
1.56	72.0	1.32	71.9	4.45
2.08	114.0	1.50	113.9	6.97
2.60	161.0	1.70	160.9	9.71
3.12	225.0	1.89	224.8	13.34
1.56	225.0	0.33	224.9	13.34
2.34	251.0	0.99	250.9	14.79
3.12	283.0	1.64	282.8	16.53
3.64	313.0	2.06	312.8	18.15
4.16	352.0	2.45	351.8	20.22
4.68	377.0	2.89	376.8	21.53
5.20	404.0	3.33	403.7	22.92
5.72	427.0	3.78	426.7	24.10
6.24	455.0	4.23	454.7	25.52

Test Results

Pressiometric modulus E:	-
Ultimate pressure P_L:	-
Ratio E / P_L:	-
Yield pressure P_F:	-
Ratio P_L / P_F:	-

Remarks

PMT test inconclusive; likely borehole disturbance due to soft soil.



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G-AM Pressuremeter Test

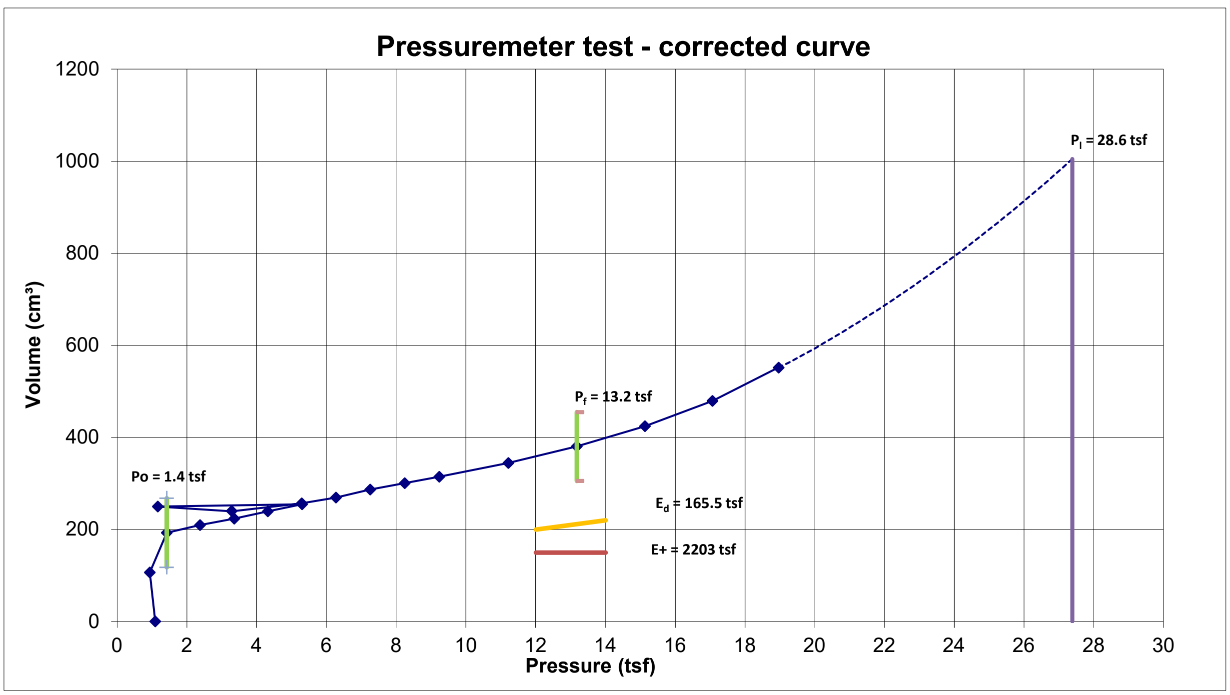
Project name:	21016 JPSTC Phase II	Material	Hard Clay with Sand
Date of test:	4/12/2021	Manometer height above ground:	1.6 ft
Type of pressuremeter:	G-AM II	SPT N	27
Borehole name:	2B-01	Poisson's coefficient:	0.33
Test Depth	30 ft	Fluid density:	1.0

Raw Readings		Corrected Readings		
Pressure tsf	Volume cm³	Pressure tsf	Volume cm³	$\Delta R/R_0$ %
0.00	0.0	1.09	0.0	0.00
1.04	107.0	0.93	106.9	6.55
2.08	193.0	1.42	192.9	11.54
3.12	210.0	2.37	209.8	12.50
4.16	224.0	3.35	223.8	13.28
5.20	240.0	4.32	239.7	14.17
6.24	255.0	5.30	254.7	14.99
2.08	250.0	1.16	249.9	14.73
4.16	240.0	3.28	239.8	14.17
6.24	257.0	5.29	256.7	15.10
7.28	270.0	6.28	269.6	15.81
8.32	287.0	7.25	286.6	16.74
9.36	301.0	8.24	300.5	17.49
10.40	315.0	9.23	314.5	18.24
12.48	345.0	11.21	344.3	19.83
14.56	381.0	13.18	380.2	21.71
16.64	425.0	15.13	424.1	23.97
18.72	480.0	17.06	479.0	26.74
20.80	553.0	18.96	551.9	30.33

Test Results

Pressiometric modulus E:	165.5 tsf
Ultimate pressure P_L:	27.4 tsf
Ratio E / P_L:	6.04
Yield pressure P_F:	13.2 tsf
Ratio P_L / P_F:	2.08

Remarks



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G-AM Pressuremeter Test

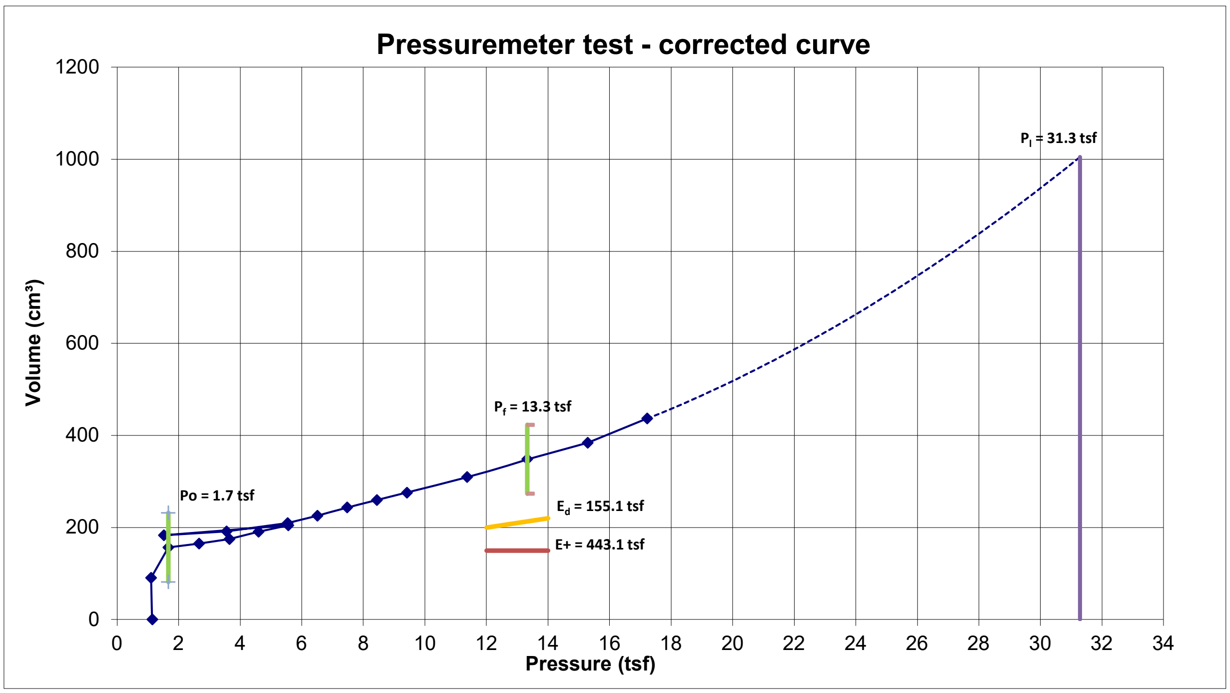
Project name:	21016 JPSTC Phase II	Material	Hard Clay with Sand
Date of test:	4/12/2021	Manometer height above ground:	1.6 ft
Type of pressuremeter:	G-AM II	SPT N	35
Borehole name:	2B-01	Poisson's coefficient:	0.33
Test Depth	35 ft	Fluid density:	1.0

Raw Readings		Corrected Readings		
Pressure tsf	Volume cm³	Pressure tsf	Volume cm³	$\Delta R/R_0$ %
0.00	0.0	1.14	0.0	0.00
1.04	91.0	1.10	90.9	5.60
2.08	157.0	1.67	156.9	9.48
3.12	165.0	2.66	164.8	9.94
4.16	175.0	3.64	174.8	10.51
5.20	191.0	4.60	190.7	11.42
6.24	205.0	5.56	204.7	12.21
2.08	183.0	1.52	182.9	10.97
4.16	192.0	3.55	191.8	11.48
6.24	210.0	5.54	209.7	12.49
7.28	226.0	6.51	225.6	13.38
8.32	244.0	7.47	243.6	14.38
9.36	260.0	8.44	259.5	15.26
10.40	276.0	9.42	275.5	16.13
12.48	310.0	11.37	309.3	17.97
14.56	349.0	13.32	348.2	20.03
16.64	385.0	15.29	384.1	21.91
18.72	438.0	17.22	437.0	24.63

Test Results

Pressiometric modulus E:	155.1 tsf
Ultimate pressure P_L:	31.3 tsf
Ratio E / P_L:	4.96
Yield pressure P_F:	13.3 tsf
Ratio P_L / P_F:	2.35

Remarks



G-AM Pressuremeter Test

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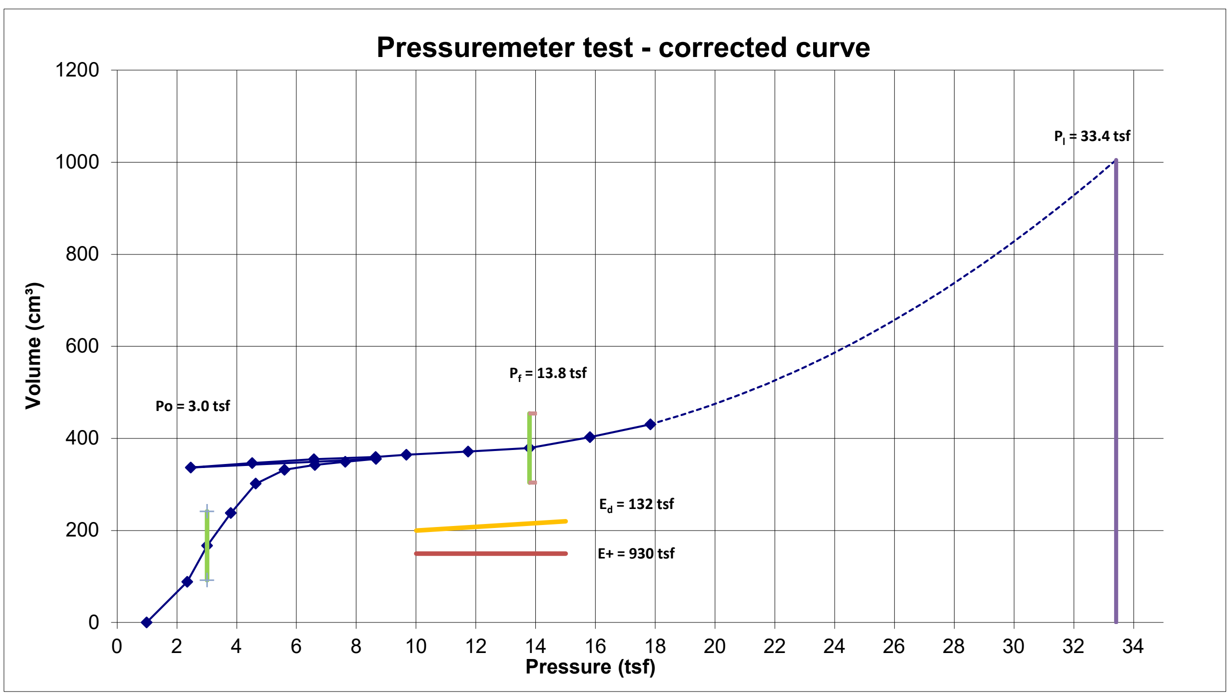
Project name:	21016 JPSTC Phase II	Material	Hard Clay with Sand
Date of test:	4/9/2021	Manometer height above ground:	1.6 ft
Type of pressuremeter:	G-AM II	SPT N	27
Borehole name:	2B-02	Poisson's coefficient:	0.33
Test Depth	30 ft	Fluid density:	1.0

Raw Readings		Corrected Readings		
Pressure tsf	Volume cm³	Pressure tsf	Volume cm³	$\Delta R/R_0$ %
0.00	0.0	0.98	0.0	0.00
1.04	83.0	2.34	88.9	6.12
2.08	169.0	3.01	166.8	11.21
3.12	196.0	3.80	237.7	15.64
4.16	211.0	4.63	301.7	19.50
5.20	231.0	5.60	331.6	21.26
6.24	250.0	6.61	342.5	21.90
7.28	270.0	7.63	349.5	22.31
3.12	241.0	8.66	355.4	22.65
5.20	259.0	2.46	336.8	21.57
7.28	277.0	4.52	346.7	22.14
8.32	293.0	6.58	354.5	22.60
9.36	310.0	8.65	359.4	22.88
10.40	330.0	9.67	364.3	23.16
12.48	370.0	11.74	371.2	23.56
14.56	416.0	13.80	379.1	24.01
16.64	477.0	15.82	403.0	25.37
18.72	553.0	17.83	430.8	26.94

Test Results

Pressiometric modulus E:	132.1 tsf
Ultimate pressure P_L:	33.4 tsf
Ratio E / P_L:	3.96
Yield pressure P_F:	13.8 tsf
Ratio P_L / P_F:	2.42

Remarks



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G-AM Pressuremeter Test

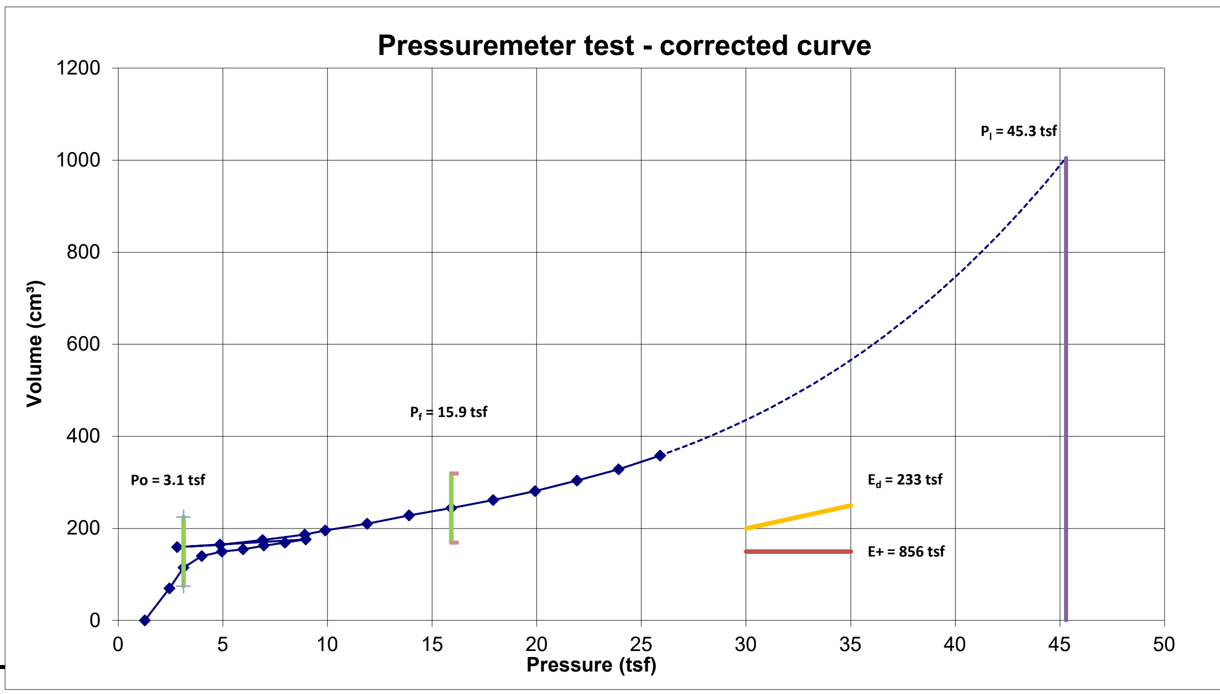
Project name:	21016 JPSTC Phase II	Material	Hard Clay with Sand
Date of test:	4/9/2021	Manometer height above ground:	1.6 ft
Type of pressuremeter:	G-AM II	SPT N	67
Borehole name:	2B-02	Poisson's coefficient:	0.33
Test Depth	35 ft	Fluid density:	1.0

Raw Readings		Corrected Readings		
Pressure tsf	Volume cm³	Pressure tsf	Volume cm³	$\Delta R/R_0$ %
0.00	0.0	1.27	0.0	0.00
2.08	70.0	2.45	69.9	4.33
3.12	115.0	3.13	114.8	7.02
4.16	140.0	3.99	139.8	8.49
5.20	150.0	4.96	149.7	9.07
6.24	155.0	5.97	154.7	9.35
7.28	163.0	6.96	162.6	9.81
8.32	170.0	7.96	169.6	10.21
9.36	177.0	8.96	176.5	10.61
3.12	160.0	2.82	159.8	9.65
5.20	165.0	4.87	164.7	9.93
7.28	175.0	6.89	174.6	10.50
9.36	187.0	8.91	186.5	11.18
10.40	196.0	9.90	195.5	11.69
12.48	211.0	11.90	210.3	12.53
14.56	229.0	13.90	228.2	13.53
16.64	245.0	15.91	244.1	14.41
18.72	263.0	17.92	262.0	15.40
20.80	282.0	19.92	280.9	16.43
22.88	305.0	21.92	303.8	17.67
24.96	330.0	23.91	328.7	19.00
27.04	360.0	25.90	358.6	20.58

Test Results

Pressiometric modulus E:	232.7 tsf
Ultimate pressure P_L:	45.3 tsf
Ratio E / P_L:	5.14
Yield pressure P_F:	15.9 tsf
Ratio P_L / P_F:	2.85

Remarks



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G-AM Pressuremeter Test

Project name:	21016 JPSTC Phase II		Material	Very Dense Silt w/ Sand
Date of test:	4/9/2021		Manometer height above ground:	1.6 ft
Type of pressuremeter:	G-AM II		SPT N	50
Borehole name:	2B-02		Poisson's coefficient:	0.33
Test Depth	40 ft		Fluid density:	1.0

Raw Readings		Corrected Readings		
Pressure tsf	Volume cm³	Pressure tsf	Volume cm³	$\Delta R/R_0$ %
0.00	0.0	1.44	0.0	0.00
2.08	89.0	2.46	88.9	6.12
3.12	167.0	2.95	166.8	11.21
4.16	238.0	3.64	237.7	15.64
5.20	302.0	4.42	301.7	19.50
6.24	332.0	5.36	331.6	21.26
7.28	343.0	6.36	342.5	21.90
8.32	350.0	7.38	349.5	22.31
9.36	356.0	8.40	355.4	22.65
3.12	337.0	2.22	336.8	21.57
5.20	347.0	4.27	346.7	22.14
7.28	355.0	6.33	354.5	22.60
9.36	360.0	8.39	359.4	22.88
10.40	365.0	9.41	364.3	23.16
12.48	372.0	11.47	371.2	23.56
14.56	380.0	13.53	379.1	24.01
16.64	404.0	15.54	403.0	25.37
18.72	432.0	17.54	430.8	26.94

Test Results

Pressiometric modulus E:	140.2 tsf
Ultimate pressure P_L:	39.5 tsf
Ratio E / P_L:	3.55
Yield pressure P_F:	15.5 tsf
Ratio P_L / P_F:	2.54

Remarks