EXHIBIT G – GEOTECHNICAL REPORT (DRAFT)

Construction Monitoring & Observations
Construction Materials Testing
Tunnels and Underground Openings
Geotechnical Engineering & Evaluation

SEECO Consultants Inc.
CONSULTING ENGINEERS

Subsurface Explorations
Foundation Analysis & Design
Structural Rehabilitation Condition Surveys
Dams and Drainage Studies

October 31, 2018

Public Building Commission of Chicago
50 West Washington Street, Room 200
Chicago, Illinois 60602
Attn: Mr. Kerl LaJeune,
Deputy Director of Planning and Design

RE: Preliminary Subsurface Exploration, Geotech Laboratory Testing and Geotechnical Engineering and Analysis for the Proposed Fire Station Engine Co. 115 Project located at Site 'B' near NWC of 119th St. and Morgan St., Chicago, Illinois SEECO Job No. 12060G

Dear Mr. LaJeune:

As per the request of the Public Building Commission of Chicago (PBC), SEECO Consultants, Inc. drilled and sampled five (5) soil borings (B-1 to B-5) to depths of 30 feet to 50 feet below the existing ground surface level at each boring location respectively deemed as Project Site 'B' by the PBC located at the northwest corner of 119th Street and South Morgan Street in the City of Chicago, Illinois. Refer to **PBC Project Sites Plan** provided in the **Appendix** of this report.

The purpose of this preliminary geotechnical report is to provide existing subsurface soil conditions, groundwater conditions encountered on this preliminary project site, provide preliminary foundation recommendations which include most feasible foundation types based on site soil and groundwater conditions, the net maximum allowable bearing capacity of these feasible foundation systems, and minimum foundation bearing depth of the proposed building foundations. Also, included are general pavement recommendations, infiltration testing and analysis, general construction considerations, and other pertinent geotechnical information.

Authorization to complete this scope of work was presented through a SEECO Consultants, Inc. proposal dated September 28, 2018 between the Public Building Commission of Chicago and SEECO Consultants, Inc. which was awarded to SEECO Consultants, Inc. on October 16, 2018. On October 16, 2018, SEECO Consultants, Inc. received the Task Order/ Notice of Award, Contract No.

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PS2062E, Task Order No. 07115-PS2062E-001 dated October 16, 2018 signed by James L. Borkman, Director of Procurement of the PBC on 10/16/18 and signed by Lori Lypson, Chief of Staff of the PBC on 10/16/18.

General Site Description and Preliminary Project Description

The Public Building Commission of Chicago (PBC) has elected to construct a new Fire Station for Engine Company 115 on one (1) of two (2) project sites (Project Site 'A' and Project Site 'B') both sites located adjacent to the intersection of South 119th Street and South Morgan Street in the City of Chicago. This geotechnical report is for Project Site 'B' and the general site description for Project Site 'B' is provided below along with the preliminary details of the proposed Fire Station.

Project Site 'B' is located at the northwest corner of West 119th Street and South Morgan Street in the City of Chicago, Illinois. Refer to **PBC Project Sites Plan** and **Boring Location Plan** both provided in the **Appendix** of this report. Project Site 'B' is a rectangular shaped property with West 118th Street as the north boundary, South Morgan Street as the east boundary, West 119th Street as the south boundary, and an industrial property along the western boundary. Based on Google Earth Maps, the Project Site 'B' is approximately ±4.5 acres in area. This project site appeared to be an existing asphalt parking lot that has been abandoned and deteriorating as for trees, bushes, shrubs, and other prairie flora is growing out of the existing asphalt pavement. The project site is relatively flat across the site. This site description is referenced from observations made by Mr. Matthew Boladz, P.E., Staff Engineer of SEECO Consultants, Inc., Project Geotechnical Engineer during the site visit on October 11, 2018.

The final location of the proposed Fire Station has not been determined yet at the time of this report (10/31/2018), but the following information is known to the authors of this report. The proposed Fire Station will have a proposed gross footprint area of approximately 23,000 square feet in area. The proposed Fire Station will be a one-story slab on grade building and will be constructed of a combination of steel framing and load bearing masonry walls. The estimated applied service (DL+LL) column loads will be approximately 150 kips and the estimates applied service (DL+LL) wall loads will be approximately 5 kips per linear foot. The concrete first floor slab will be designed for HS20 truck loading conditions which is approximately 250 psf service truck live loading. This information provided above is referenced from the email conversation between the principal author of this report and

Ms. Kathy Thalmann, Design Project Manager for the Public Building Commission of Chicago on 10/17/2018.

Site Subsurface Exploration Procedure

On October 11th and 12th, 2018, a total of five (5) soil borings (B-1 through B-5) were drilled and sampled by a two (2) man drill crew from SEECO Consultants, Inc. using a Diedrich (Model D-50) truck mounted drill rig on the project site 'B' located at the northeast corner of 119th Street and South Morgan Street in the City of Chicago, Illinois. The soil borings were drilled and sampled at the locations indicated on the **Boring Location Plan** given in the **Appendix** of this report. The soil borings were laid out in the field by the principal author of this report on October 11, 2018. These five (5) soil borings (B-1 to B-5) are preliminary subsurface exploration borings and were laid out in a grid like manner based on the locations chosen by the PBCC which was provided in the RFP dated September 24, 2018. Soil borings B-1, B-2, and B-4 to B-5 were drilled and sampled to 30 feet below the existing ground surface level at each boring location respectively and boring B-3 was drilled and sampled to a depth of 50 feet below the existing ground surface level. The borings ground surface elevation and locations were surveyed in the field by representatives of McBride Engineering a Woman Business Enterprise (WBE) and sub-consultant to SEECO Consultants, Inc. in which the ground surface elevations in City of Chicago Datum (CCD) of each boring and Northing and Easting Illinois State Plane coordinates are provided at the top of the **Boring Logs** given in the **Appendix** of this report.

The soil borings were drilled and sampled utilizing a truck mounted drill rig (Diedrich Model D-50) which advances the boreholes by the hollow stem auger method. The soil samples were obtained utilizing split spoon samples in accordance with ASTM D 1586-11. In the split barrel sampling procedure, a split spoon sampler having a two-inch outside diameter and inside diameter of 1-3/8 inches and a length of two feet is driven into the soil. This sampler is advanced by driving with a 140 pound weight falling freely from a height of 30 inches with Standard Penetration Resistance being recorded as a number of blows required to advance the sampling spoon a distance of 12 inches after an initial driving of six inches had been used to seat the sampler. The Standard Penetration Resistance, or the "N" Value, measures roughly the consistency of clayey soils and is in general related to the bearing capacity of the material. Other factors are usually taken into consideration in determining the bearing capacity value and those include the type of soil, the type of loading, the dimensions and the depths of footings below the ground surface and the proximity of the groundwater table to the base of the footings.

Representative portion of the split spoon samples were placed in glass containers with screw-type lids and taken to SEECO Consultants, Inc. geotechnical laboratory for further examination and testing.

Geotechnical Laboratory Testing Program

The geotech testing program consisted of performing in-situ natural moisture content and visual classification on all soil samples and calibrated penetrometer unconfined compression tests on representative cohesive soil samples. In the pocket penetrometer test, the unconfined compressive strength of a cohesive soil to a maximum value of 4.5 tsf is estimated by measuring the resistance of a soil sample to penetration of small spring calibrated cylinder.

In situ moisture content or natural water content is determined in the laboratory as follows (ASTM D 2216-10). A portion of each sample is weighed, oven-dried at 110° ±5°C, and reweighed to obtain the weight of water in the sample. The moisture content is the ratio of the weight of water in the soil sample to the weight of the dry soil expressed as a percentage of the total dry weight. After completion of the testing program, each soil sample was visually classified on the basis of texture and plasticity in accordance with the Unified Soil Classification System (ASTM D 2487-17 and D 2488-17). The estimated group symbol according to this system is included following the description of the soil on the boring logs.

Five (5) dry unit weight tests per ASTM D7263-09 (2018) and unconfined compressive strength tests per ASTM 2166-16 were performed on representative soils obtained from representative split spoon samples to determine the current in-situ dry unit weight, corresponding moisture and compressive strength of each representative cohesive sample. Liquid limit and plastic limit tests were performed in accordance with ASTM D4318-10 on seven (7) representative soil samples. Five (5) particle size analyses (including sieve analysis and hydrometer analysis tests) were performed in accordance with ASTM D 422-63(2007) on representative soil samples. The Atterberg Limits tests and sieve analysis and hydrometer analysis tests were performed by Rubino Engineering a Women Business Enterprise (WBE) and sub consultant for SEECO Consultants, Inc.

A brief explanation of the **Unified Soil Classification System** is included in the **Appendix** of this report. All laboratory test data is noted on the **Boring Logs** which are also included in the **Appendix** of this report.

Site Geology

The soils in this area are the product of the result of Wisconsinan Stage of the Continental Glacier. The Wisconsinan ice was the last to cover the North American Continent, receding from this area some 13,500 years ago. Present land forms in this area are the results of the Wisconsinan glaciation action during the Pleistocene Epoch. The soils were formed from the natural deposition erosion and weathering processes that have prevailed to the present time. The Pre-Wisconsin glacial deposits are found only in deep bedrock valleys and ravines where they were sheltered from the erosive action of the Wisconsinan Glaciation.

According to the Illinois State Geological Survey (ISGS) Surficial Geology of The Chicago Region (Willman, H.B. and Lineback, Jerry A., 1970), the native soils at this project site below the existing surficial existing asphalt pavement overlying urban fill soils have been assigned to the Lake Plain Formation. These soils were deposited during the Woodfordian, Twocreekan, and Valderan Substage of the Wisconsinan Glaciation stage. This soil is described as floors of glacial lakes flattened by wave erosion and by minor deposition in low areas, largely underlain by glacial till with thin deposits of silt, clay, and sand of the Equality Formation per the above referenced surficial geology map.

The soil borings performed at this project site generally encountered existing asphalt pavement overlying urban manmade fill materials consisting of sand, silt, clay, and gravel to the depth of approximately 4 feet below existing grade underlain by layers of loose virgin poorly graded sand to virgin silty clayey sandy soils which is underlain by very stiff to hard gray silty clay glacial till soils. The soil conditions encountered at this project site, in general, do not confirm the local site geology of this site based on the ISGS surficial geology map for this area due to the deep layer of surficial urban fill.

Site Soil Conditions

Soil borings B-1 to B-5 were drilled and sampled through approximately 2.5 inches to 5 inches of bituminous concrete pavement overlying approximately 5 inches to 9 inches of crushed stone base course to dark brown sand and gravel base course. Underlying the existing pavement section, boring B-1 encountered wet loose dark brown, brown, and black silty clayey sand to an approximate depth of 4 feet below the existing ground surface level which is overlying moist loose brown and gray virgin silty clayey sand to an approximate depth of 9.5 feet below the existing ground surface level. Underlying the virgin poorly graded sand, boring B-1 encountered hard to very stiff gray virgin silty clay to the termination depth of 30 feet below the existing ground surface level.

Underlying the above mentioned existing pavement section, boring B-2 encountered approximately 2.17 feet of moist loose dark brown and brown silty sand fill overlying approximately 3 feet of moist loose brown poorly graded fine sand overlying moist loose brown poorly graded fine sand to an approximate depth of 8.5 feet below the existing ground surface level. Underlying the brown and gray poorly graded sand, boring B-2 encountered approximately 1 foot of moist medium dense brown poorly graded fine sand overlying stiff to very stiff gray silty clay to an approximate depth of 23 feet below the existing ground surface level, which is overlying hard to very stiff gray silty clay to the termination depth of 30 feet below the existing ground surface level.

Underlying the above mentioned existing pavement section, boring B-3 encountered moist loose dark brown, brown, gray, and trace black clayey sand fill to an approximate depth of 4 feet below the existing ground surface level, which is overlying moist loose brown virgin poorly graded fine sand to an approximate depth of 9.5 feet below the existing ground surface level. Underlying the virgin poorly graded sand, boring B-3 encountered moist very stiff to hard gray virgin silty clay to the termination depth of 50 feet below the existing ground surface level.

Underlying the above mentioned existing pavement section, boring B-4 encountered moist loose black, brown, and gray silty sand fill to an approximate depth of 4 feet below the existing ground surface level which is overlying approximately 2.5 feet of saturated loose brown and gray virgin poorly graded fine sand. Underlying the poorly graded fine sand, boring B-4 encountered saturated loose brown and gray sandy silt to an approximate depth of 10 feet below the existing ground surface level. Underlying the virgin poorly graded sand, boring B-4 encountered moist very stiff gray virgin silty clay to the termination depth of 30 feet below the existing ground surface level.

Underlying the above mentioned existing pavement section, boring B-5 encountered approximately 8 inches of moist medium dense dark brown and black sand fill overlying moist very stiff brown and gray virgin silty clay to an approximate depth of 3.5 feet below the existing ground surface level. Underlying the virgin silty clay, boring B-5 encountered approximately 2.5 feet of moist loose brown poorly graded fine sand overlying moist to wet loose brown and gray clayey silty sand to an approximate depth of 9.5 feet below the existing ground surface level. Underlying the clayey silty sand, boring B-5 encountered moist very stiff gray silty clay to the termination depth of 30 feet below the existing ground surface level.

It is recommended that **Boring Logs** given in the **APPENDIX** of this report should be studied for the soil conditions present at each boring location respectively.

Site Groundwater Conditions

Groundwater elevations encountered for each individual boring location while drilling, while sampling and after the removal of the hollow stem augers from the boreholes at the time these borings were performed is given below in the following **Table No. 1.**

Table No. 1 – Approximate Groundwater Depths

Boring No.	Approximate Groundwater Level Depths at the time of Drilling & Sampling			
	While Sampling (Feet)	While Drilling (Feet)	After Hollow Stem Auger Removal –(Feet)	Date of Reading
B-1	17'	WS	9.5'	10/11/2018
B-2	18'	-	10'	10/12/2018
B-3	-	13'	8.5'	10/11/2018
B-4	17'	-	10'	10/11/2018
B-5	13'	-	8.5'	10/12/2018

The five (5) borings generally encountered groundwater at approximately 13 feet to 18 feet below the ground surface level, which rose generally to approximately 8.5 feet to 10 feet below the existing ground surface level after removal of the hollow stem augers from the boreholes respectively. The yearly seasonal highs can be predicted by the gray color meaning the soil has not been exposed to water long enough to have been oxidized and turn brown to brownish gray.

The groundwater levels and times of recording are indicated above on the **Boring Logs** found in the **Appendix** of this report. However, yearly and seasonal fluctuations can be anticipated in the water table due to changes in the groundwater hydrogeological regime.

Field Slug-In Tests

On October 23, 2018, one (1) engineer from SEECO Consultants, Inc. and one (1) engineer from Kalgen Consultants, Inc., SEECO Consultants, Inc. Minority Business Enterprises (MBE) sub consultant carried out (2) slug-in tests I-1 and I-2 near the approximate soil borings B-1 and B-2 locations and borings B-4 and B-5 locations respectively on Project Site 'B' for the proposed Engine Company 115 Fire Station project located at the northwest corner of South 119th Street and South Morgan Street in the City of Chicago, Illinois. Refer to the **Boring Location Plan** given in the **Appendix** of this report for approximate slug-in test locations. The two (2) slug-in tests I-1 and I-2 were performed at an approximate depth of 4.0 feet below the existing ground surface level. The purpose of these tests is to compute the infiltration rate for the use of Best Management Practices (BMP) of the Urban Stormwater Best Management Practices of the City of Chicago Stormwater Management Manual for stormwater detention design in the proposed permeable pavement.

A four (4) feet deep borehole was blank drilled and a 4" inside diameter PVC pipe was inserted in the slug-in test locations I-1 to I-2 respectively. Water was added to the borehole and allowed to equilibrate for 15 minutes. An In-Situ Level Troll 700® used for sampling time and the water level was inserted in the borehole to approximately 0.5 feet above the bottom of the borehole. The Level Troll was connected to the laptop running Win-Situ software which allows real-time viewing and graphing of the slug-in test data. A slug of water was added to the borehole and the time and water level drop readings were recorded for a minimum of 30 minutes.

The collected slug-in test data was downloaded to a computer and analyzed in a Microsoft Excel spreadsheet program. Drop in the water level with time was observed during the test. The data from the test was reduced and analyzed as the infiltration rate of the subgrade soil. Based on the head drop for the given time interval, the infiltration rate at slug-in test locations I-1 and I-2 were found to be 0.87 in. / hr. and 0.95 in. /hr. respectively.

The long-term infiltration rates at all the test boreholes are greater than 0.5 inches/hr. which is the minimum infiltration required rate to consider infiltration of the stormwater into the subgrade as per City of Chicago Stormwater Management Ordinance Manual, 2016 edition. Therefore, it is concluded that the subgrade soils at these locations are permeable soils and these soils can be utilized to store excess stormwater runoff in the subsoil interstitial voids of these permeable soils. The result of the slug-in tests are attached in the **Appendix** of this report.

Table 2: Slug-In Test Results

Location	Slug-In Test No.	Approximate Bottom of Borehole Depth from Existing Ground Surface Level (feet)	Long Term Infiltration Rate Based on Slug-In Test (Inch./hour)	Recommended Average Long Term Infiltration Rate for This Project Site (Inch./hour)	Encountered Soil Type at Bottom of Borehole Based on Adjacent Soil Boring
Project Site 'B' Near Borings B-1 & B-2	I-1	4.0	0.87	0.91	Moist Loose Brown and Gray Poorly Graded Sand (SP), Little Silt
Project Site 'B' Near Borings B-4 & B-5	I-2	4.0	0.95		Moist to Saturated Loose Brown and Gray Poorly Graded Sand (SP), Little Silt

Slug-In Test Results Interpretation for Design

Based on the slug-in test performed at the two (2) representative locations and based on the geotech laboratory combined analysis test result, the soils in slug-in test location I-1 and I-2 has mostly poorly graded fine sand with little silt to silty clayey sand soils to depths of 9.5 feet to 10 feet below the existing ground surface level which are generally permeable soils. Therefore, based on the slug-in tests (I-1 and I-2), the recommended design infiltration rate should be 0.91 inches per hour for any future green infrastructure or permeable pavement that is proposed to be constructed on this project site. It is recommended permeable pavement should only be utilized in parking lot areas not exposed to the heavy firetruck loading conditions (HS-20 truck loading).

Although the design infiltration rate does not require the use of an underdrain system (above 0.5

inches per hour), it is recommended any potential permeable pavement design should also include design of an underdrain system at this project location due to the variable fines content within the sandy soils. Also, per the City of Chicago Stormwater Management Ordinance Manual, 2016 edition the seasonal high groundwater table shall be a maximum 3.5 feet below any underdrain system. Minimum of 4-inch diameter PVC perforated underdrain pipes should be installed in the reservoir stone to drain the excess detention runoff to the storm sewer system and should be placed above the bottom filter fabric. The invert elevation of the perforated pipes should be at approximately 2 inch higher than the subgrade elevation and the perforated pipes should be wrapped with porous geotextile filter fabric and must be sloped toward the storm sewer. The spacing, number, and size of the PVC underdrain pipes should be designed based on the volume of the runoff to be drained.

Geotechnical Laboratory Test Results

Atterberg Limit Tests

Seven (7) Atterberg Limit Tests were performed according to ASTM D4318-10 on the stiff to hard gray silty clay (CL) to aid in the USCS soil classification. The results of the seven (7) Atterberg Limit Tests yields the values of plasticity indices (PI) and liquidity indices (LI) in which provide correlations for preconsolidation pressure of the in-situ soils and provide an indication of the degree of consolidation. Atterberg Limit test results were used to both to classify soils as well as an indication of the overconsolidation ratio for these soils layers in the zone of influence for the proposed building footings.

The seven (7) Atterberg Limit tests performed on the chosen soil samples are summarized in **Table No. 3** as shown below.

Table No. 3- Atterberg Limit Test Summary

Boring	Sample/Depth (ft)	Soil Description	Natural Moisture Content (w%)	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Liquidity Index (LI)
B-1	S-4 / 11'	Hard Gray Silty Clay (CL)	16.4	34	19	15	-0.17
B-2	S-5 / 11.75'	Very Stiff Gray Silty Clay (CL)	16.4	33	19	14	-0.18
B-2	S-9 / 29'	Very Stiff Gray Silty Clay (CL)	19.9	39	20	19	0.0
B-3	S-5 / 19'	Very Stiff Gray Silty Clay (CL)	19.7	39	19	20	+0.04
B-3	S-10 / 39'	Hard Gray Silty Clay (CL)	14.9	29	16	13	-0.08
B-4	S-5 / 14'	Very Stiff Gray Silty Clay (CL)	18.8	39	20	19	-0.06
B-5	S-8 / 24'	Very Stiff Gray Silty Clay (CL)	18.5	36	19	17	-0.03

The Atterberg Limit test results for these virgin silty clay indicate the liquid limit of these tested soil samples varies between approximately 29% to 39% and are less than 50% with corresponding plasticity indices (PI's) being 13% to 20%. These seven (7) representative silty clay soil samples with Atterberg Limit results plot on the plasticity chart as being "CL" type soils per the Unified Classification System. The LIs of these clay soils range from -0.18 to +0.04 values and indicate a moderate to heavily overconsolidated silty clay glacial till soils.

The Atterberg Limits results are shown on the **ATTERBERG LIMITS TEST RESULTS** given in the **Appendix** of this report. The Atterberg Limit tests are also shown on the **Boring Logs** located in the **Appendix** of this report.

Unit Weight Tests and Unconfined Compressive Strength (Qu) Tests

Five (5) wet and dry unit weights and five (5) unconfined compressive strength tests (Qu) were taken on representative clay soil samples (one sample per boring) within potential bearing soil strata to aid in determining engineering soil properties necessary for foundation design.

For the virgin very stiff to hard gray silty clay, five (5) unit weight tests were performed and the average dry unit weight for the samples tested is 112.6 pcf and the average wet unit weight for the samples tested is 132.8 pcf with an average moisture content of 17.9% and an average unconfined test strength (out of five tests) of 3.6 TSF.

The unit weight tests and unconfined compressive strength tests are provided below in **Table No.4: Unit Weight and Unconfined Compressive Strength (Qu) Summary** and are typical for clay till soils in this area. The dry unit weights and unconfined compressive strength tests are also shown on the **Boring Logs** located in the **Appendix** of this report.

Table No.4: Unit Weight and Unconfined Compressive Strength (Qu) summary

Unit Weight & Unconfined Compressive Strength (Qu) Summary						
SOIL DESCRIPTION: Gray Silty Clay						
Boring	Sample No.	Depth (ft)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Water Content (%)	Qu (TSF)
B-1	S-4	11.0	133.6	114.8	16.4	5.5
B-2	S-5	11.75	133.6	114.8	16.4	3.0
B-3	S-6	19	130.2	108.8	19.7	2.8
B-4	S-5	14	131.4	110.7	18.7	3.9
B-5	S-8	24	135.2	114.1	18.5	2.6
		Averages	**132.8**	**112.6**	**17.9**	**3.6**

Grain Size Analysis Tests

A total of five (5) combined Sieve and Hydrometer analyses tests in accordance with ASTM D 422-63(2007)) were performed on representative soil samples in borings (B-1 to B-5) consisting of granular soils and non-cohesive clay soils for classification purposes.

The three (3) combined analysis test results performed on the representative granular soils are summarized as follows: Percentage of clay ranged from 19% to 19.7% Percentage of silt ranged from 12.4% to 44.2%. Percentage of sand ranged from 36.1% to 67.1%. Percentage of gravel ranged from 0.0% to 1.5%. The four (4) gradation tests indicate the USCS classifications is generally silty clayey sand (SC-SM) material.

Two (2) combined analysis test results performed on the silty clay soils are summarized as follows: Percentage of clay ranged from 50.3% to 55.0% Percentage of silt ranged from 30.6% to 32.9%. Percentage of sand ranged from 14.4% to 16.1%. Percentage of gravel ranged from 0.0% to 0.7%. The two (2) gradation tests indicate the USCS classification as silty clay (CL).

The combined sieve and hydrometer analysis results are shown on the **GRAIN SIZE ANALYSIS RESULTS** given in the **Appendix** of this report. The location of the combined sieve and hydrometer analysis tests are also shown as "CA" on the **Boring Logs** located in the **Appendix** of this report.

Demolition and Site Preparation

While onsite (10/11/2018), it was observed by the principal author of this report that this project site 'B' is an existing deteriorating asphalt parking lot which may have stormwater manhole sewers (none observed during boring layout) located on this project site. Therefore it is recommended to remove all existing storm sewer manholes (if present onsite) within the proposed building footprint area. It is also recommended to plug and abandon any existing storm sewer manholes within the proposed parking lot areas. Any demolition excavation should be backfilled with approved engineered granular fill material placed in maximum 8-inch loose lifts with each lift compacted to a minimum of 95% (proposed building area) and 90% (proposed pavement areas) of the maximum dry density in accordance with the Modified Proctor Test ASTM D 1557-12. This engineered fill material can be CA-6, Type B stone as per the State of Illinois "Standard Specifications for Road and Bridge Construction", 2016 Edition.

After demolition of the existing asphalt parking lot and any existing storm sewer manholes, it is recommended to perform the ground improvement schemes provided under the next section **Preliminary Foundation Engineering Recommendations** below.

After the site ground improvement scheme has been performed, the proposed building footprint and parking lot areas should be proofrolled by using a rubber tire truck or tractor-trailer combination loaded with 20 tons of payload to verify that the surficial soils have been densified for the construction of the building slab on grade and proposed pavement areas respectively. Also, for the 'Remove, Replace and Recompact' insitu sandy soils ground improvement scheme it is recommended to proofroll the bottom of the building excavation by using a rubber tire truck or tractor-trailer combination loaded with 20 tons of payload before the backfill process begins and the following is recommended. Upon proofrolling, if any of the floor slab or pavement areas are found to be pumping or excessive rutting is observed, then all the soft or unsuitable material should be removed and replaced with compacted selected granular fill to the proposed pavement subgrade elevation or bottom of granular drainage fill (subslab elevation) in the building floor slab areas.

During the site soil densification ground improvement scheme, the existing ground surface level will be lowered due to densifying the granular soils therefore is it recommended to raise the project site with a select granular fill to the bottom of the proposed building drainage fill and proposed bottom of pavement base course elevation.

The selected granular fill material should be placed in loose eight inch lifts and compacted to a minimum 95% (in the building area) or a minimum 90% (in the parking lot areas) of the maximum density in accordance with ASTM D 1557-12. A typical select granular fill material consists of crushed stone fill consists of CA-6, Type B-stone as per the State of Illinois Standard Specifications for Road and Bridge Construction, 2016 Edition.

After the site ground improvement and proofroll is performed, select granular fill material (crushed stone IDOT CA-6 gradation) should be used to raise the site elevation to match the subgrade elevation in the floor slab or pavement areas. A field engineer from SEECO Consultants, Inc. should be present during the placing of the engineered fill and for compaction testing of backfill material. This engineered fill material should be placed in lifts not to exceed eight inches in loose thickness with each lift compacted to the density requirements as given in the following **Table No. 5: Summary of Density Requirements**

Table No. 5: Summary of Density Requirements

Area	Density Requirements
Building	95% Maximum Density*
Parking lots	90% Maximum Density*
Open Areas (Grass Areas)	85% Maximum Density*

*In accordance with ASTM Number D 1557-12.

Preliminary Foundation Engineering Recommendations

This section will cover preliminary foundation recommendations for the construction of a one-story slab-on-grade Fire Station Building proposed to be constructed on either Project Site 'A' or Project Site 'B' located adjacent to the intersection of 119th Street and Morgan Street in the City of Chicago, Illinois. The foundation recommendations provided in this section of this geotechnical report are for the preliminary Project Site 'B' which soil borings B-1 to B-5 were drilled and sampled by SEECO Consultants, Inc. Based on the loose sandy soils encountered within the upper 10 feet of the soil profile in borings B-1 to B-5, this project site is feasible to construct the new one story slab on grade Fire Station Building with a conventional shallow foundation system consisting of exterior continuous wall footings and interior isolated spread footings, however ground improvement techniques will be required. Deep foundation systems such as caissons or driven piling can be utilized to support the proposed building but these foundation systems would have construction costs far greater than the ground improvement techniques with conventional shallow foundation system recommended below. The estimated applied service (DL+LL) column loads will be approximately 150 kips and the estimates applied service (DL+LL) wall loads will be approximately 5 kips per linear foot. The concrete first floor slab will be designed for HS20 firetruck loading conditions which is approximately 250 psf service firetruck live loading.

Based on the loose poorly graded sand with little silt to clayey silty sand encountered in all five (5) soil borings (B-1 to B-5) to approximate depths of 9.5 feet to 10 feet below the existing grade level, it is recommended to use these ground improvement techniques which are 1) Vibro-Compaction (vibroflotation) or 2) Remove, Replace and Recompact the insitu sandy soil to densify the insitu upper sandy soils. Details for each ground improvement technique are provided below. It is recommended to utilize one of these ground improvement techniques within the foundation and floor slab areas respectively based on the above mentioned loading conditions.

1) <u>Vibro-Compaction (Vibroflotation) Ground Improvement Method for Insitu Soil:</u> This ground improvement technique is an insitu treatment by densifying the loose silty sand fill to poorly graded virgin sand to virgin silty clayey sand to approximate depths of 9.5 feet to 10 feet below the existing grade level within the proposed building footprint area and proposed parking lot area by a vibration technique. The insitu sandy soils are densified by a high frequency vibrator probe attached to a small crane and also water injection into the soil to cause mobili-

zation of the sand particles into a denser configuration. However, the effectiveness of this ground improvement technique is affected by the fines (silts and clays) content in the insitu soils, which higher the fines content of the sandy soil the densification effectiveness is lowered. It is recommended that a minimum of 65% relative density is achieved in the field after this ground improvement technique is implemented. It can estimated the grade will be lowered approximately 10% of the total treatment depth and therefore granular structural fill will have to be trucked onsite for regrading purposes. To verify the relative density and bearing capacity of the improved subgrade soil it is recommended to establish a Quality Control program through Split Spoon Sampler Testing (SPT) within the proposed ground improvement areas after using the Vibroflotation Method. Please contact Mr. Raymond Franz, P.E., Division Manager for Hayward Baker, Inc. Chicago office located at 1350 West Lake Street, Roselle, Illinois at the following phone number 630-339-4300 for further Vibro-Compaction information and construction cost estimates.

2) Remove, Replace and Recompact Insitu Soil: For this ground improvement scheme it is recommended to excavate and remove all the insitu loose silty sand fill to poorly graded virgin sand to virgin silty clayey sand to approximate depths of 9.5 feet to 10 feet below the existing grade level within the proposed Fire Station building footprint area plus a 10 foot offset from the perimeter of the proposed building footprint area and stockpile this material onsite. For the proposed parking lot area it is recommended to only excavate and re-compact approximately 2 feet to 3 feet below the existing ground surface level. Then, the excavated sandy soil should be utilized to backfill the building excavation area as a controlled engineered structural fill placed in maximum 8 inch loose lifts with each lift compacted to a minimum of 95% (within building pad area) or to 90% (within parking lot area) of the maximum dry density obtained in accordance with the Modified Proctor Test (ASTM D 1557-12). This procedure densifies the sandy soils on this project site to provide a suitable controlled bearing for the proposed Fire Station building foundations and first floor slab. A well-documented Quality Control (QC) program should be implemented with this ground improvement scheme to verify the compaction of each lift of placed soil to ensure the re-compacted soil is stabilized and suitable for bearing of the proposed Fire Station Building. Since all five (5) soil borings (B-1 to B-5) drilled and sampled on this project site generally encountered the same soil profile, therefore this scheme will have to be implemented regardless the location of the pro-

posed building on this project site. The building foundations may be designed for a maximum net allowable bearing capacity of 3,000 psf after replacement and compaction of the surficial sandy soils.

Based on the sandy soil profile encountered in soil borings B-1 to B-5 drilled and sampled on this project site and also based on the dry sieve and hydrometer tests analysis of representative soil samples from borings B-1 to B-5, it is concluded that this project site should utilize the Vibro-Compaction ground improvement method scheme for this project site as for improvement costs may be cheaper than the Remove, Replace, and Recompact ground improvement scheme. This recompaction of the existing surficial soils ground improvement method may incur higher construction costs than the Vibro-Compaction ground improvement method therefore it is recommend to consider constructing the proposed Fire Station Building on this Project Site 'B'. It is recommended to perform a cost feasibility study of both ground improvement schemes recommended. Also, both ground improvement schemes will require re-grading as for during the densification process the grade will decrease and granular structural fill will be required to build the site back to proposed grade level. The granular structural fill within the proposed building area should consist of CA-6, Type B-stone as per the State of Illinois Standard Specifications for Road and Bridge Construction, 2016 Edition placed in loose eight inch lifts and each lift compacted to a minimum 95% of the maximum density in accordance with ASTM D 1557-12.

It is recommended to support the Fire Station building on conventional shallow footings consisting of continuous exterior wall footings and interior isolated spread footings after the ground improvement techniques have been implemented. Based on the improved subsurface soil conditions within the proposed building footprint area, it is concluded that the proposed Fire Station building can be supported on conventional shallow footing foundation system consisting of continuous exterior wall strip footings and interior isolated spread footings. The foundation for the proposed fire station building can be supported at approximately 4 feet below the existing ground surface level bearing on the improved insitu sandy soils and can be designed for a maximum net allowable bearing capacity of 3,000 psf for either the Remove, Replace and Recompact Scheme or the Vibroflotation Scheme. The maximum net allowable bearing pressure is the pressure in excess of the final effective vertical stress at the level of the footing base elevation. The exterior footings should be provided a minimum of 3.5 feet of frost protection from external finish grade. It is also recommended that the minimum width of the proposed building wall footings should be 18 inches whereas the minimum size of isolated spread footings should be 36"x36" for lateral stability.

Building Floor Slab Design

A reinforced concrete floor slab is recommended for the proposed Fire Station building to support the firetruck wheel loading conditions (approximately 250 psf service live load). Based on soil borings B-1 to B-5 drilled and sampled on this project site, the subgrade soils generally require a ground improvement method as recommend in the previous section **Preliminary Foundation Engineering Recommendations.** Therefore, after the proposed building footprint area has undergone a ground improvement treatment the improved insitu soil would be sufficient to support a slab-on-grade floor slab with minimal reinforcement and should generally pass a proofroll test, however with the heavy wheel loading from the firetrucks (HS-20 loading) it is recommended to utilized reinforced concrete floor slab designed for the firetruck (HS-20 loading) conditions. The floor slab should be constructed after placing a minimum six (6) inches of compacted crushed stone drainage fill. The crushed stone fill should be compacted to a minimum of 95% of the maximum dry density obtained in accordance with the Modified Proctor Test (ASTM D 1557-12). A typical crushed stone fill consists of CA-6, Type B-stone as per the State of Illinois Standard Specifications for Road and Bridge Construction, 2016 Edition.

The proposed concrete floor slab for the proposed Fire Station building should be designed for an average vertical subgrade modulus of 150 pci based on either the PCA methodology or the ACI-360R-06 publication "Design of Slabs-on-Ground" current edition by a Registered Structural Engineer in the State of Illinois. In order to minimize dampness in the concrete floor slab, a sheet of 6 mil thick visqueen positioned on the top of the granular drainage fill should be placed before the concrete floor slab on grade is poured.

Seismic Site Classification

The Chicago Building Code does not include seismic lateral load design therefore it is recommended to utilize the International Building Code (IBC), 2009 Edition. The Seismic Site Classification according to IBC 2009 for the proposed Fire Station building in City of Chicago, Illinois is provided in this section. The soil is classified per section 1613.5.2 "Site Class Definitions" per the 2009 edition of the *International Building Code* for the average properties on the top 100 feet of subsurface materials. The soil borings (B-1 to B-5) were drilled and sampled to a termination depth of 30 feet to 50 feet below existing ground level which encountered loose sandy soil overlying very stiff to hard silty clay till soils for the 30 feet to 50 foot depth. Bedrock in this project area was not encountered at the termination depth of 30 feet to 50 feet below the existing grade and bedrock is generally 90 to 100 feet below the existing grade level from previous experience in this area. The blow counts range greater than 15 blows per foot but less than 50 blows per foot which indicate on average the soil conditions by Seismic Site Class definition of this site is "Site Class D" (Stiff Soil) per the 2009 *International Building Code.* The proposed Fire Station Building should be seismically designed based on the 2009 IBC.

Parking Lot Design Criteria

The design of the pavement should be based on Chapter 54 'Pavement Design' of IDOT Bureau of Design and Environmental Manual, current edition after the site is prepared as per the **Site Preparation** section of this report. The new bituminous concrete pavement design should be made utilizing an IBR value of four (4) for the improved silty sand subgrade soils for flexible pavement design and the concrete pavement design shall be performed utilizing a vertical subgrade modulus of 150 pci when the pavement is supported on the improved silty sand subgrade soils. The pavement design method used should be based on Chapter 54 'Pavement Design' of IDOT Bureau of Design and Environmental Manual, current edition in the structural design of the flexible and rigid pavement sections. Heavy duty pavement should be constructed where the firetruck loading conditions are applied and also at the entrance driveway to the site.

Once the final site location has been chosen and the land plan has been completed, permeable or porous pavement can be utilized in parking lot areas not subject to firetruck traffic (HS-20 loading) conditions.

The crushed stone base course should consist of CA-6, Type B-stone as per the State of Illinois Standard Specifications for Road and Bridge Construction, 2016 Edition placed in 8 inch loose lifts with each lift compacted to a minimum of 90% of the maximum dry density obtained in accordance with the Modified Proctor Test (ASTM D 1557-12).

For the flexible pavement, the HMA surface course and HMA binder course should consist of hot mix asphalt mixtures as defined in Section 1030. Hot Mix Asphalt of the State of Illinois "Standard Specifications for Road and Bridge Construction," April 1, 2016, Edition. The HMA surface course and HMA binder course should be compacted to a minimum 93% and maximum 97% theoretical density as determined by AASHTO T 209-11. This is the IDOT Big "D" value which is used with the nuclear density testing of the asphalt in order to determine the percentage of in-place compaction achieved in the field. The field density of the bituminous concrete surface and binder courses should be tested with a nuclear density gauge by a SEECO Consultants, Inc. Field Engineer.

Excavation Procedure

Excavations that extend greater than five feet in depth should be designed in accordance with U.S. Department of Labor, Occupational Safety and Health Administration 1989 (OSHA) "Occupational Safety and Health Standards - Excavations; Final Rule" 29 CFR, Part 1926, Subpart P. Excavations with properly sloped or braced excavation earth retention systems to prevent excavation instability and provide safety.

The soils encountered on this project site generally consist of medium dense to loose silty sandy to silty clay soils to depths of 9.5 feet to 10 feet below existing ground surface which are Type B soils overlying very stiff to hard silty clay soils which are Type A soils. Any excavations for the proposed ground improvement scheme or building footings between 1 to 10 feet depth should be generally made with maximum allowable side slopes of 1H: 1V in these non-cohesive granular soils.

The general contractor and excavation subcontractor are responsible for the means and methods of safe construction excavation and construction sequencing or scheduling per the current OSHA regulations referenced above. Stockpiles of materials or construction equipment should not be placed near the edge of excavation slopes per OSHA.

Potential Construction Problems

When considering the depth to the true groundwater table in relation to the proposed average excavation depth of the proposed Fire Station building ground improvement Remove, Replace and Recompact scheme and also foundations excavations, it is thought that groundwater problems will be minimal when excavating for the proposed Fire Station building, however due to the sandy soils encountered within the upper 9.5 feet to 10 feet surface water runoff infiltration will have to be mitigated after storm rainfall events. It is recommended that any water, if encountered, should be completely removed from the bottom of foundation excavation before placement of concrete for the proposed spread footing by sump and pump technique. Means and method for any possible dewatering are the responsibility of the contractor.

Construction Consultation Engineering

A representative of the Geotechnical Engineer should be present at the site during the earthwork operations to ensure compliance with the specifications. Due to potential variations in site conditions, soil type and depth to net allowable bearing capacity for the foundation for the proposed building should be confirmed in the field by a Field Geotechnical Engineer from SEECO Consultants, Inc. during construction at this project site. A Field Geotechnical Engineer from SEECO Consultants, Inc. should be present to inspect the depth and check the compaction of each lift of soil for the "Remove, Replace and Recompact Scheme" at this project site to ensure soils of the required net allowable bearing capacity are encountered. If the Vibro-compaction scheme is utilized then it is recommended to verify the ground improvement scheme through additional soil borings with SPT testing after the Vibro-compaction is completed.

All proofroll inspections should be performed by a Field Geotechnical Engineer from SEECO Consultants, Inc. at this site. At this proposed site, field density tests to determine the degree of compaction for the engineered fill for the proposed building pad and pavement areas as well as for the demolition backfill, building backfill, drainage fill and pavement base course and bituminous concrete pavement should be performed by a Field Engineering Technician or Field Geotechnical Engineer from SEECO Consultants, Inc.

Conclusion

Project Site 'B' is generally feasible to construct the proposed Fire Station on utilizing of the ground improvement schemes provided in this report, however since this project is preliminary it is recommended to perform additional soil borings within the proposed footprint area of the Fire Station Building, parking lots for both heavy duty and light duty pavement, and also in the location of any stormwater green infrastructure once the final approved site plan is available.

Closing Remarks

We trust this information is satisfactory for your present requirements. We have welcomed the opportunity to be of service to you on this project. If you have any questions with regards to this report, please contact us at your convenience.

Respectfully submitted,

SEECO Consultants, Inc.

Matthew Boladz, P.E.
Geotechnical Staff Engineer

Collin W. Gray, S.E., P.E.
President

MB:arm

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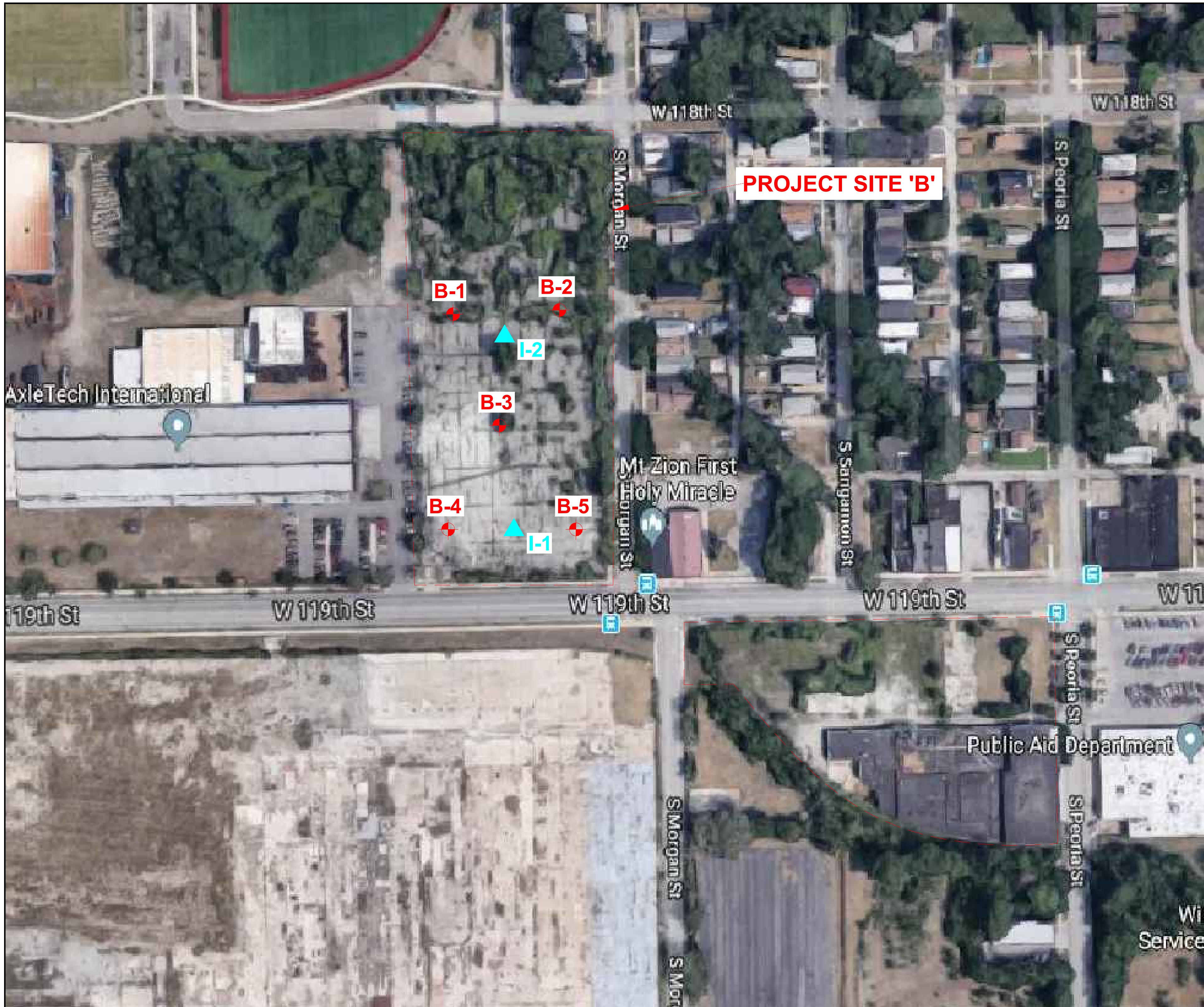
APPENDIX

1. BORING LOCATION PLAN
2. PBC PROJECT SITE PLAN
3. GENERAL NOTES
4. BORING LOGS
5. UNIFIED SOIL CLASSIFICATION SYSTEM
6. ATTERBERG LIMITS TEST RESULTS
7. GRAIN SIZE ANALYSIS RESULTS
8. SLUG-IN TEST RESULTS
9. GENERAL REMARKS

APPENDIX 1



LEGEND

B-1 = APPROXIMATE BORING LOCATION

I-1 = APPROXIMATE INFILTRATION TEST LOCATION

Project Site

VICINITY MAP
SCALE: NONE

NO.	DATE	REVISIONS	BY:		
				DRAWN BY	SD
				DESIGNED	SD
				APPROVED	CWG

SEECO Consultants, Inc.
7350 Duvan Drive, Tinley Park, Illinois 60477
OFFICE: (708) 429-1666 FAX: (708) 429-1689

CLIENT: Public Building Commission of Chicago

PROJECT NAME & LOCATION: Proposed Fire Station for Engine Company 115, W 119th St., Chicago, IL

BORING LOCATION PLAN
PROJECT SITE B

DATE: 10/23/2018
SCALE: NONE
JOB NO.: 12060G

SHEET 1 OF 1

APPENDIX 2

Zoning and Land Use Map
Department of Planning and Development

NRHP - Property
NRHP - District
NHL - Property
NHL - District

APPENDIX 3

SEECO Consultants Inc.
7350 DUVAN DRIVE
TINLEY PARK, ILLINOIS 60477

GENERAL NOTES

DRILLING AND SAMPLING SYMBOLS

SS	SPLIT SPOON	1-3/8" I.D. x 2" O.D. (EXCEPT WHERE NOTED)
2T	THINWALL TUBE SAMPLER	2" O.D. x 1-7/8" I.D.
3T	THINWALL TUBE SAMPLER	3" O.D. x 2-7/8" I.D.
3P	PISTON SAMPLER	3" O.D. THINWALL TUBE
FA	CONTINUOUS FLIGHT AUGER	4" O.D.
HS	HOLLOW STEM AUGER	6-3/4" O.D. x 3-1/4" I.D.
HA	HAND AUGER	
RB	ROLLER ROCK BIT	
FT	FISHTAIL BIT	
DB	DIAMOND BIT	
AX	ROCK CORE	1-3/16" DIAMETER
BX	ROCK CORE	1-5/8" DIAMETER
NX	ROCK CORE	2-1/8" DIAMETER
AS	AUGER SAMPLE	
WS	WASH SAMPLE	
CA	COMBINED ANALYSIS	
SA	SIEVE ANALYSIS	

Standard "N" Penetration: Blows per foot of a 140 pound hammer falling 30 inches on a two inch O.D. split spoon, except where noted.

WATER LEVEL MEASUREMENT SYMBOLS

▼	WATER LEVEL OBSERVATION	WD	WHILE DRILLING
WCI	WET CAVE-IN	BCR	BEFORE CASING REMOVAL
DCI	DRY CAVE-IN	ACR	AFTER CASING REMOVAL
WS	WHILE SAMPLING	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 groundwater levels. In impervious soils, the accurate determination of groundwater elevations are not possible in even several days observation, and additional evidence on groundwater elevations must be sought.

SOIL IDENTIFICATION TERMINOLOGY

COHESIONLESS SOILS

COMPONENT	SIZE RANGE	DESCRIPTIVE TERM	PERCENT OF WEIGHT
BOULDERS	OVER 8"	TRACE	0 – 10
COBBLES	8" TO 3"	LITTLE	10 – 20
GRAVEL	3" TO #4 SIEVE (4.75 mm)	SOME	20 – 35
SAND	#4 TO #200 SIEVE (0.074 mm)	AND	35 – 50
SILT	PASSING #200 SIEVE (0.074 mm)		

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GENERAL NOTES

SOIL IDENTIFICATION TERMINOLOGY (Cont'd)

COHESIVE SOILS

DESCRIPTIVE TERM	PLASTICITY INDEX
CLAYEY SILT OR ORGANIC CLAYEY SILT	4 – 7
SILTY CLAY OR ORGANIC SILTY CLAY	8 – 30
CLAY OR ORGANIC CLAY	> 30

INTERMEDIATE SOILS

DESCRIPTIVE TERM	PLASTICITY INDEX
SILT	0 – 3

Unconfined compression tests are generally not applicable for intermediate soils.

CONSISTENCY OF COHESIVE SOILS

UNCONFINED COMP. STRENGTH, Qu, TSF	CONSISTENCY
<0.25	VERY SOFT
0.25 - 0.49	SOFT
0.50 - 1.00	MEDIUM
1.01 - 1.99	STIFF
2.00 - 3.99	VERY STIFF
4.00 - 8.00	HARD
>8.00	VERY HARD

RELATIVE DENSITY OF GRANULAR SOILS

1-3/8" I.D. x 2" O.D. with 140 pound hammer falling 30"

N – BLOWS/FT.	RELATIVE DENSITY
0 – 3	VERY LOOSE
4 – 9	LOOSE
10 – 29	MEDIUM DENSE
30 – 49	DENSE
50 – 80	VERY DENSE
>80	EXTREMELY DENSE

CONSISTENCY OF COHESIVE SOILS

N – BLOWS/FT.	RELATIVE DENSITY
0 – 2	VERY SOFT
2 – 4	SOFT
4 – 8	MEDIUM
8 – 15	STIFF
15 – 30	VERY STIFF
>30	HARD

APPENDIX 4

BORING LOG

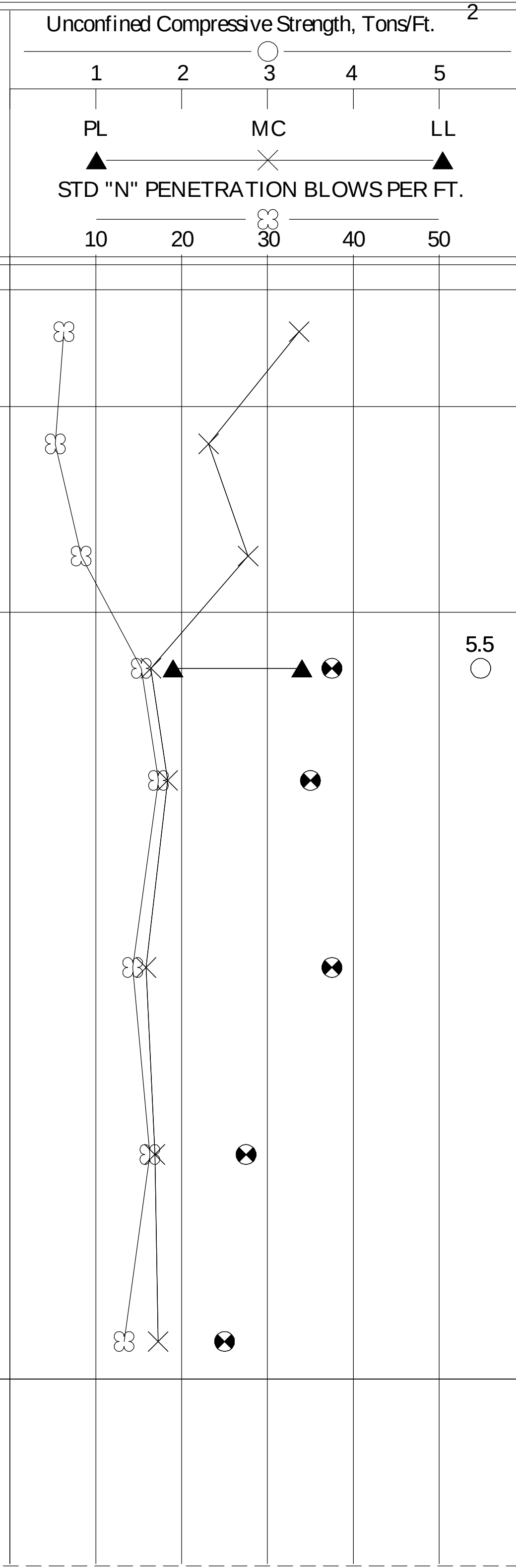
CLIENT	Public Building Commission of Chicago	PROJECT	Proposed Fire Station Engine Company 115
ARCHITECT	Public Building Commission of Chicago	LOCATION	Site 'B' at 119th St. & Morgan St., Chicago, Illinois

BORING NUMBER **B-1**

APPROX. SURFACE ELEVATION (C.C.D.) ± **34.34**

NORTH **1826326.51** EAST **1171492.17**

DEPTH ELEVATION	SAMPLE NO.	SAMPLER TYPE	SAMPLE REC. (%)	DESCRIPTION OF MATERIALS (LABORATORY CLASSIFICATION)	UNIT DRY WT. LBS./FT³	REMARKS
		HS		2.5" BITUMINOUS CONCRETE PAVEMENT		
				8" CRUSHED STONE BASE COURSE		
2.5	1	SS	46	FILL: SILTY CLAYEY SAND, Dark Brown, Brown, and Black, Loose, Wet (SM-SC)		
		HS				
5.0	2	SS	67	SILTY CLAYEY SAND, Brown and Gray, Fine, Trace Gravel, Loose, Moist (SC-SM)		C.A. Test
		HS				
7.5	3	SS	50			
		HS				ACR
10.0	4	SS	71	SILTY CLAY, Gray, Trace Sand and Gravel, Hard to Very Stiff, Moist (CL)	114.8	
12.5		HS				
15.0	5	SS	58			
17.5		HS				WS
20.0	6	SS	75			
22.5		HS				
25.0	7	SS	33			
27.5		HS				
30.0	8	SS	46			
32.5				End of Boring @ 30.0 Feet.		



Calibrated Penetrometer Unconfined Compression

Water Level Observations		
	17' WS	9.5' ACR

SEECO Consultants, Inc.
7350 Duvan Drive, Tinley Park, IL 60477

Boring Started	10/11/18		
Boring Completed	10/11/18		
Driller	EN	Rig	D-50
Drawn By	MB	Sheet	1 of 1
Approved By	CWG	Job No.	12060G

BORING LOG

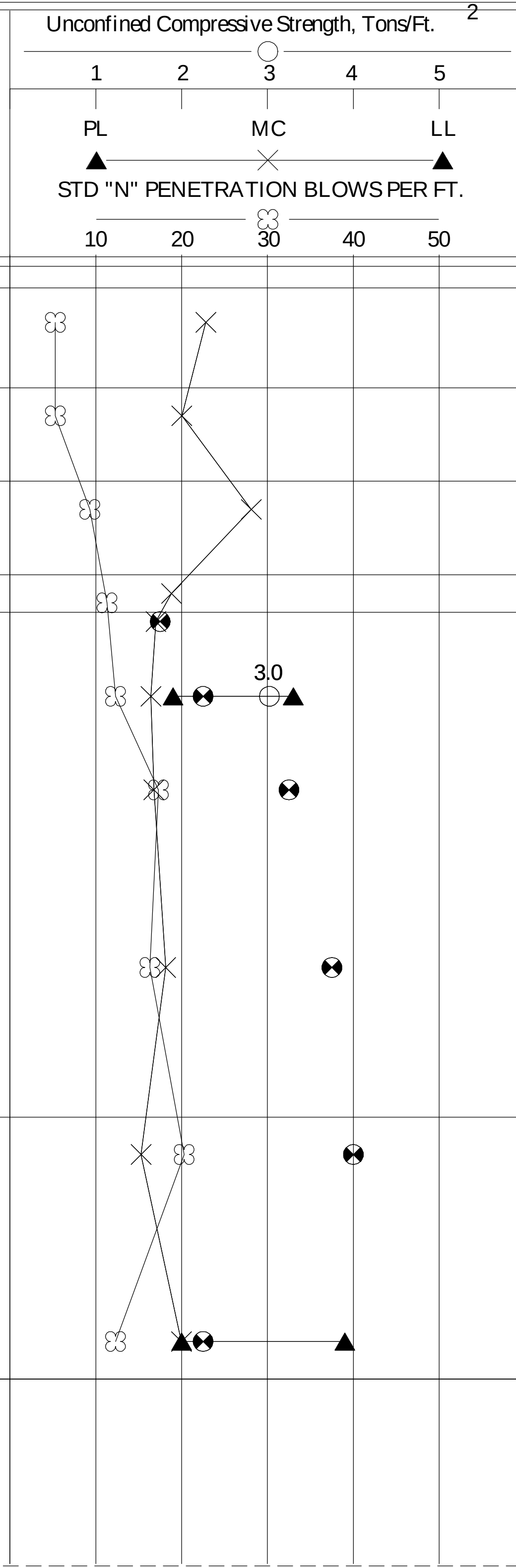
CLIENT **Public Building Commission of Chicago**	PROJECT **Proposed Fire Station Engine Company 115**
ARCHITECT **Public Building Commission of Chicago**	LOCATION **Site 'B' at 119th St. & Morgan St., Chicago, Illinois**

BORING NUMBER **B-2**

APPROX. SURFACE ELEVATION (C.C.D.) + - **35.13**

NORTH **1826278.79** EAST **1171720.33**

DEPTH ELEVATION	SAMPLE NO.	SAMPLER TYPE	SAMPLE REC. (%)	DESCRIPTION OF MATERIALS (LABORATORY CLASSIFICATION)	UNIT DRY WT. LBS./FT.3	REMARKS
		HS		3" BITUMINOUS CONCRETE PAVEMENT		
				7" CRUSHED STONE BASE COURSE		
2.5	1	SS	56	FILL: SILTY SAND, Dark Brown and Brown, Loose, Moist (SM)		
		HS				
5.0	2	SS	67	POORLY GRADED SAND, Brown, Fine, Little Silt, Trace Clay, Loose, Moist (SP)		
		HS				
7.5	3	SS	44	POORLY GRADED SAND, Brown and Gray, Fine, Little Silt, Loose, Moist (SP)		
		HS				
10.0	4A 4B	SS	50	POORLY GRADED SAND, Brown, Fine, Little Silt, Trace Clay, Medium Dense, Moist (SP)		ACR
		HS		SILTY CLAY, Gray, Little Sand, Trace Gravel, Stiff to Very Stiff, Moist (CL)		
12.5	5	SS	72		114.8	
		HS				
15.0	6	SS	89			C.A. Test
17.5		HS				WS
20.0	7	SS	71			
22.5		HS				
25.0	8	SS	58	SILTY CLAY, Gray, Trace Sand and Gravel, Hard to Very Stiff, Moist (CL)		
27.5		HS				
30.0	9	SS	63			
32.5				End of Boring @ 30.0 Feet.		



Calibrated Penetrometer Unconfined Compression

Water Level Observations		SEECO Consultants, Inc.	Boring Started	10/12/18
		7350 Duvan Drive, Tinley Park, IL 60477	Boring Completed	10/12/18
18' WS	**10' ACR**		Driller **EN**	Rig **D-50**
		Approved By **CWG** Job No. **12060G**	Drawn By **MB**	Sheet **1 of 1**

BORING LOG

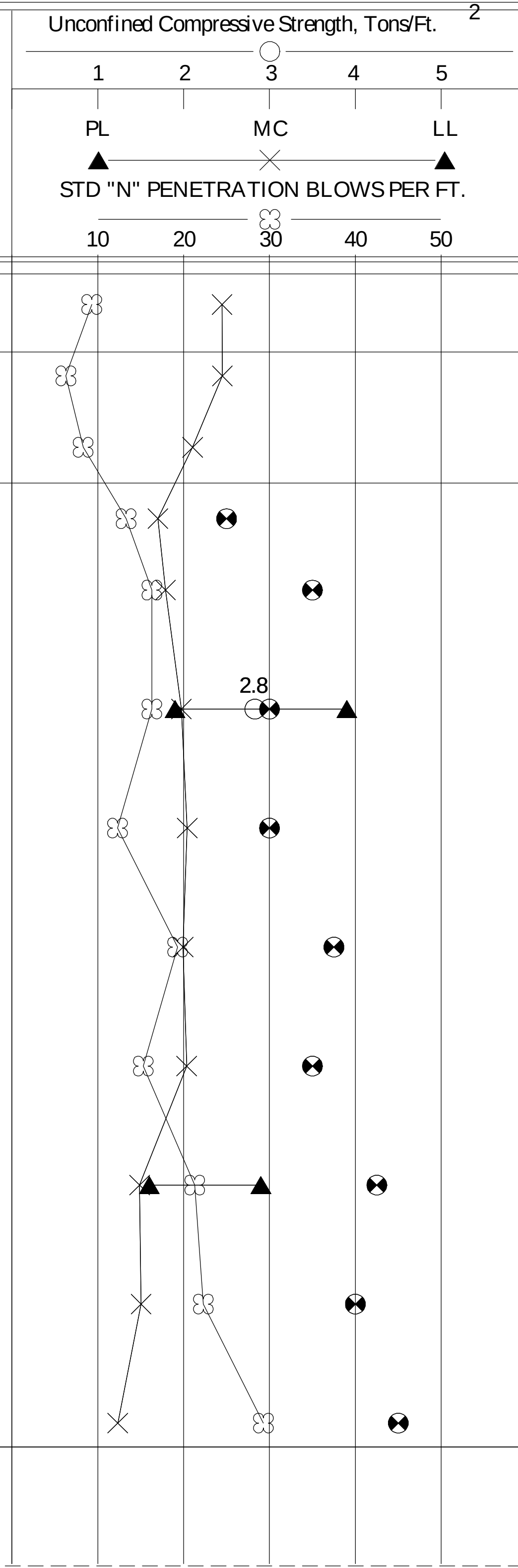
CLIENT	Public Building Commission of Chicago	PROJECT	Proposed Fire Station Engine Company 115
ARCHITECT	Public Building Commission of Chicago	LOCATION	Site 'B' at 119th St. & Morgan St., Chicago, Illinois

BORING NUMBER **B-3**

APPROX. SURFACE ELEVATION (C.C.D.) + - **35.89**

NORTH **1826141.13** EAST **1171624.26**

DEPTH ELEVATION	SAMPLE NO.	SAMPLER TYPE	SAMPLE REC. (%)	DESCRIPTION OF MATERIALS (LABORATORY CLASSIFICATION)	UNIT DRY WT. LBS./FT.³	REMARKS
		HS		2.5" BITUMINOUS CONCRETE PAVEMENT		
2.5	1	SS	50	6" SAND AND GRAVEL BASE COURSE, Dark Brown		
		HS		FILL: CLAYEY SAND, Dark Brown, Brown, Gray, Trace Black, Loose, Moist (SC)		
5.0	2	SS	67			
		HS		POORLY GRADED SAND, Brown Fine, Little Silt, Trace Clay, Loose, Moist (SP)		
7.5	3	SS	79			ACR
10.0		HS		SILTY CLAY, Gray, Trace Sand and Gravel, Trace Sand, Very Stiff to Hard, Moist (CL)		
	4	SS	38			
12.5		HS				WD
	5	SS	42			C.A. Test
15.0		HS				
17.5	6	SS	71		108.8	
20.0		HS				
22.5	7	SS	63			
25.0		HS				
27.5	8	SS	54			
30.0		HS				
32.5	9	SS	75			
35.0		HS				
37.5	10	SS	83			
40.0		HS				
42.5	11	SS	46			
45.0		HS				
47.5	12	SS	63			
50.0				End of Boring @ 50.0 Feet.		
52.5						



Calibrated Penetrometer Unconfined Compression

Water Level Observations	
13' WD	8.5' ACR

SEECO Consultants, Inc.
7350 Duvan Drive, Tinley Park, IL 60477

Boring Started	10/11/18		
Boring Completed	10/11/18		
Driller	EN	Rig	D-50
Approved By	CWG	Job No.	12060G
Drawn By	MB	Sheet	1 of 1

BORING LOG

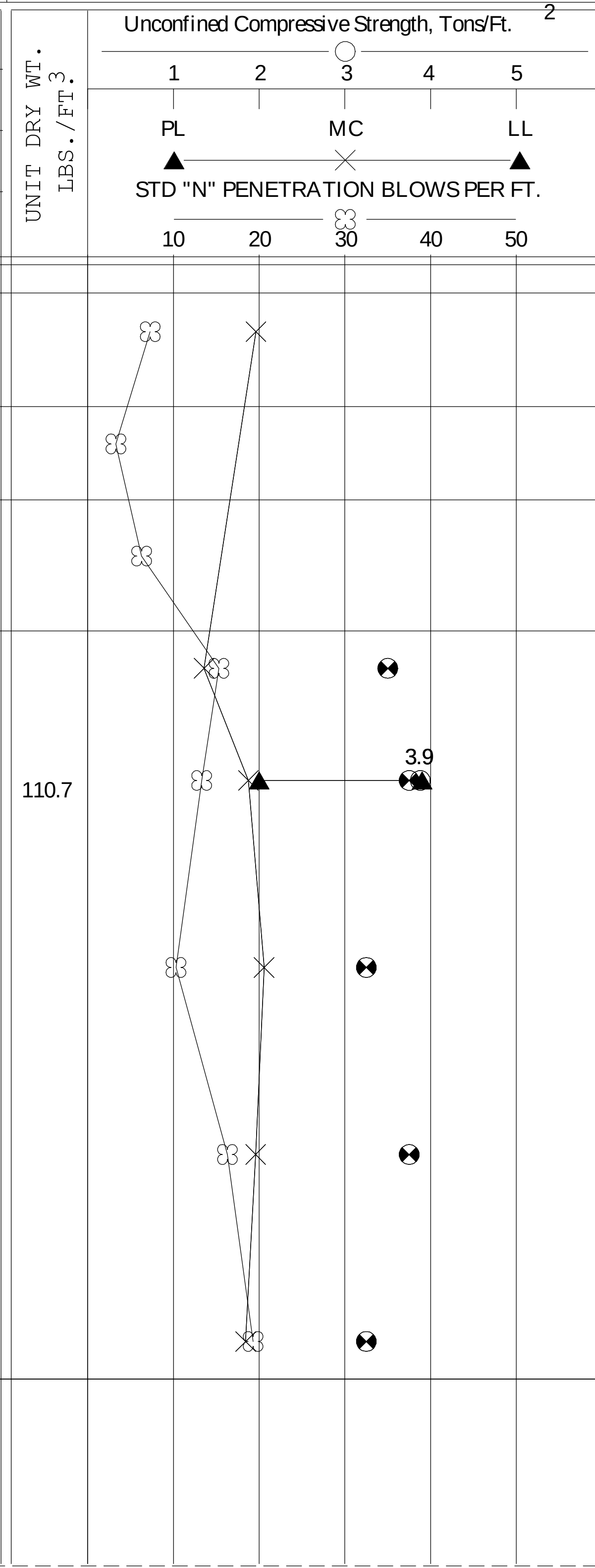
CLIENT: **Public Building Commission of Chicago**	PROJECT: **Proposed Fire Station Engine Company 115**
ARCHITECT: **Public Building Commission of Chicago**	LOCATION: **Site 'B' at 119th St. & Morgan St., Chicago, Illinois**

BORING NUMBER **B-4**

APPROX. SURFACE ELEVATION (C.C.D.) ± **35.36**

NORTH **1826002.84** EAST **1171525.82**

DEPTH ELEVATION	SAMPLE NO.	SAMPLER TYPE	SAMPLE REC. (%)	DESCRIPTION OF MATERIALS (LABORATORY CLASSIFICATION)	UNIT DRY WT. LBS./FT.³	REMARKS
		HS		2.5" BITUMINOUS CONCRETE PAVEMENT		
				9" CRUSHED STONE BASE COURSE		
2.5	1	SS	63	FILL: SILTY SAND, Black, Brown, and Gray, Loose, Moist (SM)		
		HS				WS
5.0	2	SS	38	POORLY GRADED SAND, Brown and Gray, Fine, Little Silt, Loose, Saturated (SP)		
		HS				
7.5	3	SS	71	SANDY SILT, Brown and Gray, Loose, Saturated (ML)		C.A. Test
		HS				
10.0	4	SS	50	SILTY CLAY, Gray, Trace Sand and Gravel, Very Stiff, Moist (CL)		ACR
12.5		HS				
	5	SS	79		110.7	
15.0		HS				
17.5						WS
	6	SS	58			
20.0		HS				
22.5	7	SS	50			
25.0		HS				
27.5	8	SS	75			
30.0				End of Boring @ 30.0 Feet.		
32.5						



Calibrated Penetrometer Unconfined Compression

Water Level Observations		Boring Started	10/11/18
4' WS (Infiltrated Water)		Boring Completed	10/11/18
17' WS	10' ACR	Driller: EN	Rig: D-50
		Drawn By: MB	Sheet 1 of 1

SEECO Consultants, Inc.
7350 Duvan Drive, Tinley Park, IL 60477

Approved By **CWG** Job No. **12060G**

BORING LOG

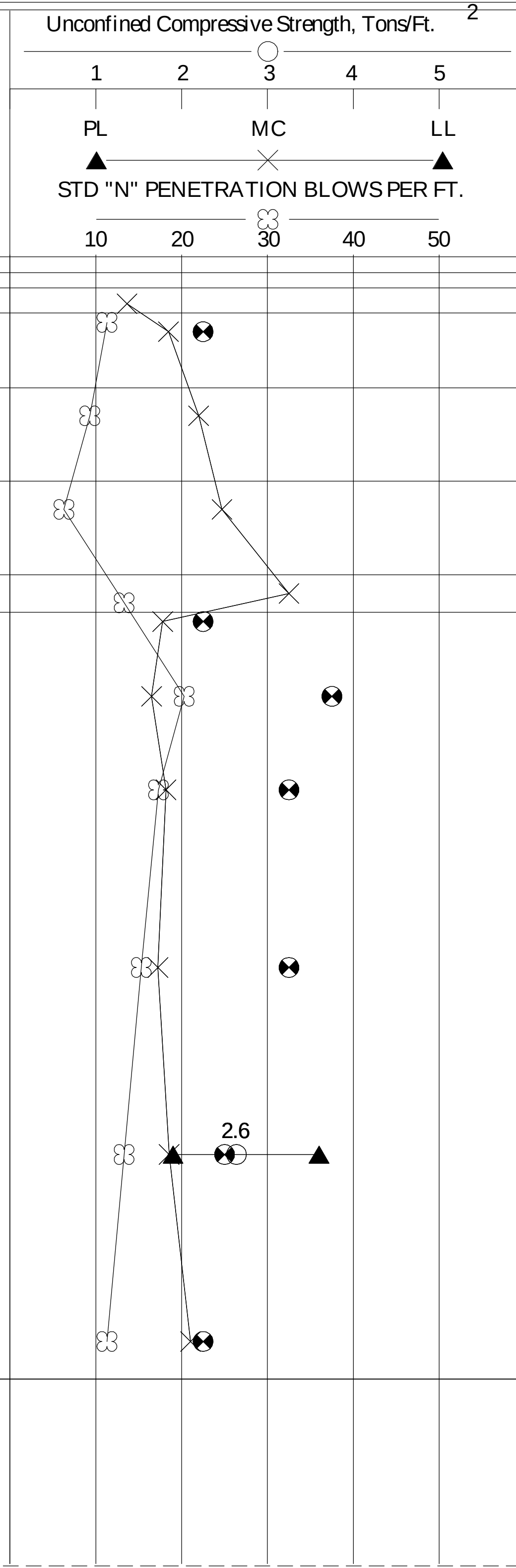
CLIENT **Public Building Commission of Chicago**	PROJECT **Proposed Fire Station Engine Company 115**
ARCHITECT **Public Building Commission of Chicago**	LOCATION **Site 'B' at 119th St. & Morgan St., Chicago, Illinois**

BORING NUMBER **B-5**

APPROX. SURFACE ELEVATION (C.C.D.) ± **35.35**

NORTH **1826004.51** EAST **1171703.66**

DEPTH ELEVATION	SAMPLE NO.	SAMPLER TYPE	SAMPLE REC. (%)	DESCRIPTION OF MATERIALS (LABORATORY CLASSIFICATION)	UNIT DRY WT. LBS./FT.^{3}	REMARKS
		HS		5" BITUMINOUS CONCRETE PAVEMENT		
	1A			5" CRUSHED STONE BASE COURSE		
	1B	SS	56	8" FILL: SAND, Dark Brown and Black, Little Gravel, Medium Dense, Moist (SP)		
2.5		HS				
	2	SS	72	SILTY CLAY, Brown and Gray, Trace Sand and Gravel, Very Stiff, Moist (CL)		
5.0		HS				
	3	SS	83	POORLY GRADED SAND, Brown, Fine, Trace Silt, Loose, Moist (SP)		C.A. Test
7.5		HS		SILTY CLAYEY SAND, Brown, Trace Gray, Loose, Moist (SC-SM)		
	4A	SS	67			ACR
10.0	4B	HS		CLAYEY SILTY SAND, Brown and Gray, Medium Dense, Wet (SC-SM)		
	5	SS	89	SILTY CLAY, Gray, Trace Sand and Gravel, Very Stiff, Moist (CL)		
12.5		HS				WS
	6	SS	50			
15.0		HS				
17.5						
	7	SS	71			
20.0		HS				
22.5						
	8	SS	75		114.1	
25.0		HS				
27.5						
	9	SS	58			
30.0				End of Boring @ 30.0 Feet.		
32.5						



Calibrated Penetrometer Unconfined Compression

Water Level Observations		SEECO Consultants, Inc.	Boring Started 10/12/18
		7350 Duvan Drive, Tinley Park, IL 60477	Boring Completed 10/12/18
13' WS	8.5' ACR		Driller EN / Rig D-50
		Approved By CWG / Job No. 12060G	Drawn By MB / Sheet 1 of 1

APPENDIX 5

CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

ASTM Designation: D 2487-10

(Based on United Soil Classification System)

SEECO Consultants, Inc.

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% coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]	GW	Well graded gravel[F]
			$Cu \geq 4$ and/or $1 > Cc > 3$[E]	GP	Poorly graded gravel[F]
		Gravels with fines More than 12% fines[C]	Fines classify as ML or MH	GM	Silty gravel[F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel[F, G, H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]	SW	Well-graded sand[I]
			$Cu < 6$ and /or $1 > Cc > 3$[E]	SP	Poorly graded sand[I]
		Sands with fines More than 12% fines[D]	Fines classify as ML or MH	SM	Silty sand[G, H, I]
			Fines classify as CL or CH	SC	Clayey sand[G, H, I]
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	Inorganic	PI>7 and plots on or above "A" line[J]	CL	Lean clay[K, L, M]
			PI<4 or plots below "A" line[J]	ML	Silt[K, L, M]
		Organic	$\frac{\text{Liquid limit – oven dried}}{\text{Liquid limit – not dried}} < 0.75$	OL 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	$\frac{\text{Liquid limit – oven dried}}{\text{Liquid limit – not dried}} < 0.75$	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 three 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] $Cu = D_{60}/D_{10}$ $\quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[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 soils contains ≥15% gravel, add "with gravel" to group name

[J] If Atterberg limits plot in hatched 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

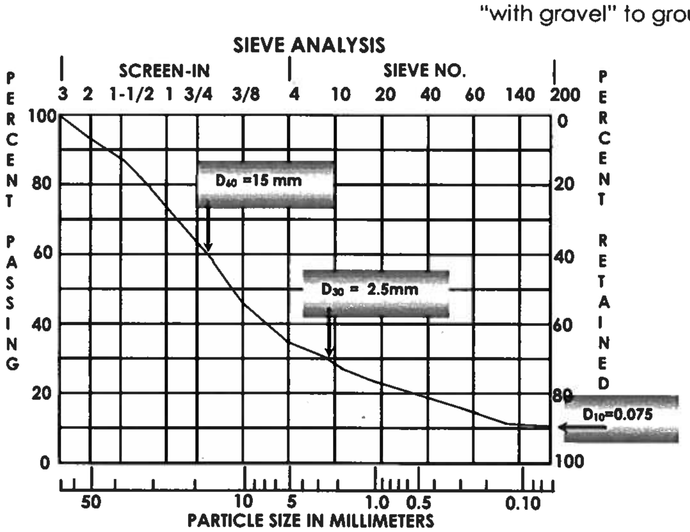
[M] If soil contains ≥30% plus No. 200, predominantly gravel, add "gravelly" to group name

[N] PI ≥4 and plots on or above "A" line

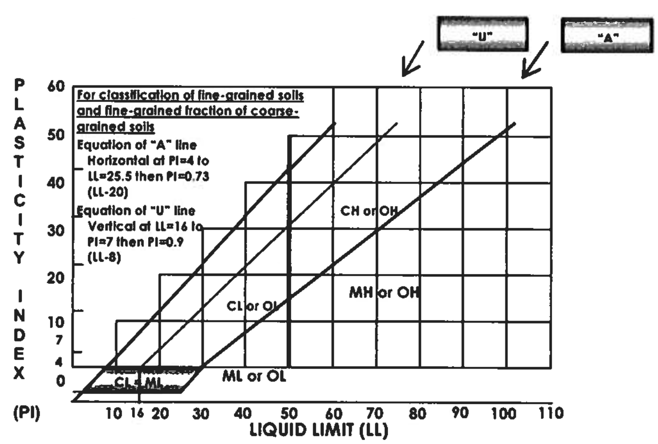
[O] PI <4 or plots below "A" line

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

[Q] PI plots below "A" line

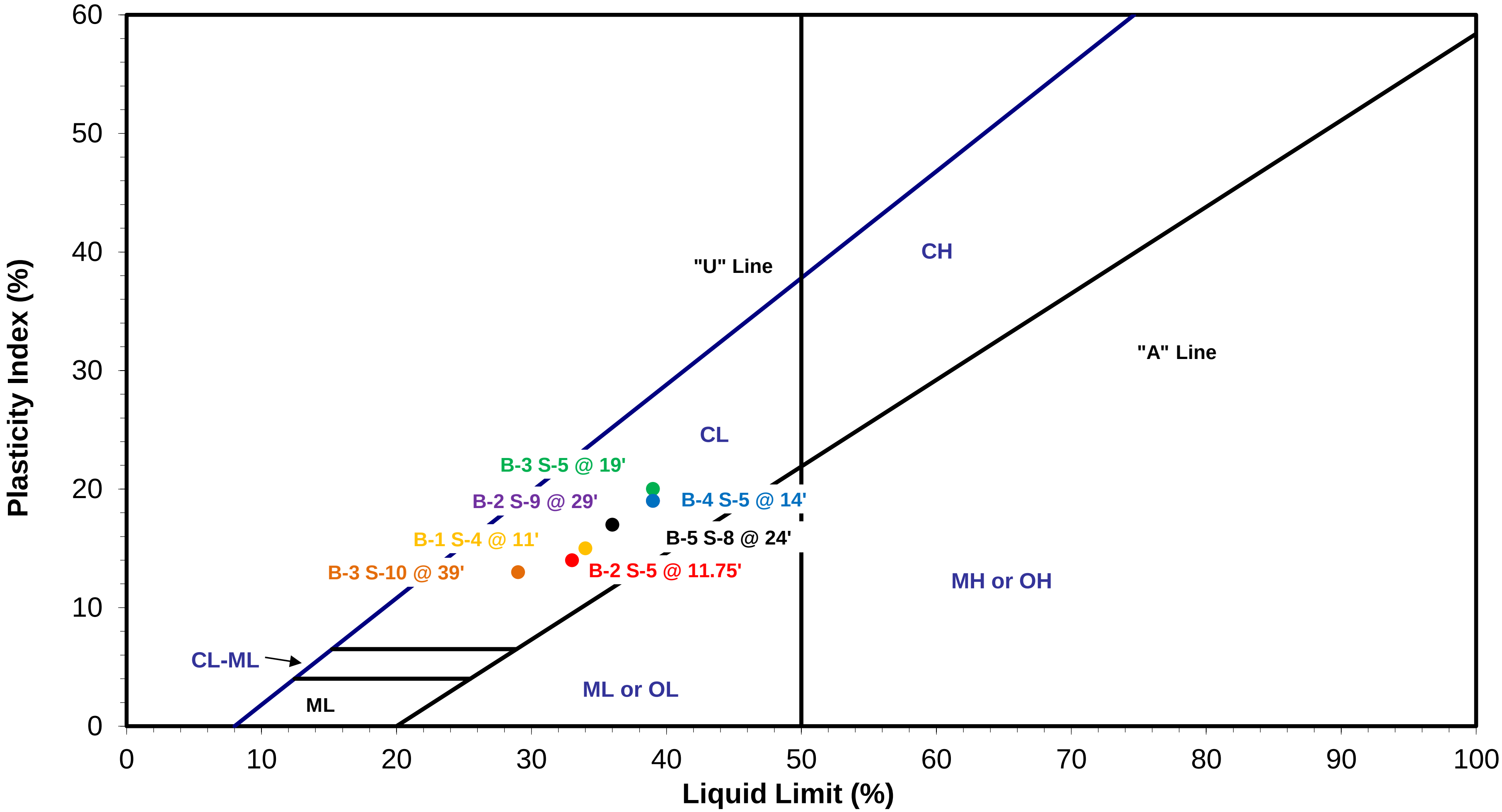


$Cu = \frac{D_{60}}{D_{10}} = \frac{15}{0.075} = 200 \qquad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}} = \frac{(2.5)^2}{0.075 \times 15} = 5.6$



APPENDIX 6

Report of Atterberg Limits Test (ASTM D4318 / AASHTO T89 / AASHTO T90)

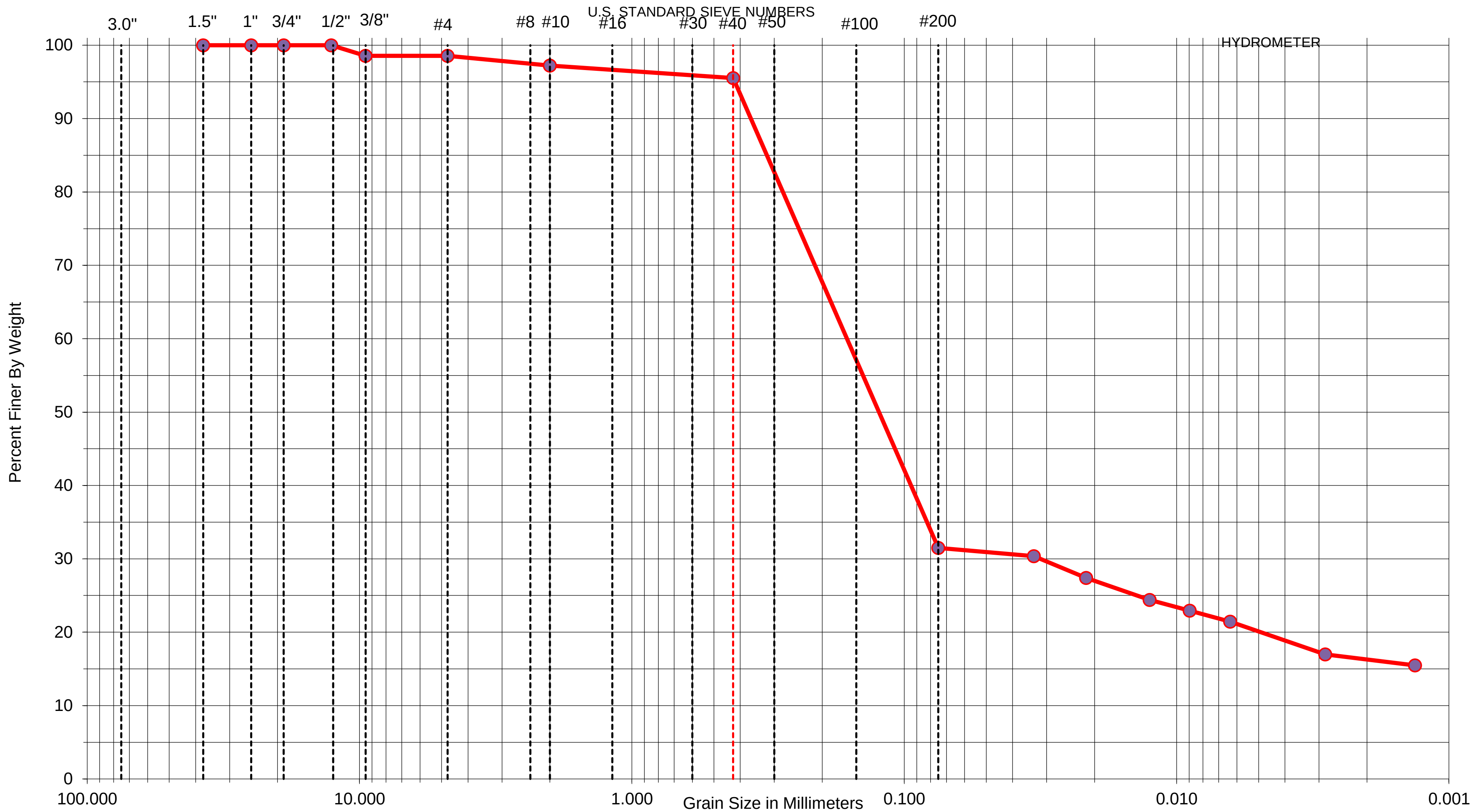


Boring #	B-1 S-4 @ 11'	B-2 S-5 @ 11.75'	B-2 S-9 @ 29'	B-3 S-5 @ 19'	B-3 S-10 @ 39'	B-4 S-5 @ 14'	B-5 S-8 @ 24'
LL	34	33	39	39	29	39	36
PL	19	19	20	19	16	20	19
PI	15	14	19	20	13	19	17
LI	-0.17	-0.18	0.0	+0.04	-0.08	-0.06	-0.03

Project: Proposed Fire Station Engine Co 115-PBC
Location: 119th St & S. Morgan St., Chicago, IL
Client: SEECO
Project #: G18.145

APPENDIX 7

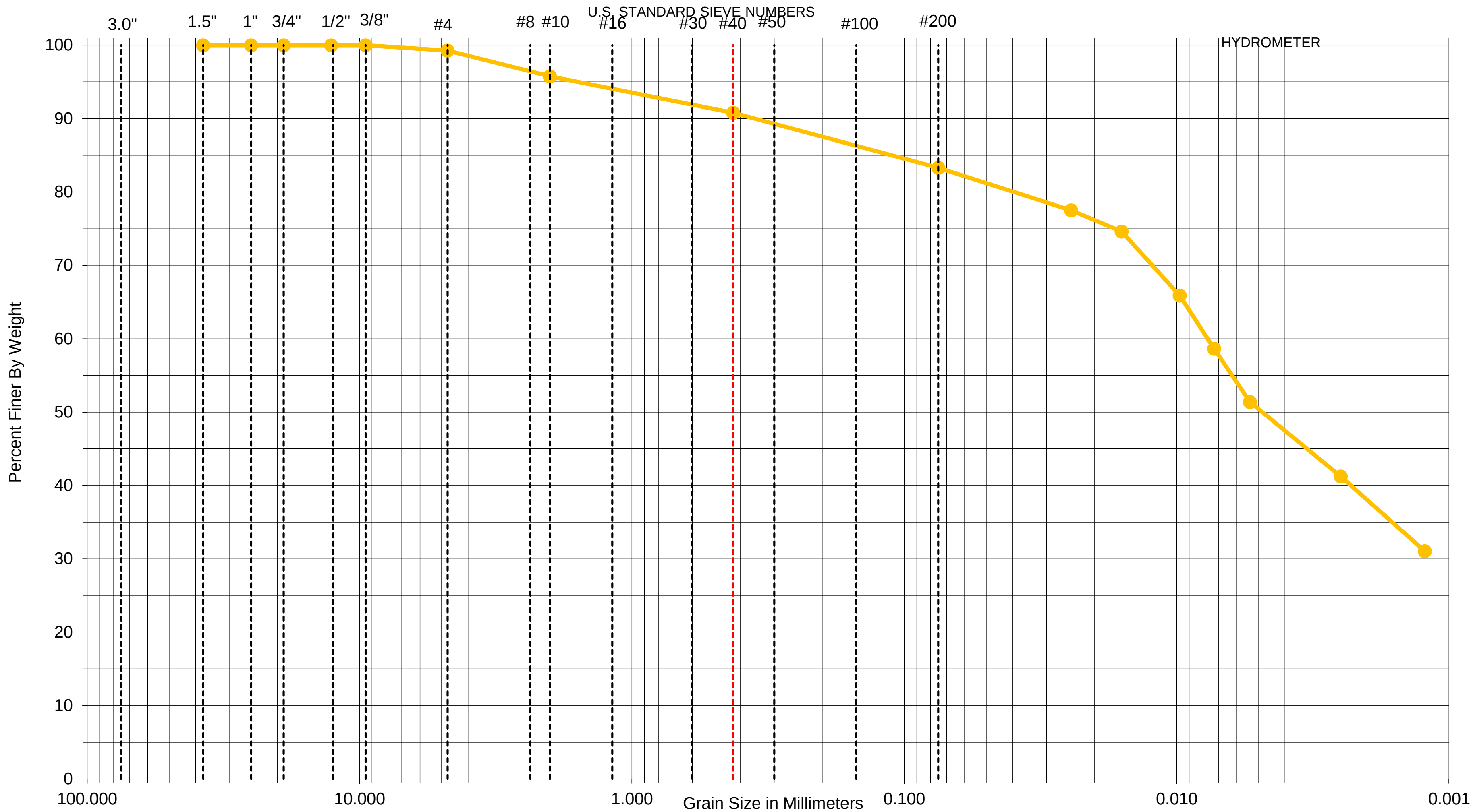
REPORT OF PARTICLE-SIZE ANALYSIS OF SOIL



Key	Boring No.	Depth	USCS Classification	WC%	ORG%	Cc	Cu	%Gravel	%Sand	%Silt	%Clay	D60	D30	D10
●	B-1 S-2	5'	Brown & Gray Silty Clayey Sand (SC-SM)	23.1				1.5	67.1	12.4	19.0	0.162	0.029	

REPORT OF PARTICLE-SIZE ANALYSIS OF SOIL	**SEECO LAB**	File No.	**G18.145**

REPORT OF PARTICLE-SIZE ANALYSIS OF SOIL

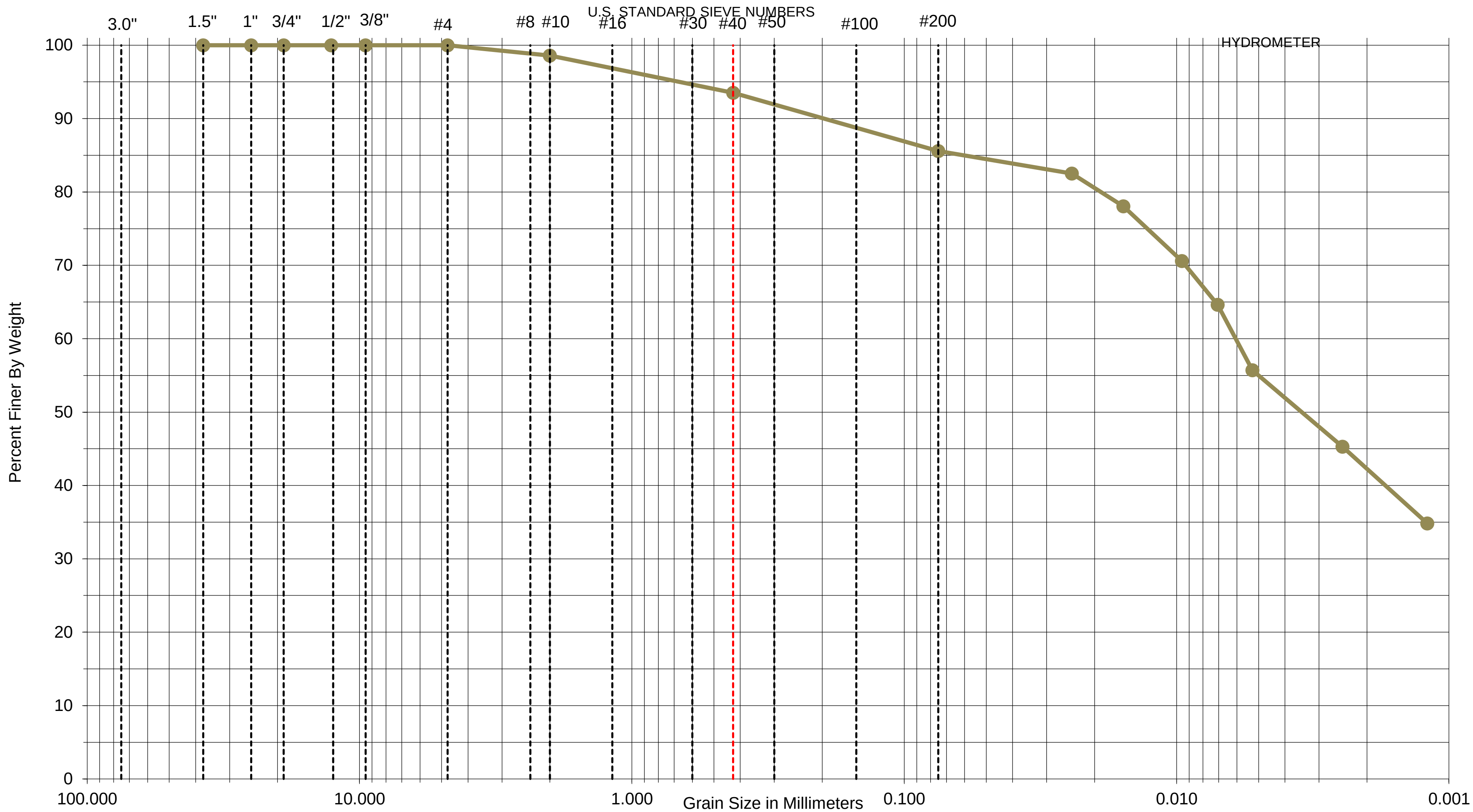


Key	Boring No.	Depth	USCS Classification	WC%	ORG%	Cc	Cu	%Gravel	%Sand	%Silt	%Clay	D60	D30	D10
●	B-2, S-6	14.25'	Gray Silty Clay (CL)	16.8	N/A			0.7	16.1	32.9	50.3	0.008		

REPORT OF PARTICLE-SIZE ANALYSIS OF SOIL	**SEECO LAB**	File No.	**G18.145**

Rubino Engineering Inc ● 425 Shepard Drive● Elgin, IL 60123 ● 847-931-1555 ● 847-931-1560 (Fax)

REPORT OF PARTICLE-SIZE ANALYSIS OF SOIL

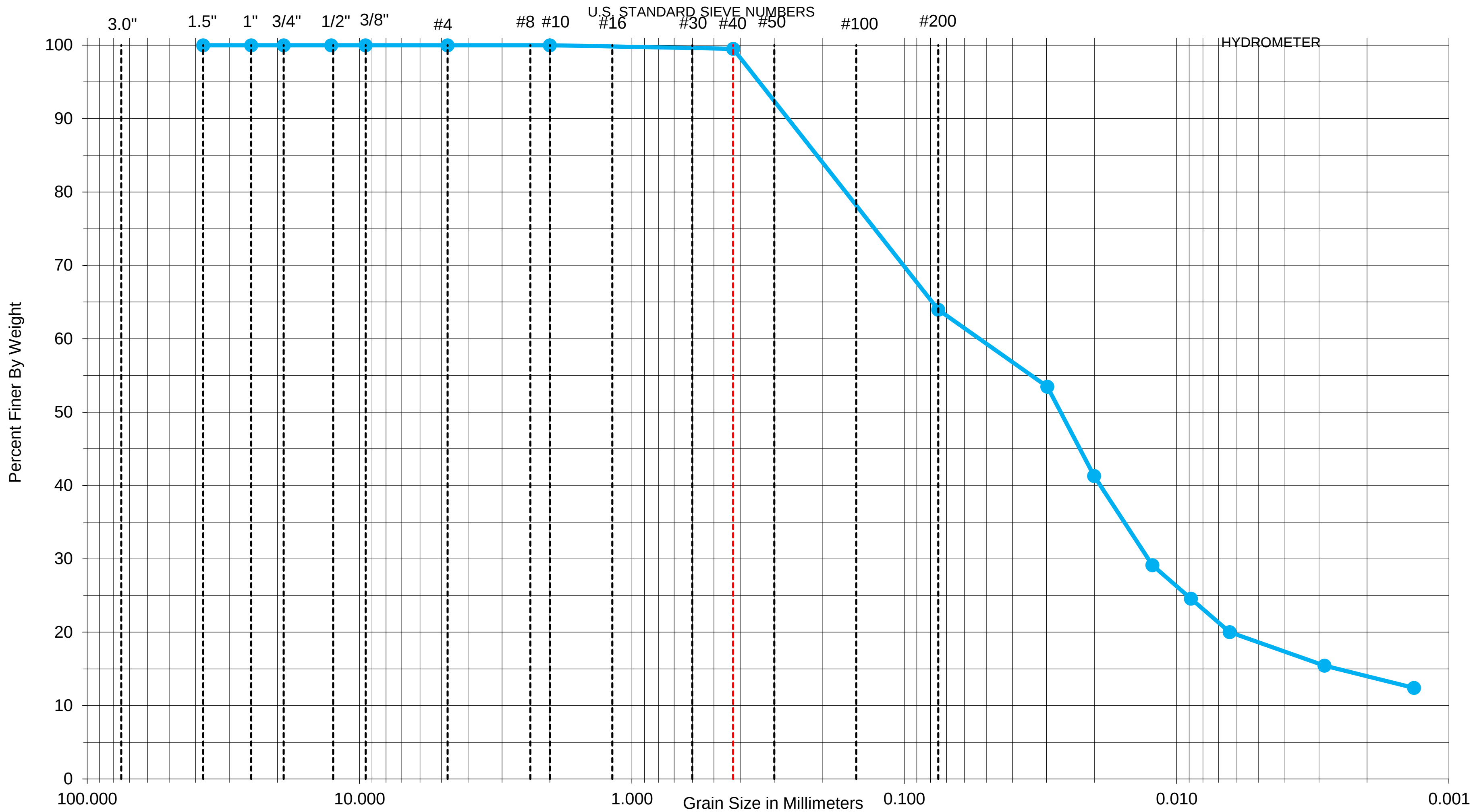


Key	Boring No.	Depth	USCS Classification	WC%	ORG%	Cc	Cu	%Gravel	%Sand	%Silt	%Clay	D60	D30	D10
●	B-3, S-5	14.25'	Gray Silty Clay (CL)	17.9				0.0	14.4	30.6	55.0	0.006		

REPORT OF PARTICLE-SIZE ANALYSIS OF SOIL	**SEECO LAB**	File No.	**G18.145**

Rubino Engineering Inc ● 425 Shepard Drive● Elgin, IL 60123 ● 847-931-1555 ● 847-931-1560 (Fax)

REPORT OF PARTICLE-SIZE ANALYSIS OF SOIL

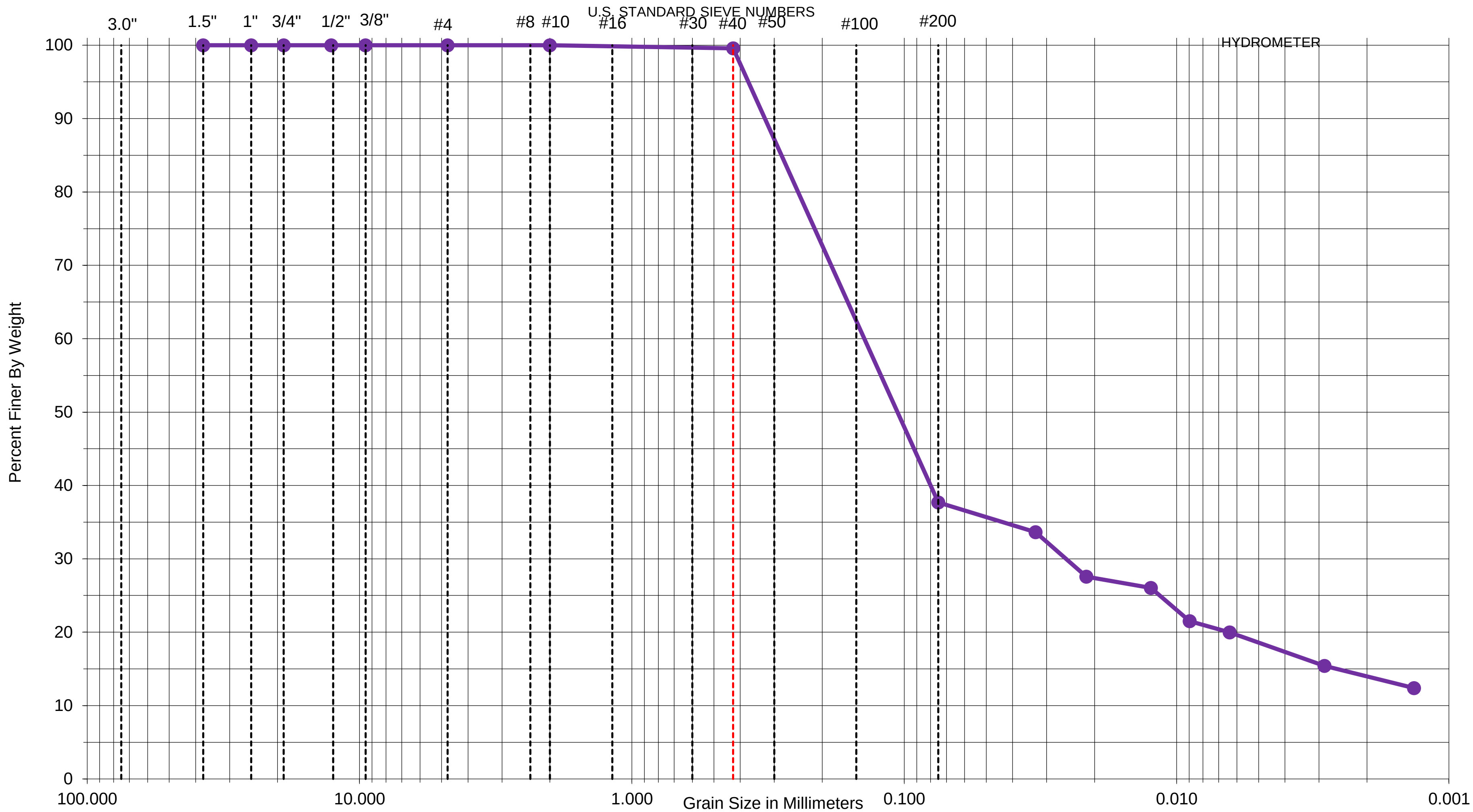


Key	Boring No.	Depth	USCS Classification	WC%	ORG%	Cc	Cu	%Gravel	%Sand	%Silt	%Clay	D60	D30	D10
●	B-4, S-3	8'	Brown & Gray Sandy Silt (ML)	N/A				0.0	36.1	44.2	19.7	0.058	0.013	

REPORT OF PARTICLE-SIZE ANALYSIS OF SOIL | **SEECO LAB** | File No. **G18.145**

Rubino Engineering Inc ● 425 Shepard Drive● Elgin, IL 60123 ● 847-931-1555 ● 847-931-1560 (Fax)

REPORT OF PARTICLE-SIZE ANALYSIS OF SOIL

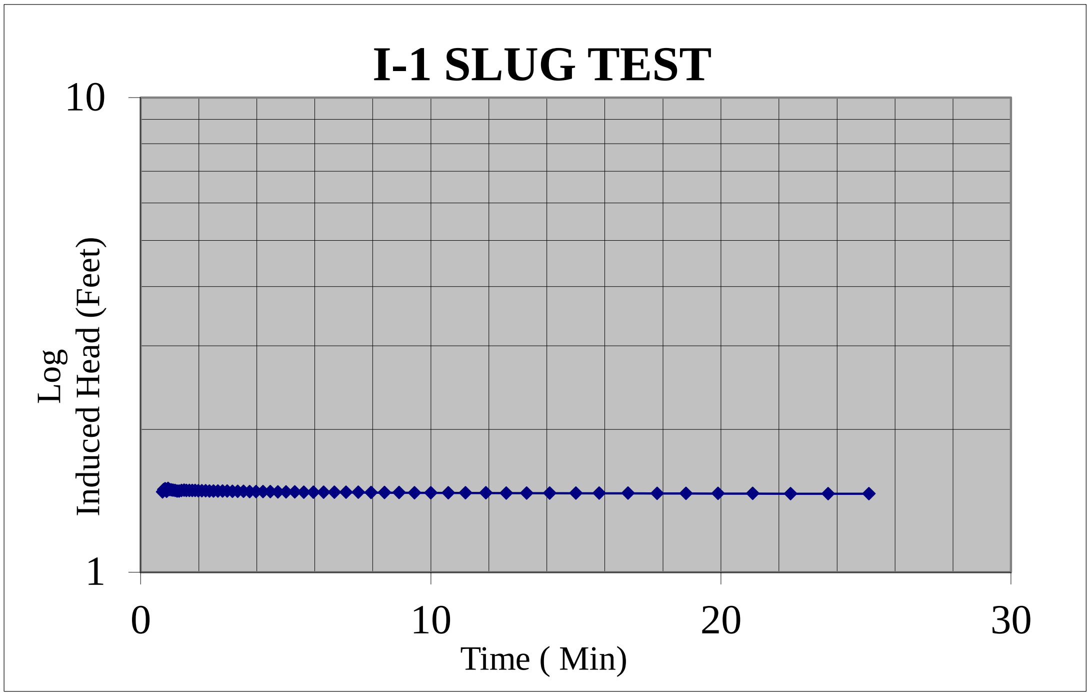


Key	Boring No.	Depth	USCS Classification	WC%	ORG%	Cc	Cu	%Gravel	%Sand	%Silt	%Clay	D60	D30	D10
●	B-5, S-3	6.75'	Brown & Gray Silty Clayey Sand (SC-SM)	24.7				0.0	62.3	18.0	19.7	0.140	0.026	

REPORT OF PARTICLE-SIZE ANALYSIS OF SOIL	**SEECO LAB**	File No.	**G18.145**

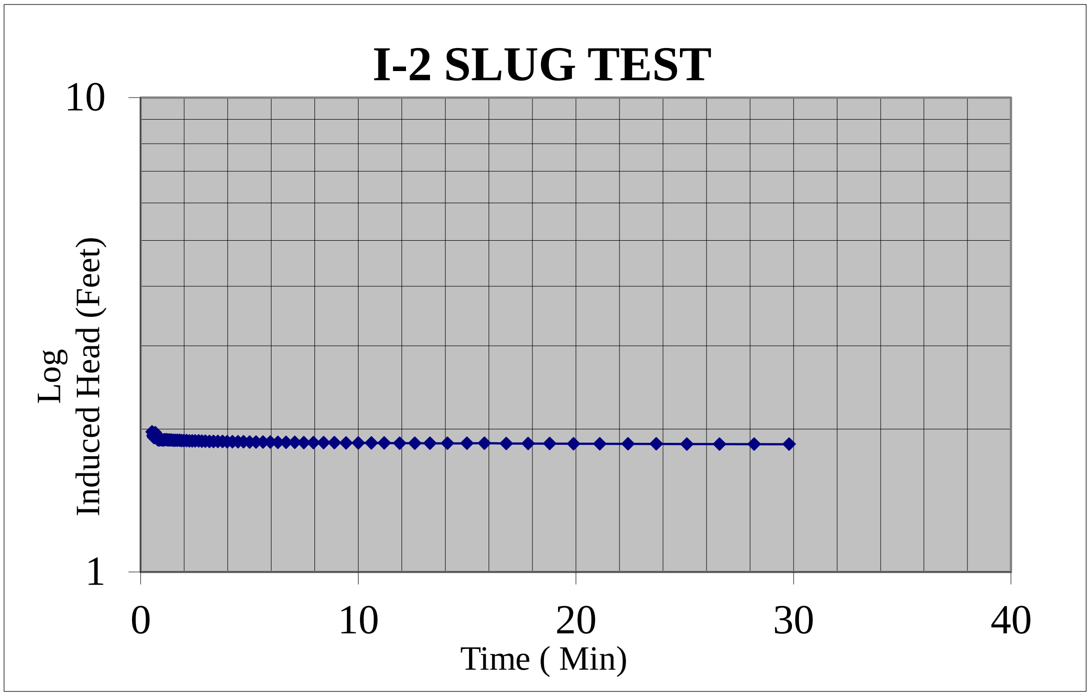
Rubino Engineering Inc ● 425 Shepard Drive● Elgin, IL 60123 ● 847-931-1555 ● 847-931-1560 (Fax)

APPENDIX 8



Head Drop	0.029	ft.
Time Interval	0.402	hr.
I.D. of Pipe	4	in.
Head Drop in inch	0.348	in.
Rate of Infiltration	0.87	in/hr

PROPOSED FIRE STATION ENGINE COMPANY 115
119TH ST. & MORGAN STREET, CHICAGO, ILLINOIS
SEECO JOB NO: 12060G



Head Drop	0.038	ft.
Time Interval	0.480	hr.
I.D. of Pipe	4	in.
Head Drop in inch	0.456	in.
Rate of Infiltration	0.95	in/hr

APPENDIX 9

GENERAL REMARKS

This report has been prepared in order to aid in the evaluation of this property and to assist the architect and/or engineer in the design of this project. The scope is limited to the specific project and location described herein, and our description of the project represents our understanding of the significant aspects relevant to soil and foundation characteristics. In the event that any changes in the design or location of the building(s) as outlined in this report are planned, we should be informed so the changes can be reviewed and the conclusions of this report modified as necessary in writing by the geotechnical engineer. As a check, we recommend that we be authorized to review the project plans and specifications to confirm that the recommendations contained in this report have been interpreted in accordance with our intent. Without this review, we will not be responsible for misinterpretation of our data, our analysis, and/or our recommendations, nor how these are incorporated into the final design.

It is recommended that all construction operations dealing with earthwork and foundations be reviewed by an experienced geotechnical engineer to provide information on which to base a decision whether the design requirements are fulfilled in the actual construction. If you wish, we would welcome the opportunity to provide field construction services for you during construction.

The analysis and recommendations submitted in this report are based upon the data obtained from the soil borings performed at the locations indicated on the location diagram and from any other information discussed in this report. This report does not reflect any variations which may occur between these borings. In the performance of subsurface explorations, specific information is obtained at specific locations at specific times. However, it is a well-known fact that variations in soil and rock conditions exist on most sites between boring locations and also such situations as groundwater levels vary from time to time. The nature and extent of variations may not become evident until the course of construction. If variations then appear evident, it will be necessary for re-evaluation of the recommendations of this report after performing on-site observations during the construction period and noting the characteristics of any variations.