Geotechnical Engineering Report

Poe Elementary School Annex
Chicago, Illinois
November 1, 2018
Terracon Project No. MR185297

Prepared for:
Public Building Commission of Chicago
Chicago, Illinois

Prepared by:
Terracon Consultants, Inc.
Chicago, Illinois

November 1, 2018

Public Building Commission of Chicago
50 West Washington Street, Room 200
Chicago, Illinois 60602

Attn: Mr. Michael Powell
E: Mike.Powell@cityofchicago.org

Re: Geotechnical Engineering Report
Poe Elementary School Annex
10538 S. Langley Avenue
Chicago, Illinois
Terracon Project No. MR185297

Dear Mr. Powell:

We have completed our geotechnical engineering evaluation for the above referenced project. This study was performed in general accordance with Terracon Proposal No. PMR185297 dated October 5, 2018. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations, floor slabs, and pavement for the proposed project.

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

Sincerely,
Terracon Consultants, Inc.

Daniel B. Mabirizi, E.I.T.
Senior Staff Engineer

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Senior Geotechnical Consultant

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REPORT SUMMARY

Topic [1]	Overview Statement [2]
Project Description	Project is a three-story building annex building. Other structures include a stormwater detention pond and new artificial turf play area. Anticipated building Column loads: Max. 250 kips, Wall loads: Max. 10 kips per linear foot, Slabs: Max. 150 psf
Geotechnical Characterization	Approximately 2 to 4 inches of asphaltic concrete underlain by about 3 to 4 inches of crushed stone in four borings. About 12 inches of concrete in two borings. Approximately 12 inches of topsoil in three borings. Existing fill consisting of lean clays, sand, recycled asphalt fragments to depths of about 2 to 3 feet. The native subsurface soils generally consist of very stiff to hard lean clays with occasional silt layers. Groundwater was encountered in one out of nine borings at a depth of 7 feet. Water level may be perched.
Shallow Foundations	Shallow foundations may be utilized to support the proposed building addition. Allowable bearing pressure: 4,000 psf Minimum embedment depth: 3½ feet below final grade Expected settlements: ¾ inch total, ½ inch differential Detect and remove zones of soft/weak soils as noted in **Earthwork**.
Earthwork	Areas of soft or otherwise unsuitable material should be undercut and replaced with new structural fill or suitable, existing on-site materials. Existing lean clays can be used for engineered fill (a.k.a structural fill) in the new artificial turf areas. Clays are sensitive to moisture variation, so attention to moisture content to clay soils should be paid during construction.
Pavements (Driveway)	With subgrade prepared as noted in **Earthwork** section, asphalt and concrete pavements may be considered for the new driveway. Recommendations are provided in the **Pavements** section.
General Comments	This section contains important information about the limitations of this geotechnical engineering report.

1. If the reader is reviewing this report as a pdf, the topics above can be used to access the appropriate section of the report by simply clicking on the topic itself.
2. This summary is for convenience only. It should be used in conjunction with the entire report for design purposes.

Geotechnical Engineering Report

Poe Elementary School Annex
10538 S. Langley Avenue
Chicago, Illinois
Terracon Project No. MR185297
November 1, 2018

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed three-story building addition to be located at 10538 S. Langley Avenue in Chicago, Illinois. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Site preparation and earthwork
- Stormwater pond considerations
- Foundation design and construction
- Floor slab design and construction
- Seismic site classification per IBC

The geotechnical engineering Scope of Services for this project included the advancement of nine (9) test borings to depths ranging from approximately 10 to 50 feet below existing site grade. In addition, two (2) in-situ single-ring infiltration tests were performed in the proposed new artificial turf area to determine the subgrade permeability characteristics.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs in the **Exploration Results** section.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project site is located at 10538 S. Langley Avenue in Chicago, Illinois. See **Site Location**
Existing Improvements	School building, parking lots, playgrounds, and fence along the existing property line.

Item	Description
Current Ground Cover	Concrete and asphalt pavements, synthetic turf natural grass, and synthetic turf.
Existing Topography	Relatively flat.

PROJECT DESCRIPTION

Our understanding of the project is as follows:

Item	Description
Proposed Structures	■ A three-story annex (building addition) with a footprint area of about 8,800 square feet. The annex will be connected to the existing school building. The annex will be typical slab-on-grade construction (no basement). ■ A stormwater detention pond will be constructed at the southwest corner of the property. We anticipate the pond will have a maximum depth of 5 feet. ■ New artificial turf will be constructed on the west side of the existing artificial turf. ■ A new driveway will be constructed west of the proposed annex.
Building Construction (assumed by Terracon)	Steel frame with load bearing masonry walls.
Finished Floor Elevation (assumed by Terracon)	Within 1 to 2 feet above existing grade and match the finished floor elevation of the existing building.
Maximum Loads (assumed by Terracon)	■ Columns: 250 kips ■ Walls: 10 kips per linear foot (klf) ■ Slabs: 150 pounds per square foot (psf)
Below-Grade Structures (assumed by Terracon)	None
Pavements	Paved driveway will be constructed. We assume both rigid (concrete) and flexible (asphalt) pavement sections are planned to be considered. Anticipated traffic is as follows: ■ Passenger cars and light trucks: Max. 500 vehicles per week. ■ Light delivery and trash collection trucks: < 5 vehicles per week. ■ Tractor-trailer trucks: < 1 vehicle per week. The pavement design period is 20 years.

GEOTECHNICAL CHARACTERIZATION

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization forms the basis of our geotechnical calculations and evaluation of site preparation and foundation options. Conditions encountered at each exploration point are indicated on the individual logs. The individual boring logs can be found in the **Exploration Results** section.

Subsurface Profile

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/Density
Surface 1 [1]	0.45 to1	Concrete and Asphalt Pavement	N/A
Surface 2 [2]	1	Topsoil	N/A
1 [3]	2 to 3	Fill – Lean Clay, Sand, and Recycled Asphaltic Concrete Fragments	Hand penetrometer: 2.25 to 5.5 tsf N-value [4]: 4 to 12 bpf
2	18 to 22.5	Lean Clay 1	Stiff to Hard Hand penetrometer: 1.5 to 5.5 tsf UC [5]: 3 to 6.3 tsf N-value: 4 to 23 bpf
3	30 to 50	Lean Clay 2	Very Stiff to Hard Hand penetrometer: 4 to 10 tsf UC: 2.5 to 6.8 tsf N-value: 18 to 34 bpf

1. Encountered in borings B-1 through B-6.
2. Encountered in borings B-7 through B-9.
3. Encountered in boring B-1, B-6 through B-9.
4. N-values = standard penetration resistance values, indicated in blows per foot (bpf).
5. UC = unconfined compressive strength.

Conditions encountered at each boring location are indicated on the individual boring logs shown in the **Exploration Results** section and are attached to this report. Stratification boundaries on the boring logs represent the approximate location of changes in native soil types; in situ, the transition between materials may be gradual.

As previously stated, two (2) single-ring infiltration tests was performed near borings B-8 and B-9 in the proposed new artificial turf area to determine the subgrade permeability characteristics. This test consisted of setting a 12-inch inside diameter casing pipe approximately 3 feet below grade. The annulus around the casing pipe was filled will bentonite chips to prevent the outflow of water from the bottom of the casing out through the annulus. Water was then added to the pipe to maintain a constant water head above the base of the casing pipe.

The infiltration tests performed at this site yielded an estimated infiltration rate of 0.06 in/hr near boring B-8 and 2.14 in/hr near boring B-9. The infiltration test results are included in the **Exploration Results** section.

Groundwater Conditions

The boreholes were observed while drilling and after completion for the presence and level of groundwater. Groundwater was observed at boring B-1 before and after casing removal at a depth of 7 feet below ground surface.

Groundwater was not observed at borings B-2 through B-6 while drilling, or for the short duration the borings were open. However, this does not necessarily mean the borings terminated above groundwater, or the water levels summarized above are stable groundwater levels. Due to the low permeability of the soils encountered in the borings, a relatively long period may be necessary for a groundwater level to develop and stabilize in a borehole. Long term observations in piezometers or observation wells sealed from the influence of surface water, are often required to define groundwater levels in materials of this type.

Another method used to estimate the level of the water table in fine grained soils is to observe the change in color from brown to gray. Fine grained soils are typically brown above the water table where they have been oxidized, and gray below. The change in color occurred at depths of about 6 to 8 feet. Water levels in B-1 may be perched water levels.

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

SHALLOW FOUNDATIONS

If the site has been prepared in accordance with the requirements noted in **Earthwork**, the following design parameters are applicable for shallow foundations.

Design Parameters – Compressive Loads

Item	Description
Maximum Net Allowable Bearing Pressure [1]	4,000 psf
Minimum Embedment Depth Below Finished Grade for Frost Protection [2]	3½ feet
Estimated Total Settlement from Structural Loads [3]	Less than ¾ inch

Item	Description
Estimated Differential Settlement [3]	About ½ total settlement
Minimum Foundation Dimensions	Isolated spread footings: 30 inches Continuous footings: 18 inches

1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. This pressure assumes that any soft/weak soils, existing fill, and/or unsuitable materials, if encountered, will be undercut and replaced with properly placed and compacted structural fill or lean concrete.
2. For unheated structures, the minimum footing embedment for frost protection should be increased to 4 feet.
3. Foundation settlements will depend upon the variations within the subsurface soil profile, the structural loading conditions, the embedment depth of the footings, the thickness of structural fill, and the quality of the earthwork operations and footings construction.

Uplift resistance of spread footings can be developed from the effective weight of the footing and the overlying soils. The maximum allowable uplift capacity should be taken as a sum of the effective weight of soil plus the dead weight of the foundation, divided by an appropriate factor of safety. A maximum total unit weight of 120 pcf should be used for the backfill.

Construction Adjacent to Existing Building

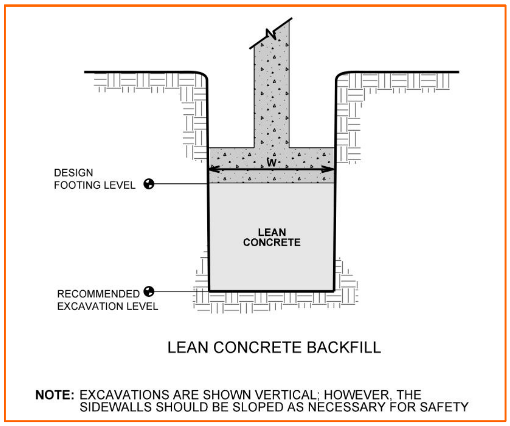
Differential settlement between the building addition and the existing building could approach the magnitude of the total settlement of the building addition. Underground piping between the two structures should be designed with flexible couplings and utility knockouts in foundation walls should be oversized, so minor deflections in alignment do not result in breakage or distress. Care should be taken during excavation adjacent to existing foundations and grade beams to avoid disturbing existing soils.

Depending upon their locations and current loads on the existing footings, footings for the new building addition could cause settlement of adjacent walls. To reduce this concern and risk, clear distances at least equal to the new footing widths should be maintained between the addition's footings and the foundations supporting the existing building. New footings should be placed at the level of existing footings so that existing footings are not undermined or new load is not applied to existing foundation walls if the existing structure has a basement.

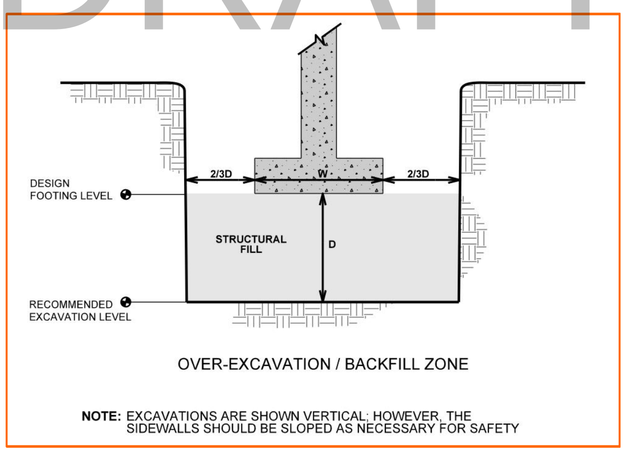
Foundation Construction Considerations

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

If unsuitable bearing soils are encountered at the base of the planned footing excavation, the excavation should be extended deeper to suitable soils, and the footings could bear directly on these soils at the lower level, or on structural soil fill or lean concrete backfill placed in the excavations. This is illustrated on the sketches below. If lean concrete backfill (minimum 28-day compressive strength of 1,500 psi) is used, widening of the footing excavation may not be needed.



Over-excavation for structural fill placement below footings should be conducted as shown below. The over-excavation should be backfilled up to the footing base elevation, with structural fill placed, as recommended in the **Earthwork** section.



FLOOR SLABS

Design parameters for floor slabs assume the requirements for **Earthwork** have been followed. Specific attention should be given to positive drainage away from the structure and positive drainage of the aggregate base beneath the floor slab.

Floor Slab Design Parameters

Item	Description
Floor Slab Support [1]	Minimum 5 inches of free-draining (less than 3% passing the U.S. No. 200 sieve) crushed aggregate compacted to at least 95% of modified Proctor (ASTM D1557) maximum dry density.
Estimated Modulus of Subgrade Reaction [2]	125 pounds per square inch per inch (psi/in) for point loads.

1. Floor slabs should be structurally independent of footings or walls to reduce the possibility of floor slab cracking caused by differential movements between the slab and foundation.
2. Modulus of subgrade reaction is an estimated value based upon our experience with the subgrade condition, the requirements noted in **Earthwork**, and the floor slab support as noted in this table. It is provided for point loads. For large area loads the modulus of subgrade reaction would be lower.

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

Saw-cut control joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations refer to the ACI Design Manual. Joints or cracks should be sealed with a water-proof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means.

Floor Slab Construction Considerations

Finished subgrade, within and for at least 10 feet beyond the floor slab, should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become damaged or desiccated prior to construction of floor slabs, the affected material should be removed and structural fill should be added to replace the resulting excavation. Final conditioning of the finished subgrade should be performed immediately prior to placement of the floor slab support course.

The Geotechnical Engineer should approve the condition of the floor slab subgrades immediately prior to placement of the floor slab support course, reinforcing steel, and concrete. Attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located.

SEISMIC CONSIDERATIONS

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7-10.

Description	Value
2012/2015 International Building Code Site Classification (IBC) [1]	C [2]
Site Latitude	41.70216° N
Site Longitude	87.60669° W
S_{DS} Spectral Acceleration for a Short Period [3]	0.110 g
S_{D1} Spectral Acceleration for a 1-Second Period [3]	0.073 g

1. Seismic site classification in general accordance with the *2012/2015 International Building Code*, which refers to ASCE 7-10.
2. The 2012/2015 International Building Code (IBC) uses a site profile extending to a depth of 100 feet for seismic site classification. Borings at this site were extended to a maximum depth of 50 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.
3. These values were obtained using online seismic design maps and tools provided by the USGS (http://earthquake.usgs.gov/hazards/designmaps/).

EARTHWORK

Earthwork is anticipated to include clearing and grubbing, excavations, and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations, floor slabs, and pavements.

Site Preparation

The existing pavements (including crushed stone material), vegetation, topsoil, and other debris/unsuitable material should be completely removed from the proposed construction areas. The existing pavement materials could be crushed to an appropriate gradation and reused as structural soil fill or recycled pavement, if deemed cost effective. Crushed stone may also be reused, if desired. Proper drainage should be maintained during construction so that ponding of surface runoff does not occur and cause construction delays and/or inhibit site access.

As noted in **Geotechnical Characterization**, existing fill was encountered in borings B-1 and B-6 through B-9 to depths ranging from about 2 to 3 feet. Fill soils may be present at other locations and at varying depths within the site not explored during our field program. Support of floor slabs and pavements on or above existing fill soils is discussed in this report. However, even with the recommended construction procedures, there is an inherent risk for the owner that compressible fill or unsuitable material within or buried by the fill will not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill but can be reduced by following the recommendations contained in this report.

Once initial stripping has been completed, the exposed subgrade soils should be proof-rolled with an adequately loaded vehicle such as a fully loaded tandem axle dump truck with a gross weight of at least 25 tons or similar loaded equipment. The proof-rolling should be performed under the direction of the Geotechnical Engineer. Areas that rut or excessively deflect under the proof-roll should be improved by scarifying and compaction or by removal and replacement with an approved engineered fill as discussed in **Fill Material Types**. Excessively wet or dry material should either be removed or moisture conditioned and recompacted.

Fill Material Types

Engineered fill should meet the following material property requirements:

Soil Type [1, 2]	USCS Classification	Acceptable Location for Placement
Cohesive	CL[3], CL-ML[3] (LL ≤ 45 and PI ≤ 20)	Adjacent to footings Below/Adjacent to floor slabs and pavements
Granular	GW, GP, GM, GC, SW, SP, SM, SC 5% to 15% passing #200 sieve	Below/Adjacent to footings, floor slabs, and pavements
Unsuitable	CH[4], MH[4], OL OH[4], PT	Non-structural locations (general fill can include engineered fill as well)

1. Engineered fill soils should consist of approved materials free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site.
2. Any organic material, rock fragments larger than 3 inches, and other unsuitable material should be removed prior to use of these soils as fill.
3. Highly susceptible to frost, unstable when wet, are commonly used for pavement support with the knowledge that additional maintenance and/or shorter pavement life are likely.
4. High plasticity CH, MH, or OH soils should not be used beneath or adjacent to movement sensitive structures such as foundations, floor slabs, and pavements.

Fill Compaction Requirements

Engineered fill should meet the following compaction requirements:

Item	Description
Maximum Lift Thickness	9 inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used
Minimum Compaction Requirements [1, 2, 3]	95% of the modified Proctor (ASTM D1557) maximum dry density below foundations, floor slabs, and pavements. The compaction effort should extend laterally beyond the edges of the structures at least 8 inches for every foot of fill below the structure's elevation. 90% of the modified Proctor (ASTM D1557) maximum dry density in landscape areas.
Water Content Range [1]	Cohesive: -2% to +3% of modified Proctor optimum moisture content (ASTM D1557) at the time of placement and compaction. Granular: As required to achieve minimum compaction requirements.

1. We recommend that engineered fill soils be tested for moisture content and compaction during placement. If the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.
2. If the granular material is a coarse sand or gravel, is of uniform size, or has a low fines content, compaction comparison to relative density (ASTM D4253 and D4254) may be more appropriate. In this case, granular material should be compacted to at least 60% and 65% of the maximum relative density for the 90% and 95% modified Proctor recommendations, respectively.
3. Moisture levels should be maintained to achieve compaction without bulking during placement or pumping when proof-rolled.

Grading and Drainage

All grades must provide effective drainage away from the building during and after construction. Final surrounding grades should be sloped away from the structure on all sides to prevent ponding of water. Gutters, downspouts, or other appropriate methods that direct water a minimum of 5 feet beyond the footprint of the proposed structure is recommended. Site grades should be set considering the estimated seasonal high groundwater presented in **Geotechnical Characterization**.

Exposed ground should be sloped and maintained at a minimum 5 percent away from the building for at least 5 feet beyond the perimeter of the building. Locally, flatter grades may be necessary to transition ADA access requirements for flatwork. After building construction and landscaping, final grades should be verified to document effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted as necessary as part of the structure's maintenance program. Where paving or flatwork abuts the structure a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

Earthwork Construction Considerations

After initial proofrolling and compaction, unstable subgrade conditions could develop during general construction operations, particularly if the soils are wetted and/or subjected to repetitive construction traffic. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of floor slabs. Construction traffic over the completed subgrades should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become frozen, desiccated, saturated, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted, prior to floor slab construction.

Based on the groundwater conditions observed during our field program and the predominantly clay soils encountered at this site, groundwater is not expected to be a major concern during construction of the proposed structures. However, if water seepage is encountered, the contractor should be prepared to remove water from the excavations. Water should not be allowed to accumulate in the bottom of the excavations. Water seepage that may occur can likely be managed by sump pits and pumps.

As a minimum, all temporary excavations should be sloped or braced as required by Occupational Health and Safety Administration (OSHA) regulations to provide stability and safe working conditions. Temporary excavations will probably be required during foundation and underground fuel tank construction operations. The contractor, by his contract, is usually responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required, to maintain stability of both the excavation sides and bottom. All excavations should comply with applicable local, state and federal safety regulations, including the current OSHA Excavation and Trench Safety Standards.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

The earthwork efforts should be monitored under the observation of the Geotechnical Engineer or their representative. Monitoring should include documentation of adequate removal of vegetation and top soil, proof-rolling and mitigation of areas delineated by the proof-roll to require mitigation.

Each lift of compacted fill should be tested, evaluated, and reworked as necessary until approved by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency stated in **Earthwork**.

In areas of foundation excavations, the bearing subgrade should be evaluated under the direction of the Geotechnical Engineer. In the event unanticipated conditions are encountered, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

PAVEMENTS

General Pavement Comments

We understand that a new driveway is planned to be constructed at this site. Pavement designs are provided for the traffic conditions and pavement life conditions as noted in **Project Description** and in the following sections of this report. A critical aspect of pavement performance is site preparation. Pavement designs, noted in this section, must be applied to the site, which has been prepared as recommended in the **Earthwork** section.

Pavement Design Parameters

Design of Asphaltic Concrete (AC) pavements are based on the procedures outlined in the National Asphalt Pavement Association (NAPA) Information Series 109 (IS-109). Design of Portland Cement Concrete (PCC) pavements are based upon American Concrete Institute (ACI) 330R-01; Guide for Design and Construction of Concrete Parking Lots.

A subgrade CBR of 3 was used for the AC pavement designs, and a modulus of subgrade reaction of 125 pci was use for the PCC pavement designs. The values were empirically derived based upon our experience with the described soil type subgrade soils and our understanding of the quality of the subgrade as prescribed by the **Site Preparation** conditions as outlined in **Earthwork**.

Driveway Pavement Section Thicknesses

The following table provides options for AC and PCC Sections:

Asphaltic Concrete Design	
Layer	**Thickness (inches)**
	Driveway
Asphaltic Concrete [1]	3½
Aggregate Base [2]	10

1. Illinois Department of Transportation (IDOT) requires that the minimum AC binder lift thickness be 3 times the normal aggregate size. For a typical IDOT binder mix (IL-19.0 N50), the minimum lift thickness would be 2¼ inches.
2. IDOT CA 7 or an approved alternate gradation.

Portland Cement Concrete Design	
Layer	**Thickness (inches)**
	Driveway
Portland Cement Concrete [1]	6
Aggregate Base [2]	5

1. The PCC should be air-entrained and have a minimum compressive strength of 4,000 psi after 28 days of laboratory curing (ASTM C31).
2. IDOT CA 7 or an approved alternate gradation.

We recommend a minimum 7 inches of PCC in areas of anticipated heavy traffic, fire trucks, delivery trucks, or concentrated loads (e.g. dumpster pads), and areas with repeated turning or maneuvering of heavy vehicles.

If asphalt pavements are used in truck traffic areas, the owner must accept the potential for some rutting/shoving of the pavement surface. Frequent mill-and-overlay rehabilitation or other pavement repairs may be required if asphalt pavements are used in areas subject to turning trucks and/or heavy static loads (e.g. parked trucks/trailers).

PCC pavements should be designed with longitudinal and transverse joints spaced no more than 15 feet apart. Control joints should be saw-cut at least ¼ of the depth of the concrete section and should be cut within the approximate timeframe (usually within 12 to 24 hours, depending on the concrete mix properties and conditions at the time of placement). Expansion (isolation) joints must be full depth and should only be used to isolate fixed objects abutting or within the paved area.

All joints should be sealed and maintained. The pavement designer should select the joint sealant material based on expected joint movement, in accordance with ACI 504 “Guide to Sealing Joints in Concrete Structures". All joint sealant reservoirs should be designed to accommodate the specified joint sealant compound's thermal and shrinkage tolerances.

Pavements and subgrades will be subject to freeze-thaw cycles and seasonal fluctuations in moisture content. Construction traffic on the pavements was not considered in developing the estimated minimum pavement thicknesses. If the pavements will be subject to construction equipment/vehicles, the pavement sections should be revised to consider the additional loading.

Pavement Drainage

Pavements and adjacent sidewalks should be sloped to provide rapid drainage of surface water. Water should not be allowed to pond on or adjacent to the pavements or sidewalks, since this could saturate the subgrade and contribute to premature pavement or slab deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the granular base section. Appropriate sub-drainage or connection to a suitable daylight outlet should be provided to remove water from the granular subbase.

Pavement Maintenance

The design life is considered to be the interval over which, with proper maintenance, the pavement will not require major repairs. A regular maintenance program should be implemented to maintain satisfactory serviceability over the deign life.

The pavement sections represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore, preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Maintenance consists of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Preventive maintenance is usually the priority when implementing a pavement maintenance program. Additional engineering observation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur, and repairs may be required.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2%.
- Subgrade and pavement surfaces should have a minimum 2% slope to promote proper surface drainage.
- Install below pavement drainage systems surrounding areas anticipated for frequent wetting.
- Install joint sealant and seal cracks immediately.

- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.
- Place compacted, low permeability backfill against the exterior side of curb and gutter.
- Place curb, gutter and/or sidewalk directly on clay subgrade soils rather than on unbound granular base course materials.

STORMWATER DETENTION POND CONSIDEATIONS

We understand that a stormwater detention pond is planned to be constructed at the southwest corner of the property. We anticipate the detention pond will have a maximum depth of 5 feet. Based on the soil boring B-7 drilled in the detention pond area, the native soils, as defined by the USDA Textural Classification System, consisted of clay. The design infiltration rate for the native clay encountered is estimated to be 0.07 inches per hour as defined by Table 3-1 of the Chicago Stormwater Ordinance Manual, page 31. Thus, the native clays are relatively impermeable, and the detention pond should be designed on the assumption that water will not infiltrate into the clay soils.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

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

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Boring Number	Boring Depth (feet)	Planned Location
B-1 through B-4	30	Building addition area
B-5	50	
B-6	15	Hardscape area
B-7	10	Stormwater detention pond area
B-8	15	New synthetic turf area
B-9	10	

Boring Layout and Elevations: The borings were located using field measurements from existing site features. The approximate surface elevations are obtained by interpolation from the site-specific, surveyed topographic map provided to us. We understand the elevations on the topographic map are refenced to the Chicago City Datum (CCD).

Subsurface Exploration Procedures: We advanced the borings with a truck-mounted rotary drill rig using hollow stem continuous flight auger and power auger drilling techniques. Samples were obtained at 2.5-foot intervals in the upper 15 feet of each boring and at intervals of 5 feet thereafter. Soil sampling was mostly performed using split-barrel sampling procedure. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon is driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. A few samples were obtained using thin-walled tube sampling procedure. In the thin-walled tube sampling procedure, a thin-walled, seamless steel tube with a sharp cutting edge was pushed hydraulically into the soil to obtain a relatively undisturbed sample. We observed and recorded groundwater levels during drilling and upon completion of drilling. For safety purposes, B-5 was backfilled with grout and the remaining borings were backfilled with auger cuttings and bentonite chips after their completion. Pavements were patched with cold-mix asphalt, as appropriate.

The sampling depths, penetration distances, and other sampling information were recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a geotechnical engineer. Our exploration team prepared field boring logs as part of the drilling operations. These field logs include visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the geotechnical engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

In-Situ Infiltration Tests: Two (2) single-ring infiltration tests was performed at boring B-8 and B-9 within the proposed new artificial turf area. This test consisted of setting a 12-inch inside diameter casing pipe approximately three to four feet below grade. The annulus around the casing pipe was filled will bentonite chips to prevent the outflow of water from the bottom of the casing out through the annulus. Water was then added to the pipe to maintain a constant water head above the base of the casing pipe. The results of the in-situ infiltration tests are included in **Exploration Results** section of this report.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests to better understand the engineering properties of the soil strata encountered in the borings. The following tests were performed on the samples. The test results are provided on the boring logs included in **Exploration Results** section of this report.

- Hand penetrometer compressive strength
- Moisture content
- Unconfined compressive strength

The laboratory testing program included examination of soil samples by the project engineer. Based on the material's texture and plasticity, we described and classified the soil samples in general accordance with the Unified Soil Classification System (USCS).

SITE LOCATION AND EXPLORATION PLANS

Contents:

Site Location
Exploration Plan

SITE LOCATION

Poe Elementary School Annex ■ Chicago, Illinois

November 1, 2018 ■ Terracon Project No. MR185297

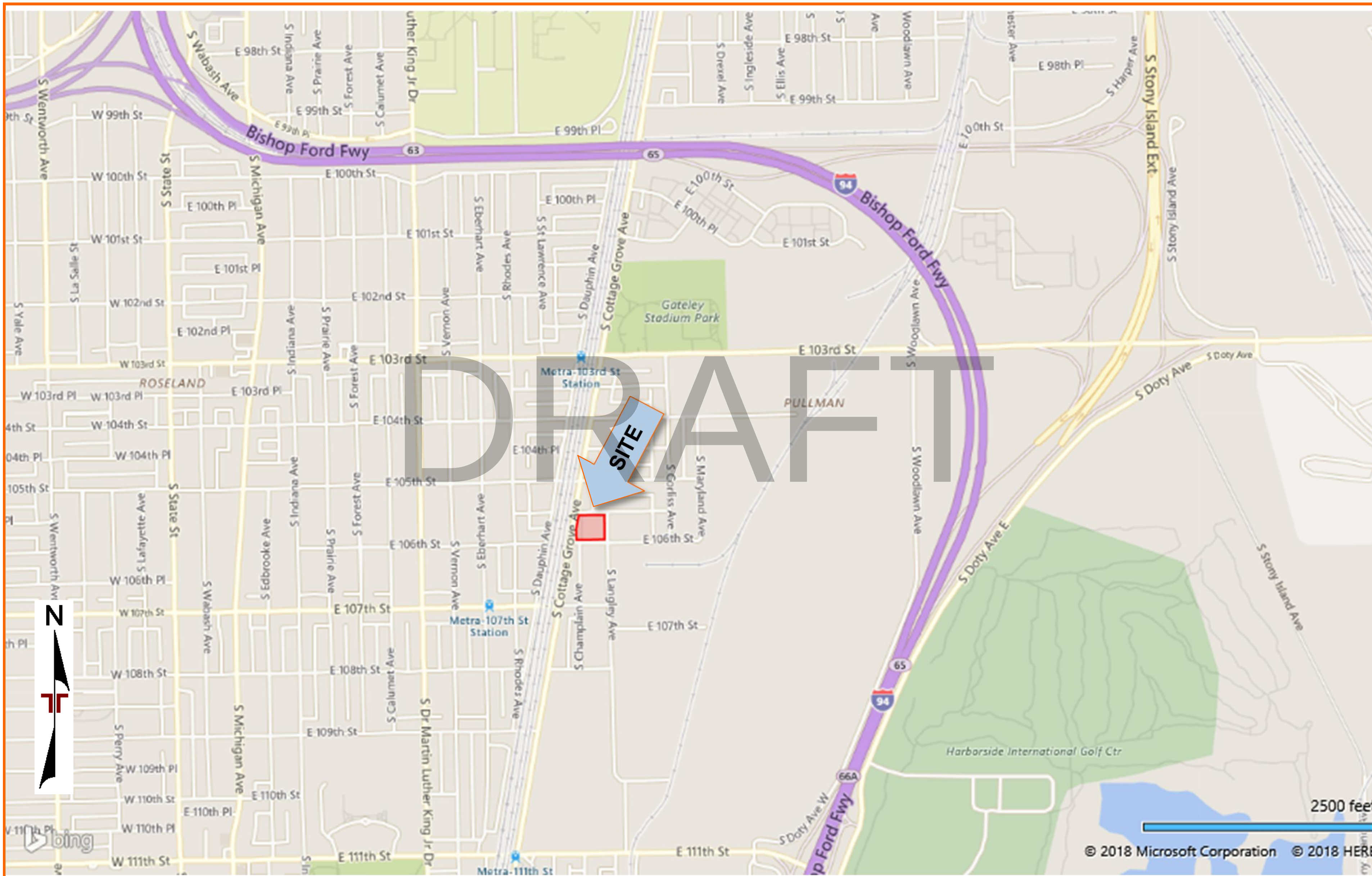


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

Poe Elementary School Annex ■ Chicago, Illinois
November 1, 2018 ■ Terracon Project No. MR185297

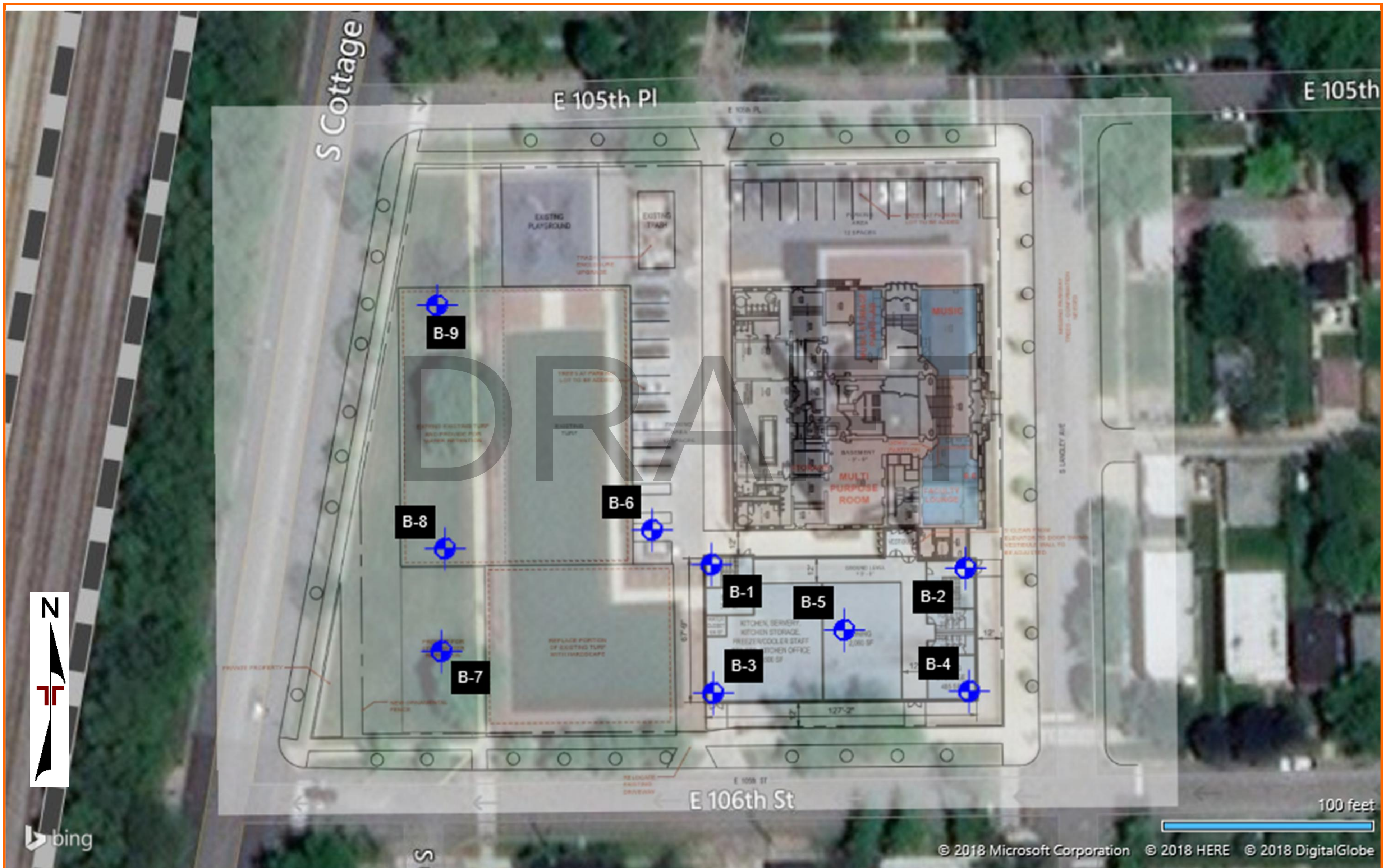


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

Contents:

Boring Logs (B-1 through B-9)
Infiltration Test Results (2 pages)

BORING LOG NO. B-1

PROJECT: Poe Elementary School Annex

CLIENT: Public Building Commission of Chicago
Chicago, Illinois

SITE: 10538 S. Langley Avenue
Chicago, Illinois

LOCATION See Exploration Plan

Latitude: 41.7022° Longitude: -87.6069°

Approximate Surface Elev: 13.8 (Ft.) +/-

DEPTH (Ft.)	Description	ELEVATION (Ft.)
1.0	**CONCRETE PAVEMENT**, about 12 inches of concrete	13+/-
1.3	**FILL - RECYCLED ASPHALT FRAGMENTS**, recycled asphalt with glass fragment	12.5+/-
2.5	**FILL - LEAN CLAY (CL)**, dark gray and brown, with traces of sand	11.5+/-
18.0	**LEAN CLAY (CL)**, brown and gray, very stiff, with traces of sand and gravel; - gray 8.5 to 18 feet	-4+/-
30.0	**LEAN CLAY (CL)**, gray, very stiff to hard, with traces of sand and gravel	-16+/-
	Boring Terminated at 30 Feet	

Approx. Depth (Ft.)	Water Level Observations	Recovery ()	Field Test Results	Sample Number	Laboratory HP (tsf)	Strength Test: Test Type	Compressive Strength (tsf)	Strain (%)	Water Content (%)
0.5				1					
1.3		3	2/3"	2	2.25 (HP)				15
2		12	2-2	2A					31
4		15	2-2-3 N=5	3	2.75 (HP)				24
6.5	▽ (7 ft)	15	1-2-3 N=5	4	2.50 (HP)				21
9		15	4-5-6 N=11	5	3.00 (HP)				17
12		24		6	4.25 (HP)	UC	3.95	12.4	12
14		15	4-5-7 N=12	7	3.50 (HP)				19
19		18	5-8-13 N=21	8	5.50 (HP)				16
24		18		9	6.25 (HP)	UC	2.51	5.8	9
29		18	9-14-15 N=29	10	6.50 (HP)				13

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

Hammer Type: Automatic

Advancement Method:
4" casings to depth of 10 feet; power augered thereafter.

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *7 ft Before casing removal*

▽ *7 ft After casing removal*

Terracon
650 W Lake St, Ste 420
Chicago, IL

Boring Started: 10-23-2018	Boring Completed: 10-23-2018
Drill Rig: CME-75	Driller: STRATA/Ullrich
Project No.: MR185297	

BORING LOG NO. B-2

PROJECT: Poe Elementary School Annex

CLIENT: Public Building Commission of Chicago Chicago, Illinois

SITE: 10538 S. Langley Avenue Chicago, Illinois

LOCATION See Exploration Plan

Latitude: 41.7022° Longitude: -87.6065°

Approximate Surface Elev: 13.7 (Ft.) +/-

DEPTH	MATERIAL DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE NUMBER	LABORATORY HP (tsf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)
0.5	**ASPHALT PAVEMENT**, approximately 2.5 inches of asphaltic concrete overlying about 3 inches of crushed stone	13.5+/-						1					
	LEAN CLAY (CL), dark gray, very stiff to hard, with traces of sand and gravel					15	1-2-3 N=5	2	3.00 (HP)				24
	- brown and gray 3.5 to 8.5 feet					18	2-2-3 N=5	3	3.50 (HP)				20
			5			18	2-3-4 N=7	4	5.50 (HP)				18
	- gray 8.5 to 22.5 feet					18	2-3-5 N=8	5	3.00 (HP)				7
			10			18	3-5-6 N=11	6	4.00 (HP)				17
						18	3-5-7 N=12	7	4.50 (HP)				18
			15										
						18	7-9-14 N=23	8	3.25 (HP)				19
			20										
22.5	**LEAN CLAY (CL)**, gray, hard, with traces of sand and gravel	-9+/-											
						18	14-15-17 N=32	9	7.50 (HP)				11
			25										
30.0		-16.5+/-				18	8-8-11 N=19	10	7.50 (HP)				13
	Boring Terminated at 30 Feet		30										

DRAFT

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

Hammer Type: Automatic

Advancement Method:
2¼" hollow stem augers

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not encountered

Terracon
650 W Lake St, Ste 420
Chicago, IL

Boring Started: 10-22-2018	Boring Completed: 10-22-2018
Drill Rig: CME-45	Driller: STRATA/Ullrich
Project No.: MR185297	

BORING LOG NO. B-3

PROJECT: Poe Elementary School Annex

CLIENT: Public Building Commission of Chicago Chicago, Illinois

SITE: 10538 S. Langley Avenue Chicago, Illinois

LOCATION See Exploration Plan

Latitude: 41.7021° Longitude: -87.6069°

Approximate Surface Elev: 13.5 (Ft.) +/-

DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE NUMBER	LABORATORY HP (tsf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)
1.0	**CONCRETE PAVEMENT**, about 12 inches of concrete	12.5+/-											
	LEAN CLAY (CL), gray and brown, stiff to very stiff, with traces of sand and gravel				X	6	3-2-2 N=4	1	2.50 (HP)				26
			5		X	6	1-2-3 N=5	2	2.50 (HP)				23
					X	18	1-3-4 N=7	3	1.75 (HP)				24
	- gray 8.5 to 22.5 feet		10		X	18	4-5-7 N=12	4	2.25 (HP)				18
					X	18	3-5-8 N=13	5	2.00 (HP)				17
			15		X	18	3-4-8 N=12	6	2.50 (HP)				20
			20		X	18	5-7-15 N=22	7	4.00 (HP)				18
22.5		-9+/-											
	LEAN CLAY (CL), gray, hard, with traces of sand and gravel		25		X	18	12-13-18 N=31	8					18
30.0		-16.5+/-	30		X	18	5-7-11 N=18	9	4.50 (HP)				15
	Boring Terminated at 30 Feet												

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

Hammer Type: Automatic

Advancement Method:
4" casings to depth of 10 feet; power augered thereafter.

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not encountered

Terracon
650 W Lake St, Ste 420
Chicago, IL

Boring Started: 10-24-2018 | Boring Completed: 10-24-2018

Drill Rig: B-57 | Driller: STRATA/Ullrich

Project No.: MR185297

DRAFT

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL MR185297 POE ELEMENTARY SC.GPJ TERRACON_DATATEMPLATE.GDT 11/1/18

BORING LOG NO. B-4

PROJECT: Poe Elementary School Annex

CLIENT: Public Building Commission of Chicago Chicago, Illinois

SITE: 10538 S. Langley Avenue Chicago, Illinois

LOCATION See Exploration Plan

Latitude: 41.7021° Longitude: -87.6065°

Approximate Surface Elev: 13.2 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DESCRIPTION	SAMPLE NUMBER	RECOVERY ()	FIELD TEST RESULTS	LABORATORY HP (tsf)	TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)	WATER CONTENT (%)
0.5	13+/-	**ASPHALT PAVEMENT**, approximately 2.5 inches of asphaltic concrete overlying about 3 inches of crushed stone	1							
		LEAN CLAY (CL), dark gray, stiff to very stiff, with traces of sand and gravel	2	9	2-3-3 N=6	2.75 (HP)				29
		- brown and gray 3.5 to 6 feet	3	10	2-3-3 N=6	3.50 (HP)				20
		- gray 6 to 18.5 feet	4	9	1-3-4 N=7	1.50 (HP)				25
			5	21		3.00 (HP)	UC	3.04	6.4	10
			6	18	2-4-6 N=10	2.00 (HP)				21
			7	14	3-3-4 N=7	2.50 (HP)				18
18.5	-5.5+/-	**CLAYEY SILT (ML)**, gray, medium stiff	8	17		0.75 (HP) 3.00 (HP)	UC	0.48 1.09	15	17
20.5	-7.5+/-	**LEAN CLAY (CL)**, gray, hard, with traces of sand and gravel	9	15	9-12-16 N=28	7.50+ (HP)				13
30.0	-17+/-		10	18	10-12-13 N=25	7.50 (HP)				13

Boring Terminated at 30 Feet

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

Hammer Type: Automatic

Advancement Method:
4" casings to depth of 10 feet; power augered thereafter.

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not encountered

Terracon
650 W Lake St, Ste 420
Chicago, IL

Boring Started: 10-24-2018 | Boring Completed: 10-24-2018

Drill Rig: B-57 | Driller: STRATA/Ullrich

Project No.: MR185297

BORING LOG NO. B-5

PROJECT: Poe Elementary School Annex

CLIENT: Public Building Commission of Chicago Chicago, Illinois

SITE: 10538 S. Langley Avenue Chicago, Illinois

LOCATION See Exploration Plan

Latitude: 41.7022° Longitude: -87.6067°

Approximate Surface Elev: 13.3 (Ft.) +/-

DEPTH	MATERIAL DESCRIPTION	ELEVATION (Ft.)
0.4	**ASPHALT PAVEMENT**, approximately 2 inches of asphaltic concrete overlying about 3 inches of crushed stone	13+/-
	LEAN CLAY (CL), dark gray and brown, stiff to hard, with traces of sand and gravel - gray and brown 3.5 to 6 feet - gray 6 to 22.5 feet	
22.5		-9+/-
	LEAN CLAY (CL), gray, very stiff to hard, with traces of sand and gravel	

SAMPLE NUMBER	RECOVERY ()	FIELD TEST RESULTS	LABORATORY HP (tsf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)
1							
2	14	3-3-4 N=7	3.00 (HP)				24
3	10	1-2-3 N=5	2.50 (HP)				22
4	14	WOH-2-2 N=4	1.50 (HP)				24
5	20		3.00 (HP)	UC	6.30	9.2	17
6	22	3-6-9-11 N=15	2.50 (HP)				18
7	18	4-8-10 N=18	3.50 (HP)				18
8	22		4.75 (HP)	UC	3.49	15	13
9	18	10-16-18 N=34					14
10	23		10.00 (HP)	UC	6.32	7.1	8

DEPTH (Ft.): 5, 10, 15, 20, 25, 30

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

Hammer Type: Automatic

Advancement Method:
4" casings to depth of 10 feet; power augered thereafter.

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not encountered

Terracon
650 W Lake St, Ste 420
Chicago, IL

Boring Started: 10-24-2018	Boring Completed: 10-24-2018
Drill Rig: B-57	Driller: STRATA/Ullrich
Project No.: MR185297	

BORING LOG NO. B-5

PROJECT: Poe Elementary School Annex

CLIENT: Public Building Commission of Chicago, Chicago, Illinois

SITE: 10538 S. Langley Avenue, Chicago, Illinois

LOCATION See Exploration Plan

Latitude: 41.7022° Longitude: -87.6067°

Approximate Surface Elev: 13.3 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE NUMBER	LABORATORY HP (tsf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)
LEAN CLAY (CL), gray, very stiff to hard, with traces of sand and gravel *(continued)*												
		35			18	5-7-11 N=18	11	4.00 (HP)				15
		40			24		12	8.25 (HP)	UC	6.81	11.3	9
		45			18	7-9-11 N=20	13	4.75 (HP)				14
50.0	-36.5+/-	50			18	9-13-18 N=31	14	6.25 (HP)				14
Boring Terminated at 50 Feet												

DRAFT

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

Hammer Type: Automatic

Advancement Method:
4" casings to depth of 10 feet; power augered thereafter.

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not encountered

Terracon
650 W Lake St, Ste 420
Chicago, IL

Boring Started: 10-24-2018	Boring Completed: 10-24-2018
Drill Rig: B-57	Driller: STRATA/Ullrich
Project No.: MR185297	

BORING LOG NO. B-6

PROJECT: Poe Elementary School Annex

CLIENT: Public Building Commission of Chicago, Chicago, Illinois

SITE: 10538 S. Langley Avenue, Chicago, Illinois

LOCATION See Exploration Plan

Latitude: 41.7023° Longitude: -87.607°

Approximate Surface Elev: 13.1 (Ft.) +/-

DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE NUMBER	LABORATORY HP (tsf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)
0.7	**ASPHALT PAVEMENT**, approximately 4 inches of asphaltic concrete overlying about 4 inches of crushed stone	12.5+/-						1					
						18	7-7-5 N=12	2					15
3.0	**FILL - SILTY SAND (SM)**, brown and gray, with traces of gravel	10+/-											
	LEAN CLAY (CL), brown and gray, very stiff to hard, with traces of sand and gravel					18	2-2-3 N=5	3	4.00 (HP)				21
			5										
						18	2-4-4 N=8	4	4.50 (HP)				20
	- gray below 8.5 feet					18	3-5-6 N=11	5	3.50 (HP)				18
			10										
						18	3-5-7 N=12	6	4.50 (HP)				18
15.0		-2+/-	15			18	6-8-11 N=19	7	4.75 (HP)				18
	Boring Terminated at 15 Feet												

DRAFT

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

Hammer Type: Automatic

Advancement Method:
Power auger

Abandonment Method:
Boring backfilled with cement-bentonite grout upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not encountered

Terracon
650 W Lake St, Ste 420
Chicago, IL

Boring Started: 10-22-2018 | Boring Completed: 10-22-2018

Drill Rig: CME-45 | Driller: STRATA/Ullrich

Project No.: MR185297

BORING LOG NO. B-7

PROJECT: Poe Elementary School Annex

CLIENT: Public Building Commission of Chicago
Chicago, Illinois

SITE: 10538 S. Langley Avenue
Chicago, Illinois

LOCATION See Exploration Plan

Latitude: 41.7021° Longitude: -87.6074°

Approximate Surface Elev: 12.8 (Ft.) +/-

DEPTH	Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE NUMBER	LABORATORY HP (tsf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)
1.0	**TOPSOIL**, about 12 inches of topsoil, with crushed concrete fragments	12+/-						1					23
2.5	**FILL - LEAN CLAY (CL)**, brown and gray, with traces of sand and gravel	10.5+/-				15	7-4-7 N=11	2	5.50 (HP)				19
	LEAN CLAY (CL), brown and gray, stiff to very stiff, with traces of sand and gravel					18	2-3-4 N=7	3	3.50 (HP)				21
			5										
	- gray below 6 feet					6	2	4	1.50 (HP)				19
	- with brown sand layer 7 to 7.5 feet					12	3-4	4A					8
10.0		3+/-	10			18	3-3-4 N=7	5	2.75 (HP)				18

Boring Terminated at 10 Feet

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

Hammer Type: Automatic

Advancement Method:
Power auger

Abandonment Method:
Boring backfilled with soil cuttings and bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not encountered

Terracon
650 W Lake St, Ste 420
Chicago, IL

Boring Started: 10-22-2018	Boring Completed: 10-22-2018
Drill Rig: CME-45	Driller: STRATA/Ullrich
Project No.: MR185297	

BORING LOG NO. B-8

PROJECT: Poe Elementary School Annex

**CLIENT: Public Building Commission of Chicago
Chicago, Illinois**

**SITE: 10538 S. Langley Avenue
Chicago, Illinois**

LOCATION See Exploration Plan

Latitude: 41.7023° Longitude: -87.6074°

Approximate Surface Elev: 12.9 (Ft.) +/-

DEPTH	Material Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE NUMBER	LABORATORY HP (tsf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)
1.0	**TOPSOIL**, about 12 inches of topsoil, with crushed stone fragments	12+/-						1					18
2.0	**FILL - CLAY MIXED WITH ASPHALT FRAGMENTS**	11+/-				12	4-4	2					16
						6	3	2A					20
	LEAN CLAY (CL), brown and gray, very stiff to hard, with traces of sand and gravel					18	3-3-3 N=6	3	2.75 (HP)				22
			5										
	- gray below 6 feet					18	2-3-5 N=8	4	3.50 (HP)				17
						18	3-5-5 N=10	5	3.75 (HP)				18
			10										
						18	3-4-6 N=10	6	3.75 (HP)				19
15.0		-2+/-	15			18	5-6-11 N=17	7	5.00 (HP)				18

Boring Terminated at 15 Feet

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

Hammer Type: Automatic

Advancement Method:
Power auger

Abandonment Method:
Boring backfilled with soil cuttings and bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not encountered

Terracon
650 W Lake St, Ste 420
Chicago, IL

Boring Started: 10-22-2018	Boring Completed: 10-22-2018
Drill Rig: CME-45	Driller: STRATA/Ullrich
Project No.: MR185297	

BORING LOG NO. B-9

PROJECT: Poe Elementary School Annex

CLIENT: Public Building Commission of Chicago
Chicago, Illinois

SITE: 10538 S. Langley Avenue
Chicago, Illinois

LOCATION See Exploration Plan

Latitude: 41.7026° Longitude: -87.6074°

Approximate Surface Elev: 12.8 (Ft.) +/-

DEPTH	MATERIAL DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY ()	FIELD TEST RESULTS	SAMPLE NUMBER	LABORATORY HP (tsf)	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH (tsf)	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)
1.0	**TOPSOIL**, about 12 inches of topsoil	12+/-						1					17
2.0	**FILL - POORLY GRADED SAND WITH GRAVEL (SP)**, brown and gray, with clay lenses	11+/-				12	16-7	2					7
	LEAN CLAY (CL), gray, very stiff to hard, with traces of sand and gravel					6	6	2A	4.50 (HP)				19
						18	2-3-5 N=8	3	5.00 (HP)				19
			5										
						18	3-4-4 N=8	4	4.75 (HP)				19
10.0		3+/-				18	3-3-5 N=8	5	3.50 (HP)				19
	Boring Terminated at 10 Feet		10										

DRAFT

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

Hammer Type: Automatic

Advancement Method:
Power auger

Abandonment Method:
Boring backfilled with soil cuttings and bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Not encountered

Terracon
650 W Lake St, Ste 420
Chicago, IL

Boring Started: 10-22-2018	Boring Completed: 10-22-2018
Drill Rig: CME-45	Driller: STRATA/Ullrich
Project No.: MR185297	

Single-Ring Infiltrometer Infiltration Rate Determination

Project:	Poe Elementary School Annex
Project No.:	MR185297
Boring No.	B-8
Operators:	STRATA/Steve
Date of Test:	10/23/2018

FIELD DATA

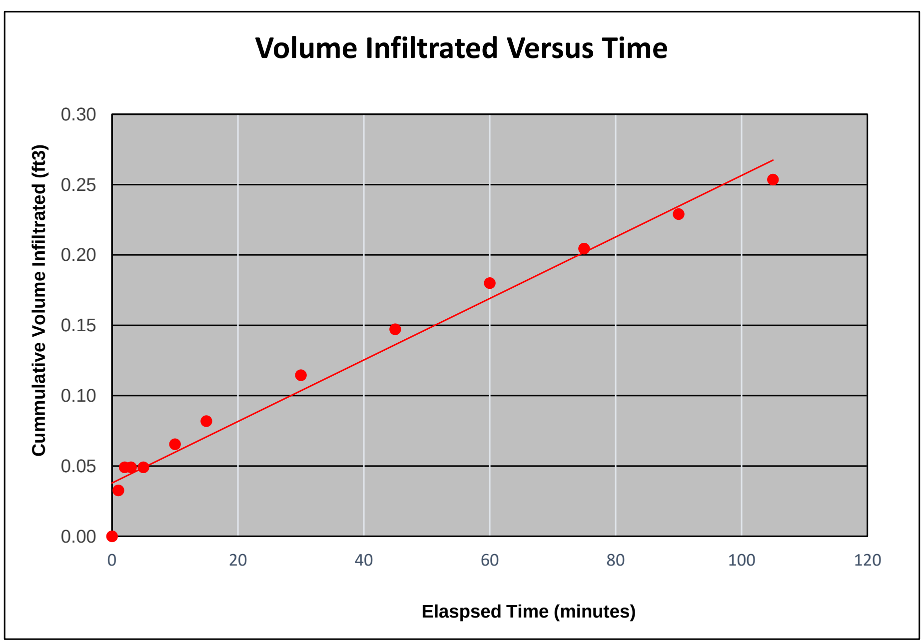
Elapsed Time (minutes)	Change in Time (minutes)	Water Decline (inches)	Water Decline (feet)	Cumulative Volume (ft^3)
0	0	0	0	0
1	1	0.5	0.04167	0.03272
2	1	0.25	0.02083	0.04909
3	1	0	0.00000	0.04909
5	2	0	0.00000	0.04909
10	5	0.25	0.02083	0.06545
15	5	0.25	0.02083	0.08181
30	15	0.5	0.04167	0.11454
45	15	0.5	0.04167	0.14726
60	15	0.5	0.04167	0.17999
75	15	0.375	0.03125	0.20453
90	15	0.375	0.03125	0.22907
105	15	0.375	0.03125	0.25362
	Total:	**3.875**	**0.32292**	**0.25362**

INFILTROMETER SETUP

Casing Diameter	1	ft
Casing Radius	0.5	ft
Infiltrometer Volume Rate	0.78540	ft^3 per foot of drop
Depth of Test below Grade	3	ft
Average Depth of Water in Casing, z	5	ft
In-Situ Soil Porosity, n	0.3	(assumed)

CALCULATED VALUES

Total Water Decline, y_t	0.32292	feet
Rate, i_n	0.00003472	ft/sec
Flow Rate or Flux, i_w	0.00001543	ft/sec
Depth of Wet Front, L	0.478	feet
Infiltration Rate, K	**0.00000135**	**ft/sec**
	0.06	**in/hr**



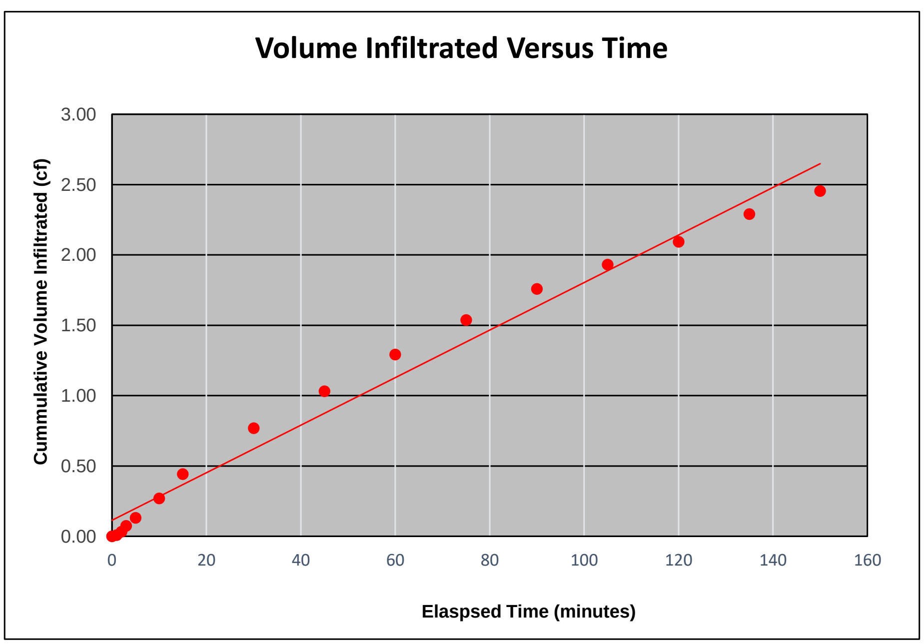
Single-Ring Infiltrometer Infiltration Rate Determination

Project:	Poe Elementary School Annex	**Operators:**	STRATA/Steve
Project No.:	MR185297	**Date of Test:**	10/23/2018
Boring No.	B-9		

FIELD DATA				
Elapsed Time (minutes)	Change in Time (minutes)	Water Decline (inches)	Water Decline (feet)	Cumulative Volume (ft^3)
0	0	0	0.00000	0
1	1	0.125	0.01042	0.00818
2	1	0.375	0.03125	0.03272
3	1	0.625	0.05208	0.07363
5	2	0.875	0.07292	0.13090
10	5	2.125	0.17708	0.26998
15	5	2.625	0.21875	0.44179
30	15	5	0.41667	0.76904
45	15	4	0.33333	1.03084
60	15	4	0.33333	1.29263
75	15	3.75	0.31250	1.53807
90	15	3.375	0.28125	1.75896
105	15	2.625	0.21875	1.93077
120	15	2.5	0.20833	2.09440
135	15	3	0.25000	2.29074
150	15	2.5	0.20833	2.45437
	Total:	**37.5**	**3.12500**	**2.45437**

INFILTROMETER SETUP		
Casing Diameter	1	ft
Casing Radius	0.5	ft
Infiltrometer Volume Rate	0.78540	ft^3 per foot of drop
Depth of Test below Grade	3	ft
Average Depth of Water in Casing, z	5	ft
In-Situ Soil Porosity, n	0.3	(assumed)

CALCULATED VALUES		
Total Water Decline, y_t	3.12500	feet
Rate, i_n	0.00023148	ft/sec
Flow Rate or Flux, i_w	0.00010288	ft/sec
Depth of Wet Front, L	4.630	feet
Infiltration Rate, K	**0.00004946**	**ft/sec**
	2.14	**in/hr**



SUPPORTING INFORMATION

Contents:

General Notes
Unified Soil Classification System

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

Poe Elementary School Annex ■ Chicago, Illinois

October 29, 2018 ■ Terracon Project No. MR185297

Terracon GeoReport

SAMPLING	WATER LEVEL	FIELD TESTS
Auger Cuttings Shelby Tube Split Spoon	**Water Initially Encountered** **Water Level After a Specified Period of Time** **Water Level After a Specified Period of Time** Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	**N** **Standard Penetration Test Resistance (Blows/Ft.)** **(HP)** **Hand Penetrometer** **(T)** **Torvane** **(DCP)** **Dynamic Cone Penetrometer** **UC** **Unconfined Compressive Strength** **(PID)** **Photo-Ionization Detector** **(OVA)** **Organic Vapor Analyzer**

DESCRIPTIVE SOIL CLASSIFICATION

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

LOCATION AND ELEVATION NOTES

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

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (tsf)**	**Standard Penetration or N-Value Blows/Ft.**
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

RELATIVE PROPORTIONS OF SAND AND GRAVEL		RELATIVE PROPORTIONS OF FINES	
Descriptive Term(s) of other constituents	Percent of Dry Weight	**Descriptive Term(s) of other constituents**	**Percent of Dry Weight**
Trace	<15	Trace	<5
With	15-29	With	5-12
Modifier	>30	Modifier	>12

GRAIN SIZE TERMINOLOGY		PLASTICITY DESCRIPTION	
Major Component of Sample	**Particle Size**	**Term**	**Plasticity Index**
Boulders	Over 12 in. (300 mm)	Non-plastic	0
Cobbles	12 in. to 3 in. (300mm to 75mm)	Low	1 - 10
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)	Medium	11 - 30
Sand	#4 to #200 sieve (4.75mm to 0.075mm	High	> 30
Silt or Clay	Passing #200 sieve (0.075mm)		

UNIFIED SOIL CLASSIFICATION SYSTEM

Terracon GeoReport

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification	
				Group Symbol	Group Name [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu ³ 4 and 1 £ Cc £ 3 [E]	GW	Well-graded gravel [F]
			Cu < 4 and/or [Cc<1 or Cc>3.0] [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 ³ 6 and 1 £ Cc £ 3 [E]	SW	Well-graded sand [I]
			Cu < 6 and/or [Cc<1 or Cc>3.0] [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G, H, I]
			Fines classify as CL or CH	SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]	CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OL	Organic clay [K, L, M, N]
					Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line	CH	Fat clay [K, L, M]
			PI plots below "A" line	MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OH	Organic clay [K, L, M, P]
					Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

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

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

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

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

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

[F] If soil contains ³ 15% sand, add "with sand" to group name.

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

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

[I] If soil contains ³ 15% gravel, add "with gravel" to group name.

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

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

[L] If soil contains ³ 30% plus No. 200 predominantly sand, add "sandy" to group name.

[M] If soil contains ³ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ³ 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.