PATERSON GROUP

Geotechnical Investigation

Proposed Warehouse Buildings

Campeau Drive at Huntmar Drive
Ottawa, Ontario

Prepared for Rosefellow Holdings Inc.

Report PG6394-1 Revision 03 dated May 31, 2023

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1.0 Introduction

Paterson Group (Paterson) was commissioned by Rosefellow Holdings Inc. to prepare a geotechnical investigation report for the proposed industrial development to be located at Campeau Drive at Huntmar Drive, Ottawa, Ontario (refer to Figure 1 - Key Plan presented in Appendix 2).

The objective of the geotechnical investigation was to:

☐ determine the subsoil and groundwater conditions at the site by means of test holes.

☐ provide geotechnical recommendations for the design of the proposed development including construction considerations which may affect its design.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. It contains our findings and includes geotechnical recommendations pertaining to the design and construction of the subject development as they are understood at the time of writing this report.

2.0 Proposed Development

Based on the available conceptual drawings, it is anticipated that the proposed industrial development will consist of two slab-on-grade warehouse buildings with associated access lanes, Loading docks, parking areas and landscaped areas. It is further understood that the proposed development will be municipally serviced.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the current investigation was carried out on August 19 and 22, 2022 and consisted of advancing four (4) boreholes to a maximum depth of 6.5 m and seven (7) test pits which were excavated to a maximum depth of 3.5 m below existing grade. A previous investigation was also completed by Paterson at the subject site in 2014 for the original owners. At that time, a total of 5 boreholes were advanced to a maximum depth of 10.2 m below existing ground surface. The test holes were placed in a manner to provide general coverage of the subject site taking into consideration site features and underground utilities. The test hole locations for the current investigation are presented on Drawing PG6394-1 - Test Hole Location Plan included in Appendix 2.

The boreholes were completed using a low-clearance rubber-track mounted drill rig operated by a two-person crew. The test pits were completed by a rubber-tired backhoe at the selected locations across the site. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer from the geotechnical division. The drilling and excavation procedure consisted of augering or digging to the required depth at the selected locations, sampling and testing the overburden.

Sampling and In Situ Testing

The soil samples were recovered from the auger flights and using a 50 mm diameter split-spoon sampler. Soil samples from the test pits were recovered from the side walls of the open excavation. The samples were initially classified on site, placed in sealed plastic bags and transported to our laboratory. The depths at which the auger, split-spoon and grab samples were recovered from the boreholes are shown as AU, SS, and GG respectively, on the Soil Profile and Test Data sheets in Appendix 1.

The Standard Penetration Test (SPT) was conducted in conjunction with the recovery of the split-spoon samples. The SPT results are recorded as “N” values on the Soil Profile and Test Data sheets. The “N” value is the number of blows required to drive the split-spoon sampler 300 mm into the soil after a 150 mm initial penetration using a 63.5 kg hammer falling from a height of 760 mm.

Undrained shear strength testing was carried out in cohesive soils using a field vane apparatus.

Overburden thickness was also evaluated during the course of the investigation by completing a dynamic cone penetration test (DCPT) at BH 1-22. The DCPT consists of driving a steel drill rod, equipped with a 50 mm diameter cone at its tip, using a 63.5 kg hammer falling from a height of 760 mm. The number of blows required to drive the cone into the soil is recorded for each 300 mm increment.

The subsurface conditions observed in the test holes were recorded in detail in the field. The soil profiles are logged on the Soil Profile and Test Data sheets in Appendix 1 of this report.

Groundwater

Groundwater monitoring wells were installed in boreholes BH 2-22, BH 3-22 and BH 4-22 to monitor the groundwater levels subsequent of the sampling program. Also, a flexible polyethylene standpipe was installed in BH 1-22. The groundwater observations are discussed in subsection 4.3 and presented in the Soil Profile and Test Data Sheets in Appendix 1.

Monitoring Well Installation

Typical monitoring well construction details are described below:

- 3.0 m of slotted 51 mm diameter PVC screen at the base of the boreholes.
- 51 mm diameter PVC riser pipe from the top of the screen to the ground surface.
- No. 3 silica sand backfill within annular space around screen.
- 300 mm thick bentonite hole plug directly above PVC slotted screen.
- Clean backfill from top of bentonite plug to the ground surface.

Refer to the Soil Profile and Test Data sheets in Appendix 1 for specific well construction details.

Sample Storage

All samples will be stored in the laboratory for a period of one (1) month after issuance of this report. They will then be discarded unless we are otherwise directed.

3.2 Field Survey

The test hole locations were selected by Paterson to provide general coverage of the subject site. The test hole locations and ground surface elevation at each test hole location were surveyed by Paterson using a high precision, handheld GPS and referenced to a geodetic datum. The location of the boreholes is presented on Drawing PG6394-1 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

Soil samples were recovered from the subject site and visually examined in our laboratory to review the results of the field logging. A total of two (2) Atterberg Limits tests, one (1) Grain Size Distribution and Hydrometer test, and one (1) Shrinkage test were completed on selected soil samples. The results are presented in Subsection 4.2 and enclosed in Appendix 1.

3.4 Analytical Testing

One (1) soil sample was submitted for analytical testing to assess the corrosion potential for exposed ferrous metals and the potential of sulphate attacks against subsurface concrete structures by others. The sample was submitted to determine the concentration of sulphate and chloride, the resistivity, and the pH of the samples. The results are discussed further in Subsection 6.7.

4.0 Observations

4.1 Surface Conditions

The subject site consists of former agricultural lands which are currently grass covered. The ground surface across the site is generally flat and at grade with the neighbouring roads and properties to the southwest. However, the site is observed to be approximately 1 to 2 m lower than the property to the northwest. A gravel paved road is observed to cross the site from Huntmar Drive to Journeyman Street. Furthermore, sporadic trees and brushes are observed at several locations across the subject site. Based on historical records, the central east portion of the site was occupied by a number of single storey buildings (currently demolished) with associated gravel parking areas. It should also be noted that several piles of fill, 1 to 2 m in height, and consisting mainly of topsoil and other site excavated debris, were stockpiled across the site. Furthermore, piles of rubble and construction debris of various sizes were also noted within the south portion of the site.

The site is bordered to the northeast by Huntmar Drive followed by a residential development, to the southeast by Campeau Drive followed by a commercial development, to the southwest by Journeyman Street followed by former agricultural lands, and to the northwest by agricultural lands.

4.2 Subsurface Profile

Overburden

Generally, the subsurface profile encountered at the test hole locations consisted of topsoil and/or fill underlain by a deep silty clay deposit. The fill layer was encountered below ground surface in BH 10, TP 4-22, TP 6-22, and TP 7-22, and it was observed to consist of silty sand and silty clay, trace amounts of organics and topsoil, containing cobbles, crushed stone, brick and plastic. The thickness of the encountered fill layer ranged between 0.5 to 1.8 m. The silty clay deposit was observed to consist of a weathered very stiff to stiff brown silty clay crust followed by a stiff to firm grey silty clay. Practical refusal to the DCPT was encountered at a depth of 15 m below existing ground surface at the location of borehole BH 1-22.

Grab samples taken from randomly selected locations within the existing fill piles were observed to consist mainly of topsoil and some construction debris.

Reference should be made to the Soil Profile in Appendix 1 for specific details of the soil profiles encountered at each test hole location.

Bedrock

Based on available geological mapping, the site is located in an area where the bedrock consists of interbedded limestone and shale of the Verulam formation with overburden drift thickness of 15 to 25 m.

Grain Size Distribution and Hydrometer Test

Grain size distribution and hydrometer testing was also completed on one selected soil sample. The results of the grain size analysis are summarized in Table 1 and presented on the Grain-size Distribution and Hydrometer Testing Results sheets in Appendix 1.

Table 1 - Grain Size Distribution and Hydrometer Testing

Test Hole	Sample	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH 2-22	SS2	0	2	37	61

Atterberg Limit Tests

Two selected silty clay samples were submitted for Atterberg Limit testing. The test results indicate that high plasticity silty clays are anticipated at the subject site. The results are summarized in Table 2 and presented in Appendix 1.

Table 2 - Summary of Atterberg Limits Test Results

Test Hole	Sample No.	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
BH 1-22	SS2	71	22	49
BH 3-22	SS3	55	19	36

Shrinkage Test

The shrinkage limit and shrinkage ratio of the tested silty clay sample (BH 4-22, sample No. SS3) were found to be 20.3% and 1.73, respectively.

4.3 Groundwater

Groundwater levels were measured in the installed piezometers and monitoring wells during the current investigation. Furthermore, open-hole groundwater infiltration levels were observed and recorded at the time of excavation in each test pit location. The groundwater readings obtained from the current field program are summarised in Table 3 below and are also presented on the Soil Profile and Test Data sheets in Appendix 1.

Table 3 – Summary of Groundwater Levels

Test Hole	Ground Surface Elevation (m)	Measured Groundwater Level		Date Recorded
		Depth (m)	Elevation (m)	
BH 1-22	100.94	1.53	99.41	August 26, 2022
BH 2-22	100.40	0.21	100.19	August 26, 2022
BH 3-22	100.74	0.97	99.77	August 26, 2022
BH 4-22	101.33	1.51	99.82	August 26, 2022

Note: The ground surface elevation at each borehole location was surveyed using a handheld GPS and referenced to a geodetic datum.

It is important to note that groundwater level readings could be influenced by surface water infiltrating the backfilled borehole. Long-term groundwater levels can also be estimated based on recovered soils samples moisture levels and recovered soil sample coloring and consistency. Based on the existing groundwater information and our knowledge of the groundwater within the neighboring properties, the long-term groundwater level is estimated to be at **3** to **4 m** depth below the existing grade.

It should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater level could vary at the time of construction.

5.0 Discussion

5.1 Geotechnical Assessment

The subject site is considered suitable for the proposed industrial development. It is expected that the proposed warehouse buildings will be founded using conventional shallow footings placed over an undisturbed, very stiff to stiff silty clay bearing surface.

Where fill is encountered below the footprint of the proposed buildings, considerations could be given to leaving the fill in place, free of deleterious material and significant amounts of organics, below the proposed building footprint outside of lateral support zones for the footings. However, it is recommended that the existing fill layer be proof-rolled several times, under dry conditions and above freezing temperatures and approved by Paterson at the time of construction. Any poor performing areas noted during the proof-rolling operation should be removed and replaced with an approved engineered fill.

Due to the presence of a sensitive silty clay deposit underlying the proposed warehouse buildings, the proposed development will be subjected to grade raise restriction. If higher than the permissible grade raise is required, preloading with or without a surcharge, lightweight fill and/or other measures should be investigated to reduce the risks of unacceptable long-term post construction total and differential settlements.

The above and other considerations are further discussed in the following sections.

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and deleterious fill, such as those containing significant amounts of organic materials, should be stripped from under any buildings, paved areas, pipe bedding and other settlement sensitive structures.

Existing foundation walls, and other construction debris should be entirely removed from within proposed building perimeters. Under paved areas, existing construction remnants such as foundation walls should be excavated to a minimum of 1 m below final grade.

Fill Placement

Fill used for grading beneath the building areas should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A, Granular B Type II. This material should be tested and approved prior to delivery to the site. The fill should be placed in lifts no greater than 300 mm thick and compacted using suitable compaction equipment for the lift thickness. Fill placed beneath the building areas should be compacted to at least 98% of its standard Proctor maximum dry density (SPMDD).

Non-specified existing fill, along with site-excavated soil, can be used as general landscaping fill where settlement of the ground surface is of minor concern. These materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If these materials are to be used to build up the subgrade level for areas to be paved, they should be compacted in thin lifts to a minimum density of 95% of their respective SPMDD. Site-excavated soils are not suitable for use as backfill against foundation walls unless a composite drainage blanket connected to a perimeter drainage system is provided.

Existing Fill- Below Floor Slabs

Consideration could be given to placing the proposed floor slabs, outside the lateral support zone of footings, over the existing fill. The fill should be free of deleterious materials and organics and provided the fill is approved by Paterson at the time of construction. The approved existing fill material should be proof-rolled using suitable compaction equipment under dry conditions and above freezing temperatures, tested and approved by Paterson personnel at the time of construction. Also, a geotextile liner such as Terrafix 270R or equivalent followed by a minimum 300 mm thick sub-slab granular pad, consisting of a Granular A crushed stone, compacted to 98% of its SPMDD is recommended to be placed directly below the subgrade fill material.

Existing Fill- Below Proposed Footings

Where fill is encountered below the proposed footings, it is recommended to sub-excavate the fill to an approved native bearing medium by means of vertical, zero entry trenches. The vertical trenches should be in-filled with minimum 15 MPa lean concrete mix (28-day strength) and/or OPSS Granular A or Granular B Type II and compacted to a minimum 98% of the material’s SPMDD, up to the proposed underside of footing elevation. The in-filled vertical trenches should be a minimum 150 mm horizontally beyond the footing face in all directions at footing level and throughout the lateral support zone of the footing.

Alternatively, the sub-excavated material can be replaced with OPSS Granular A or Granular B Type II, placed in maximum 300 mm thick lifts and compacted to a minimum 98% of the material's SPMDD. The extent of the granular pad should be a minimum 300 mm beyond the footing face in all directions. If this option is selected, a wider trench would be expected to be completed to allow a safe work area for the workers performing the compaction efforts.

5.3 Foundation Design

Shallow Footings

Strip footings, up to 2 m wide, and pad footings, up to 5 m wide, placed on an undisturbed, very stiff to stiff brown silty clay bearing surface or on engineered fill pad over approved fill, engineered pad/concrete in-filled trench placed over a very stiff to stiff brown silty clay can be designed using a bearing resistance value at serviceability limit states (SLS) of **150 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **225 kPa**. A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance value at ULS.

Strip footings, up to 2 m wide, and pad footings, up to 5 m wide, placed on an undisturbed, stiff to firm grey silty clay bearing surface, engineered pad/concrete in-filled trench placed over a stiff to firm grey silty clay, can be designed using a bearing resistance value at SLS of **120 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **200 kPa**. A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance value at ULS.

An undisturbed soil bearing surface consists of one from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, whether in situ or not, have been removed, in the dry, prior to the placement of concrete for footings.

Footings designed using the bearing resistance values at SLS given above will be subjected to potential post construction total and differential settlements of 25 and 20 mm, respectively.

Lateral Support

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Adequate lateral support is provided to the encountered overburden material above the groundwater table when a plane extending down and out from the bottom edge of the footing at a minimum of 1.5H:1V passes only through in situ soil of the same or higher capacity as the bearing medium soil.

Modulus of Subgrade Reaction

In order to provide a sufficient slab design, the modulus of subgrade reaction for the native stiff to very stiff brown clay or engineering fill placed over clay can be taken as **8 MPa/m** for a contact pressure of 150 kPa.

Permissible Grade Raise Recommendations

Based on the undrained shear strength values of the silty clay deposit encountered within the vicinity of the subject site, the **permissible grade raise restriction of 2 m** is recommended for the site.

If higher than permissible grade raises are required, preloading with or without a surcharge, lightweight fill, and/or other measures should be investigated to reduce the risks of unacceptable long-term post construction total and differential settlements. Provided sufficient time is available to induce the required settlements, consideration could be given to surcharging the subject site.

5.4 Slab-on-Grade Construction

With the removal of all topsoil and deleterious fill, containing significant amounts of organic matter, within the footprints of the proposed buildings, the native material or existing fill surface, reviewed and approved by Paterson, will be considered acceptable subgrade on which to commence backfilling for floor slab construction. The upper 300 mm of sub-slab fill should consist of an OPSS Granular A crushed stone. All backfill material within the footprint of the proposed buildings should be placed in maximum 300 mm thick loose lifts and compacted to at least 98% of its SPMDD.

Any soft areas should be removed and backfilled with appropriate backfill material. OPSS Granular B Type II, with a maximum particle size of 50 mm, are recommended for backfilling below the floor slab.

5.5 Design for Earthquakes

Shear wave velocity testing was completed for the subject site to accurately determine the applicable seismic site classification for the proposed buildings in accordance with Table 4.1.8.4.A of the Ontario Building Code 2012. The shear wave velocity testing was completed by Paterson personnel. The results of the shear wave velocity test are provided in Figures 2 and 3 in Appendix 2 of the present report.

Field Program

The seismic array testing location was placed as presented in Drawing PG6650-1 - Test Hole Location Plan, attached to the present report. Paterson field personnel placed 24 horizontal 4.5 Hz. geophones mounted to the surface by means of two 75 mm ground spikes attached to the geophone land case. The geophones were spaced at 3 m intervals and connected by a geophone spread cable to a Geode 24 Channel seismograph.

The seismograph was also connected to a computer laptop and a hammer trigger switch attached to a 12-pound dead blow hammer. The hammer trigger switch sends a start signal to the seismograph. The hammer is used to strike an I-Beam seated into the ground surface, which creates a polarized shear wave. The hammer shots are repeated between four (4) to eight (8) times at each shot location to improve signal to noise ratio.

The shot locations are also completed in forward and reverse directions (i.e.- striking both sides of the I-Beam seated parallel to the geophone array). The shot locations were 20, 4.5 and 3 m away from the first and last geophone and at the centre of the seismic array.

Data Processing and Interpretation

Interpretation for the shear wave velocity results was completed by Paterson personnel. Shear wave velocity measurement was made using reflection/refraction methods. The interpretation is performed by recovering arrival times from direct and refracted waves.

The interpretation is repeated at each shot location to provide an average shear wave velocity, V_{s30}, of the upper 30 m profile, immediately below the foundation of the buildings. The layer intercept times, velocities from different layers and critical distances are interpreted from the shear wave records to compute the bedrock depth at each location.

The bedrock velocity was interpreted using the main refractor wave velocity, which is considered a conservative estimate of the bedrock velocity due to the increasing quality of the bedrock with depth. It should be noted that as bedrock quality increases, the bedrock shear wave velocity also increases.

Based on our testing results, the average overburden shear wave velocity is **193 m/s**, while the bedrock shear wave velocity is **2,945 m/s**. Considering that the overburden drift is 15m, the Vs_{30} was calculated using the standard equation for average shear wave velocity provided in the OBC 2012 and as presented below:

$$V_{s30} = \frac{Depth_{of\ interest}(m)}{\left(\frac{Depth_{Layer1}(m)}{V_{s_{Layer1}}(m/s)} + \frac{Depth_{Layer2}(m)}{V_{s_{Layer2}}(m/s)}\right)}$$

$$V_{s30=} \frac{30\ m}{\left(\frac{15\ m}{193\ m/s} + \frac{15\ m}{2{,}945\ m/s}\right)}$$

$$V_{s30=}\,362\ \ m/s$$

Based on the results of the shear wave velocity testing, the average shear wave velocity, V_{s30}, is **362 m/s**. Therefore, a **Site Class C** is applicable for the design of the proposed building founded on conventional footings as per Table 4.1.8.4.A of the OBC 2012. The soils underlying the subject site are not susceptible to liquefaction.

5.6 Pavement Design

The pavement structures presented in the following tables could be used for the design of car only parking, heavy truck parking and loading areas and access lanes.

Table 4 - Recommended Pavement Structure – Car Only Parking Areas

Thickness (mm)	Material Description
50	**Wear Course** - HL-3 or Superpave 12.5 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II
SUBGRADE – Either fill, in situ soils or OPSS Granular B Type I or II material placed over in situ soil or fill	

Table 5 - Recommended Pavement Structure –Heavy Truck Loading Areas and Access Lanes

Thickness (mm)	Material Description
40	**Wear Course -** HL-3 or Superpave 12.5 Asphaltic Concrete
50	**Binder Course -** HL-8 or Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
400	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or fill	

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project.

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type I or II material. The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 100% of the material's SPMDD using suitable vibratory equipment.

Pavement Structure Drainage

Satisfactory performance of the pavement structure is largely dependent on keeping the contact zone between the subgrade material and the base stone in a dry condition. Failure to provide adequate drainage under conditions of heavy wheel loading can result in the fine subgrade soil being pumped into the voids in the stone subbase, thereby reducing its load carrying capacity.

For areas where silty clay is encountered at subgrade level, it is recommended that subdrains be installed during the pavement construction as per City of Ottawa standards. The subdrain inverts should be approximately 300 mm below subgrade level. The subgrade surface should be crowned to promote water flow to the drainage lines.

5.7 Percolation Rates

Infiltration galleries are anticipated to be located at the subject site. It is anticipated that silty clay will be encountered at the base of the infiltration galleries during the installation and will affect the rate of stormwater infiltration into the underlying material.

The percolation rate was interpreted from the hydraulic conductivity which was estimated based on previous investigations within the area and on experience. Based on these values, the average percolation rate (T-Time) was estimated to be within the ranges in Table 6.

Table 6 - Estimated Percolation Rates

Material	Hydraulic Conductivity - k (m/sec)	Percolation (T-time) - (mins/cm)
Silty Clay [1]	**$3x10^{-6}$ to $1x10^{-10}$**	**35 to 50+**

[1] - Values are based upon site-specific testing carried out at a nearby phase of the development

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Foundation Drainage

It is recommended that a perimeter foundation drainage system be provided for the proposed structures. The system should consist of a 150 mm diameter perforated corrugated plastic pipe, surrounded on all sides by 150 mm of 10 mm clear crushed stone, placed at the footing level around the exterior perimeter of the structure. The pipe should have a positive outlet, such as a gravity connection to the storm sewer.

Foundation Backfilling

Backfill against the exterior sides of the foundation walls should consist of free-draining non frost susceptible granular materials. The greater part of the site excavated materials will be frost susceptible and, as such, are not recommended for re-use as backfill against the foundation walls, unless used in conjunction with a drainage geocomposite, such as Miradrain G100N or Delta Drain 6000, connected to the perimeter foundation drainage system. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should otherwise be used for this purpose.

6.2 Protection Against Frost Action

Perimeter footings of heated structures are required to be insulated against the deleterious effect of frost action. A minimum of 1.5 m thick soil cover (or equivalent) should be provided in this regard.

Exterior unheated footings, such as those for isolated exterior piers, are more prone to deleterious movement associated with frost action than the exterior walls of the structure proper and require additional protection, such as soil cover of 2.1 m or a combination of soil cover and foundation insulation.

It is expected that frost migration may occur during freezing conditions while loading doors are open for loading/unloading purposes. Therefore, it is highly recommended that rigid insulation be used to prevent frost migration. A detailed review can be completed once detailed architectural drawings are available.

6.3 Excavation Side Slopes

The side slopes of excavations in the overburden materials should either be cut back at acceptable slopes or should be retained by shoring systems from the start of the excavation until the structure is backfilled. It is assumed that sufficient room will be available for the greater part of the excavation to be undertaken by open-cut methods (i.e., unsupported excavations).

Unsupported Excavations

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be cut back at 1H:1V or flatter. The flatter slope is required for excavation below groundwater level. The subsoil at this site is considered to be mainly a Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should be kept away from the excavation sides.

Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

It is recommended that a trench box be used at all times to protect personnel working in trenches with steep or vertical sides. It is expected that services will be installed by “cut and cover” methods and excavations will not be left open for extended periods of time.

6.4 Pipe Bedding and Backfill

At least 150 mm of OPSS Granular A should be used for pipe bedding for sewer and water pipes. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to at least 300 mm above the obvert of the pipe, should consist of OPSS Granular A or Granular B Type II with a maximum size of 25 mm. The bedding layer should be increased to a minimum thickness of 300 mm where the subgrade consists of grey silty clay. The bedding and cover materials should be placed in maximum 225 mm thick lifts compacted to 95% of the material’s standard Proctor maximum dry density.

It should generally be possible to re-use the upper portion of the dry to moist (not wet) silty clay above the cover material if the excavation and filling operations are carried out in dry weather conditions. Any stones greater than 200 mm in their longest dimension should be removed from these materials prior to placement.

The backfill material within the frost zone (about 1.8 m below finished grade) should match the soils exposed at the trench walls to reduce potential differential frost heaving. The backfill should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the material's SPMDD.

6.5 Groundwater Control

Groundwater Control for Building Construction

Based on our observations, it is anticipated that groundwater infiltration into the excavations should be low and controllable using open sumps. Pumping from open sumps should be sufficient to control the groundwater influx through the sides of shallow excavations. The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

Permit to Take Water

A temporary Ministry of the Environment, Conservation and Parks (MECP) permit to take water (PTTW) may be required for this project if more than 400,000 L/day of ground and/or surface water is to be pumped during the construction phase. A minimum 4 to 5 months should be allowed for completion of the PTTW application package and issuance of the permit by the MECP.

For typical ground or surface water volumes being pumped during the construction phase, typically between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Person as stipulated under O.Reg. 63/16. If a project qualifies for a PTTW based upon anticipated conditions, an EASR will not be allowed as a temporary dewatering measure while awaiting the MECP review of the PTTW application.

6.6 Winter Construction

Precautions must be taken if winter construction is considered for this project.

The subsoil conditions at this site mostly consist of frost susceptible materials. In the presence of water and freezing conditions, ice could form within the soil mass. Heaving and settlement upon thawing could occur.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the use of straw, propane heaters and tarpaulins or other suitable means. In this regard, the base of the excavations should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level.

Trench excavations and pavement construction are also difficult activities to complete during freezing conditions without introducing frost in the subgrade or in the excavation walls and bottoms. Precautions should be taken if such activities are to be carried out during freezing conditions.

6.7 Corrosion Potential and Sulphate

The results of analytical testing show that the sulphate content is less than 0.1%. This result is indicative that Type 10 Portland cement (normal cement) would be appropriate for this site. The chloride content and the pH of the sample indicate that they are not significant factors in creating a corrosive environment for exposed ferrous metals at this site, whereas the resistivity is indicative of a mild to slightly aggressive corrosive environment.

6.8 Landscaping Considerations

Tree Planting Restrictions

In accordance with the City of Ottawa Tree Planting in Sensitive Marine Clay Soils (2017 Guidelines), Paterson completed a soils review of the site to determine applicable tree planting setbacks. Atterberg limits testing was completed for recovered silty clay samples at selected locations throughout the subject site. The soil samples were recovered from elevations below the anticipated design underside of footing elevation and 3.5 m depth below anticipated finished grade. The results of our testing are presented in Table 1 and Table 2 in Subsection 4.2 and in Appendix 1.

Based on the results of our testing, two tree planting setback areas are present within the proposed development. The two areas are detailed below and have been outlined in Drawing PG6394-2 - Tree Planting Setback Recommendations presented in Appendix 2.

Area 1 - High Sensitivity Clay Soils

A high sensitivity clay soil was encountered between anticipated underside of footing elevations and 3.5 m below anticipated finished grade as per City Guidelines at the areas outlined in Drawing PG6394-2 - Tree Planting Setback Recommendations in Appendix 2. Based on our Atterberg Limits test results, the modified plasticity limit generally exceeds 40%. The following tree planting setbacks are recommended for these high sensitivity areas.

Large trees (mature height over 14 m) can be planted within Area 1 provided a tree to foundation setback equal to the full mature height of the tree can be provided (e.g. in a park or other green space).

Area 2 - Low/Medium Sensitivity Clay Soils

A low to medium sensitivity clay soil was encountered between anticipated underside of footing elevations and 3.5 m below preliminary finished grade as per City Guidelines at Area 2 outlined in Drawing PG6394-2 - Tree Planting Setback Recommendations in Appendix 2. Based on our Atterberg Limits test results, the modified plasticity limit does not exceed 40% in these areas.

The following tree planting setbacks are recommended for the low to medium sensitivity area. Large trees (mature height over 14 m) can be planted within these areas provided a tree to foundation setback equal to the full mature height of the tree can be provided (e.g. in a park or other green space). Tree planting setback limits may be reduced to 4.5 m for small (mature tree height up to 7.5m) and medium size trees (mature tree height 7.5 m to 14 m) provided that the conditions noted below are met:

☐ The underside of footing (USF) is 2.1 m or greater below the lowest finished grade must be satisfied for footings within 10 m from the tree, as measured from the center of the tree trunk and verified by means of the Grading Plan.

☐ A small tree must be provided with a minimum of 25 m^3 of available soils volume while a medium tree must be provided with a minimum of 30 m^3 of available soil volume, as determined by the Landscape Architect. The developer is to ensure that the soil is generally un-compacted when backfilling in street tree planting locations.

☐ The tree species must be small (mature tree height up to 7.5 m) to medium size (mature tree height 7.5 m to 14 m) as confirmed by the Landscape Architect.

- ☐ The foundation walls are to be reinforced at least nominally (minimum of two upper and two lower 15M bars in the foundation wall).

- ☐ Grading surrounding the tree must promote drainage to the tree root zone (in such a manner as not to be detrimental to the tree), as noted on the subdivision Grading Plan.

7.0 Recommendations

It is a requirement for the foundation design data provided herein to be applicable that the following material testing and observation program be performed by the geotechnical consultant.

☐ Review detailed grading plan(s) from a geotechnical perspective.

☐ Review detailed temporary excavation and shoring drawings from a geotechnical perspective, once available.

☐ Review of the frost protection measures proposed for the loading areas, from a geotechnical perspective.

☐ Observation of all bearing surfaces prior to the placement of concrete.

☐ Sampling and testing of the concrete and fill materials.

☐ Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.

☐ Observation of all subgrades prior to backfilling.

☐ Field density tests to ensure that the specified level of compaction has been achieved.

☐ Sampling and testing of the bituminous concrete including mix design reviews.

All excess soils, with the exception of engineered crushed stone fill, generated by construction activities that will be transported on-site or off-site should be handled as per *Ontario Regulation 406/19: On-Site and Excess Soil Management.*

A report confirming that these works have been conducted in general accordance with our recommendations could be issued upon the completion of a satisfactory inspection program by the geotechnical consultant.

8.0 Statement of Limitations

The recommendations provided are in accordance with the present understanding of the project. Paterson requests permission to review the recommendations when the drawings and specifications are completed.

A soils investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test locations, Paterson requests immediate notification to permit reassessment of our recommendations.

The recommendations provided herein should only be used by the design professionals associated with this project. They are not intended for contractors bidding on or undertaking the work. The latter should evaluate the factual information provided in this report and determine the suitability and completeness for their intended construction schedule and methods. Additional testing may be required for their purposes.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Rosefellow Holdings Inc. or their agent(s) is not authorized without review by Paterson Group for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

Maha K. Saleh, M.A.Sc., P.Eng.

Faisal I. Abou-Seido, P.Eng.

LICENSED PROFESSIONAL ENGINEER
May 31, 2023
M. SALEH
100507739
PROVINCE OF ONTARIO

Report Distribution:

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- ❑ Paterson Group (1 copy)

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ATTERBERG LIMIT TESTING RESULTS

GRAIN SIZE DISTRIBUTION AND HYDROMETER TESTING RESULTS

ANALYTICAL TESTING RESULTS

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Campeau Drive at Huntmar Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

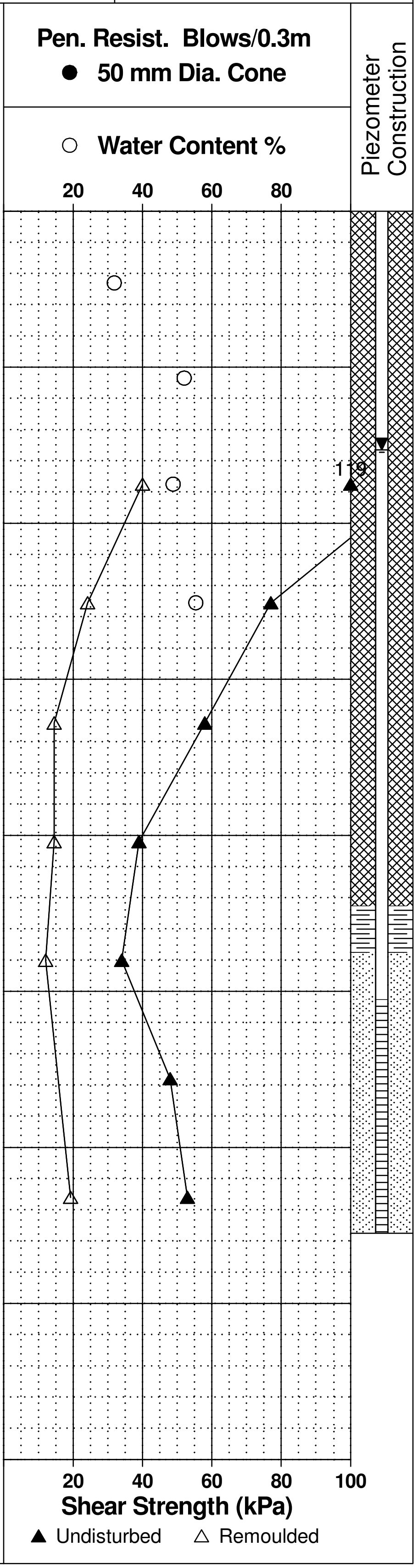
BORINGS BY CME-55 Low Clearance Drill

DATE August 19, 2022

FILE NO. PG6394

HOLE NO. BH 1-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.94
TOPSOIL 0.28							
		AU	1				
						1	99.94
		SS	2	92	6		
						2	98.94
Very stiff to stiff, brown **SILTY CLAY**							
						3	97.94
- firm and grey by 4.0m depth						4	96.94
						5	95.94
						6	94.94
6.55							
Dynamic Cone Penetration Test commenced at 6.55m depth. Cone pushed to 13.1m depth.						7	93.94
						8	92.94



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Campeau Drive at Huntmar Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

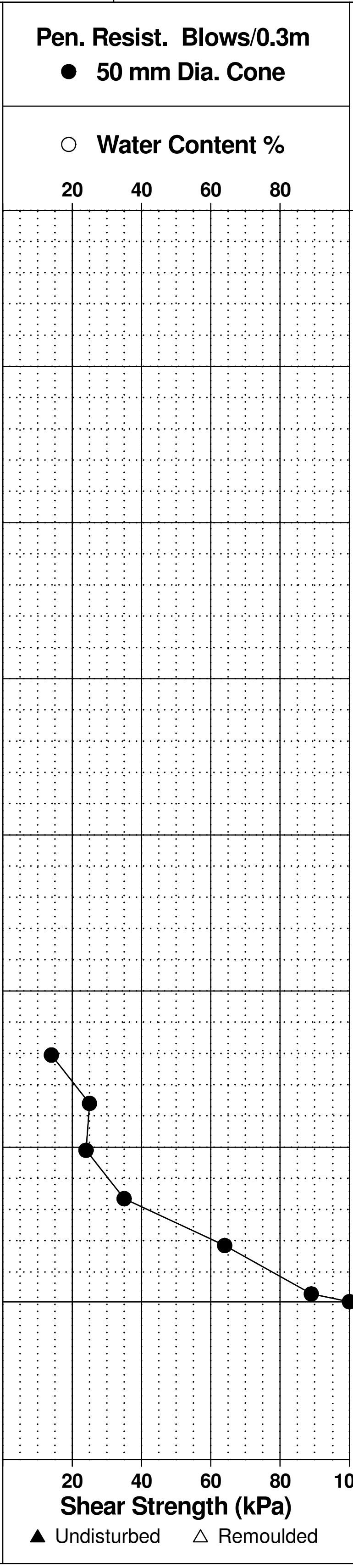
BORINGS BY CME-55 Low Clearance Drill

DATE August 19, 2022

FILE NO. PG6394

HOLE NO. BH 1-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
Dynamic Cone Penetration Test commenced at 6.55m depth. Cone pushed to 13.1m depth.						8	92.94
						9	91.94
						10	90.94
						11	89.94
						12	88.94
						13	87.94
						14	86.94
14.99							
End of Borehole Practical DCPT refusal at 14.99m depth. (GWL @ 1.53m - August 26, 2022)							



Piezometer Construction

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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Campeau Drive at Huntmar Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

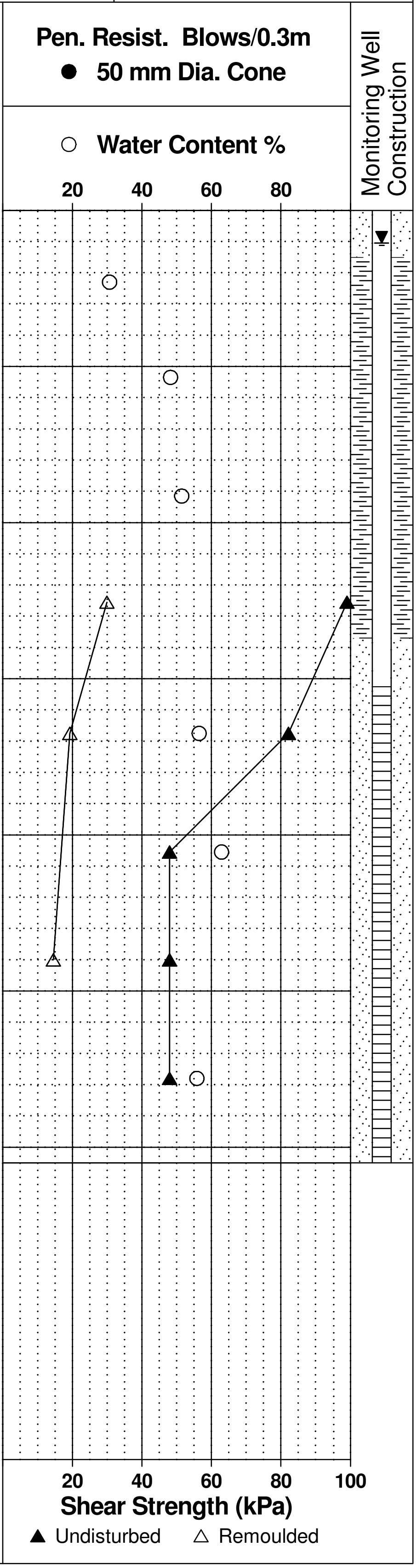
BORINGS BY CME-55 Low Clearance Drill

DATE August 19, 2022

FILE NO. PG6394

HOLE NO. BH 2-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.40
TOPSOIL 0.25							
		AU	1				
						1	99.40
		SS	2	83	9		
Very stiff to stiff, brown **SILTY CLAY**							
		SS	3	92	3		
						2	98.40
						3	97.40
- stiff to firm and grey by 3.0m depth							
		SS	4	75	P		
						4	96.40
		SS	5	75	P		
						5	95.40
						6	94.40
6.10							
End of Borehole							
(GWL @ 0.21m - August 26, 2022)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Campeau Drive at Huntmar Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

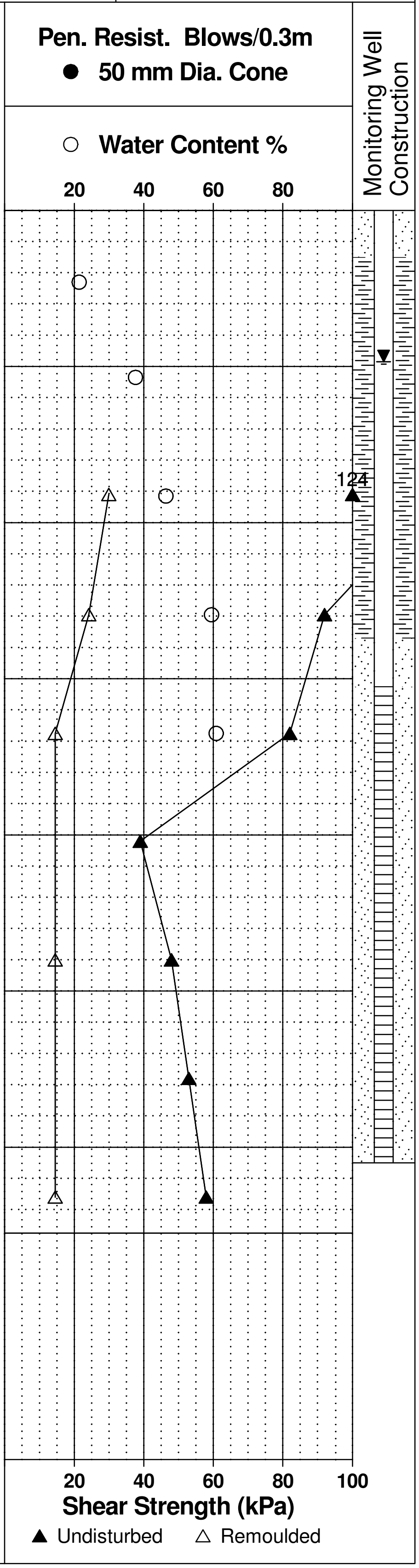
BORINGS BY CME-55 Low Clearance Drill

DATE August 19, 2022

FILE NO. **PG6394**

HOLE NO. **BH 3-22**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.74
TOPSOIL 0.38							
Very stiff, brown **SILTY CLAY**		AU	1				
		SS	2	75	9	1	99.74
		SS	3	67	P	2	98.74
		SS	4	83	P		
- grey by 3.0m depth						3	97.74
		SS	5	75	P		
- firm to stiff by 3.8m depth						4	96.74
						5	95.74
						6	94.74
6.55							
End of Borehole							
(GWL @ 0.97m - August 26, 2022)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Campeau Drive at Huntmar Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

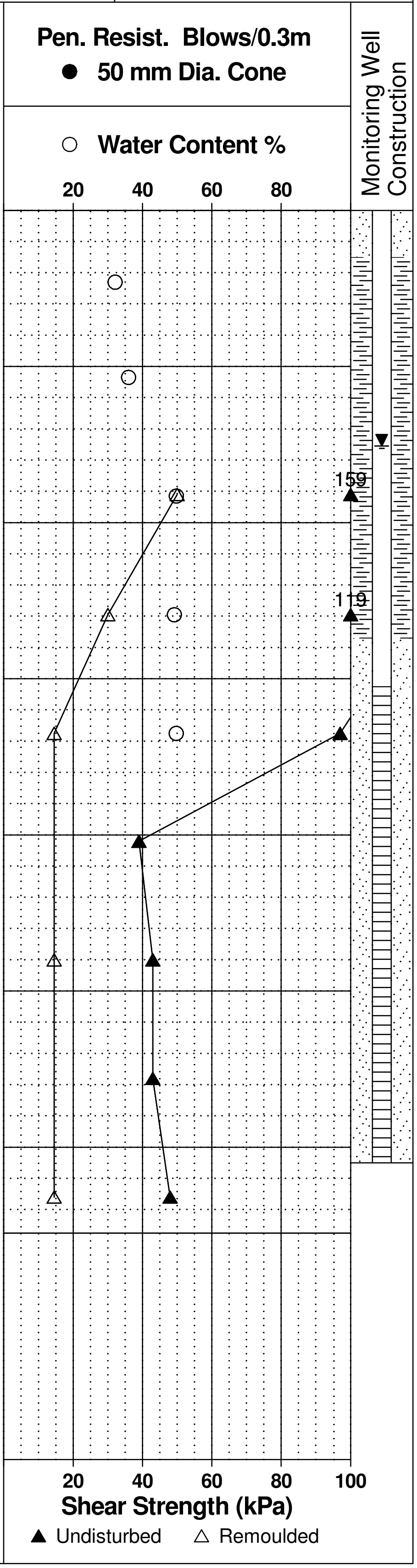
BORINGS BY CME-55 Low Clearance Drill

DATE August 19, 2022

FILE NO. PG6394

HOLE NO. BH 4-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
TOPSOIL						0	101.33
0.36							
		AU	1				
		SS	2	83	9	1	100.33
Very stiff, brown **SILTY CLAY**							
		SS	3	75	P	2	99.33
		SS	4	83	P		
- stiff to firm and grey by 3.0m depth						3	98.33
		SS	5	92	P		
						4	97.33
						5	96.33
						6	95.33
6.55							
End of Borehole							
(GWL @ 1.51m - August 26, 2022)							



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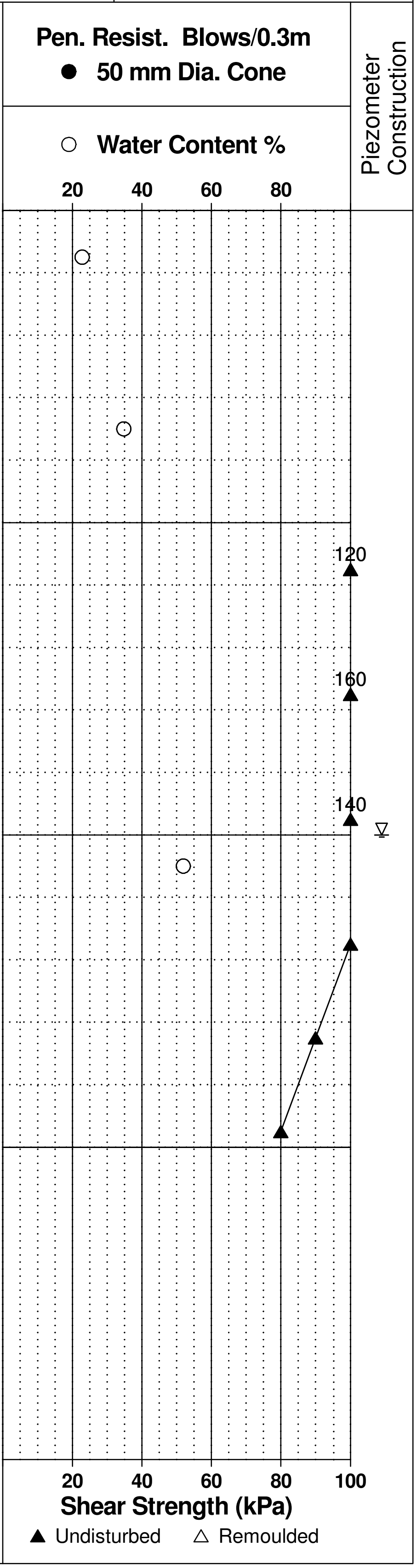
SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Campeau Drive at Huntmar Road
Ottawa, Ontario

DATUM Geodetic
REMARKS
BORINGS BY Backhoe
DATE August 22, 2022
FILE NO. PG6394
HOLE NO. TP 1-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	101.57
TOPSOIL		G	1				
0.30							
		G	2				
						1	100.57
Very stiff, brown **SILTY CLAY**							
						2	99.57
		G	3				
- stiff by 2.6m depth							
3.00						3	98.57
End of Test Pit (Groundwater infiltration at 2.0m depth)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Campeau Drive at Huntmar Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

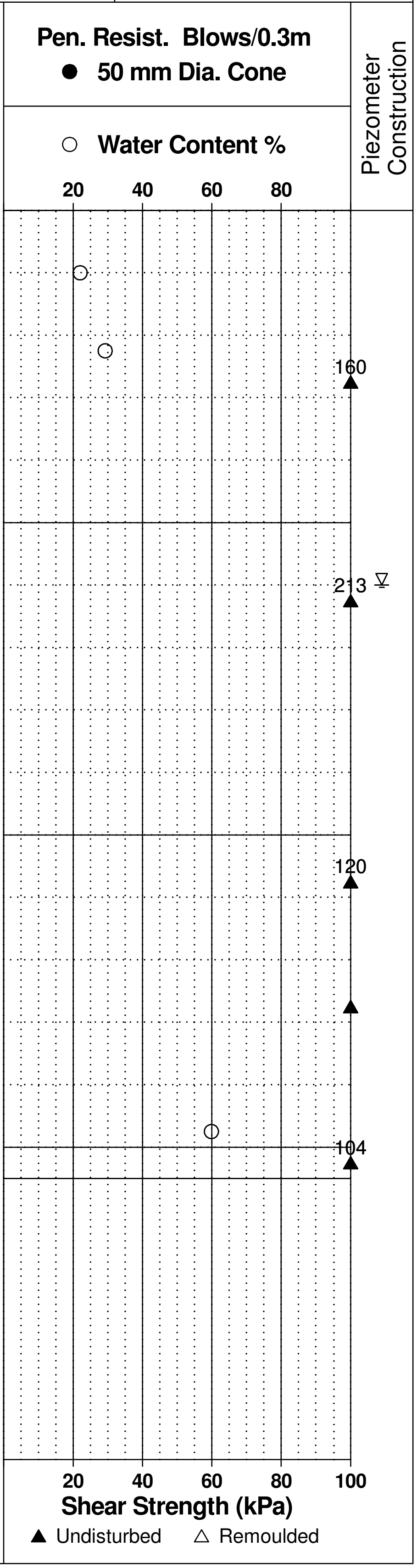
BORINGS BY Backhoe

DATE August 22, 2022

FILE NO. **PG6394**

HOLE NO. **TP 2-22**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.72
TOPSOIL							
0.20		G	1				
Hard to very stiff, brown **SILTY CLAY**		G	2				
						1	99.72
						2	98.72
		G	3				
						3	97.72
3.10							
End of Test Pit (Groundwater infiltration at 1.2m depth)							



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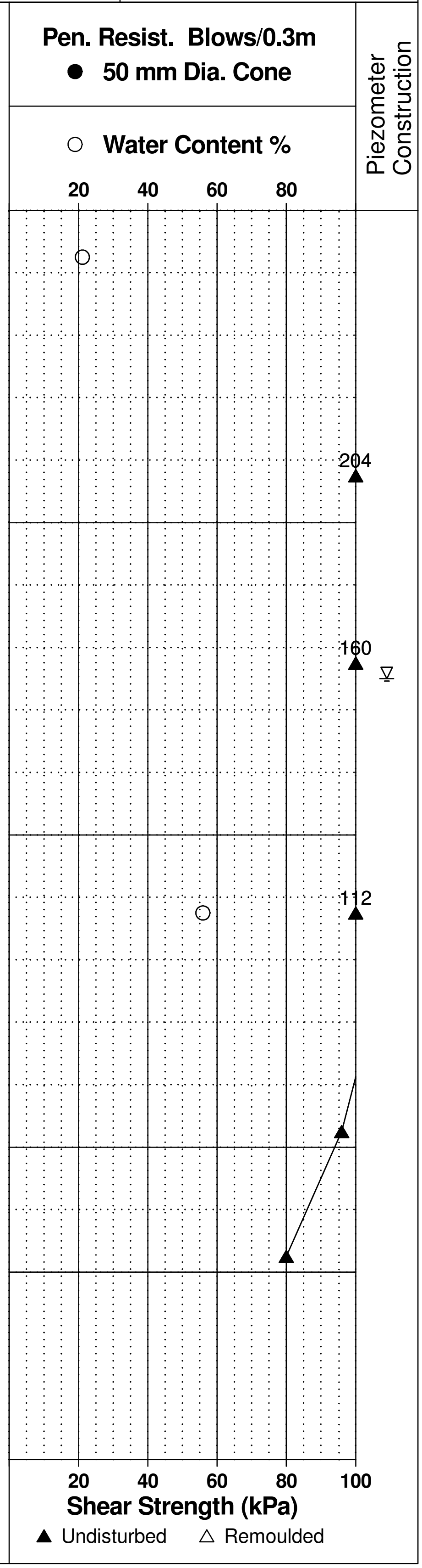
SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Campeau Drive at Huntmar Road
Ottawa, Ontario

DATUM Geodetic
REMARKS
BORINGS BY Backhoe
DATE August 22, 2022
FILE NO. PG6394
HOLE NO. TP 3-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.88
TOPSOIL		G	1				
0.30							
Hard to very stiff, brown **SILTY CLAY**						1	99.88
						2	98.88
		G	2				
- stiff by 2.9m depth						3	97.88
3.40							
End of Test Pit (Groundwater infiltration at 1.5m depth)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Campeau Drive at Huntmar Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Backhoe

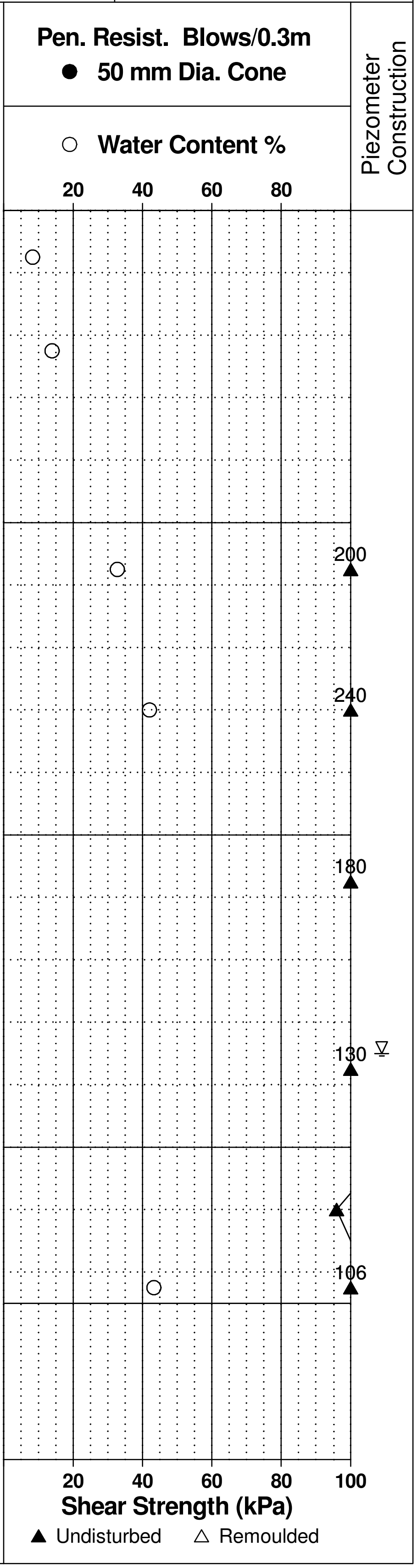
DATE August 22, 2022

FILE NO. **PG6394**

HOLE NO. **TP 4-22**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD
GROUND SURFACE					
FILL: Brown silty sand with gravel, trace organics (0.40)		G	1		
FILL: Brown silty sand to sandy silt (0.50)		G	2		
TOPSOIL (0.80)					
Hard to very stiff, brown **SILTY CLAY** - stiff by 3.15m depth (3.50)		G G G	3 4 5		
End of Test Pit (Groundwater infiltration at 2.7m depth)					

DEPTH (m)	ELEV. (m)
0	101.61
1	100.61
2	99.61
3	98.61



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Campeau Drive at Huntmar Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

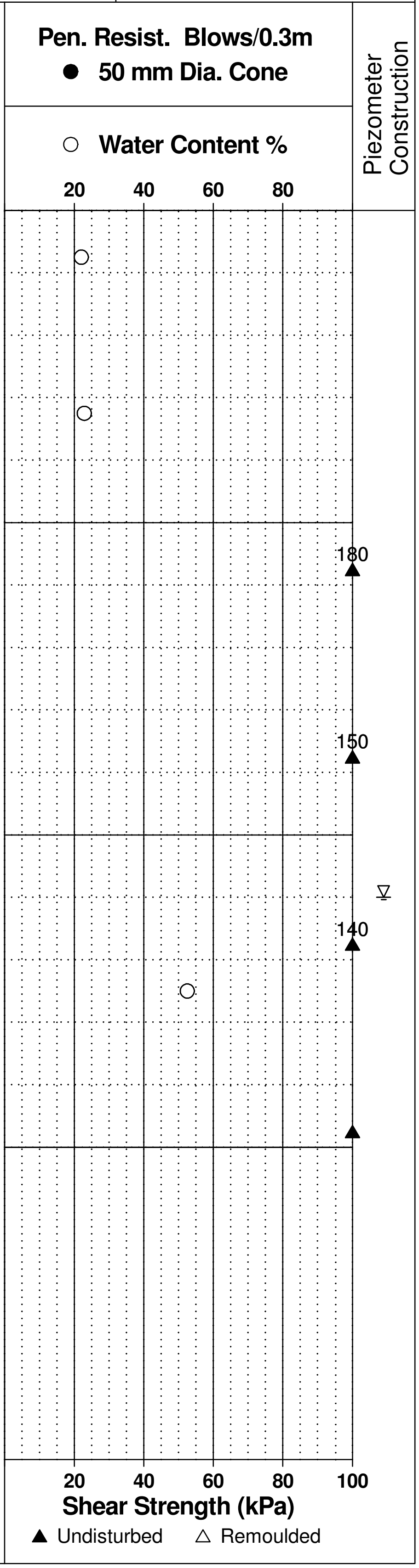
BORINGS BY Backhoe

DATE August 22, 2022

FILE NO. PG6394

HOLE NO. TP 5-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	101.29
TOPSOIL		G	1				
0.30							
		G	2				
						1	100.29
Very stiff, brown **SILTY CLAY**							
						2	99.29
		G	3				
3.00						3	98.29
End of Test Pit (Groundwater infiltration at 2.2m depth)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Campeau Drive at Huntmar Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

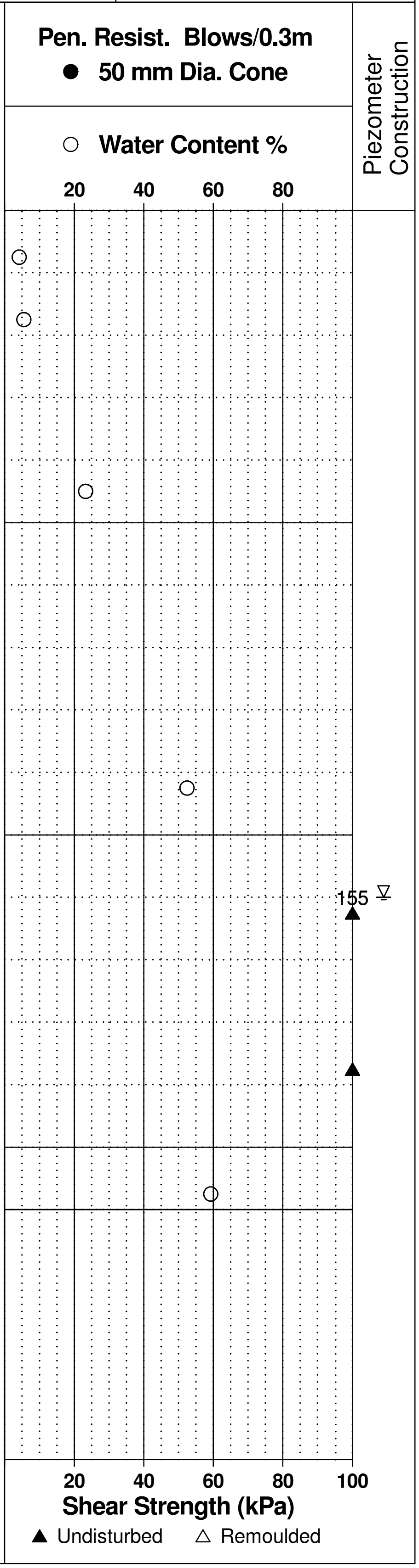
BORINGS BY Backhoe

DATE August 22, 2022

FILE NO. PG6394

HOLE NO. TP 6-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	101.02
FILL: Crushed stone with topsoil							
0.20		G	1				
FILL: Brown silty sand with gravel, occasional cobbles		G	2				
0.80							
FILL: Black-stained silty clay, trace organics, occasional cobbles		G	3				
1.00						1	100.02
FILL: Brown silty clay							
1.50							
FILL: Cobbles and boulders, some sand and clay							
1.80		G	4				
Very stiff, brown **SILTY CLAY**						2	99.02
						3	98.02
3.20		G	5				
End of Test Pit (Groundwater infiltration at 2.2m depth)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Development - Campeau Drive at Huntmar Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

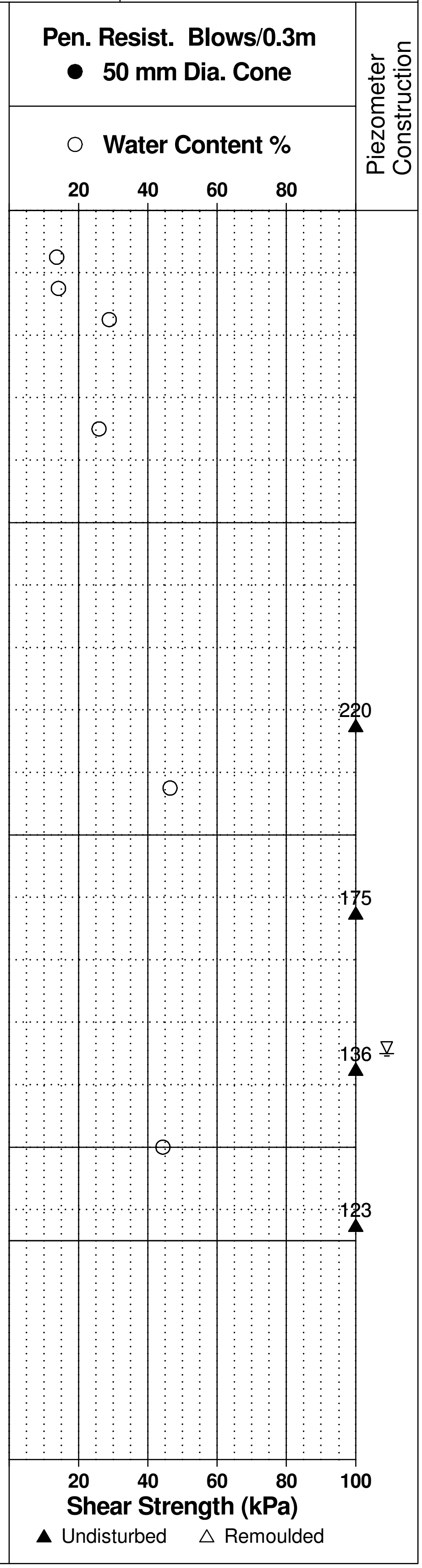
BORINGS BY Backhoe

DATE August 22, 2022

FILE NO. **PG6394**

HOLE NO. **TP 7-22**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.77
TOPSOIL 0.12							
FILL: Brown silty sand with gravel 0.30		G G	1 2				
FILL: Brown silty clay with organics 0.50		G	3				
FILL: Brown silty sand with clay, organics, brick and plastic 1.60		G	4			1	99.77
Hard to very stiff, brown **SILTY CLAY** 3.30		G G	5 6			2 3	98.77 97.77
End of Test Pit (Groundwater infiltration at 2.7m depth)							



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Commercial Development - Huntmar Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

BORINGS BY CME 55 Power Auger

DATE January 10, 2014

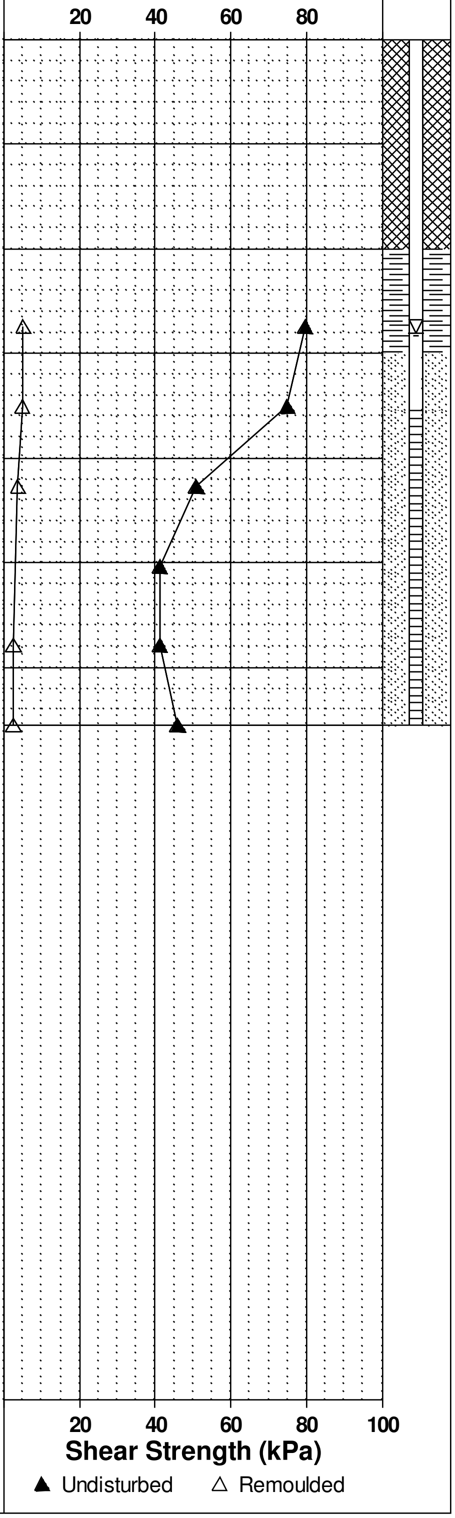
FILE NO. PG3115

HOLE NO. BH 8

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	101.02
TOPSOIL 0.25							
		AU	1				
		SS	2	100	3	1	100.02
Stiff to firm, brown **SILTY CLAY**		SS	3	100	2		
- grey-brown by 2.2m depth						2	99.02
						3	98.02
						4	97.02
- grey by 4.4m depth						5	96.02
6.55						6	95.02
End of Borehole (GWL @ 2.8m depth based on field observations)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Commercial Development - Huntmar Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

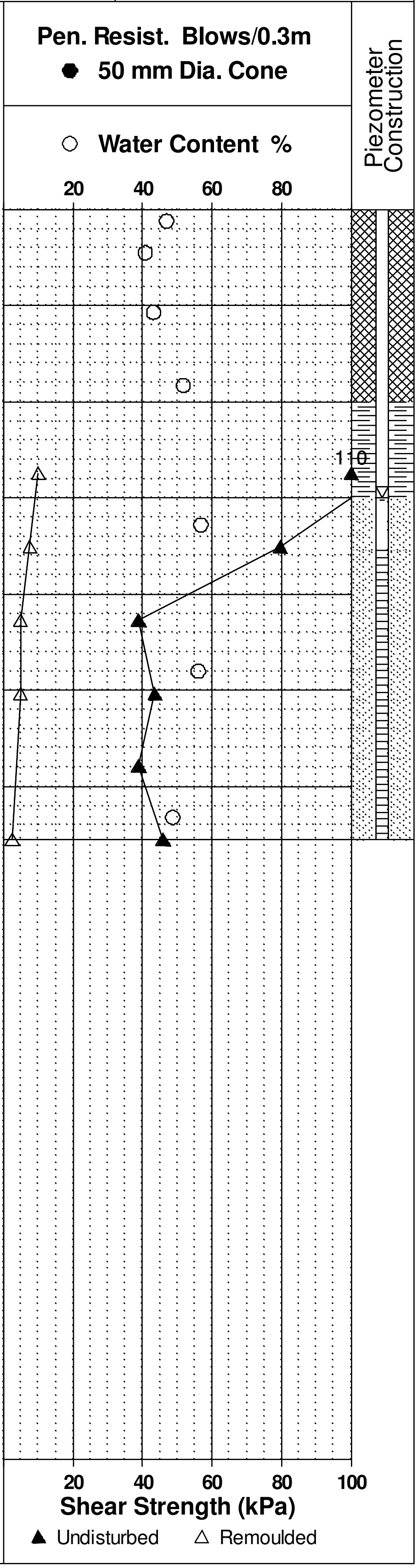
BORINGS BY CME 55 Power Auger

DATE January 10, 2014

FILE NO. PG3115

HOLE NO. BH 9

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.70
TOPSOIL 0.25		AU	1				
		AU	2				
		SS	3	100	9	1	99.70
Very stiff to stiff, brown **SILTY CLAY**		SS	4	83	3	2	98.70
- grey-brown by 2.9m depth						3	97.70
- firm and grey by 3.7m depth						4	96.70
						5	95.70
6.55						6	94.70
End of Borehole							
(GWL @ 3.0m depth based on field observations)							



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Commercial Development - Huntmar Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

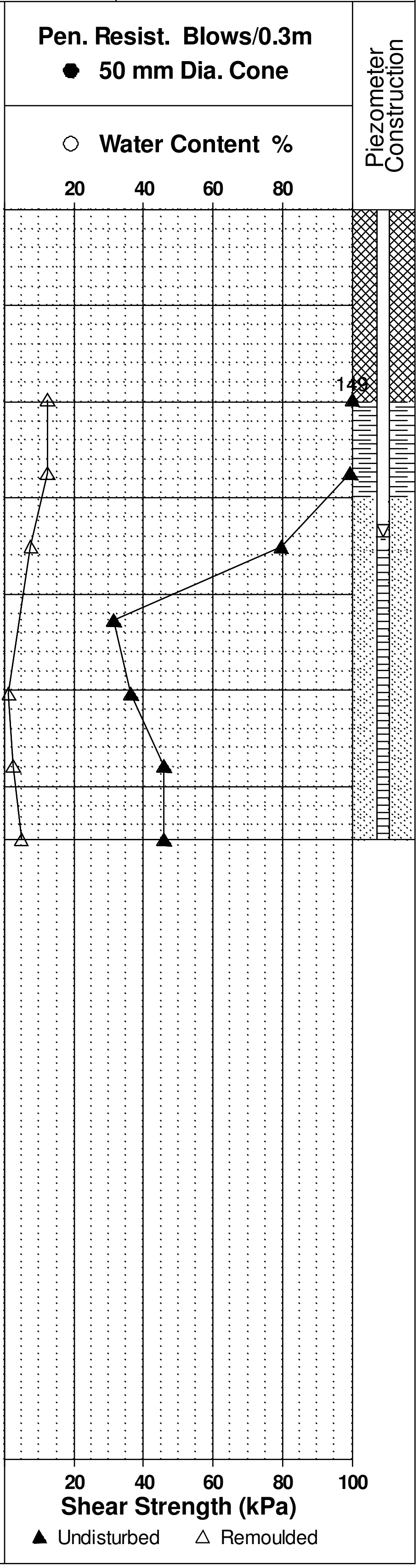
BORINGS BY CME 55 Power Auger

DATE January 10, 2014

FILE NO. PG3115

HOLE NO. BH10

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	101.02
FILL: Brown silty sand with gravel, trace cobbles and clay 0.33		AU	1				
		SS	2		6	1	100.02
Very stiff to stiff, brown **SILTY CLAY**						2	99.02
						3	98.02
- firm by 3.7m depth						4	97.02
- grey-brown by 4.4m depth						5	96.02
						6	95.02
6.55							
End of Borehole (GWL @ 3.4m depth based on field observations)							



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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Commercial Development - Huntmar Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

REMARKS

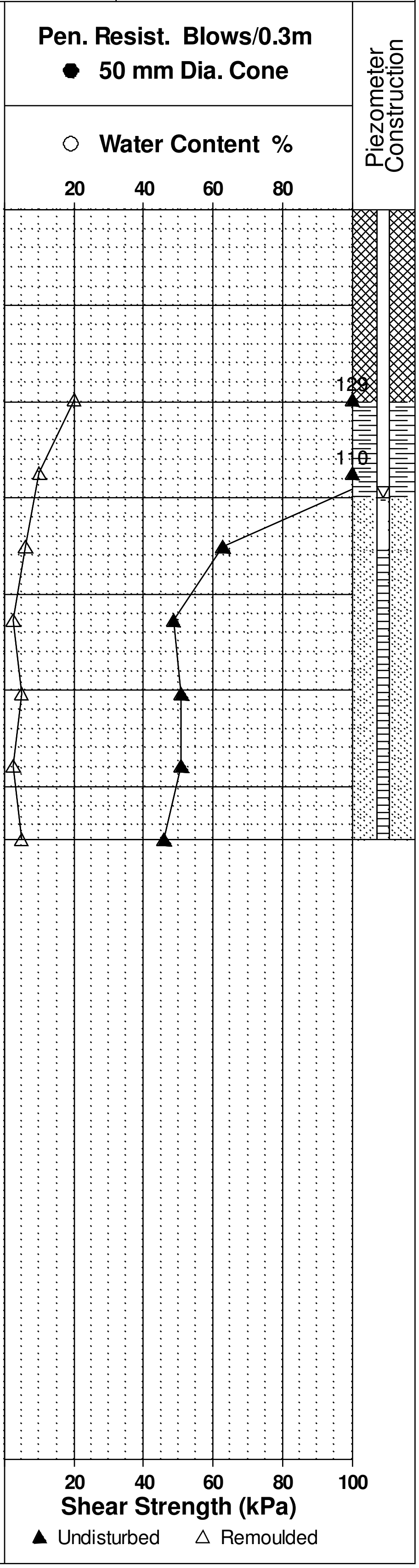
BORINGS BY CME 55 Power Auger

DATE January 9, 2014

FILE NO. PG3115

HOLE NO. BH25

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE						0	101.39
TOPSOIL 0.28		AU	1				
		AU	2				
		SS	3		5	1	100.39
						2	99.39
Very stiff to stiff, brown **SILTY CLAY** - firm and grey-brown by 3.7m depth						3	98.39
						4	97.39
						5	96.39
						6	95.39
6.55							
End of Borehole (GWL @ 3.0m depth based on field observations)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Commercial Development - Huntmar Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Stantec Geomatics Ltd.

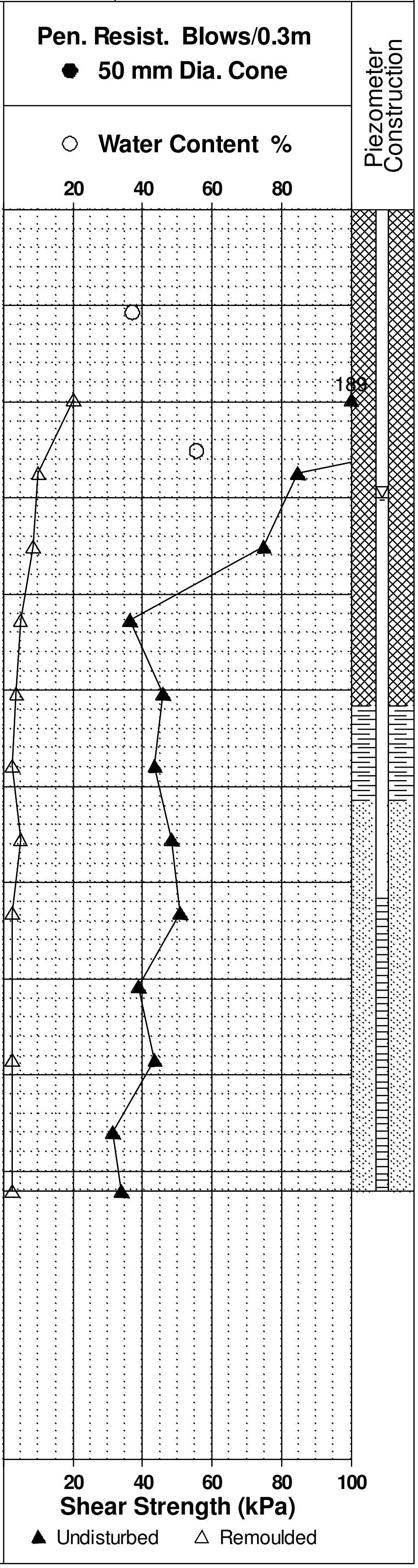
FILE NO. PG3115

REMARKS

HOLE NO. BH26

BORINGS BY CME 55 Power Auger **DATE** January 9, 2014

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	100.28
TOPSOIL 0.30	AU	1				
	SS	2	100	6	1	99.28
					2	98.28
Very stiff to stiff, brown **SILTY CLAY**						
					3	97.28
- firm and grey-brown by 3.7m depth						
					4	96.28
					5	95.28
- grey by 6.0m depth					6	94.28
					7	93.28
					8	92.28
					9	91.28
					10	90.28
10.21						
End of Borehole (GWL @ 3.0m depth based on field observations)						



SYMBOLS AND TERMS

SOIL DESCRIPTION

Behavioural properties, such as structure and strength, take precedence over particle gradation in describing soils. Terminology describing soil structure are as follows:

Desiccated	-	having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure.
Varved	-	composed of regular alternating layers of silt and clay.
Stratified	-	composed of alternating layers of different soil types, e.g. silt and sand or silt and clay.
Well-Graded	-	Having wide range in grain sizes and substantial amounts of all intermediate particle sizes (see Grain Size Distribution).
Uniformly-Graded	-	Predominantly of one grain size (see Grain Size Distribution).

The standard terminology to describe the strength of cohesionless soils is the relative density, usually inferred from the results of the Standard Penetration Test (SPT) 'N' value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm.

Relative Density	'N' Value	Relative Density %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory vane tests, penetrometer tests, unconfined compression tests, or occasionally by Standard Penetration Tests.

Consistency	Undrained Shear Strength (kPa)	'N' Value
Very Soft	<12	<2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their “sensitivity”. The sensitivity is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil.

Terminology used for describing soil strata based upon texture, or the proportion of individual particle sizes present is provided on the Textural Soil Classification Chart at the end of this information package.

ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NXL size core. However, it can be used on smaller core sizes, such as BX, if the bulk of the fractures caused by drilling stresses (called “mechanical breaks”) are easily distinguishable from the normal in situ fractures.

RQD %	**ROCK QUALITY**
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

SAMPLE TYPES

SS - Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))

TW - Thin wall tube or Shelby tube

PS - Piston sample

AU - Auger sample or bulk sample

WS - Wash sample

RC - Rock core sample (Core bit size AXT, BXL, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

GRAIN SIZE DISTRIBUTION

MC% - Natural moisture content or water content of sample, %
LL - Liquid Limit, % (water content above which soil behaves as a liquid)
PL - Plastic limit, % (water content above which soil behaves plastically)
PI - Plasticity index, % (difference between LL and PL)

Dxx - Grain size which xx% of the soil, by weight, is of finer grain sizes
These grain size descriptions are not used below 0.075 mm grain size
D10 - Grain size at which 10% of the soil is finer (effective grain size)
D60 - Grain size at which 60% of the soil is finer

Cc - Concavity coefficient = $(D30)^2 / (D10 \times D60)$
Cu - Uniformity coefficient = $D60 / D10$

Cc and Cu are used to assess the grading of sands and gravels:
Well-graded gravels have: $1 < Cc < 3$ and $Cu > 4$
Well-graded sands have: $1 < Cc < 3$ and $Cu > 6$
Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.
Cc and Cu are not applicable for the description of soils with more than 10% silt and clay
(more than 10% finer than 0.075 mm or the #200 sieve)

CONSOLIDATION TEST

p'_o - Present effective overburden pressure at sample depth
p'_c - Preconsolidation pressure of (maximum past pressure on) sample
Ccr - Recompression index (in effect at pressures below p'_c)
Cc - Compression index (in effect at pressures above p'_c)

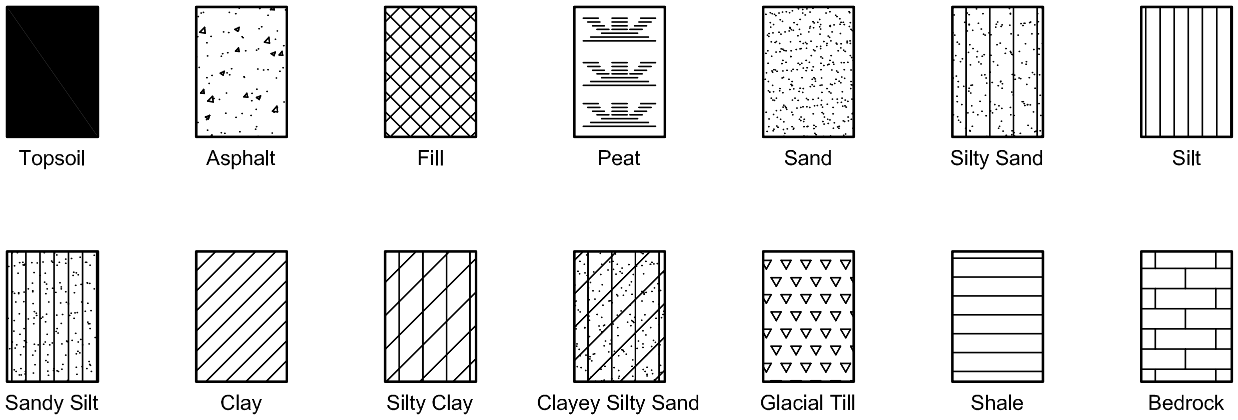
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

PERMEABILITY TEST

k - Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during the test.

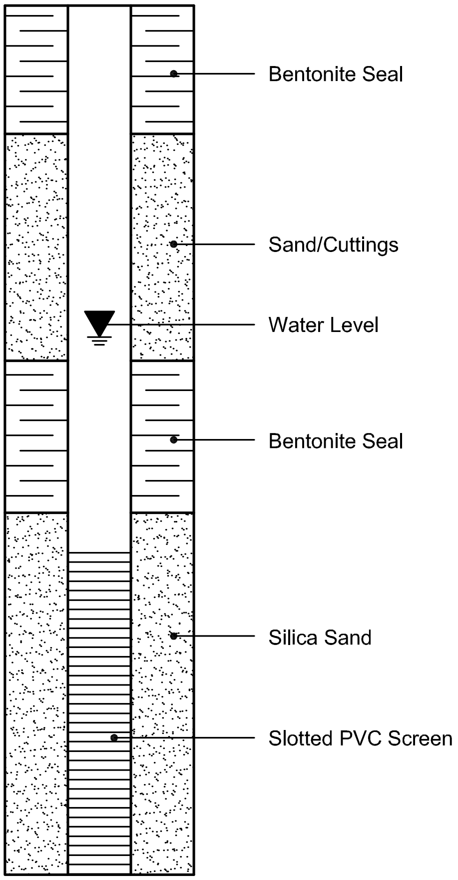
SYMBOLS AND TERMS (continued)

STRATA PLOT

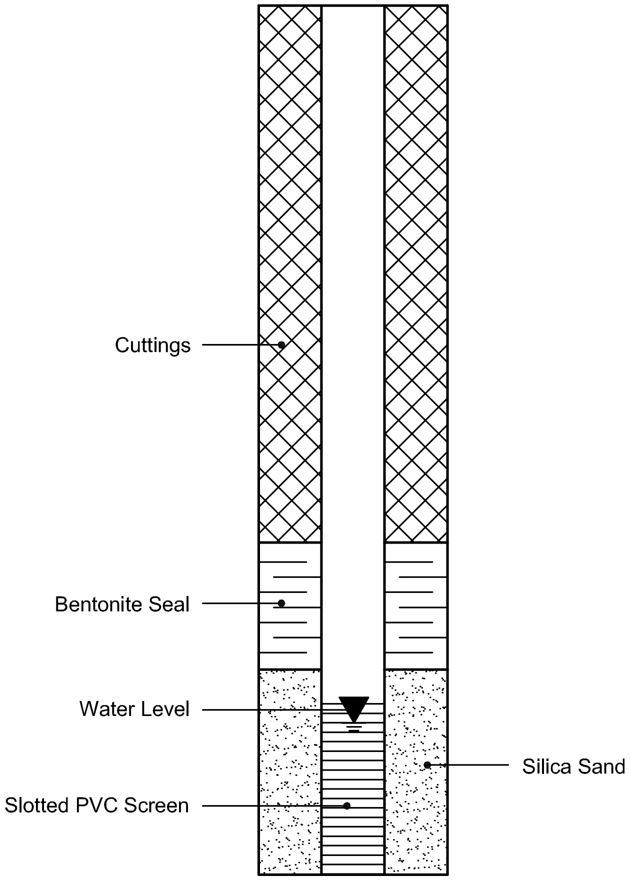


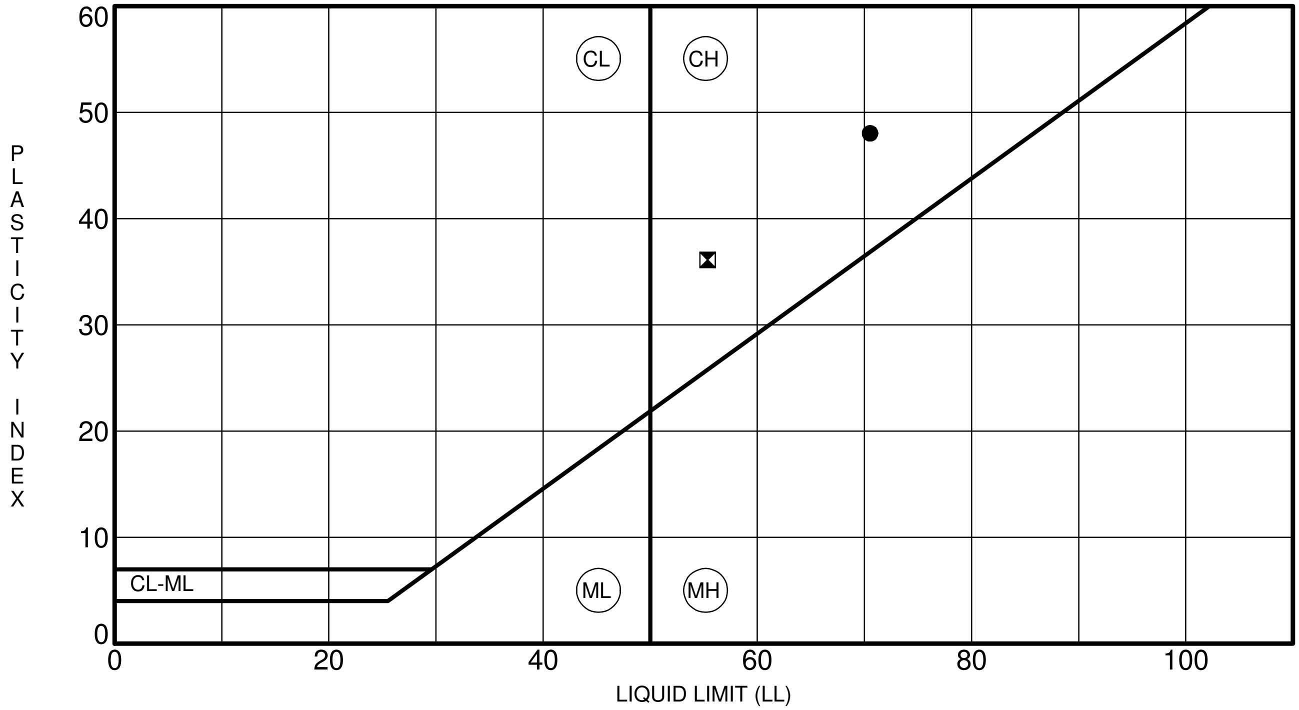
MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION





Specimen Identification			LL	PL	PI	Fines	Classification
●	**BH 1-22**	**SS2**	**71**	**22**	**49**		**CH - Inorganic clays of high plasticity**
☒	**BH 3-22**	**SS3**	**55**	**19**	**36**		**CH - Inorganic clays of high plasticity**

CLIENT **Rosefellow Developments**

PROJECT **Geotechnical Investigation - Prop. Development -**
Campeau Drive at Huntmar Road

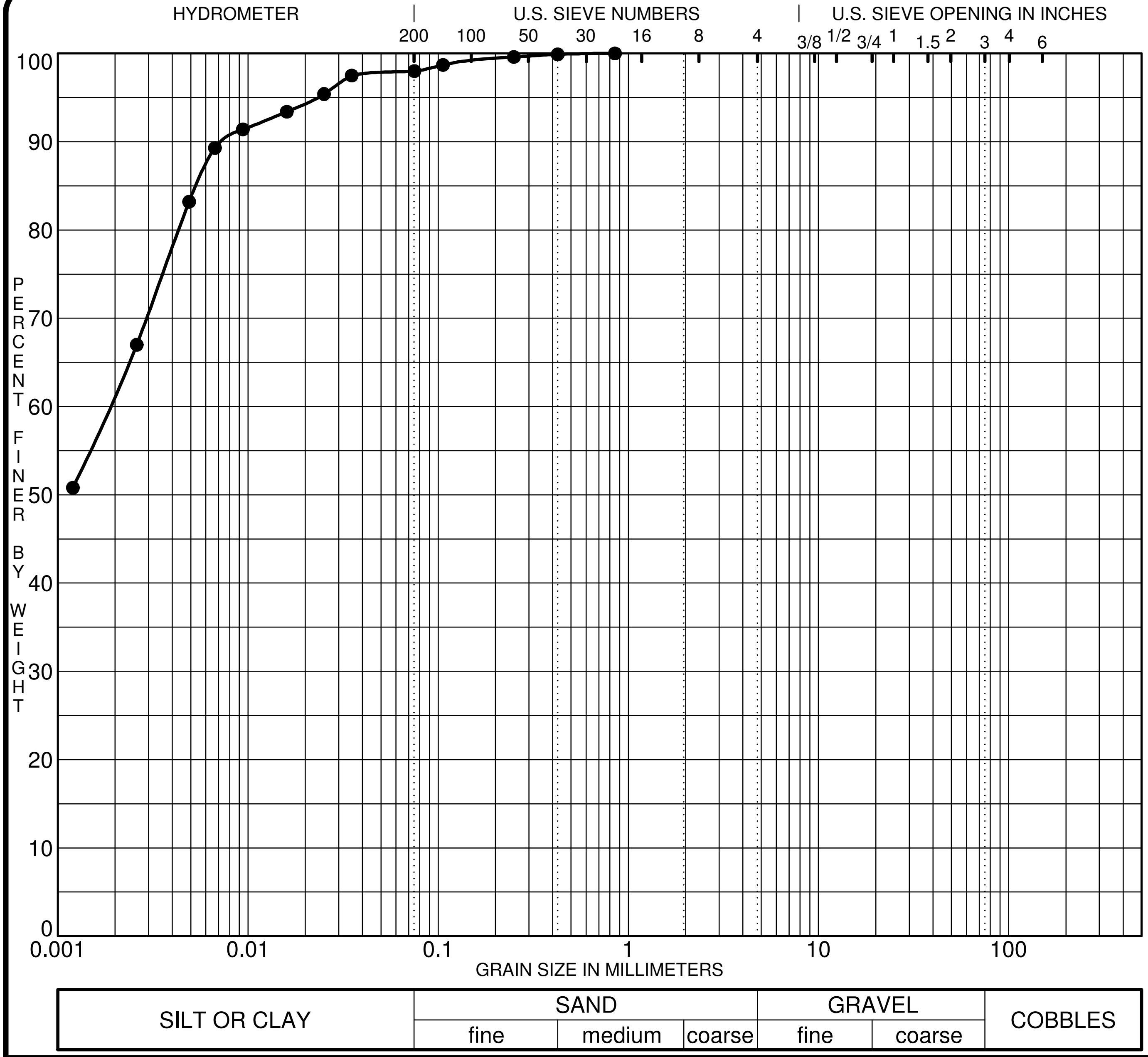
FILE NO. **PG6394**

DATE **19 Aug 22**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

ATTERBERG LIMITS' RESULTS



	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	**BH 2-22**	**SS2**							
⊠									
▲									
★									

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**BH 2-22**	**SS2**	**0.85**	**0.00**			**0.0**	**2.0**	**98.0**	
⊠										
▲										
★										

CLIENT **Rosefellow Developments**

FILE NO. **PG6394**

PROJECT **Geotechnical Investigation - Prop. Development - Campeau Drive at Huntmar Road**

DATE **19 Aug 22**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

GRAIN SIZE DISTRIBUTION

Certificate of Analysis

Report Date: 29-Aug-2022

Client: **Paterson Group Consulting Engineers**

Order Date: 23-Aug-2022

Client PO: 55598

Project Description: PG6394

	Client ID:	BH2-22-SS3	-	-	-	-	-
	Sample Date:	19-Aug-22 09:00	-	-	-		
	Sample ID:	2235088-01	-	-	-		
	Matrix:	Soil	-	-	-		
	MDL/Units						
Physical Characteristics							
% Solids	0.1 % by Wt.	64.9	-	-	-	-	-
General Inorganics							
pH	0.05 pH Units	7.34	-	-	-	-	-
Resistivity	0.1 Ohm.m	131	-	-	-	-	-
Anions							
Chloride	5 ug/g	<5	-	-	-	-	-
Sulphate	5 ug/g	<5	-	-	-	-	-

APPENDIX 2

FIGURE 1 - KEY PLAN

FIGURES 2 & 3 - SEISMIC SHEAR WAVE VELOCITY PROFILES

DRAWING PG6394-1 - TEST HOLE LOCATION PLAN

DRAWING PG6394-2 - TREE PLANTING SETBACK RECOMMENDATIONS

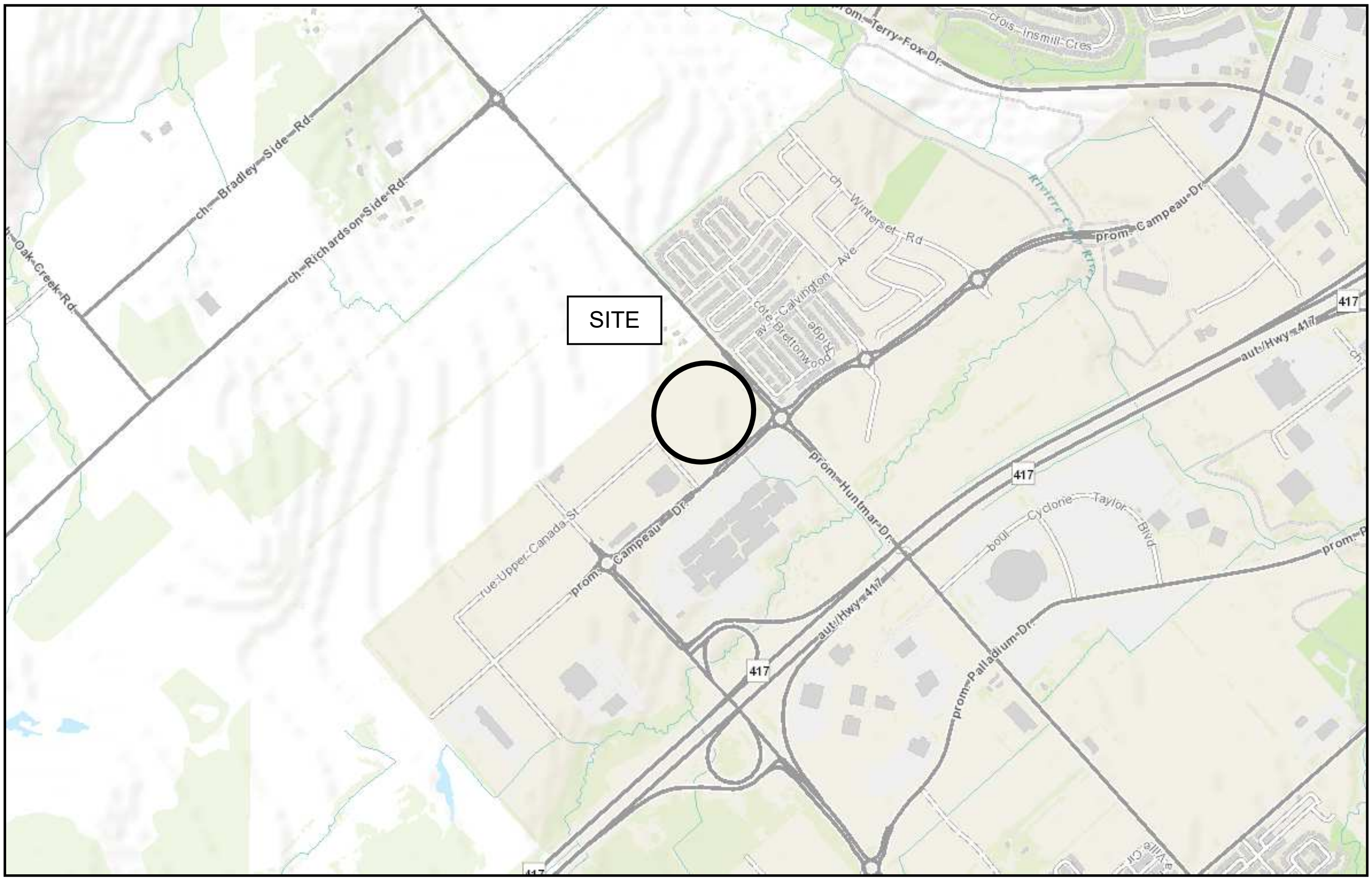


FIGURE 1

KEY PLAN

PATERSON GROUP

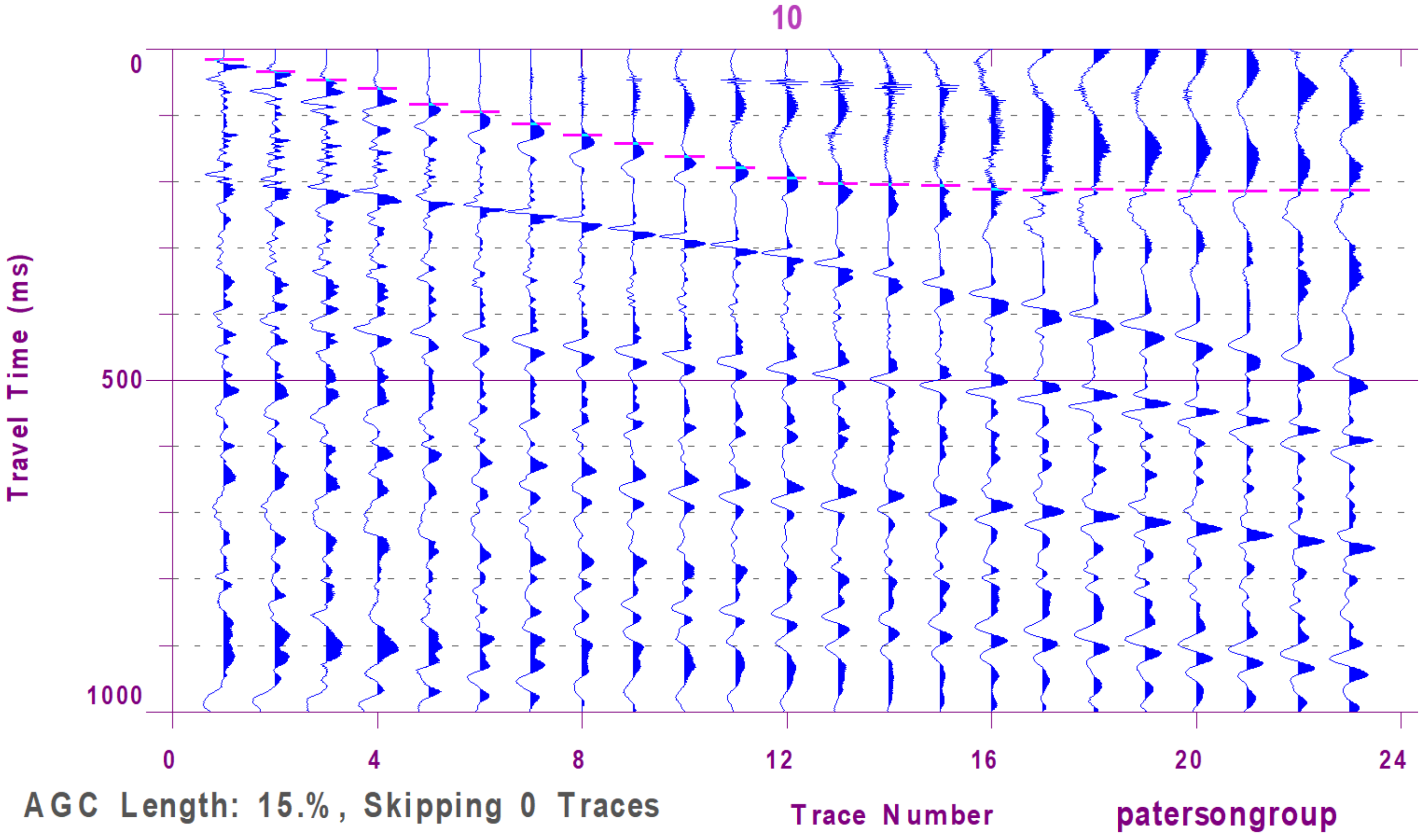


Figure 2 – Shear Wave Velocity Profile at Shot Location -3 m

PATERSON GROUP

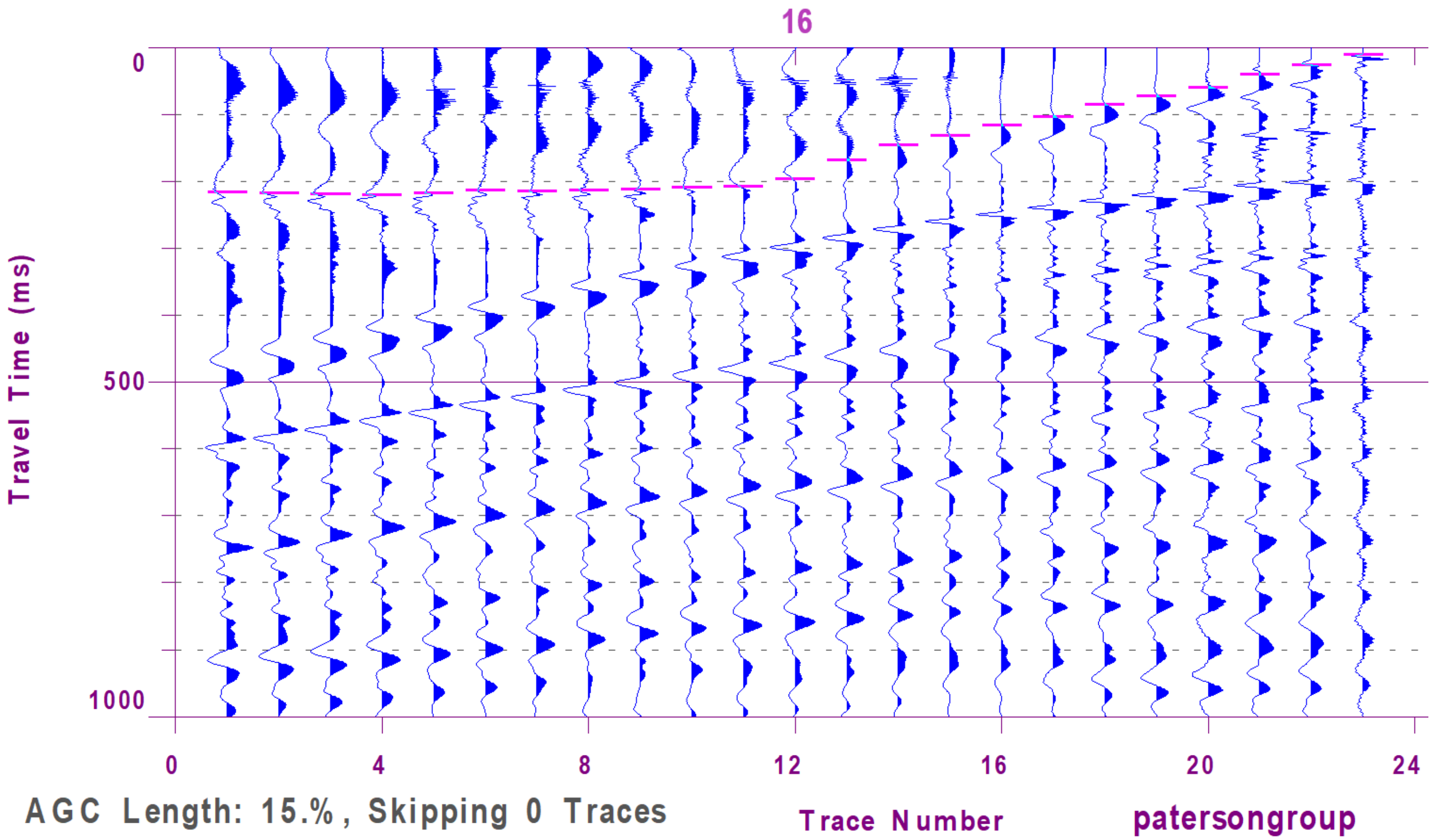
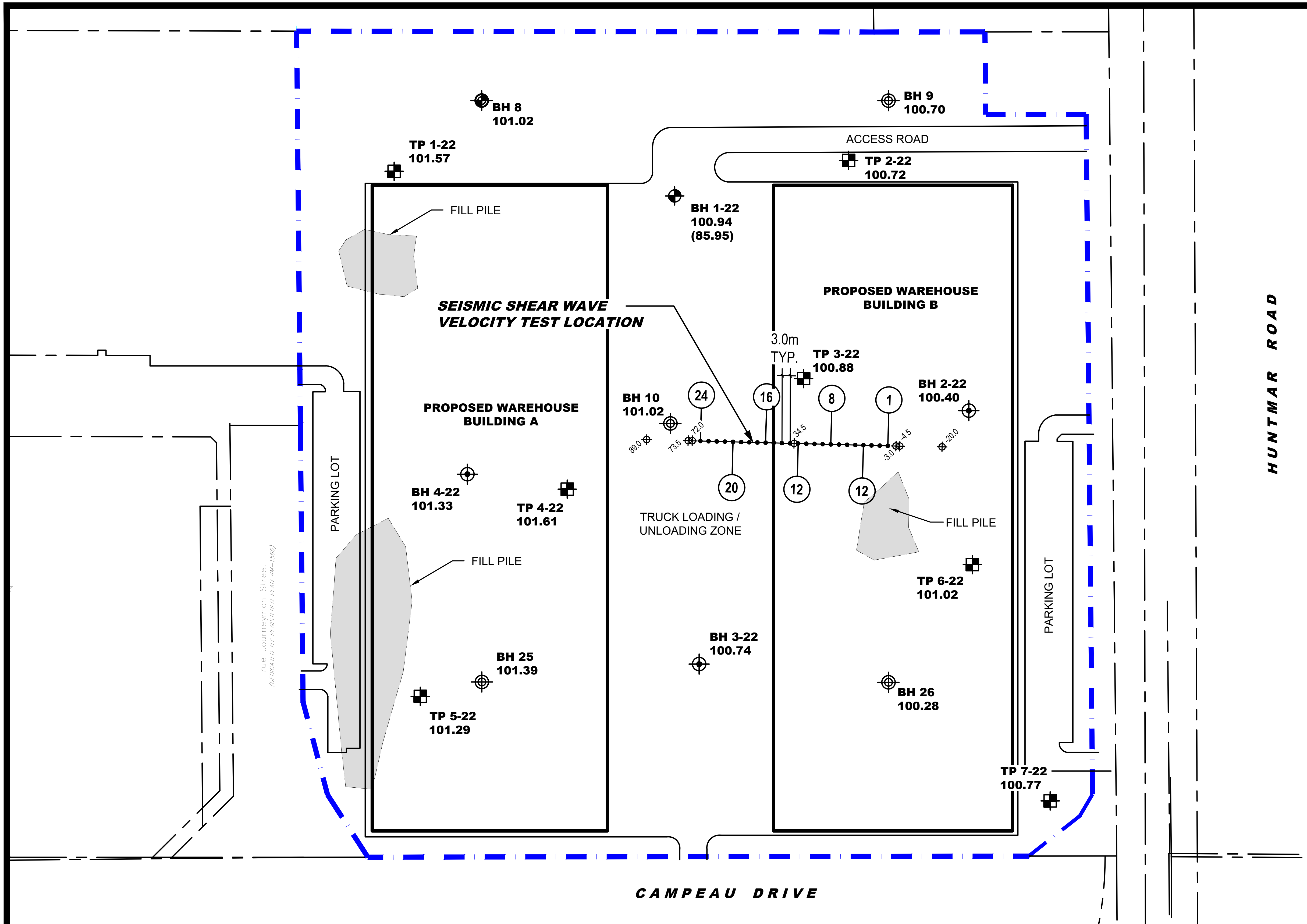


Figure 3 – Shear Wave Velocity Profile at Shot Location 73.5 m



LEGEND:

⊕	BOREHOLE LOCATION (CURRENT INVESTIGATION)
⊕	BOREHOLE WITH MONITORING WELL INSTALLED LOCATION (CURRENT INVESTIGATION)
▪	TEST PIT LOCATION (CURRENT INVESTIGATION)
⊕	BOREHOLE LOCATION, PREVIOUS PATERSON GROUP REPORT PG3115-1
101.74	GROUND SURFACE ELEVATION (m)
(90.49)	PRACTICAL REFUSAL TO DCPT/AUGERING ELEVATION (m)
•-•-•	GEOPHONE LOCATIONS
㉔	GEOPHONE NUMBER
⊕ 89.0	SHOT LOCATION

CONCEPTUAL PLAN PROVIDED BY ROSEFELLOW DEVELOPMENTS

GROUND SURFACE ELEVATIONS AT TEST HOLE LOCATIONS ARE REFERENCED TO A GEODETIC DATUM

SCALE: 1:1500

0 25 50 75 100m

PATERSON GROUP

9 AURIGA DRIVE
OTTAWA, ON
K2E 7S9
TEL: (613) 226-7381

NO.	REVISIONS	DATE	INITIAL
1	SEISMIC SHEAR WAVE VELOCITY TEST LOCATION ADDED TO PLAN	30/05/2023	FC

ROSEFELLOW DEVELOPMENTS
GEOTECHNICAL INVESTIGATION
PROPOSED WAREHOUSE BUILDINGS
CAMPEAU DRIVE AT HUNTMAR ROAD

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:1500	Date: 09/2022
Drawn by: YA	Report No.: PG6394-1
Checked by: ZA	Dwg. No.: PG6394-1
Approved by: MS	Revision No.: 1

11x17

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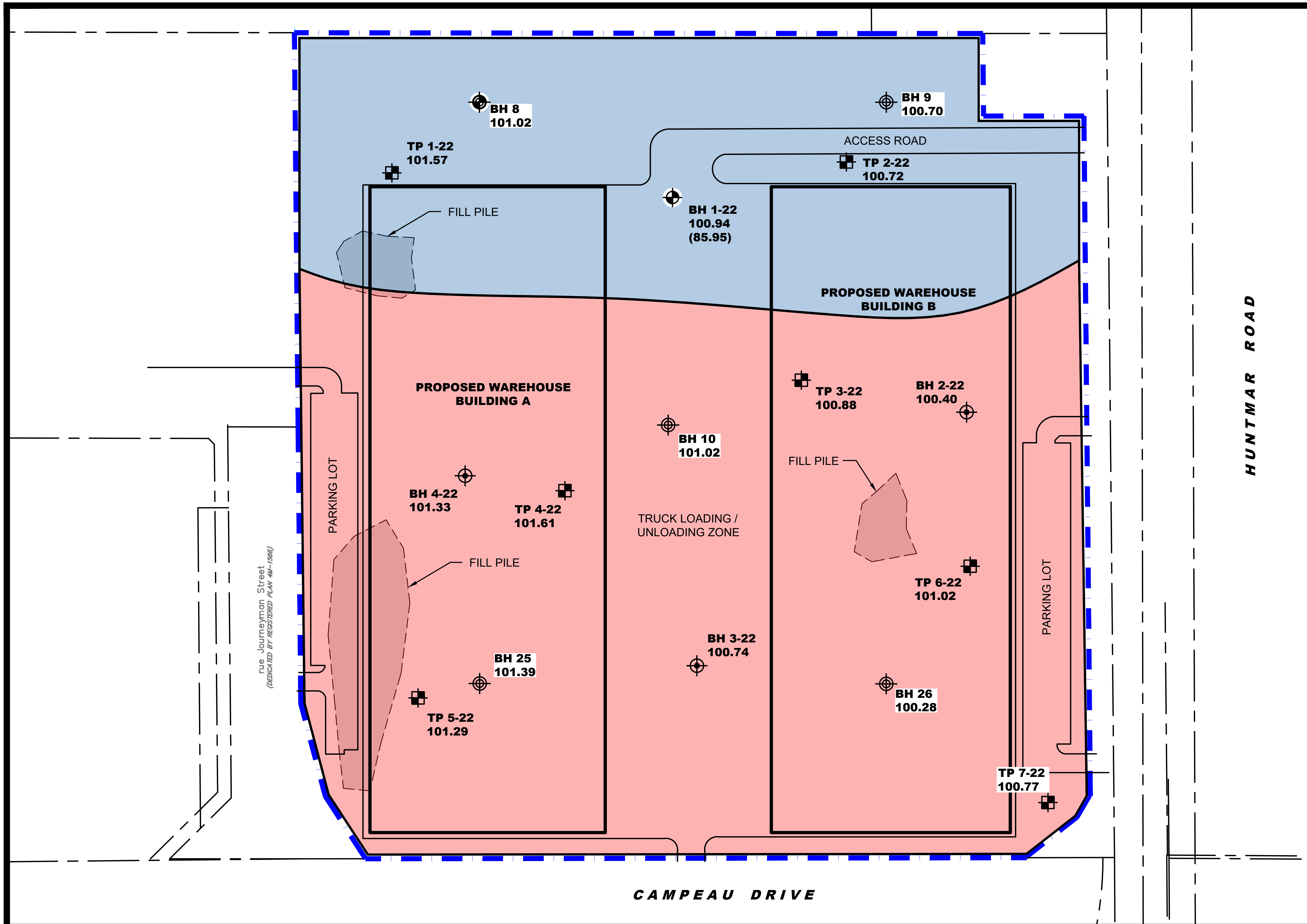

TREE PLANTING SETBACK:

🟦	AREA 1 - 7.5m TREE PLANTING SETBACKS
🟥	AREA 2 - 4.5m TREE PLANTING SETBACKS

LEGEND:

⊕	BOREHOLE LOCATION (CURRENT INVESTIGATION)
⊕	BOREHOLE WITH MONITORING WELL INSTALLED LOCATION (CURRENT INVESTIGATION)
▣	TEST PIT LOCATION (CURRENT INVESTIGATION)
⊕	BOREHOLE LOCATION, PREVIOUS PATERSON GROUP REPORT PG3115-1
101.74	GROUND SURFACE ELEVATION (m)
(90.49)	PRACTICAL REFUSAL TO DCPT/AUGERING ELEVATION (m)

CONCEPTUAL PLAN PROVIDED BY ROSEFELLOW DEVELOPMENTS

GROUND SURFACE ELEVATIONS AT TEST HOLE LOCATIONS ARE REFERENCED TO A GEODETIC DATUM

SCALE: 1:1500

0 25 50 75 100m

PATERSON GROUP

9 AURIGA DRIVE
OTTAWA, ON
K2E 7S9
TEL: (613) 226-7381

NO.	REVISIONS	DATE	INITIAL

ROSEFELLOW DEVELOPMENTS
GEOTECHNICAL INVESTIGATION
PROPOSED WAREHOUSE BUILDINGS
CAMPEAU DRIVE AT HUNTMAR ROAD

OTTAWA, ONTARIO

Title:

TREE PLANTING SETBACK RECOMMENDATIONS

Scale: 1:1500
Date: 09/2022
Drawn by: YA
Report No.: PG6394-1
Checked by: ZA
Dwg. No.: PG6394-2
Approved by: MS
Revision No.:

11x17

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