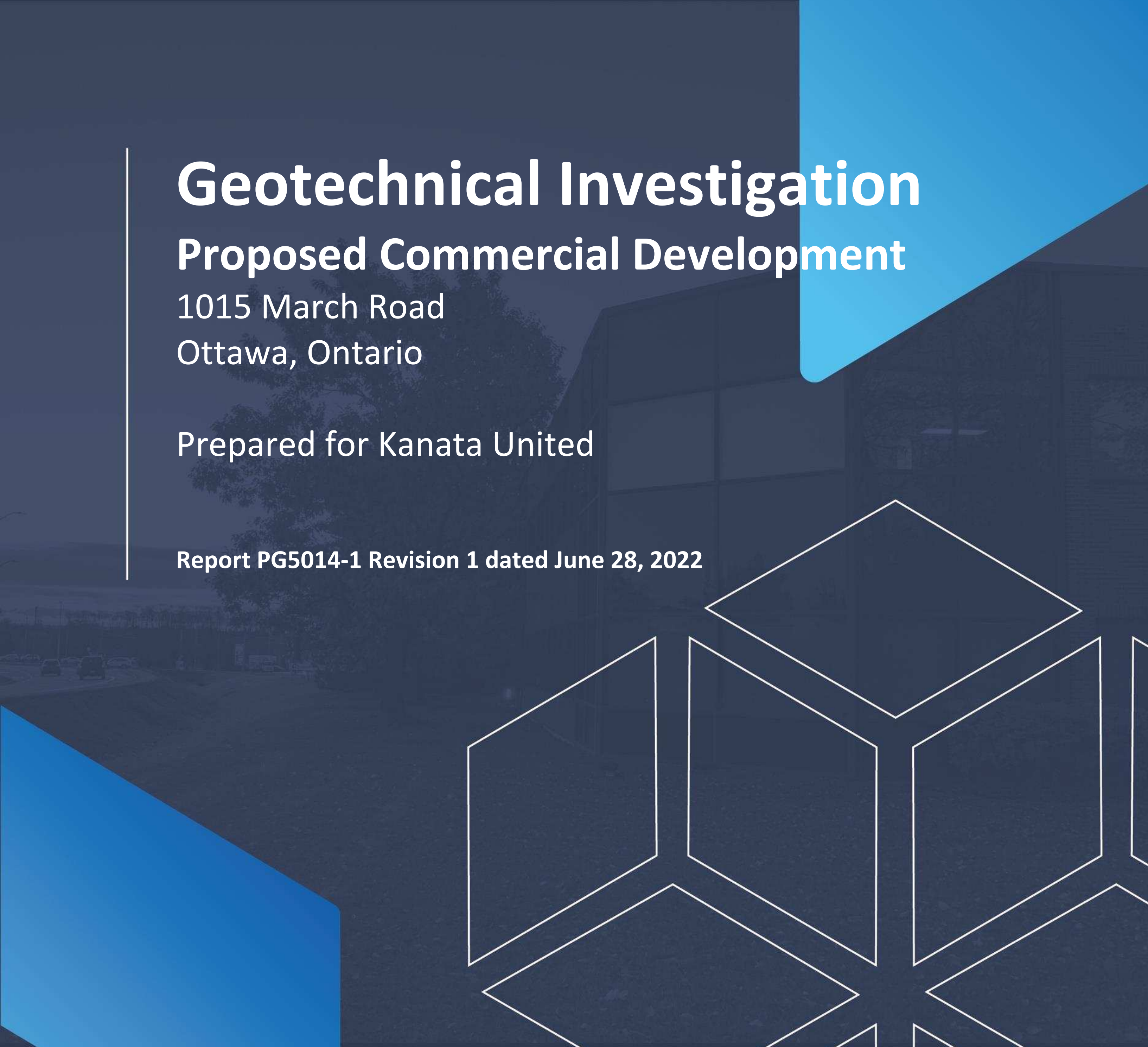


Geotechnical Investigation

Proposed Commercial Development

1015 March Road
Ottawa, Ontario

Prepared for Kanata United

Report PG5014-1 Revision 1 dated June 28, 2022

Table of Contents

Appendices

Appendix 1	Soil Profile and Test Data Sheets Symbols and Terms Atterberg Limits' Testing Results Grain Size Distribution Analysis (Hydrometer Testing) Analytical Testing Results
Appendix 2	Figure 1 - Key Plan Drawing PG5014-1 - Test Hole Location Plan Drawing PG5014-2 – Tree Planting Setback Plan

1.0 Introduction

Paterson Group (Paterson) was commissioned by Kanata United Development Limited to conduct a geotechnical investigation for the proposed commercial development to be located at 1015 March Road, in the City of Ottawa, Ontario (refer to Figure 1 - Key Plan in Appendix 2 of this report).

The objectives of the geotechnical investigation were to:

- Determine the subsoil and groundwater conditions at this site by means of boreholes.

- Provide geotechnical recommendations pertaining to the design of the proposed development including construction considerations which may affect the 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.

Investigating the presence or potential presence of contamination on the subject property was not part of the scope of work of the present investigation. Therefore, the present report does not address environmental issues.

2.0 Proposed Development

It is understood that the proposed development will consist of three commercial buildings located within the eastern portion of the site. Associated paved parking areas, walkways, access lanes and landscaped areas are also anticipated as a part of the proposed development.

It is further understood that the proposed development will be serviced by future municipal services.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the geotechnical investigation was conducted on July 24, 2019. At that time, a total of ten (10) boreholes were advanced to a maximum depth of 4.5 m below existing ground surface or practical auger refusal. A supplemental program was completed by Paterson between June 3 and 6, 2022 to provide borehole coverage within the central and western portion of the site. The boreholes were distributed in a manner to provide general coverage of the subject site taking into consideration site features and underground and overhead utilities. The locations of the test holes are shown on Drawing PG5014-1 included in Appendix 2.

The boreholes were completed using a track mounted auger drill rig operated by a two person crew. All fieldwork was conducted under the full-time supervision of Paterson personnel from our geotechnical division under the direction of a senior engineer. The testing procedure consisted of augering to the required depths and at the selected locations sampling the overburden.

Sampling and In Situ Testing

Soil samples were collected from the boreholes using two different techniques, namely, sampled directly from the auger flights (AU) or collected using a 50 mm diameter split- spoon (SS) sampler. All samples were initially classified on site and subsequently placed in sealed plastic bags and transported to our laboratory for further examination and classification. The depths at which the auger and split spoon and rock core samples were recovered from the boreholes are shown as AU and SS respectively, on the Soil Profile and Test Data Sheets in Appendix 1.

A 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 at regular depth intervals in cohesive soils. All soil samples were classified on site, placed in sealed plastic bags and were transported to our laboratory for visual inspection.

The subsurface conditions observed in the boreholes 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.

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.

Groundwater

Flexible standpipes were installed in all boreholes to monitor the groundwater levels subsequent to the completion of the sampling program. Groundwater level observations are discussed in Section 4.3 and are presented in the Soil Profile and Test Data sheets in Appendix 1.

3.2 Field Survey

The borehole locations were selected by Paterson to provide general coverage of the subject site, taking into consideration the existing site features and underground utilities. The borehole locations and ground surface elevations were surveyed by Paterson using a handheld GPS, referenced to a geodetic datum, and are presented on Drawing PG5014-1 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

The soil samples recovered from the subject site were visually examined in our laboratory to review the results of the field logging. A total of five (5) Atterberg limit tests were completed on selected silty clay samples. Grain size distribution analysis (hydrometer testing) was also completed on two (2) soil samples and two (2) soil sample were submitted for shrinkage testing. The results are presented in Subsection 4.2 and in Appendix 1.

3.4 Analytical Testing

One 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. The sample was tested to determine the concentration of sulphate and chloride, the resistivity and the pH of the sample. The results are presented in Appendix 1 and are discussed further in Subsection 6.7.

4.0 Observations

4.1 Surface Conditions

The subject site is currently occupied by a single-family residential dwelling located within the south portion of the subject site and is generally surround by agricultural land with the exception of a single family residential dwelling located to the north of the subject site. The site is sparsely surrounded by several mature trees and bordered to the east by a shallow ditch which travels parallel to March Road. The site is relatively flat and slightly lower in elevation than March Road.

4.2 Subsurface Profile

Overburden

Generally, the subsurface profile at the borehole locations consists of a layer of topsoil with organic content overlying a stiff to hard weathered brown silty clay crust extending to depths varying between 0.7 to 4.1m below existing ground surface at the test hole locations. The silty clay was generally found to be underlain by a compact to very dense glacial till consisting of a brown silty sand to silty clay, gravel, cobbles and occasional boulders.

Practical refusal to augering was encountered at all boreholes locations at depth varying between 1.5 and 4.5 m below existing ground surface.

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

Atterberg Limits Results

The results of the Atterberg Limit tests conducted within the silty clay are presented below in Table 1 - Summary of Atterberg Limits Results and are presented in Appendix 1. The tested material was classified as Inorganic Clays of High Plasticity (CH).

Table 1 - Summary of Atterberg Limits Results

Sample	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index %	Classification
BH 3 - SS 2	26.9	55	21	33	CH
BH 8 - SS 3	27.3	53	19	34	CH
BH 10 - SS 2	29.8	58	27	32	CH
BH 1-22 – SS 2	33.2	65	21	44	CH
BH 7-22 – SS 2	38.4	54	21	33	CH

Grain Size Analysis Testing

One (1) representative soil sample was submitted for grain size distribution analysis (hydrometer testing). The results are summarized in Table 2 and presented on the Grain Size Distribution sheets in Appendix 1.

Table 2 - Summary of Grain Size Distribution Analysis (Hydrometer Testing)

Sample	Gravel %	Sand %	Fines Content	
			Silt %	Clay %
BH 4 - SS 3	0	1.4	47.6	51.0
BH 3-22 SS5	1.6	3	37.4	58.0

Shrinkage Test

The shrinkage limit and shrinkage ratio of the tested silty clay sample (BH 9-SS3) were found to be 19% and 1.78, respectively. Similarly, the shrinkage limit and shrinkage ratio of the tested silty clay sample (BH 3-22 SS4) were found to be 19% and 1.78, respectively

Bedrock

Based on available geological mapping, the bedrock in the area consists of sandstone interbedded with dolomite, belonging to the March formation with an overburden thickness of ranging from 2 to 5 m.

4.3 Groundwater

The groundwater level (GWL) readings were recorded at the borehole locations during the current and previous investigation on June 10, 2022 and on July 30, 2019 and are presented in Table 3 below, and on the Soil Profile and Test Data sheets in Appendix 1.

Table 3 - Summary of Groundwater Level Readings

Test Hole Number	Ground Surface Elevation (m)	Groundwater Levels (m)	Groundwater Elevation (m)	Recording Date
BH 1-22	82.41	0.62	81.79	June 10, 2022
BH 2-22	82.23	1.15	81.08	
BH 3-22	84.13	0.34	83.79	
BH 4-22	84.18	0.21	83.97	
BH 5-22	83.04	0.61	82.43	
BH 6-22	84.86	0.18	84.68	
BH 7-22	84.49	0.06	84.43	
BH 8-22	84.09	0.33	83.76	
BH 1	81.10	1.10	80.00	July 30, 2019
BH 2	81.61	1.70	79.91	
BH 3	80.87	1.32	79.55	
BH 4	80.80	1.03	79.77	
BH 5	80.49	3.81	76.68	
BH 6	80.18	0.85	79.33	
BH 7	81.05	1.23	79.82	
BH 8	81.56	1.27	80.29	
BH 9	81.16	1.11	80.05	
BH 10	81.51	1.33	80.18	

Note: Ground surface elevations at borehole locations were surveyed by Paterson and are referenced to a geodetic datum.

It is important to note that groundwater level readings could be influenced by surface water infiltrating the backfilled borehole due to rain events, which can lead to water perching inside the boreholes resulting in higher water levels than noted during the investigation.

The long-term groundwater level can also be estimated based on moisture levels, consistency and color of the recovered soil samples. Based on these observations at the borehole locations, the long-term groundwater level is expected to be at a 2 to 3 m depth.

It should be noted that groundwater levels are subject to seasonal fluctuations and therefore groundwater levels could differ at the time of construction.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is considered adequate for development. It is expected that low rise commercial buildings can be founded by conventional style shallow foundations placed on undisturbed, stiff to hard silty clay or glacial till bearing surface.

Due to the presence of the silty clay deposit, the subject site will be subjected to a permissible grade raise. 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.

It is anticipated the bedrock removal will be needed to reach founding level at some locations. In addition, bedrock removal may be needed where deep services are anticipated.

The above and other considerations are discussed in the following paragraphs.

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and fill, such as those containing significant amounts of organic or deleterious material, should be stripped from under any buildings and other settlement sensitive structures.

Existing foundation walls and other demolished debris should be completely removed from the proposed building perimeter and within the lateral support zones of the foundation. Under paved area, existing construction remnants, such as foundation walls should be excavated to a minimum of 1 m below final grade.

Bedrock Removal

Bedrock removal can be accomplished by hoe ramming where the bedrock is weathered and/or where only small quantities of the bedrock need to be removed. Sound bedrock may be removed by line drilling in conjunction with controlled blasting and/or hoe ramming.

Prior to considering blasting operations, the blasting effects on the existing services, buildings, and other structures should be addressed. A pre-blast or pre-construction survey of the existing structures located in the proximity of the blasting operations should be carried out prior to commencing site activities. The extent of the survey should be determined by the blasting consultant and should be sufficient to respond to any inquiries or claims related to the blasting operations. The blasting operations must be planned and conducted under the supervision of a licensed professional engineer who is also an experienced blasting consultant.

Vibration Considerations

Construction operations are also the cause of vibrations, and possibly, sources of nuisance to the community. Therefore, means to reduce the vibration levels should be incorporated in the construction operations to maintain, as much as possible, a cooperative environment with the residents.

The following construction equipment could be a source of vibrations: piling rig, hoe ram, compactor, dozer, crane, truck traffic, etc. Vibrations, whether caused by blasting operations or by construction operations, could be the cause of the source of detrimental vibrations on the nearby buildings and structures. Therefore, it is recommended that all vibrations be limited.

Two parameters are used to determine the permissible vibrations, namely, the maximum peak particle velocity and the frequency. For low frequency vibrations, the maximum allowable peak particle velocity is less than that for high frequency vibrations. As a guideline, the peak particle velocity should be less than 15 mm/s between frequencies of 4 to 12 Hz, and 50 mm/s above a frequency of 40 Hz (interpolate between 12 and 40 Hz).
It should be noted that these guidelines are for today’s construction standards. Considering that these guidelines are above perceptible human level and, in some cases, could be very disturbing to some people, it is recommended that a pre-construction survey be completed to minimize the risks of claims during or following the construction of the proposed buildings.

Fill Placement

Fill placed for grading beneath the proposed building areas should consist of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or 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 buildings and paved areas should be compacted to at least 98% of the material’s 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. This material should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If this material is to be used to build up the subgrade level for areas to be paved, it should be compacted in thin lifts to at least 95% of the material's SPMDD.

Non-specified existing fill and site-excavated soils are not suitable for use as backfill against foundation walls unless used in conjunction with a composite drainage membrane, such as Miradrain G100N or Delta Drain 6000

If excavated rock is to be used as fill, it should be suitably fragmented to produce a well-graded material with a maximum particle size of 300 mm. Where the fill is open-graded, a blinding layer of finer granular fill and/or a woven geotextile may be required to prevent adjacent finer materials from migrating into the voids, with associated loss of ground and settlements. This can be assessed at the time of construction.

5.3 Foundation Design

Bearing Capacity Values (Conventional Shallow Footings)

Strip footings up to 3 m wide and pad footings up to 5 m wide founded on an undisturbed, hard to stiff silty clay can be designed using the 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**.

Footings placed on an undisturbed, compact to dense glacial till bearing surface can be designed using a bearing resistance value at SLS of **200 kPa** and at ULS of **300 kPa**. A geotechnical resistance factor of 0.5 was incorporated into the bearing resistance value at ULS.

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

An undisturbed soil bearing surface consists of a surface 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.

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 an undisturbed soil bearing surface above the groundwater table when a plane extending horizontally and vertically from the bottom edge of the footing at a minimum of 1.5H:1V, passing through in situ soil of the same or higher capacity as the bearing medium soil.

Permissible Grade Raise Recommendations

A permissible grade raise restriction has been determined for the subject site based on the undrained shear strength values completed within the silty clay deposit. Based on the testing results, a permissible grade raise restriction of **2.5 m** above existing ground surface is recommended for the subject site.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class C**. If a higher seismic site class is required (Class B), a site-specific shear wave velocity test may be completed to accurately determine the applicable seismic site classification for foundation design of the proposed buildings, as presented in Table 4.1.8.4.A of the Ontario Building Code (OBC) 2012. Soils underlying the subject site are not susceptible to liquefaction. Reference should be made to the latest revision of the OBC 2012 for a full discussion of the earthquake design requirements.

5.5 Slab on Grade Construction

With the removal of all topsoil and fill, containing deleterious or organic materials, the native soil or existing granular fill approved by the geotechnical consultant at the time of excavation will be considered to be an acceptable subgrade surface on which to commence backfilling for slab on grade construction. Any soft areas should be removed and backfilled with appropriate backfill material. OPSS Granular A or Granular B Type II are recommended for backfilling below the floor slab. All backfill materials within the footprint of the proposed buildings should be placed in maximum 300 mm thick loose layers and compacted to at least 98% of its SPMDD.

5.6 Pavement Structure

For design purposes, the pavement structure presented in the following tables could be used for the design of car parking areas and access lanes/heavy truck parking areas.

Table 4 - Recommended Pavement Structure - Car Only Parking Areas

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

Table 5 - Recommended Pavement Structure - Access Lanes/Heavy Truck Parking Areas

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

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 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 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.

Due to the low permeability of the subgrade materials consideration should be given to installing subdrains 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.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Foundation Drainage

A perimeter foundation drainage system is recommended for the proposed buildings. The system should consist of a 150 mm diameter, geotextile-wrapped, perforated, corrugated, plastic pipe, surrounded by 150 mm of 19 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 gravity connection to the storm sewer.

Backfill against the exterior sides of the foundation walls should consist of free draining, non-frost susceptible granular materials. The site excavated materials will be frost susceptible and, as such, are not recommended for re-use as backfill unless a composite drainage system (such as system Miradrain G100N) connected to a drainage system is provided. 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 of Footings Against Frost Action

Perimeter footings of heated structures are recommended to be insulated against the deleterious effects of frost action. A minimum 1.5 m thick soil cover, or an equivalent combination of soil cover and foundation insulation should be provided in this regard.

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

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 anticipated that sufficient space will be available for the great part of the excavations to be undertaken by open-cut methods (i.e. unsupported excavations)

Unsupported Side Slopes

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 is used 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

Bedding and backfill materials should be in accordance with the most recent Material Specifications & Standard Detail Drawings from the Department of Public Works and Services, Infrastructure Services Branch of the City of Ottawa.

A minimum of 150 mm of OPSS Granular A should be placed for bedding for sewer or water pipes when placed on a soil subgrade. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to a minimum of 300 mm above the obvert of the pipe, should consist of OPSS Granular A (concrete or PSM PVC pipes) or sand (concrete pipe). The bedding and cover materials should be placed in maximum 225 mm thick lifts and compacted to 98% of the SPMDD.

It is generally possible to re-use the site materials above the cover material if the operations are carried out in dry weather conditions. Wet silty clay materials will be difficult to re-use, as the high water contents make compacting impractical without an extensive drying period.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.2 m below finished grade) and above the cover material should match the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in maximum 225 mm thick loose lifts and compacted to a minimum of 98% of the material’s SPMDD.

Clay Seals

To reduce long-term lowering of the groundwater level at this site, clay seals should be provided in the service trenches. The seals should be at least 1.5 m long and should extend from trench wall to trench wall. Generally, the seals should extend from the frost line and fully penetrate the bedding, subbedding and cover material. The barriers should consist of relatively dry and compactable brown silty clay placed in maximum 225 mm thick loose layers and compacted to a minimum of 98% of the material's SPMDD. The clay seals should be placed at the site boundaries and at strategic locations at no more than 60 m intervals in the service trenches.

6.5 Groundwater Control

It is anticipated that groundwater infiltration into the excavations should be low to moderate and controllable using open sumps. Where excavation will be done above the groundwater level, 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.

It is anticipated higher rates of infiltration will be experienced throughout the shallow portions of the glacial till deposits, below the groundwater table such that conventional pumping may not be practical. Depending on the founding depth of buildings/invert level of services located throughout the glacial till deposit, consideration may need to be given to undertaking a dewatering program taking place outside the excavation footprints. The system would require the use of deep wells or well points to temporarily lower the local groundwater table below the depth of future excavations.

Permit to Take Water

A temporary Ministry of Environment, Conservation and Parks (MECP) permit to take water (PTTW) may be required if more than 400,000 L/day of ground and/or surface water are to be pumped during the construction phase. At least 4 to 5 months should be allowed for completion of the application 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 Persons 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 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 using 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 into the subgrade or in the excavation walls and bottoms. Precautions should be taken if such activities are to be carried out during freezing conditions. Additional information could be provided, if required.

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 nonaggressive to slightly aggressive corrosive environment.

6.8 Landscaping Considerations

Tree Planting Setbacks

In general 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 and grain size distribution analysis (hydrometer testing) was completed for recovered silty clay samples at selected locations throughout the subject site. The above noted test results were completed between design underside of footing elevation and a 3.5 m depth below finished grade. The results of our testing are presented in Table 1 and Table 2 in Subsection 4.2 and in Appendix 1.

The shrinkage limit and shrinkage ratio of the tested silty clay sample (BH 9-SS3) were found to be 19% and 1.78, respectively. Similarly, the shrinkage limit and shrinkage ratio of the tested silty clay sample (BH 3-22 SS4) were found to be 19% and 1.78, respectively.

Based on the results of the representative soil samples recovered between the designed underside of footing (USF) and 3.5 m from the proposed design grades at the residential dwellings, two tree planting setback areas are present within the proposed development. The two areas are detailed below and have been outlined in Drawing PG5014-2 - Tree Planting Setback Recommendations presented in Appendix 2.

Area 1 - 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 the areas outlined in Drawing PG5014-2 - 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 and hence, **a 4.5 m** horizontal setback can be taken for small (mature tree height up to 7.5m) and medium size trees (mature tree height 7.5 m to 14 m). 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).

Area 2 - High Sensitivity Area

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 PG5014-2 - Tree Planting Setback Recommendations in Appendix 2. Based on our Atterberg Limits test results, the plasticity index limit generally exceeds 40% within BH1-22. The following tree planting setbacks are recommended for these high sensitivity areas.

Large trees (mature height over 14 m) can be planted within this area 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 is **7.5 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 following conditions 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 centre of the tree trunk and verified by means of the Grading Plan as indicated procedural changes below.

- A small tree must be provided with a minimum of 25 m^3 of available soil 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.

- Grading plan review from a geotechnical perspective, once the final grading plan is available.
- 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 determine the level of compaction achieved.
- Sampling and testing of the bituminous concrete including mix design reviews.

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.

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*.

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 Kanata United or their agents is not authorized without review by Paterson for the applicability of our recommendations to the alternative use of the report.

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
June 28, 2022
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

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

David J. Gilbert, P.Eng

Report Distribution:

❑ Kanata United (email copy)
❑ Paterson Group (1 copy)

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ATTERBERG LIMITS' TESTING RESULTS

GRAIN SIZE DISTRIBUTION ANALYSIS (HYDROMETER TESTING)

ANALYTICAL TESTING RESULTS

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1015 March Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

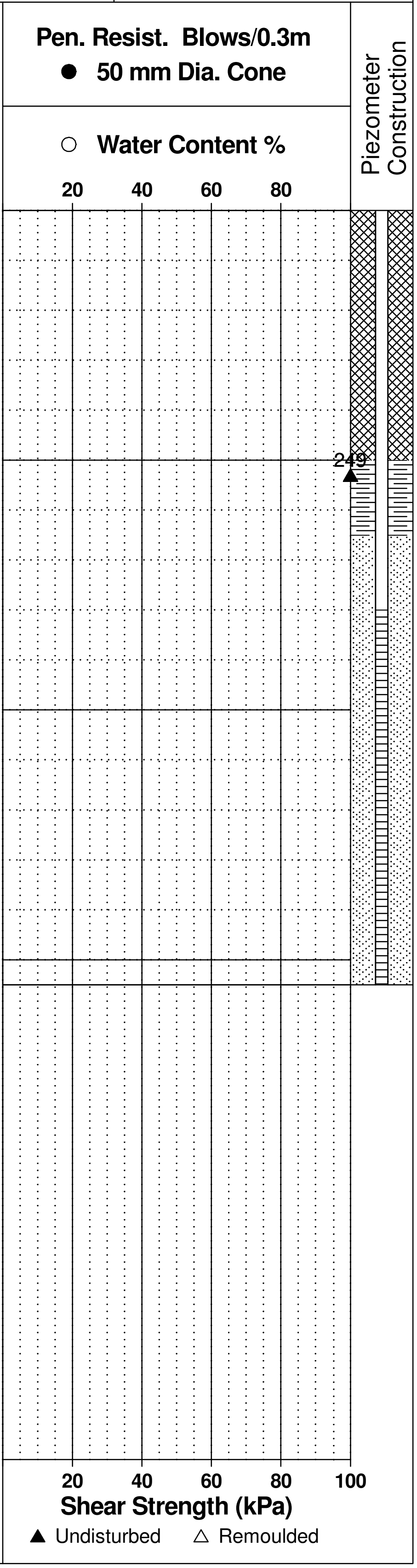
BORINGS BY Track-Mount Power Auger

DATE June 3, 2022

FILE NO. PG5014

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	82.41
TOPSOIL 0.18							
		SS	1	58	7		
		SS	2	75	P	1	81.41
Hard to very stiff, brown **SILTY CLAY,** trace sand							
		SS	3	75	9	2	80.41
2.89		SS	4	71	7		
GLACIAL TILL: Very dense silty clay with sand, gravel and cobbles 3.10		SS	5	100	50+	3	79.41
End of Borehole Practical refusal to augering at 3.10m depth.							



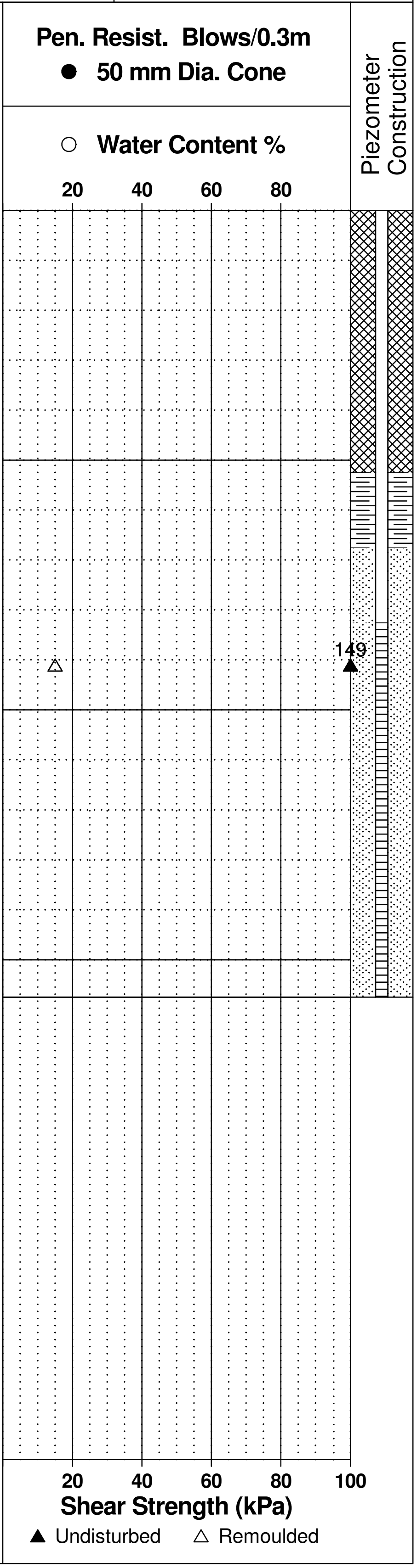
SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1015 March Road
Ottawa, Ontario

DATUM Geodetic
REMARKS
BORINGS BY Track-Mount Power Auger
DATE June 3, 2022
FILE NO. PG5014
HOLE NO. BH 2-22

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
TOPSOIL 0.25	AU	1		
Hard to very stiff, brown **SILTY CLAY,** trace sand	AU	2		
1.37	SS	3	71	8
GLACIAL TILL: Very dense, brown silty clay with sand, gravel, cbbles and boulders	SS	4	88	
	SS	5	88	7
3.15	SS	6	75	50+
End of Borehole Practical refusal to augering at 3.15m depth.				

DEPTH (m)	ELEV. (m)
0	82.23
1	81.23
2	80.23
3	79.23



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1015 March Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE June 3, 2022

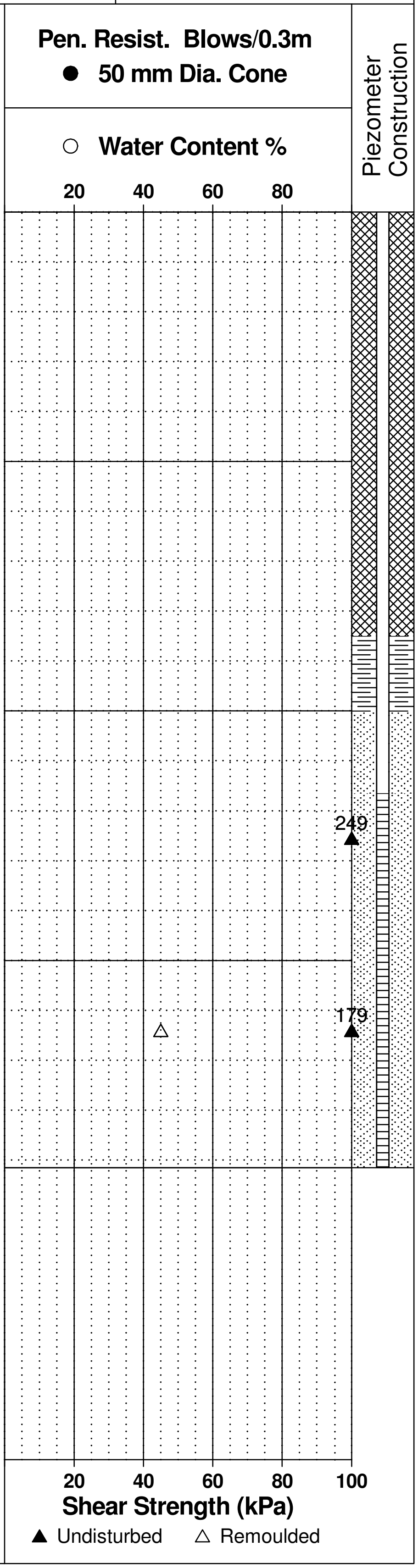
FILE NO. PG5014

HOLE NO. BH 3-22

SOIL DESCRIPTION	Depth to base (m)
GROUND SURFACE	
TOPSOIL	0.18
Hard to very stiff, brown **SILTY CLAY,** trace sand	3.66
GLACIAL TILL: Very dense, brown silty clay, some sand, gravel, cobbles and boulders	3.83
End of Borehole Practical refusal to augering at 3.83m depth.	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
AU	2		
SS	3	92	12
SS	4	92	10
SS	5	92	8
SS	6	100	50+

DEPTH (m)	ELEV. (m)
0	84.13
1	83.13
2	82.13
3	81.13



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1015 March Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE June 3, 2022

FILE NO. PG5014

HOLE NO. BH 4-22

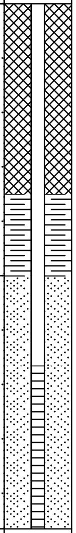
SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	84.18
TOPSOIL — 0.20	AU	1				
Hard to very stiff, brown **SILTY CLAY,** trace sand — 0.69	AU	2				
GLACIAL TILL: Compact, brown silty clay, some sand, gravel, cobbles and boulders	SS	3	92	5	1	83.18
- becoming very dense — 1.93	SS	4		50+		
End of Borehole Practical refusal to augering at 1.93m depth.						

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

○ Water Content %

20 40 60 80

Piezometer Construction



Shear Strength (kPa)

20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1015 March Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

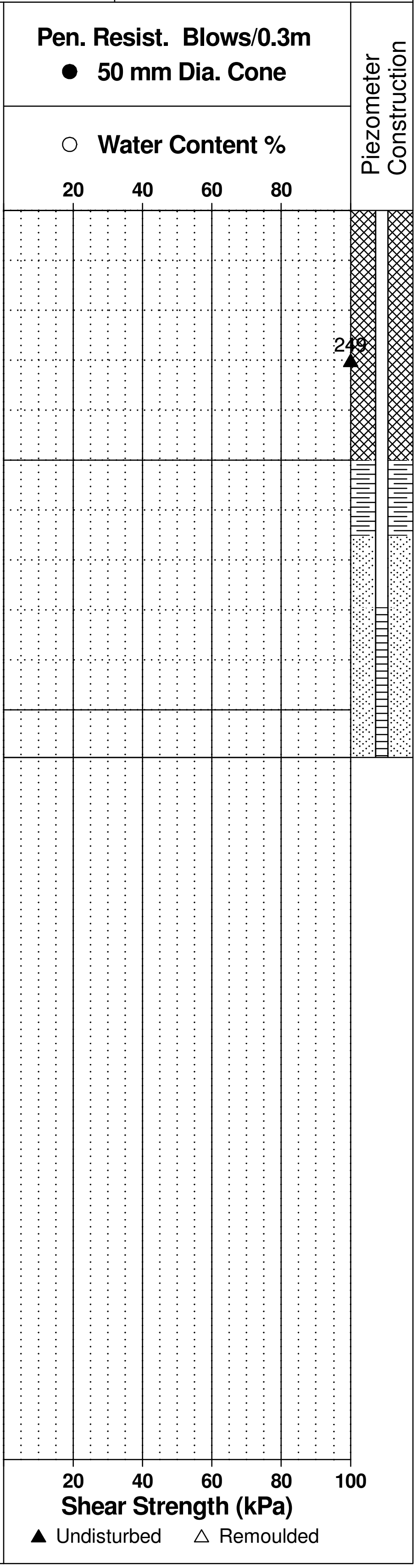
BORINGS BY Track-Mount Power Auger

DATE June 6, 2022

FILE NO. **PG5014**

HOLE NO. **BH 5-22**

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	83.04
TOPSOIL (to 0.25)						
Hard to very stiff, brown **SILTY CLAY** (0.25 to 1.45)	SS	1	33	7		
	SS	2	100	10	1	82.04
GLACIAL TILL: Compact, brown silty sand with gravel, cobbles and boulders, trace clay (1.45 to 2.19)	SS	3	50	17	2	81.04
End of Borehole Practical refusal to augering at 2.19m depth.						



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1015 March Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

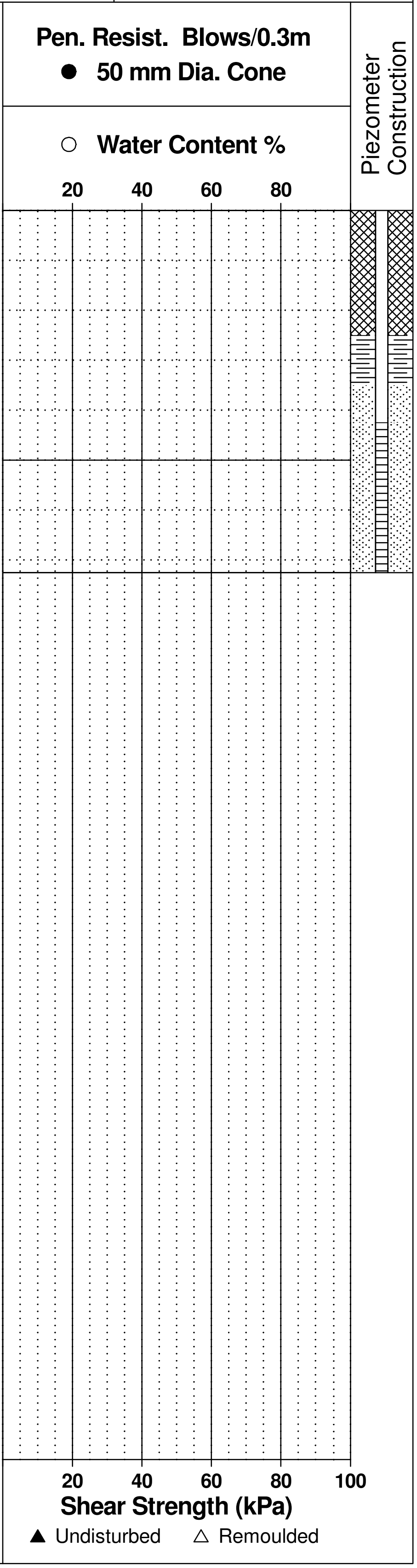
BORINGS BY Track-Mount Power Auger

DATE June 6, 2022

FILE NO. PG5014

HOLE NO. BH 6-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	84.86
TOPSOIL 0.23							
Very stiff, brown **SILTY CLAY**		AU	1				
1.07		SS	2		6	1	83.86
GLACIAL TILL: Very dense, brown silty clay with sand, gravel, cobbles and boulders 1.45							
End of Borehole Practical refusal to augering at 1.45m depth.							



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1015 March Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE June 6, 2022

FILE NO. PG5014

HOLE NO. BH 6A-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
		TYPE	NUMBER	% RECOVERY	N VALUE or RQD				
GROUND SURFACE						0	84.86		
OVERBURDEN						1	83.86		
1.47									
End of Borehole Practical refusal to augering at 1.47m depth.									

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1015 March Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

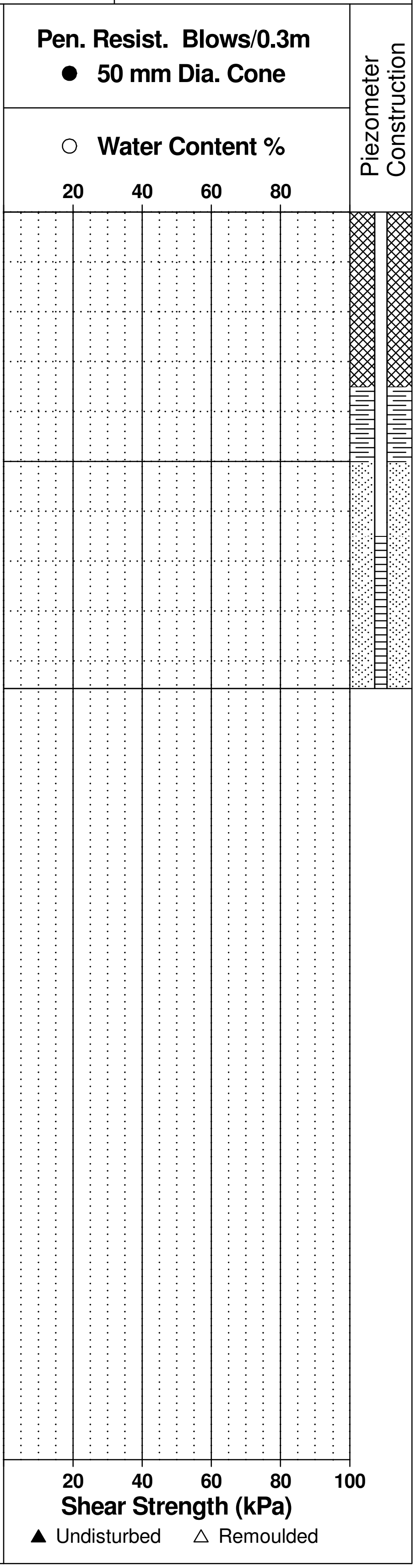
BORINGS BY Track-Mount Power Auger

DATE June 6, 2022

FILE NO. PG5014

HOLE NO. BH 7-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	84.49
TOPSOIL 0.25							
Very stiff, brown **SILTY CLAY**		AU	1				
- with sand seams by 0.7m depth		SS	2	75	4	1	83.49
1.45							
GLACIAL TILL: Very dense, brown silty sand with gravel, cobbles and boulders, trace clay 1.91		SS	3	71	50+		
End of Borehole Practical refusal to augering at 1.91m depth.							



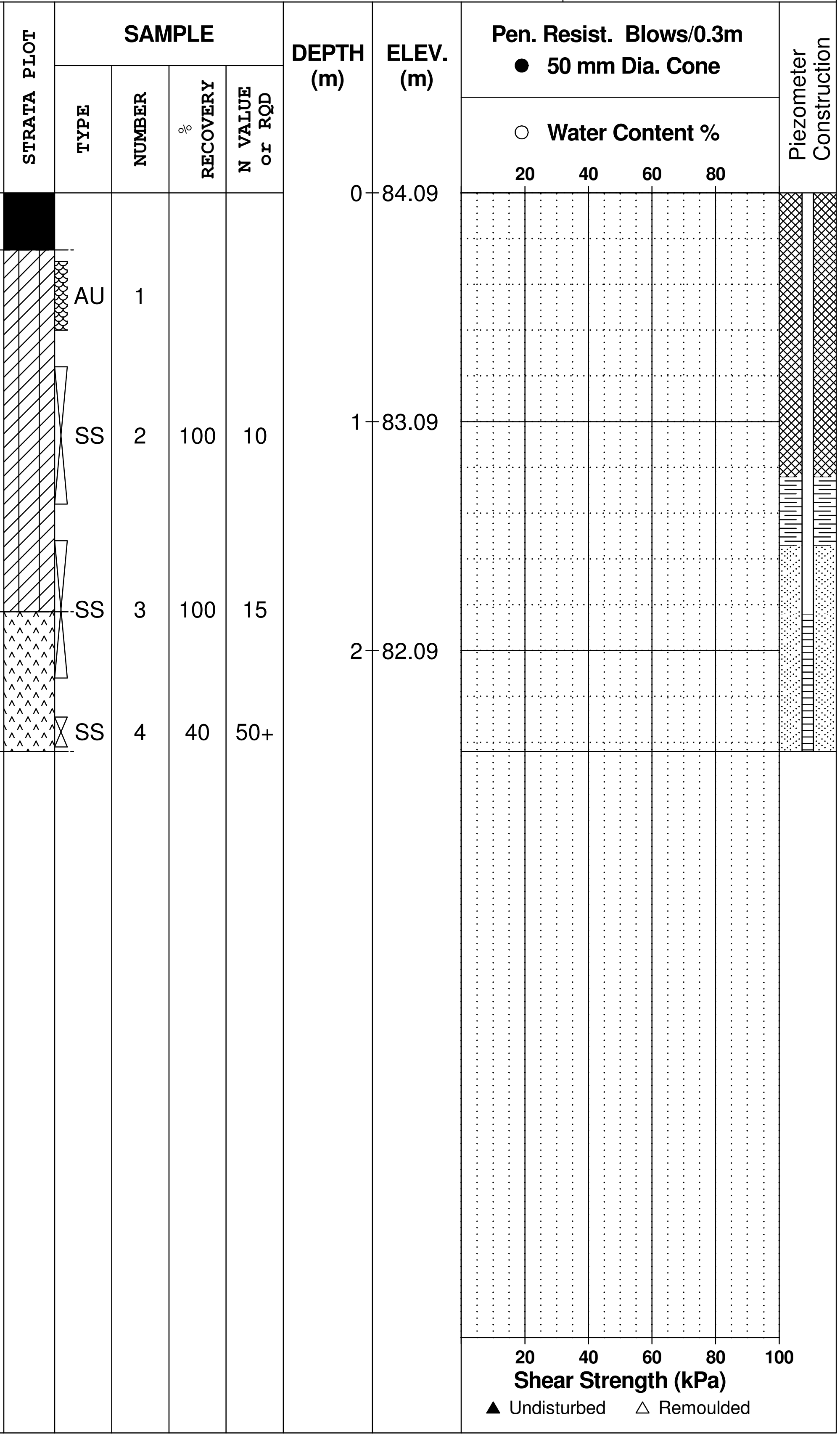
patersongroup Consulting Engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1015 March Road
Ottawa, Ontario

DATUM Geodetic
REMARKS
BORINGS BY Track-Mount Power Auger
DATE June 6, 2022
FILE NO. **PG5014**
HOLE NO. **BH 8-22**

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	84.09
TOPSOIL 0.25						
	AU	1				
Very stiff, brown **SILTY CLAY**	SS	2	100	10	1	83.09
1.83	SS	3	100	15		
GLACIAL TILL: Compact to dense, brown silty sand, some clay, gravel, cobbles and boulders					2	82.09
2.44	SS	4	40	50+		
End of Borehole Practical refusal to augering at 2.44m depth.						



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1015 March Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME 55 Power Auger

DATE July 24, 2019

FILE NO. **PG5014**

HOLE NO. **BH 1**

SOIL DESCRIPTION	Depth (m)
GROUND SURFACE	
TOPSOIL	0.15
Very stiff, brown **SILTY CLAY,** trace sand	3.40
GLACIAL TILL: Brown silty sand with gravel, some clay, cobbles and boulders	4.04

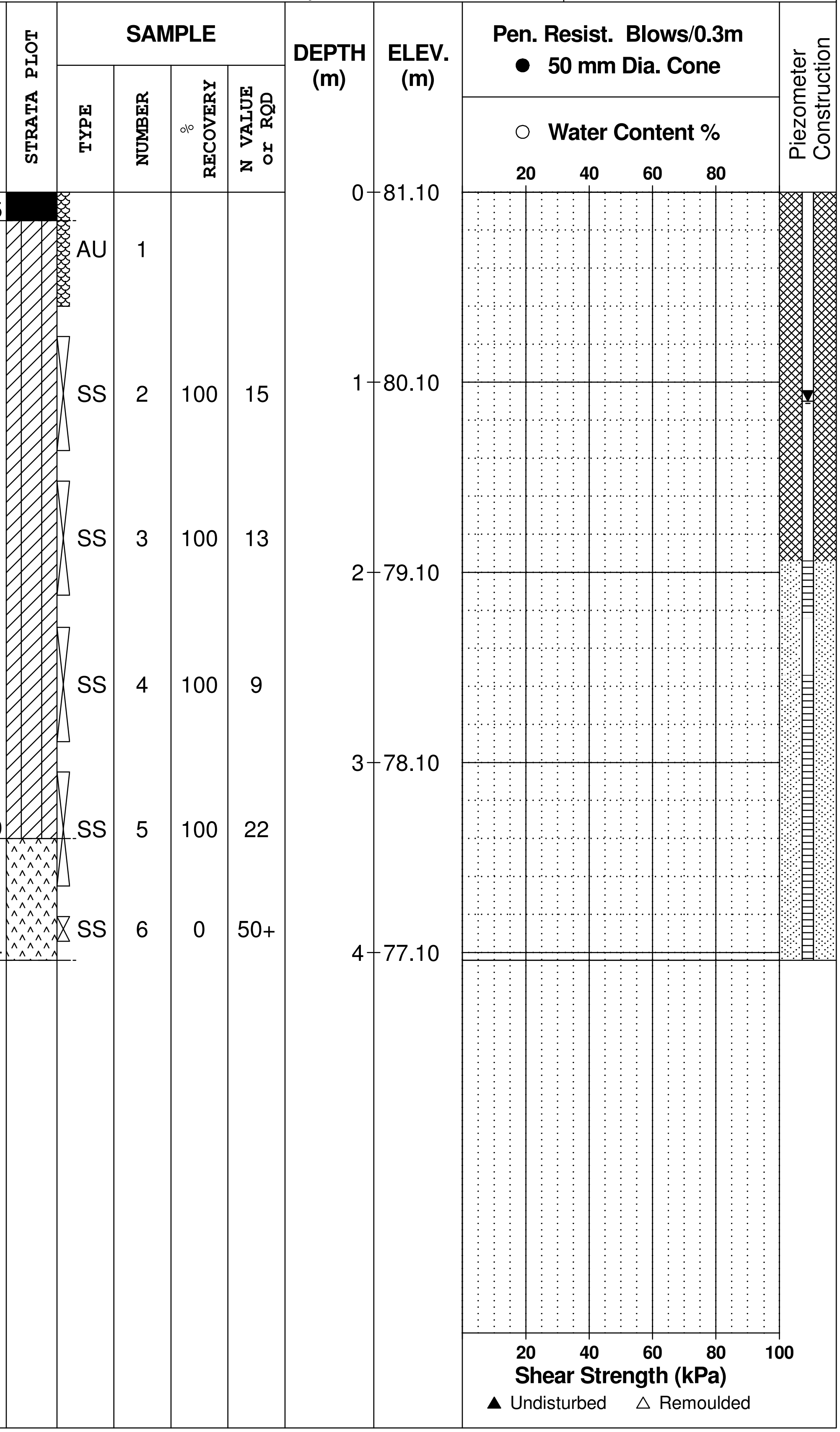
End of Borehole

Practical refusal to augering at 4.04m depth

(GWL @ 1.10m - July 30, 2019)

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	100	15
SS	3	100	13
SS	4	100	9
SS	5	100	22
SS	6	0	50+

DEPTH (m)	ELEV. (m)
0	81.10
1	80.10
2	79.10
3	78.10
4	77.10



patersongroup Consulting Engineers
9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1015 March Road
Ottawa, Ontario

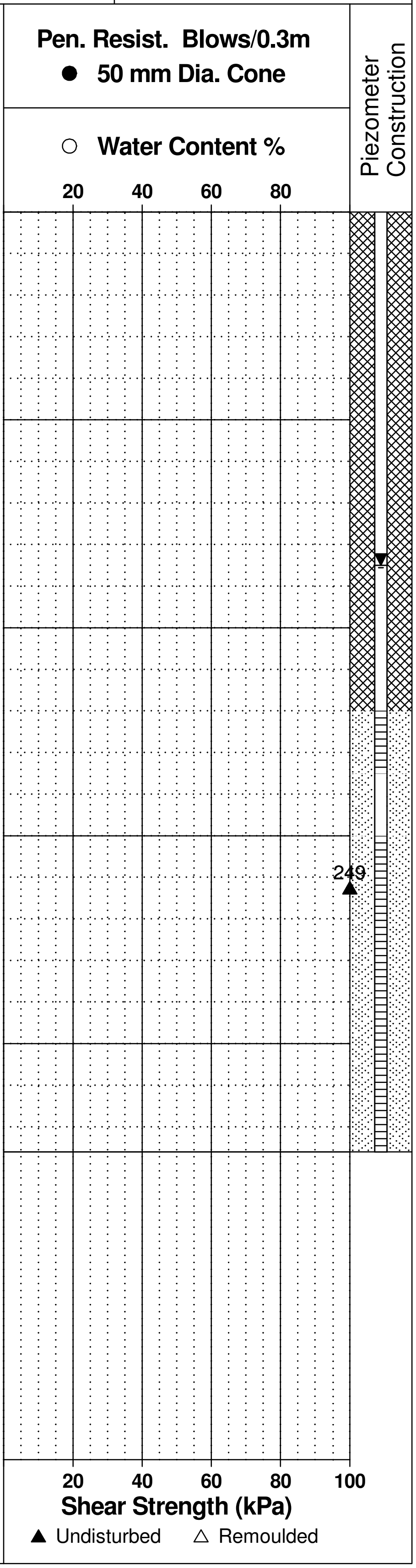
DATUM Geodetic
REMARKS
BORINGS BY CME 55 Power Auger
DATE July 24, 2019
FILE NO. PG5014
HOLE NO. BH 2

SOIL DESCRIPTION	SAMPLE				DEPTH (m)	ELEV. (m)
	TYPE	NUMBER	% RECOVERY	N VALUE or RQD		
GROUND SURFACE					0	81.61
TOPSOIL 0.15						
Very stiff to hard, brown **SILTY CLAY,** trace sand	AU	1				
	SS	2	100	11	1	80.61
	SS	3	96	12	2	79.61
	SS	4	100	9	3	78.61
4.09	SS	5	100	8	4	77.61
GLACIAL TILL: Brown silty sand with clay and gravel 4.52	SS	6	100	21		

End of Borehole

Practical refusal to augering at 4.52m depth

(GWL @ 1.70m - July 30, 2019)



patersongroup Consulting Engineers
9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1015 March Road
Ottawa, Ontario

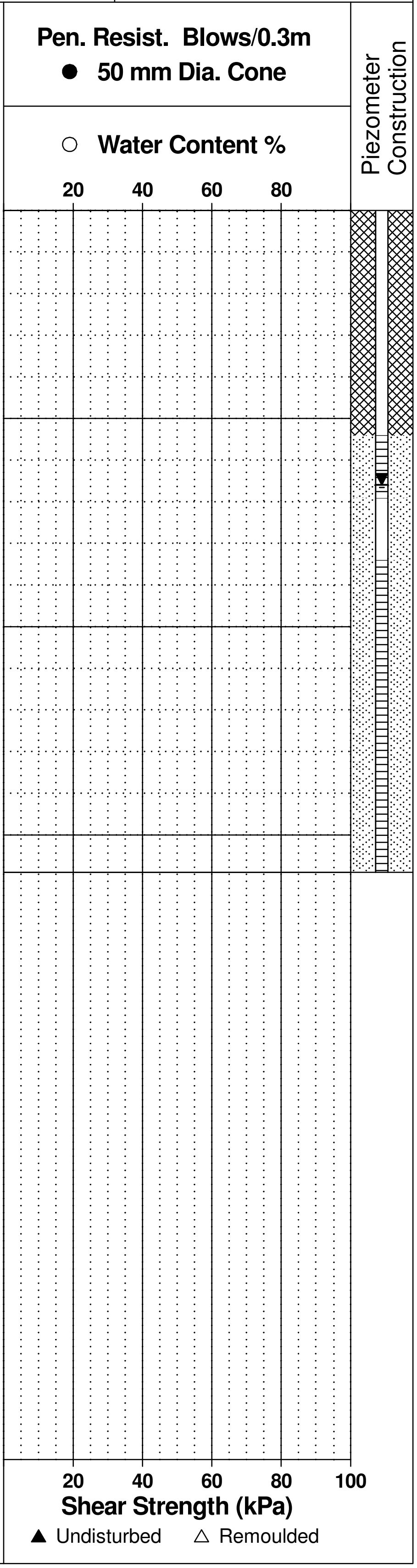
DATUM Geodetic
REMARKS
BORINGS BY CME 55 Power Auger
DATE July 24, 2019
FILE NO. PG5014
HOLE NO. BH 3

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	80.87
TOPSOIL 0.30		AU	1				
Very stiff, brown **SILTY CLAY,** trace sand		SS	2	100	12	1	79.87
		SS	3	100	13	2	78.87
3.05		SS	4	100	11		
GLACIAL TILL: Brown silty sand with clay, gravel, cobbles and boulders 3.18		SS	5	67	50+	3	77.87

End of Borehole

Practical refusal to augering at 3.18m depth

(GWL @ 1.32m - July 30, 2019)



patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1015 March Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME 55 Power Auger

DATE July 24, 2019

FILE NO. PG5014

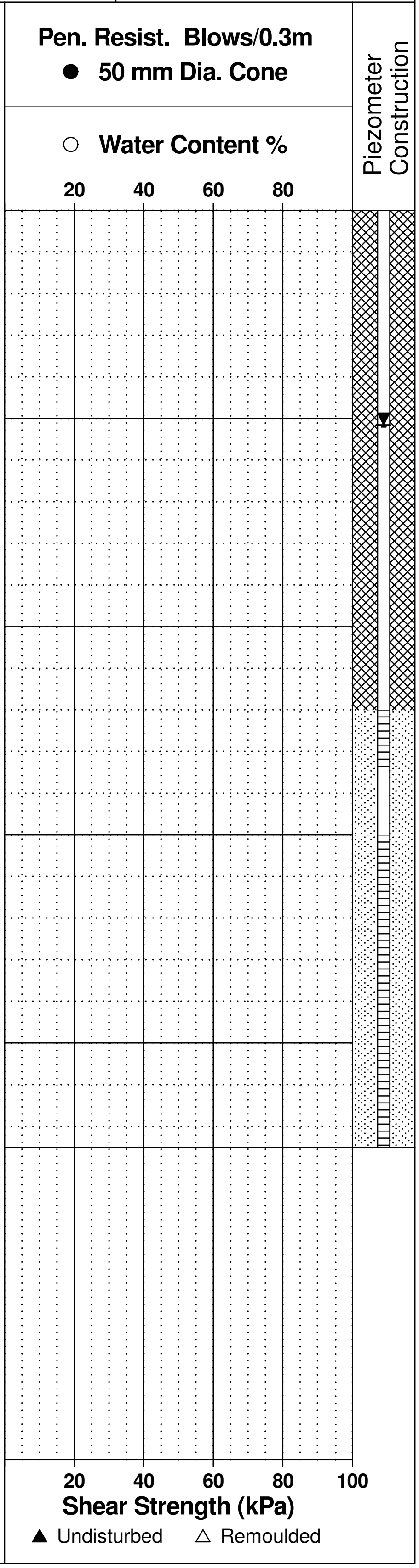
HOLE NO. BH 4

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	80.80
TOPSOIL 0.35	AU	1				
Very stiff, brown **SILTY CLAY,** trace sand	SS	2	100	12	1	79.80
	SS	3	100	9		
					2	78.80
	SS	4	100	6		
3.30					3	77.80
GLACIAL TILL: Brown silty sand with clay and gravel	SS	5	100	6		
	SS	6	42	18	4	76.80
4.50						

End of Borehole

Practical refusal to augering at 4.50m depth

(GWL @ 1.03m - July 30, 2019)



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1015 March Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME 55 Power Auger

DATE July 24, 2019

FILE NO. PG5014

HOLE NO. BH 5

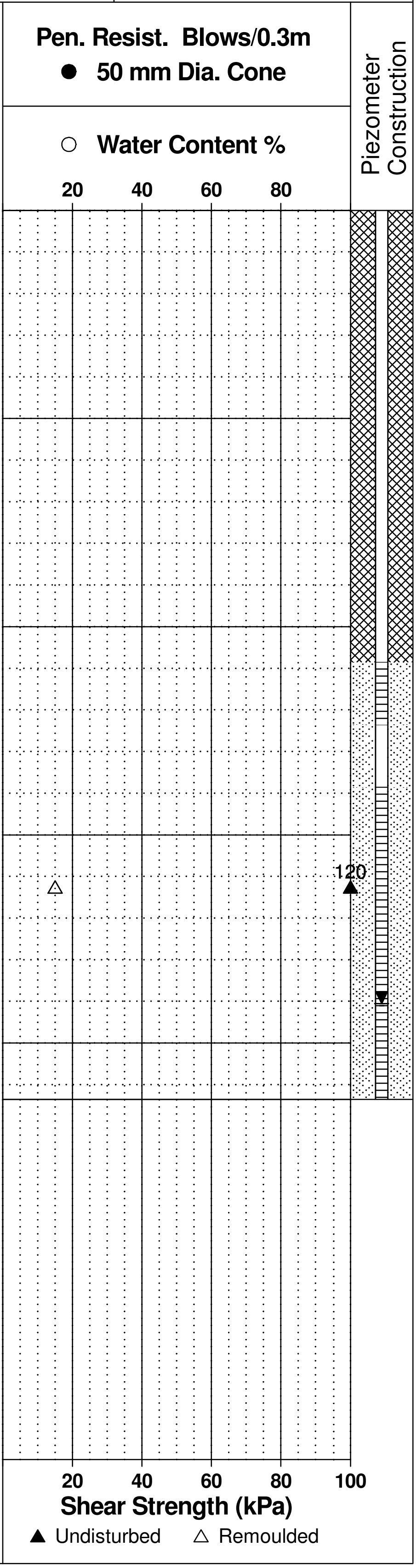
SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
TOPSOIL (0 – 0.35)	AU	1		
Very stiff, brown **SILTY CLAY,** trace sand (0.35 – 3.81)	SS	2	100	14
	SS	3	100	9
	SS	4	100	4
GLACIAL TILL: Brown silty sand with clay, gravel, cobbles and boulders (3.81 – 4.27)	SS	5		50+

DEPTH (m)	ELEV. (m)
0	80.49
1	79.49
2	78.49
3	77.49
4	76.49

End of Borehole

Practical refusal to augering at 4.27m depth

(GWL @ 3.81m - July 30, 2019)



patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1015 March Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME 55 Power Auger

DATE July 24, 2019

FILE NO. PG5014

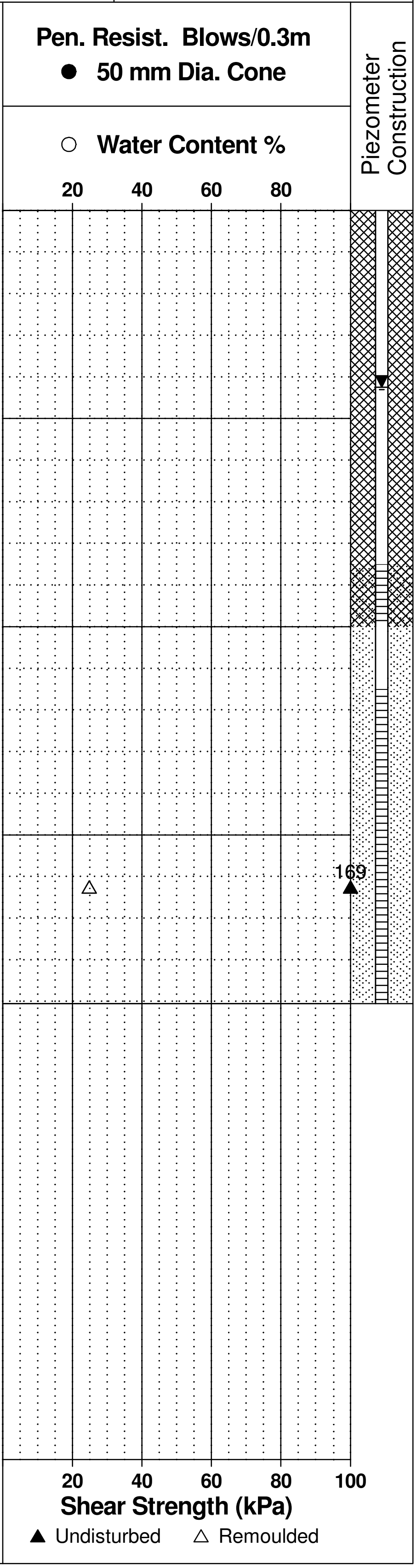
HOLE NO. BH 6

SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	80.18
TOPSOIL 0.40	AU	1				
	SS	2	100	12		
					1	79.18
Very stiff, brown **SILTY CLAY,** trace sand	SS	3	100	7		
					2	78.18
	SS	4	100	4		
					3	77.18
3.81						

End of Borehole

Practical refusal to augering at 3.81m depth

(GWL @ 0.85m - July 30, 2019)



patersongroup Consulting Engineers
9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1015 March Road
Ottawa, Ontario

DATUM Geodetic
REMARKS
BORINGS BY CME 55 Power Auger
DATE July 24, 2019
FILE NO. PG5014
HOLE NO. BH 7

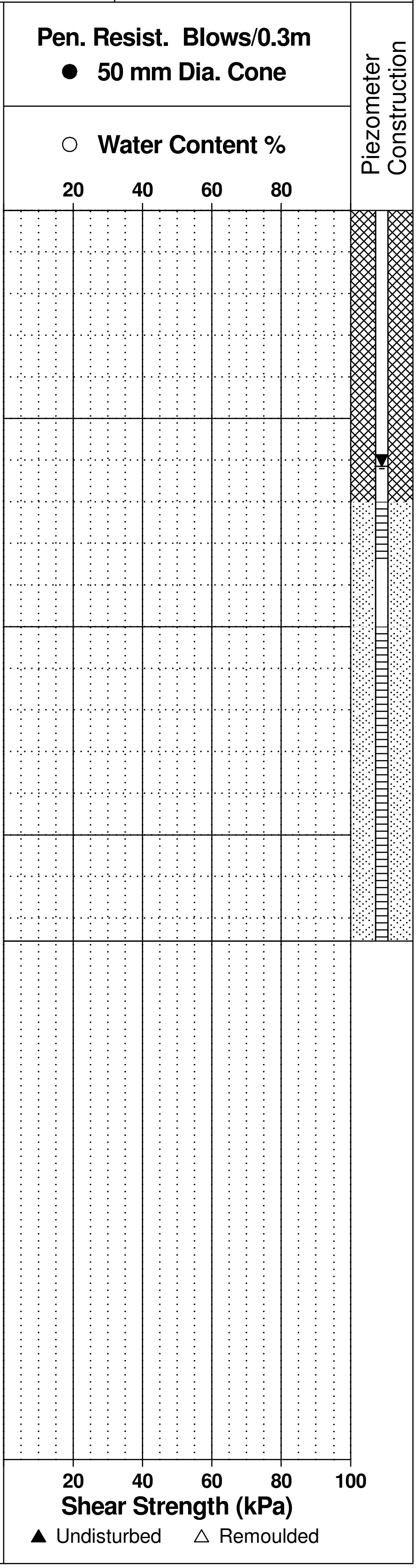
SOIL DESCRIPTION	DEPTH (m)	ELEV. (m)
GROUND SURFACE	0	81.05
TOPSOIL	0.30	
Very stiff, brown **SILTY CLAY,** trace sand	1	80.05
	2	79.05
	3.05	
	3	78.05
GLACIAL TILL: Brown silty sand with clay, gravel, cobbles and boulders	3.51	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	100	11
SS	3	100	9
SS	4	100	7
SS	5	82	50+

End of Borehole

Practical refusal to augering at 3.51m depth

(GWL @ 1.23m - July 30, 2019)



patersongroup Consulting Engineers
9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1015 March Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

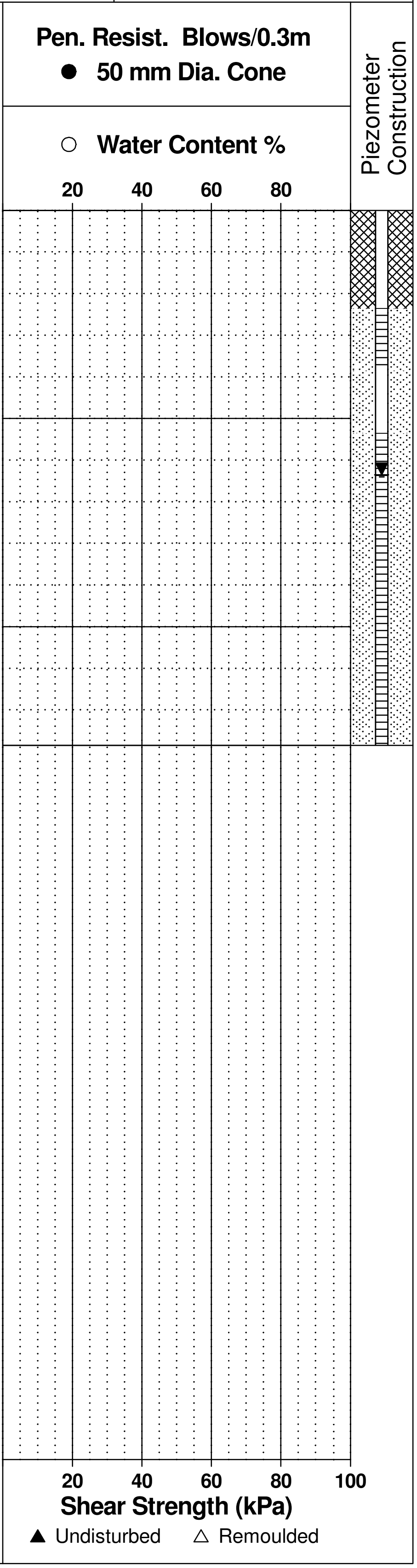
BORINGS BY CME 55 Power Auger

DATE July 24, 2019

FILE NO. **PG5014**

HOLE NO. **BH 8**

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	81.56
TOPSOIL 0.30	AU	1				
Very stiff, brown **SILTY CLAY,** trace sand	SS	2	100	9	1	80.56
	SS	3	100	11	2	79.56
2.29 **GLACIAL TILL:** Brown silty sand with clay, gravel, cobbles and boulders 2.57	SS	4	86	50+		
End of Borehole Practical refusal to augering at 2.57m depth (GWL @ 1.27m - July 30, 2019)						



SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1015 March Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

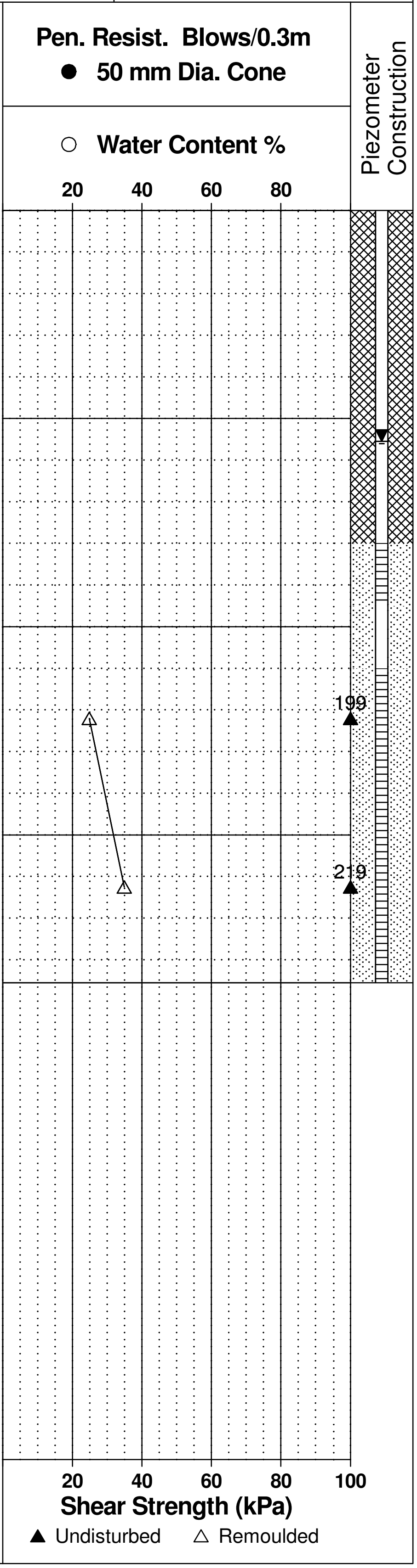
BORINGS BY CME 55 Power Auger

DATE July 24, 2019

FILE NO. PG5014

HOLE NO. BH 9

SOIL DESCRIPTION	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	81.16
TOPSOIL 0.35	AU	1				
					1	80.16
Very stiff to hard, brown **SILTY CLAY,** trace sand	SS	2	100	9		
	SS	3	100	9		
					2	79.16
					3	78.16
3.71						
End of Borehole Practical refusal to augering at 3.71m depth (GWL @ 1.11m - July 30, 2019)						



patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 1015 March Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

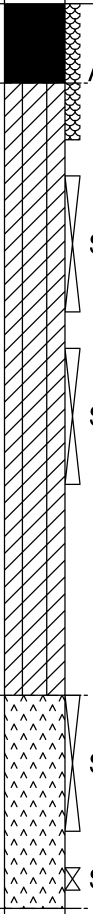
BORINGS BY CME 55 Power Auger

DATE July 24, 2019

FILE NO. PG5014

HOLE NO. BH10

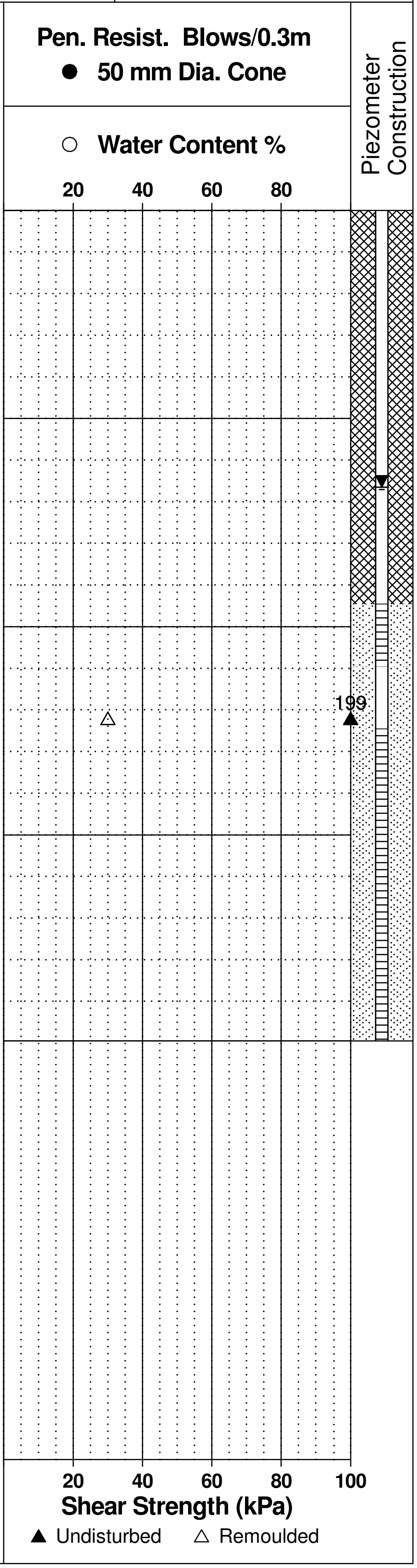
SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	81.51
TOPSOIL 0.35	AU	1				
Very stiff, brown **SILTY CLAY,** trace sand	SS	2	79	9	1	80.51
	SS	3	100	9	2	79.51
3.05					3	78.51
GLACIAL TILL: Brown silty sand with gravel, some clay	SS	4	79	10		
3.99	SS	5	0	50+		



End of Borehole

Practical refusal to augering at 3.99m depth

(GWL @ 1.33m - July 30, 2019)



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

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)

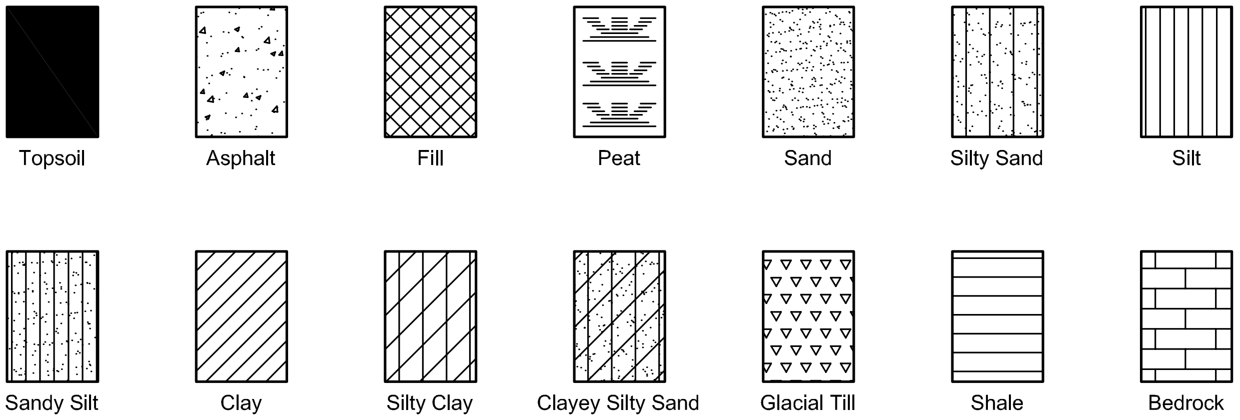
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

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.

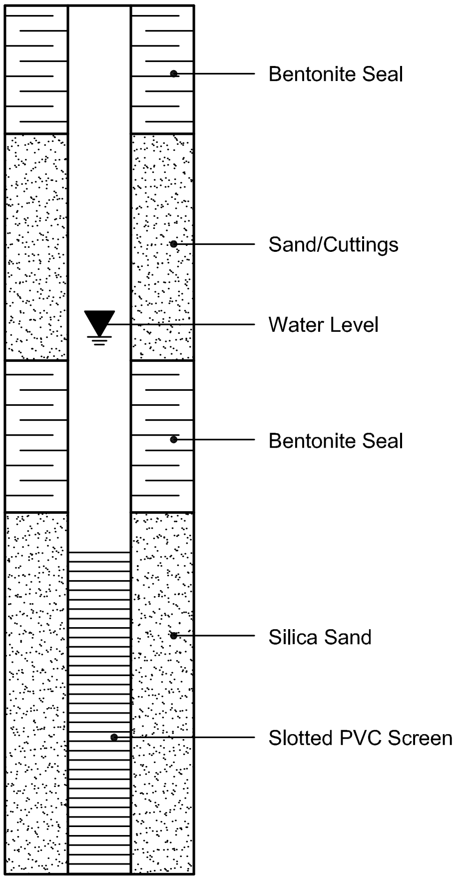
SYMBOLS AND TERMS (continued)

STRATA PLOT

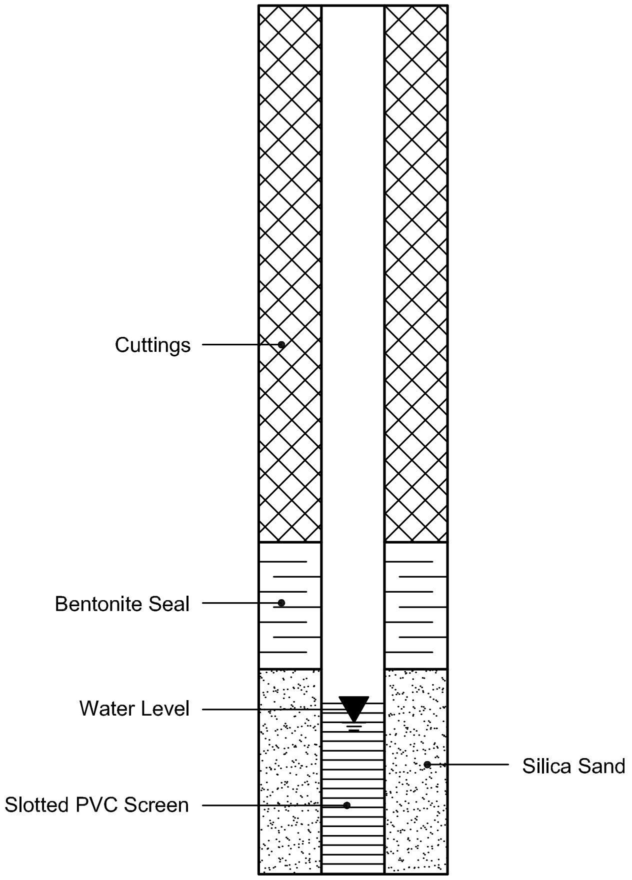


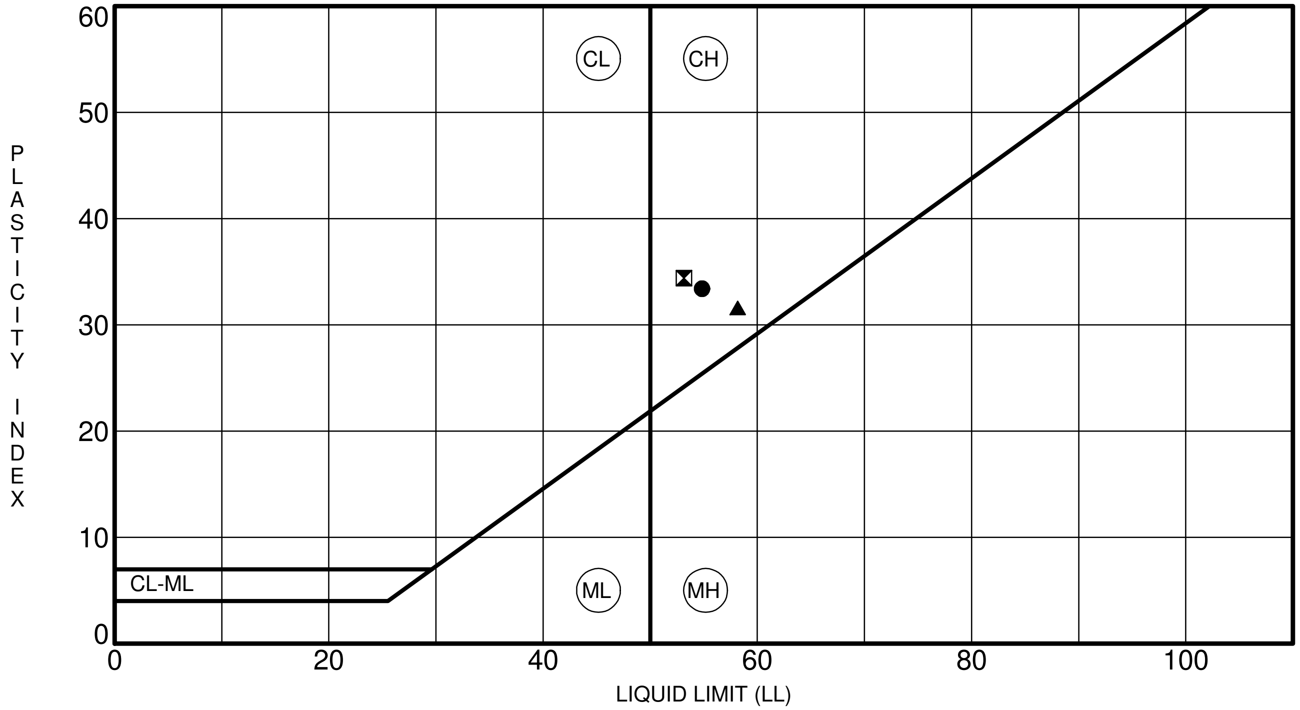
MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION





	Specimen Identification		LL	PL	PI	Fines	Classification
●	**BH 3**	**SS 2**	**55**	**21**	**33**		**CH - Inorganic clay of high plasticity**
⧗	**BH 8**	**SS 3**	**53**	**19**	**34**		**CH - Inorganic clay of high plasticity**
▲	**BH10**	**SS 2**	**58**	**27**	**32**		**CH - Inorganic clay of high plasticity**

CLIENT **Kanata United**

PROJECT **Geotechnical Investigation - 1015 March Road**

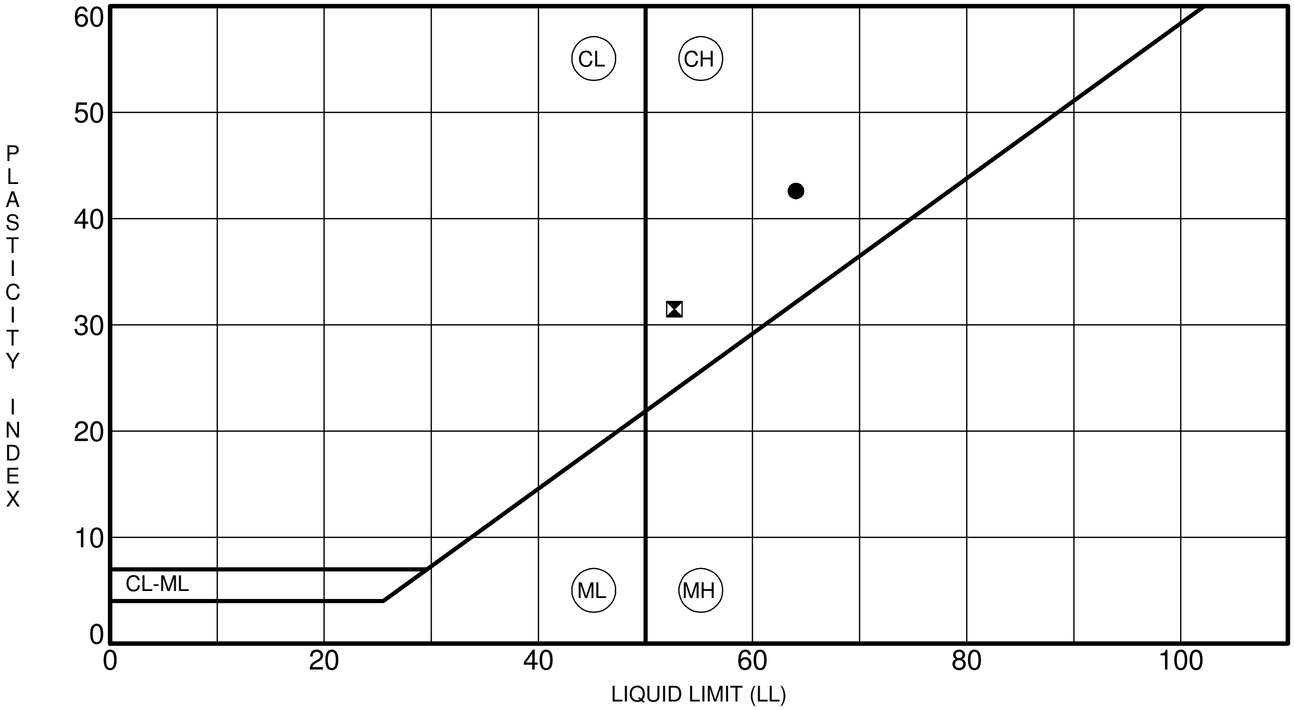
FILE NO. **PG5014**

DATE **24 Jul 19**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

ATTERBERG LIMITS' RESULTS



Specimen Identification			LL	PL	PI	Fines	Classification
●	**BH 1-22**	**SS2**	**64**	**21**	**43**		**CH - Inorganic clays of high plasticity**
⧗	**BH 7-22**	**SS2**	**53**	**21**	**31**		**CH - Inorganic clays of high plasticity**

CLIENT **Kanata United**

PROJECT **Geotechnical Investigation - Prop. Commercial Development - 1015 March Road**

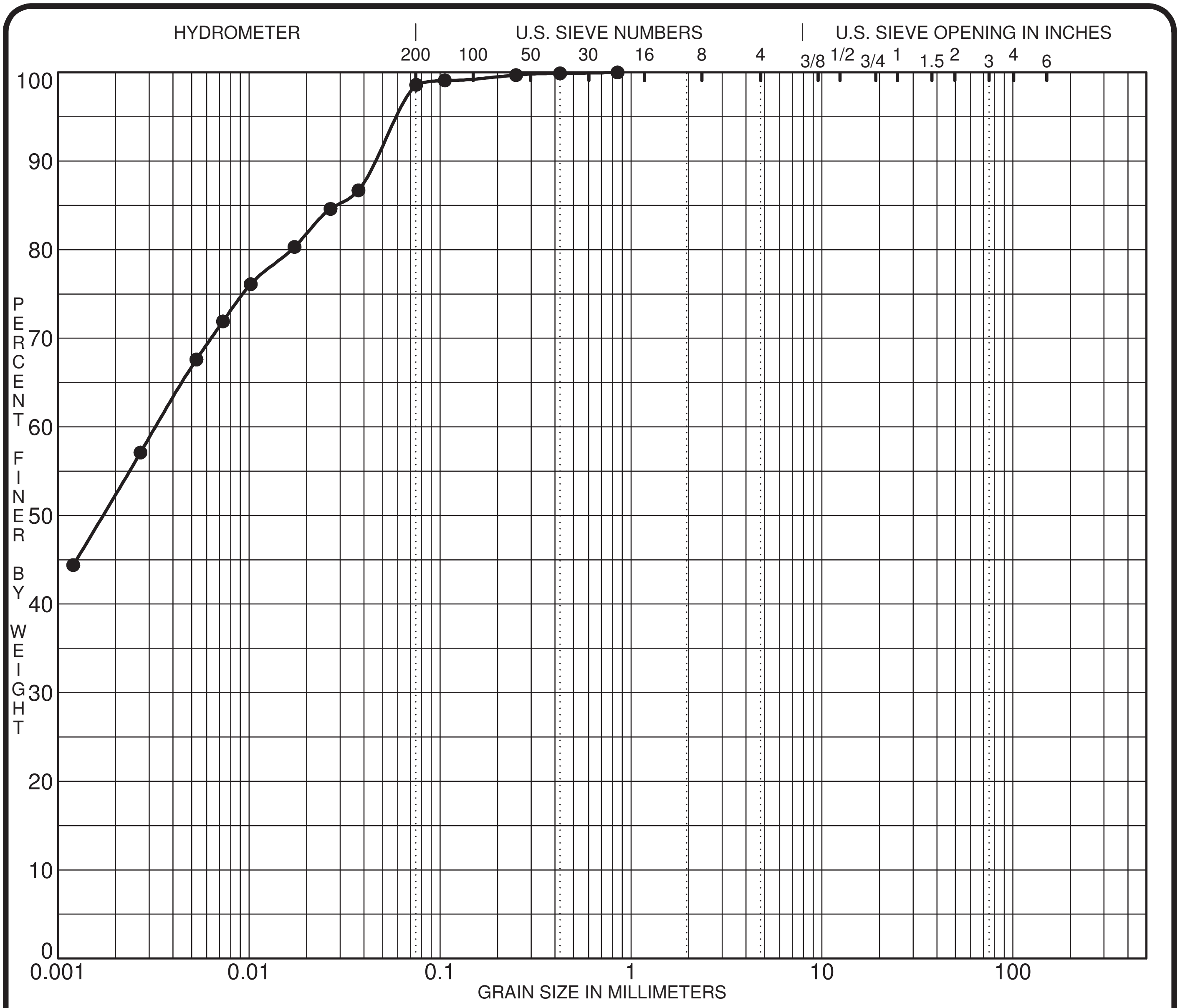
FILE NO. **PG5014**

DATE **6 Jun 22**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

ATTERBERG LIMITS' RESULTS



SILT OR CLAY	SAND			GRAVEL		COBBLES
	fine	medium	coarse	fine	coarse	

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	**BH 4**	**SS 3**	**CH - Inorganic clay of high plasticity**						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**BH 4**	**SS 3**	**0.85**	**0.00**			**0.0**	**1.4**	**47.6**	**51.0**

CLIENT **Kanata United**

FILE NO. **PG5014**

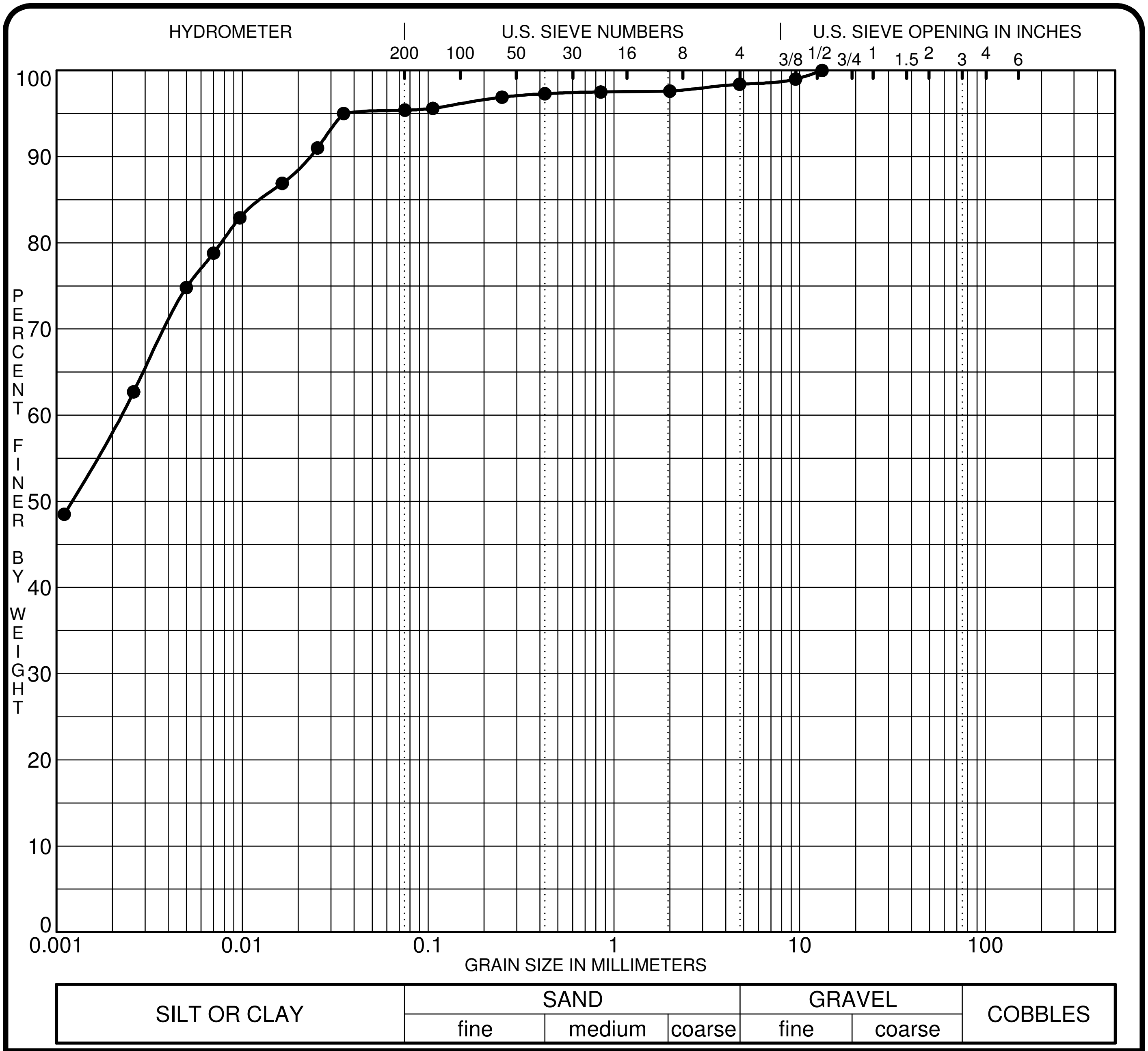
PROJECT **Geotechnical Investigation - 1015 March Road**

DATE **24 Jul 19**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

GRAIN SIZE DISTRIBUTION



Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● **BH 3-22 SS5**							
☒							
▲							
★							

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **BH 3-22 SS5**	**13.20**	**0.00**			**1.6**	**3.0**	**95.4**	
☒								
▲								
★								

CLIENT **Kanata United**

FILE NO. **PG5014**

PROJECT **Geotechnical Investigation - Prop. Commercial Development - 1015 March Road**

DATE **3 Jun 22**

patersongroup **Consulting Engineers**

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

GRAIN SIZE DISTRIBUTION

Certificate of Analysis
Client: Paterson Group Consulting Engineers
Client PO: 27678

Report Date: 16-Aug-2019
Order Date: 12-Aug-2019
Project Description: PG5014

Client ID:		BH9-SS3	-	-	-
Sample Date:		24-Jul-19 13:00	-	-	-
Sample ID:		1933119-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	72.6	-	-	-
General Inorganics					
pH	0.05 pH Units	8.10	-	-	-
Resistivity	0.10 Ohm.m	98.4	-	-	-
Anions					
Chloride	5 ug/g dry	5	-	-	-
Sulphate	5 ug/g dry	8	-	-	-

APPENDIX 2

FIGURE 1 - KEY PLAN

DRAWING PG5014-1 - TEST HOLE LOCATION PLAN

DRAWING PG5014-2 – TREE PLANTING SETBACK PLAN

PATERSON GROUP

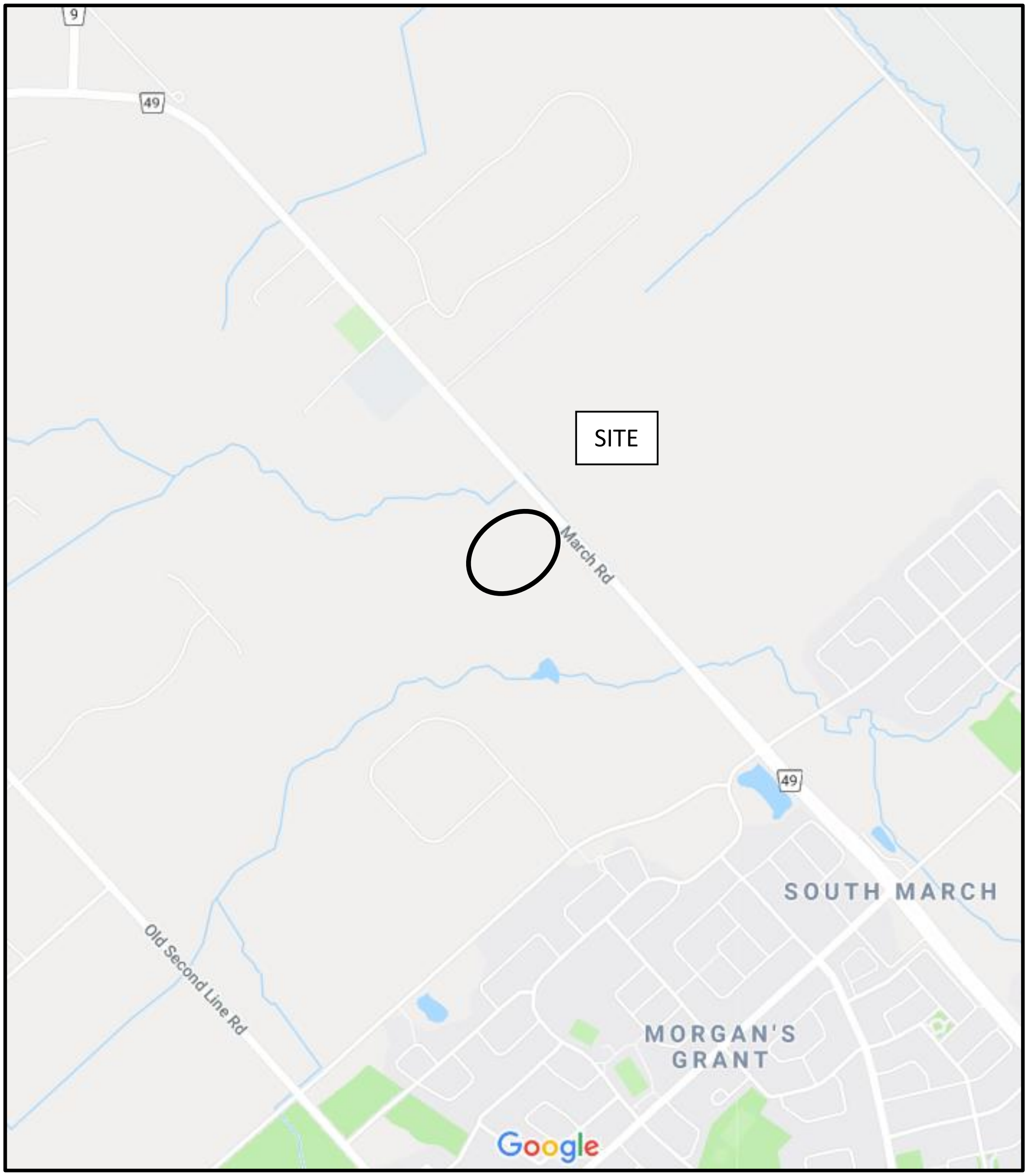
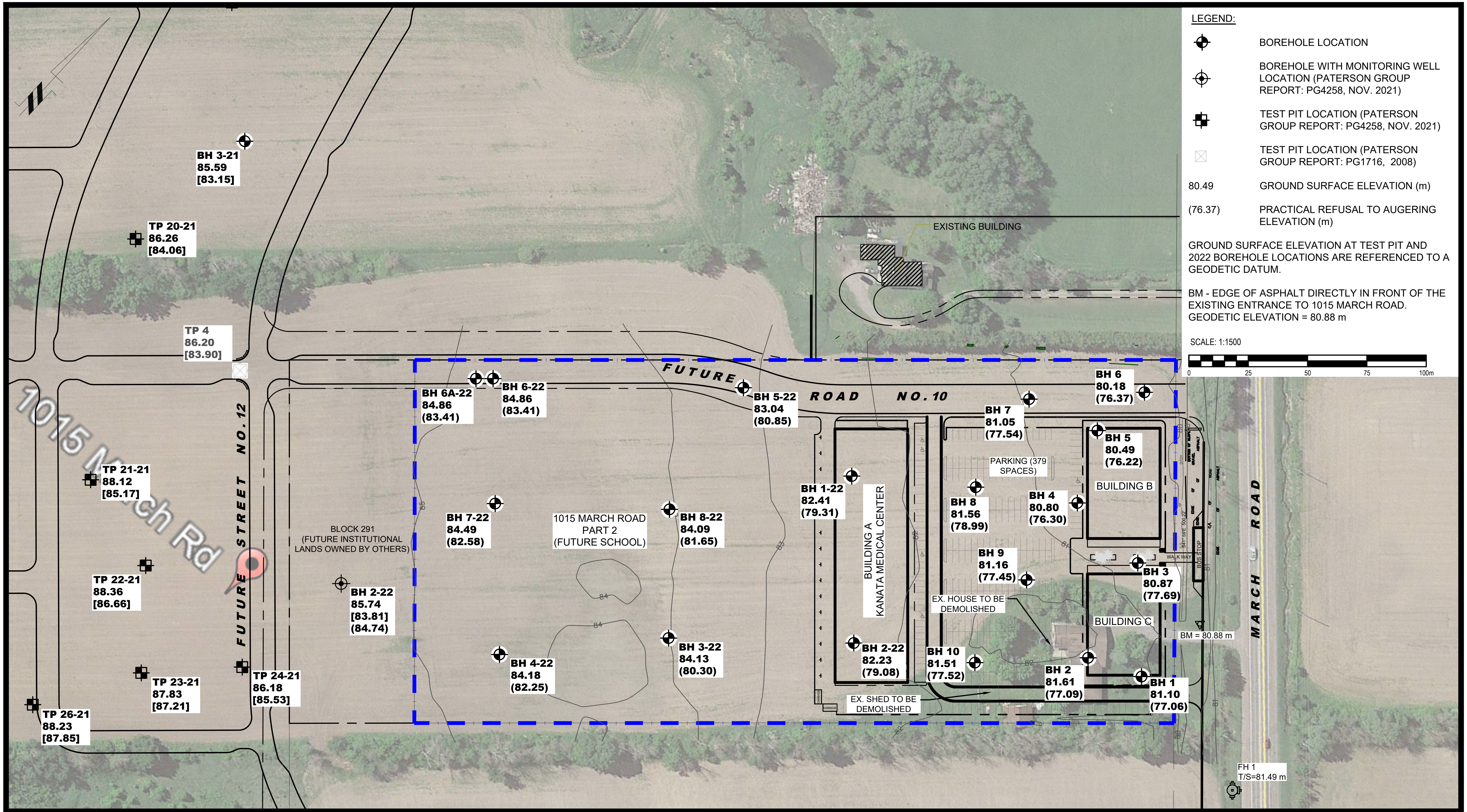


FIGURE 1

KEY PLAN



LEGEND:

⌖	BOREHOLE LOCATION
⌖	BOREHOLE WITH MONITORING WELL LOCATION (PATERSON GROUP REPORT: PG4258, NOV. 2021)
▣	TEST PIT LOCATION (PATERSON GROUP REPORT: PG4258, NOV. 2021)
☒	TEST PIT LOCATION (PATERSON GROUP REPORT: PG1716, 2008)
80.49	GROUND SURFACE ELEVATION (m)
(76.37)	PRACTICAL REFUSAL TO AUGERING ELEVATION (m)

GROUND SURFACE ELEVATION AT TEST PIT AND 2022 BOREHOLE LOCATIONS ARE REFERENCED TO A GEODETIC DATUM.

BM - EDGE OF ASPHALT DIRECTLY IN FRONT OF THE EXISTING ENTRANCE TO 1015 MARCH ROAD. GEODETIC ELEVATION = 80.88 m

SCALE: 1:1500

0 25 50 75 100m

patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL
3	ADDED 2022 BOREHOLES UPDATED BOREHOLES WITH GEODETIC ELEVATIONS	09/06/2022	MS
2	UPDATED TO NEW SITE BOUNDARY ADDED 2021 AND 2022 TEST HOLES	28/04/2022	MS
1	UPDATED NEW CONCEPTUAL PLAN	05/10/2020	RG

KANATA UNITED

GEOTECHNICAL INVESTIGATION
1015 MARCH ROAD - PROPOSED COMMERCIAL DEVELOPMENT

OTTAWA, ONTARIO

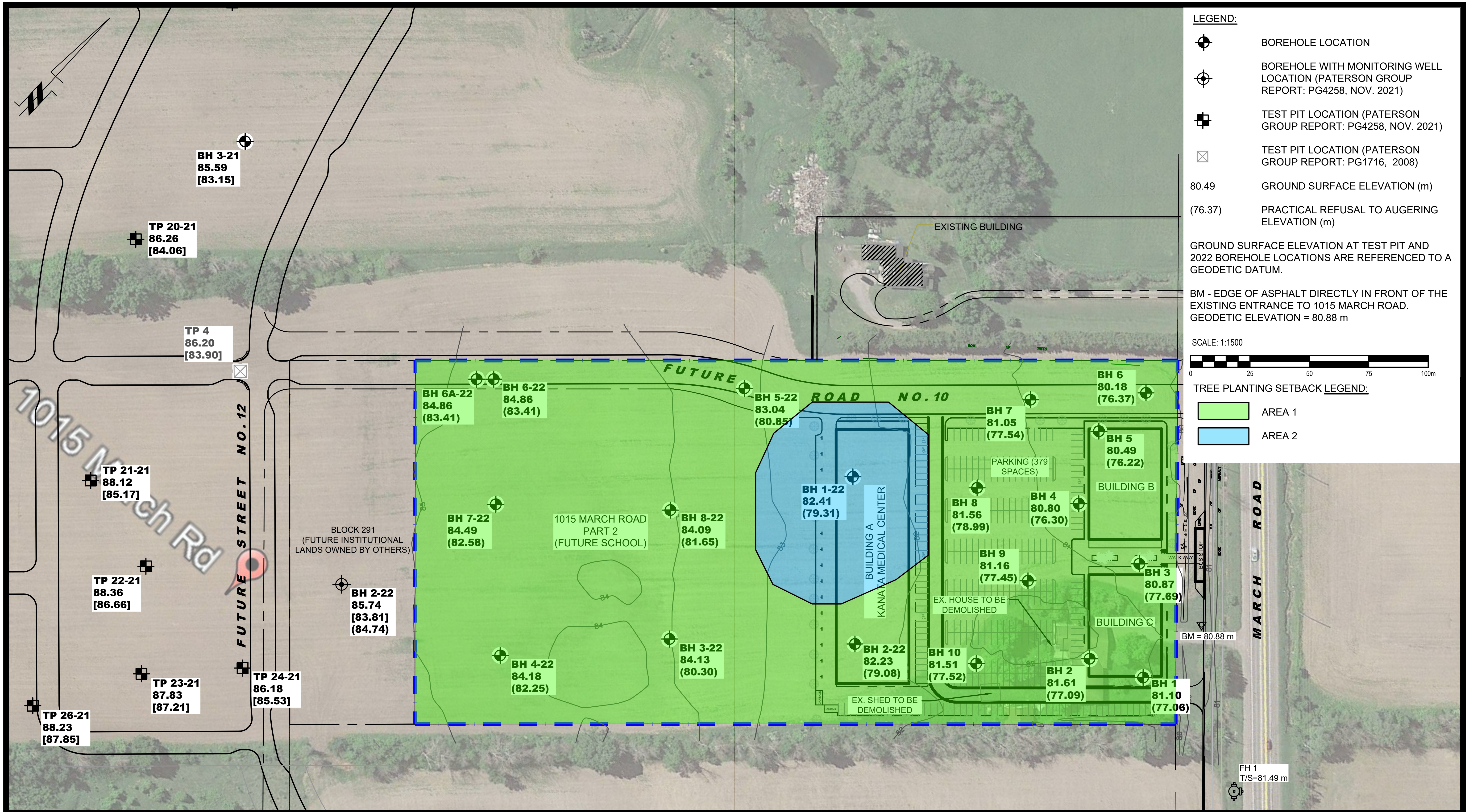
Title:

TEST HOLE LOCATION PLAN

Scale: 1:1500
Date: 09/2019
Drawn by: YA
Report No.: PG5014-1
Checked by: MS
Dwg. No.: PG5014-1
Approved by: DJG
Revision No.: 3

p:\autocad drawings\geotechnical\pg50xx\pg5014\pg5014-1-test hole location plan (rev.03).dwg

11x17



LEGEND:

⌖	BOREHOLE LOCATION
⌖	BOREHOLE WITH MONITORING WELL LOCATION (PATERSON GROUP REPORT: PG4258, NOV. 2021)
■	TEST PIT LOCATION (PATERSON GROUP REPORT: PG4258, NOV. 2021)
☒	TEST PIT LOCATION (PATERSON GROUP REPORT: PG1716, 2008)
80.49	GROUND SURFACE ELEVATION (m)
(76.37)	PRACTICAL REFUSAL TO AUGERING ELEVATION (m)

GROUND SURFACE ELEVATION AT TEST PIT AND 2022 BOREHOLE LOCATIONS ARE REFERENCED TO A GEODETIC DATUM.

BM - EDGE OF ASPHALT DIRECTLY IN FRONT OF THE EXISTING ENTRANCE TO 1015 MARCH ROAD. GEODETIC ELEVATION = 80.88 m

SCALE: 1:1500

0 25 50 75 100m

TREE PLANTING SETBACK LEGEND:

🟩	AREA 1
🟦	AREA 2

patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL
3	ADDED 2022 BOREHOLES UPDATED BOREHOLES WITH GEODETIC ELEVATIONS	09/06/2022	MS
2	UPDATED TO NEW SITE BOUNDARY ADDED 2021 AND 2022 TEST HOLES	28/04/2022	MS
1	UPDATED NEW CONCEPTUAL PLAN	05/10/2020	RG

KANATA UNITED

GEOTECHNICAL INVESTIGATION
1015 MARCH ROAD - PROPOSED COMMERCIAL DEVELOPMENT

OTTAWA, ONTARIO

Title:

TREE PLANTING SETBACK PLAN

Scale: 1:1500
Drawn by: YA
Checked by: MS
Approved by: DJG

Date: 09/2019
Report No.: PG5014-1
Dwg. No.: PG5014-2
Revision No.: 3

11x17

p:\autocad drawings\geotechnical\pg50xx\pg5014\pg5014-1-test hole location plan (rev.03).dwg