PATERSON GROUP

Geotechnical Investigation

Proposed Commercial Building

1826 Robertson Road
Ottawa, Ontario

Prepared for Northside Road Inc.
c/o The Regional Group of Companies

Report PG6426-1 dated November 9, 2022

Table of Contents

Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by Northside Road Inc. to conduct a geotechnical investigation for the proposed commercial development to be located at 1826 Robertson Road in the City of Ottawa, Ontario (reference should be made to Figure 1 - Key Plan in Appendix 2 of this report for the general site location).

The objectives of the geotechnical investigation were to:

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

- Provide geotechnical recommendations pertaining to 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.

2.0 Proposed Development

Based on the available drawings, it is understood that the proposed development will consist of a single-storey, slab-on-grade commercial building with an approximate footprint of 580 m^2. An asphalt-paved drive-thru lane will be located to the north and west of the proposed building, while asphalt-paved access lanes and parking areas will be located to the south and east.

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 geotechnical investigation was completed on October 28, 2022. At that time, a total of five (5) boreholes were advanced to a maximum depth of 6.7 m below the existing ground surface. The boreholes were located in the field by Paterson in a manner to provide general coverage of the subject site, taking into consideration site features and underground utilities. The locations of the boreholes, and ground surface elevation at each borehole location, are shown on Drawing PG6426-1 – Test Hole Location Plan presented in Appendix 2.

The boreholes were advanced using a low-clearance drill rig operated by a two-person crew. The test hole procedure consisted of augering to the required depths at the selected locations and sampling the overburden soils. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer from our geotechnical department.

Sampling and In Situ Testing

Soil samples collected from the boreholes were either recovered directly from the auger flights (AU) or collected using a 50 mm diameter split-spoon (SS) sampler. All soil samples were visually inspected and initially classified on site. The soil samples were placed in sealed plastic bags and transported to our laboratory for further examination and classification.

The depths at which the auger and split spoon samples were recovered from the test holes are shown as AU and SS, respectively, on the Soil Profile and Test Data sheets presented 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 at regular intervals of depth in cohesive soils using a field vane apparatus.

The overburden thickness was evaluated by a dynamic cone penetration test (DCPT) completed at borehole BH 2-22. The DCPT consists of driving a steel drill rod, equipped with a 50 mm diameter cone at the 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 and presented in Appendix 1.

Groundwater

Boreholes BH 1-22 and BH 2-22 were fitted with flexible standpipe piezometers to allow for groundwater level monitoring. 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. The borehole locations and ground surface elevation at each borehole location were surveyed by Paterson using a high precision, handheld GPS and referenced to a geodetic datum. The locations of the boreholes, and the ground surface elevation at each borehole location, are presented on Drawing PG6426-1 - 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. 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.

3.4 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 Paterson. 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 Section 6.7.

4.0 Observations

4.1 Surface Conditions

The subject site currently consists of a parking lot with an asphaltic-paved surface which is located in the northwest corner of the existing Lynwood Centre plaza. The site is bordered by Robertson Road to the north, Lynhar Road to the west, and additional asphalt-paved parking areas to the south and east. The ground surface across the subject site is relatively flat and approximately at-grade with the surrounding buildings and roadways at approximate geodetic elevation 88 m.

4.2 Subsurface Profile

Generally, the soil conditions encountered at the test hole locations consist of a fill layer overlying a silty clay layer, followed by a glacial till deposit. The fill was observed to generally consist of brown silty sand and/or clay with gravel and crushed stone. The fill was observed to extend to depths ranging between 0.4 and 0.9 m below the existing ground surface.

The silty clay deposit was observed to consist of a hard to very stiff, brown silty clay crust extending to depths ranging between approximately 3.7 and 4.0 m below ground surface. The silty clay crust was observed to be underlain by a firm to stiff, grey silty clay, which extends to depths ranging between 4.7 and 6.4 m below ground surface.

The glacial till deposit generally consist of compact, grey silty clay with varying amounts of sand, gravel, cobbles and boulders.

Practical refusal to augering and DCPT were encountered at borehole BH 1-22 and BH 2-22 at approximate depths of 6.6 and 7.0 m below ground surface, respectively.

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

Bedrock

Based on available geological mapping, the bedrock throughout the subject site consists of sandstone of the Nepean Formation with a drift thickness between 5 to 15 m depth.

4.3 Groundwater

Groundwater levels were measured within the installed piezometers and are presented in Table 1 below, and on the Soil Profile and Test Data sheets in Appendix 1.

Table 1 – Summary of Groundwater Level Readings

Borehole Number	Ground Surface Elevation (m)	Measured Groundwater Level		Date Recorded
		Depth (m)	Elevation (m)	
BH 1-22	87.81	2.29	85.52	November 8, 2022
BH 2-22	87.91	1.56	86.35	

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

It should be noted that surface water can become trapped within a backfilled borehole, which can lead to higher than typical groundwater level observations. Similarly, it is our experience that surface water generated by snowmelt and rainfall events may sheet drain into the borehole column given the relatively impermeable nature of the clay soil surface.

The long-term groundwater levels can also be estimated based on the observed colour and consistency of the recovered soil samples. Based on these observations, the long-term groundwater table can be expected at approximately 3 to 4 m below ground surface. However, it should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater levels could vary at the time of construction.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is considered suitable for the proposed development. It is recommended that the proposed building be supported on conventional spread footings bearing on the undisturbed, stiff silty clay.

Due to the presence of a silty clay deposit, a permissible grade raise restriction will apply to the subject site. Permissible grade raise recommendations are discussed in Section 5.3.

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

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and fill, such as those containing organic or deleterious materials, should be stripped from under any buildings and other settlement sensitive structures. It is anticipated that the existing fill within the proposed building footprint, free of deleterious material and significant amounts of organics, can be left in place below the proposed building footprint, outside of the 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 personnel at the time of construction. Any poor performing areas noted during the proof-rolling operation should be removed and replaced with an approved fill.

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 or Granular B Type II approved by the geotechnical consultant. 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 and beneath exterior parking areas where settlement of the ground surface is of minor concern. This material should be spread in thin lifts with a maximum thickness of 300 mm 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.

5.3 Foundation Design

Bearing Resistance Values – Conventional Spread Footings

Strip footings up to 3 m wide, and pad footings up to 5 m wide, placed over an undisturbed, stiff silty clay bearing surface 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 factor of 0.5 was incorporated to the bearing resistance value at ULS.

An undisturbed soil bearing surface consists of a surface from which all organic materials 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.

The above-noted bearing resistance values at SLS for undisturbed, stiff silty clay bearing surfaces 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 in-situ soils 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.

Permissible Grade Raise Restrictions

Based on the undrained shear strength testing results, a permissible grade raise of **1.2 m** is recommended for the subject 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.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class C** for the spread footings bearing on the undisturbed, stiff silty clay deposit.

The soils underlying the subject site are not susceptible to liquefaction. Reference should be made to the latest revision of the 2012 Ontario Building Code for a full discussion of the earthquake design requirements.

5.5 Slab-on-Grade Construction

With the removal of all topsoil and deleterious fill, containing organic matter, within the footprint of the proposed building, the existing fill or stiff silty clay, approved by Paterson personnel at the time of construction, is considered to be an acceptable subgrade surface on which to commence backfilling for floor slab construction.

It is recommended that the upper 200 mm of sub-slab fill consists of OPSS Granular A crushed stone. All backfill material within the footprint of the proposed building should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 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.

5.6 Pavement Design

For design purposes, the pavement structure presented in the following tables could be used for the design of asphalt-paved parking areas and access lanes.

Table 2 – 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 soil, or OPSS Granular B Type I or II material over in-situ soil or fill.	

Table 3 – Recommended Pavement Structure – Access Lanes and Heavy Truck Parking Areas

Thickness (mm)	Material Description
40	**Wear Course –** HL-3 or Superpave 12.5 Asphaltic Concrete
50	**Binder Course –** HL-8 or Superpave 19 Asphaltic Concrete
150	**BASE –** OPSS Granular A Crushed Stone
450	**SUBBASE –** OPSS Granular B Type II
SUBGRADE – Either fill, in-situ soil, or OPSS Granular B Type I or II material over fill or in-situ soil.	

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

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 99% of the material's SPMDD using suitable vibratory equipment.

Pavement Structure Drainage

Satisfactory performance of the pavement structure is largely dependent on 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 load carrying capacity.

Where silty clay is anticipated at subgrade level, consideration should be given to installing subdrains during the pavement construction as per City of Ottawa standards. These drains should extend in four orthogonal directions or longitudinally when placed along a curb. The clear crushed stone surrounding the drainage lines, or the pipe, should be wrapped with suitable filter cloth. 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. Discharge of the subdrains should be directed by gravity to storm sewers or deeper drainage ditches.

6.0 Design and Construction Precautions

6.1 Foundation Backfill

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. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, can be used for this purpose.

Concrete Sidewalks Adjacent to Building

To avoid differential settlements within the proposed walkways adjacent to the proposed building, it is recommended that the upper 600 mm of backfill placed below the walkways adjacent to the building footprint to consist of free draining, non-frost susceptible material such as, Granular A or Granular B Type II.

The granular material should be placed in maximum 300 mm loose lifts and compacted to 98% of the material's SPMDD using suitable compaction equipment. Consideration could be given to placing a rigid insulation layer below the granular fill layer to prevent frost heave issues at the building entrances.

6.2 Protection of Footings Against Frost Action

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

Other 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 primary structure. These footings should be provided with a minimum 2.1 m thick soil cover, or an equivalent thickness of soil cover and foundation insulation

6.3 Excavation Side Slopes

The side slopes of excavations in the soil and fill overburden materials should be either 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 room will be available for the greater part of the excavation to be undertaken by open-cut methods (i.e. 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.

Excavation side slopes around the building excavation should be protected from erosion by surface water and rainfall events by the use of secured tarpaulins spanning the length of the side slopes, or other means of erosion protection along their footprint. Efforts should also be made to maintain dry surfaces at the bottom of the excavation footprints and along the bottom of temporary side slopes. Additional measures may be recommended at the time of construction by the Paterson personnel where required.

6.4 Pipe Bedding and Backfill

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

The pipe bedding for water and pipes placed on a relatively dry, undisturbed subgrade surface should consist of at least 150 mm of OPSS Granular A material. Where the bedding is located upon silty clay the thickness of the bedding material should be increased to a minimum of 300 mm of OPSS Granular A. The bedding layer 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. The bedding and cover materials should be placed in maximum 300 mm thick lifts compacted to a minimum of 99% of the material’s SPMDD.

It should generally be possible to re-use the organic free, moist (not wet) overburden material above the cover material. Saturated soil fill, such as grey silty clay, will be difficult to re-use as their high water contents make compacting these materials impractical without an extensive drying period.

Trench 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 trench 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

It is anticipated that groundwater infiltration into the excavations should be low and controllable using open sumps. 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 subsurface 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 is expected to occur thereafter.

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. Additional information could be provided, if required.

6.7 Corrosion Potential and Sulphate

The analytical testing results 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 an aggressive to very aggressive corrosive environment.

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.
- 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 materials.
- 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 soil must 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 Northside Road Inc., 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.

Fernanda Carozzi, PhD. Geoph.

Scott S. Dennis, P.Eng.

Report Distribution:

- ❑ Regional Group (1 digital copy)
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APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TESTING RESULTS

patersongroup Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Commercial Building - 1826 Robertson Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE October 28, 2022

FILE NO. PG6426

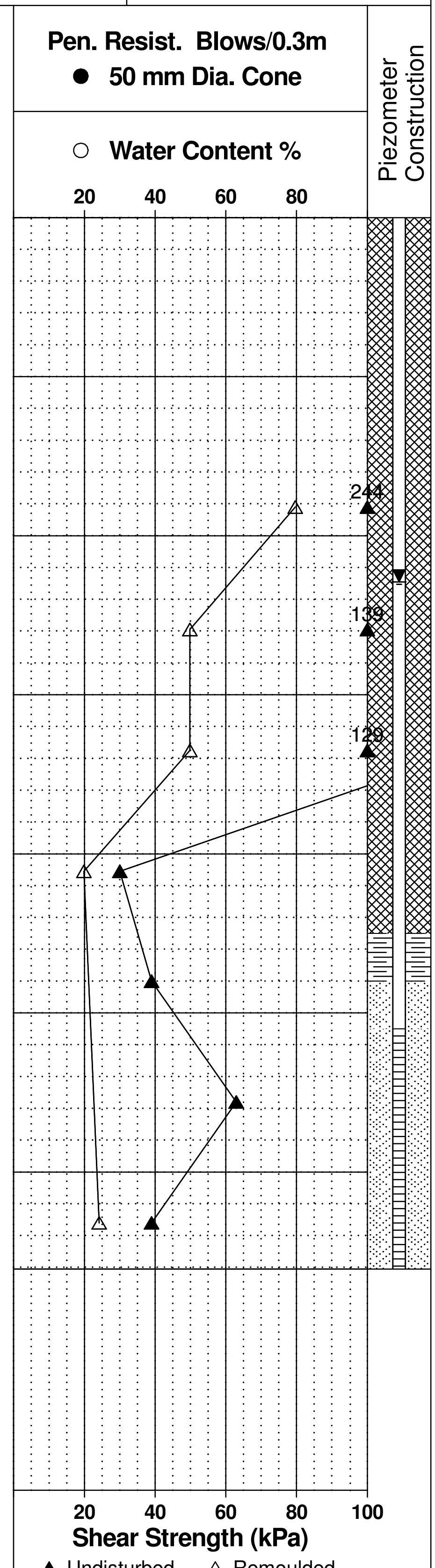
HOLE NO. BH 1-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	87.81
Asphaltic concrete 0.08							
FILL: Brown silty sand with gravel and crushed stone 0.53		AU	1				
		SS	2	42	8	1	86.81
Hard to very stiff, brown **SILTY CLAY**		SS	3	75	P	2	85.81
		SS	4	100	P		
- intermittent sand seams from 2.3 to 3.6m depth		SS	5	100	P	3	84.81
- firm to stiff and grey by 3.7m depth		SS	6	100	P	4	83.81
						5	82.81
6.40						6	81.81
GLACIAL TILL: Grey silty clay with sand and gravel 6.61		SS	7	60			

End of Borehole

Practical refusal to augering at 6.61m depth.

(GWL @ 2.29m - Nov. 8, 2022)



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Commercial Building - 1826 Robertson Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

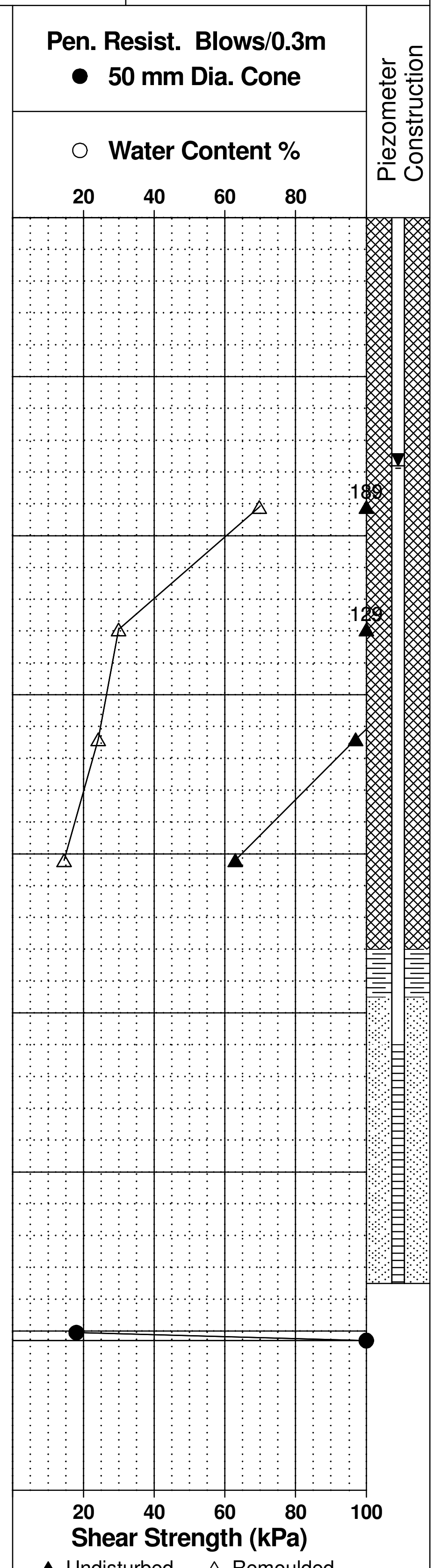
BORINGS BY CME-55 Low Clearance Drill

DATE October 28, 2022

FILE NO. PG6426

HOLE NO. BH 2-22

SOIL DESCRIPTION	Strata depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	87.91
Asphaltic concrete	0.10						
FILL: Brown silty sand with gravel and crushed stone	0.48	AU	1				
		SS	2		4	1	86.91
		SS	3	83	P		
Hard to very stiff, brown **SILTY CLAY**						2	85.91
- stiff by 3.0m depth		SS	4	100	P		
						3	84.91
		G	5				
- grey by 4.0m depth						4	83.91
	4.70						
		SS	6	100	P		
						5	82.91
GLACIAL TILL: Grey silty clay with varying amounts of sand, gravel, cobbles and boulders		SS	7	75	27		
						6	81.91
	6.71	SS	8	100	11		
Dynamic Cone Penetration Test commenced at 6.71m depth	7.06					7	80.91
End of Borehole							
Practical DCPT refusal at 7.06m depth.							
(GWL @ 1.56m - Nov. 8, 2022)							



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SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Commercial Building - 1826 Robertson Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE October 28, 2022

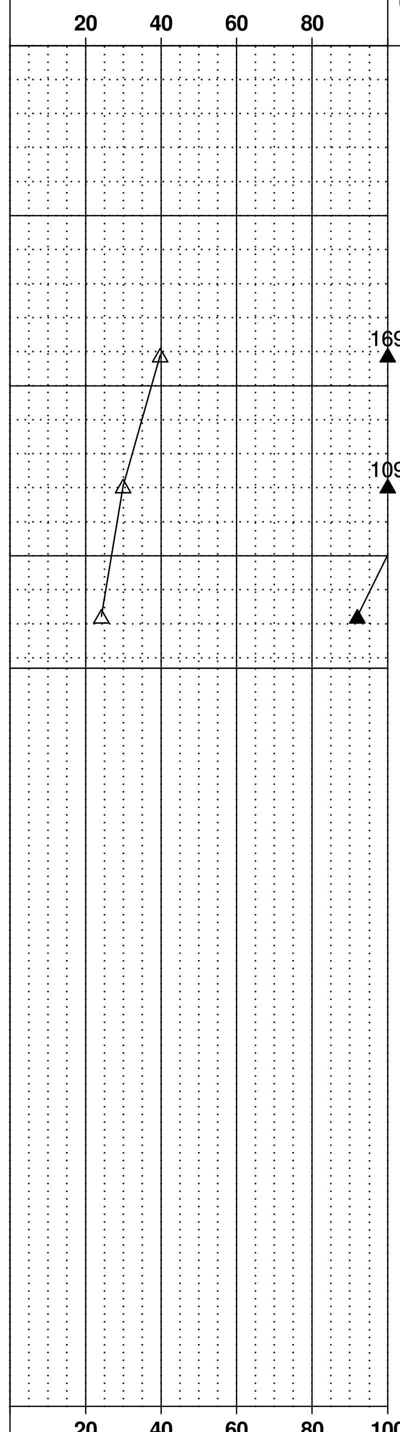
FILE NO. PG6426

HOLE NO. BH 3-22

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	87.77
Asphaltic concrete 0.13							
FILL: Brown silty sand with gravel and crushed stone 0.43		AU	1				
		SS	2	67	8	1	86.77
Hard to very stiff, brown **SILTY CLAY**		SS	3	75	P	2	85.77
- stiff by 3.0m depth		SS	4	83	P		
- intermittent sand seams from 3.0 to 3.66m depth. 3.66		SS	5	83	P	3	84.77
End of Borehole							
(BH dry upon completion)							

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

○ Water Content %



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

Piezometer Construction

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9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Commercial Building - 1826 Robertson Road
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill **DATE** October 28, 2022

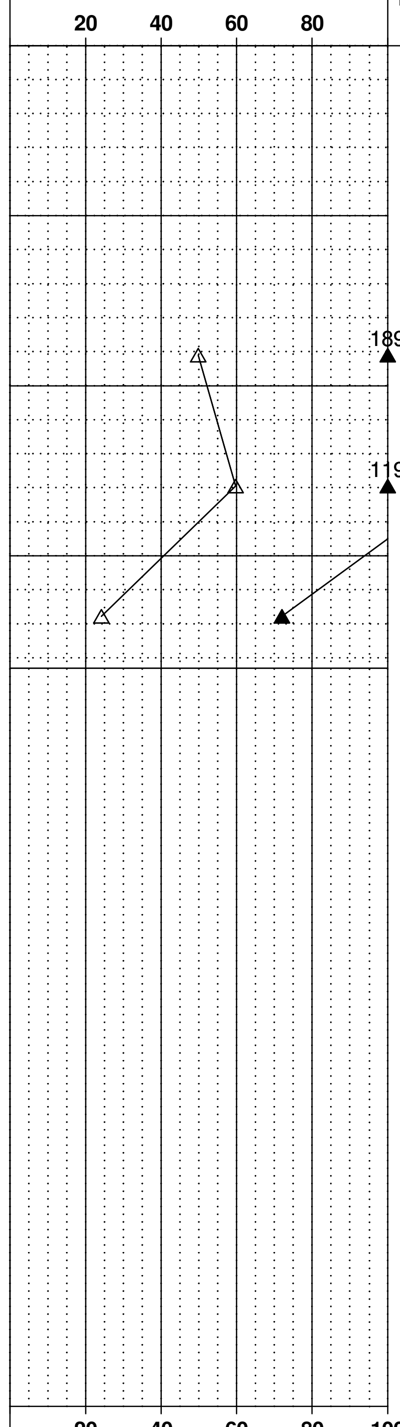
FILE NO. PG6426

HOLE NO. BH 4-22

SOIL DESCRIPTION	Depth to base (m)	STRATA PLOT	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							0	88.16
Asphaltic concrete	0.10							
FILL: Brown silty sand with gravel and crushed stone	0.46		AU	1				
FILL: Brown silty clay, some sand and gravel	0.91							
Hard to very stiff, brown **SILTY CLAY**			SS	2	33	10	1	87.16
			SS	3	100	P	2	86.16
			SS	4	100	P		
- stiff by 3.0m depth	3.66		SS	5	100	P	3	85.16
End of Borehole								
(BH dry upon completion)								

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

○ Water Content %



Shear Strength (kPa)
▲ Undisturbed △ Remoulded

Piezometer Construction

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SOIL PROFILE AND TEST DATA

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DATE October 28, 2022

FILE NO. PG6426

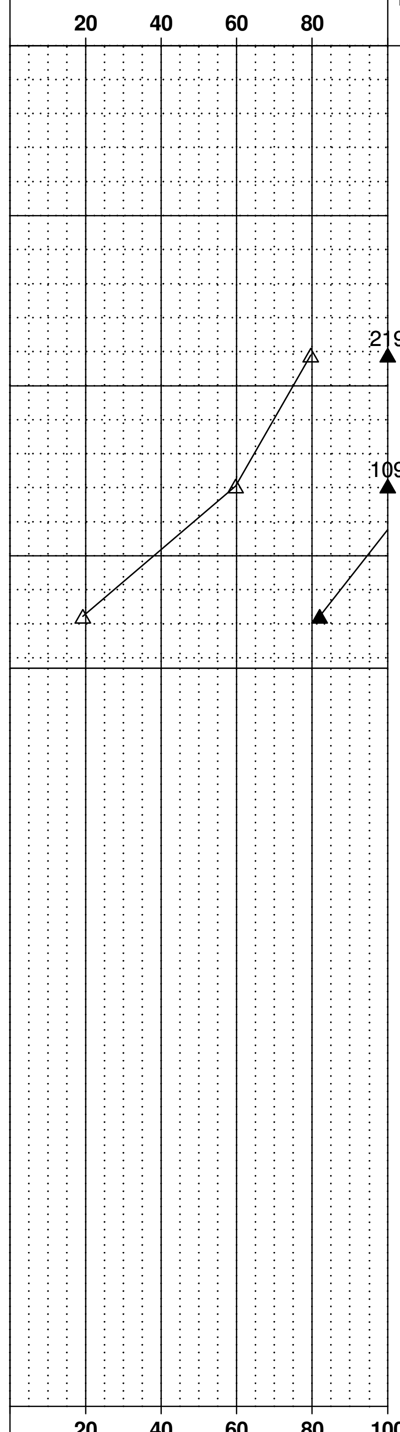
HOLE NO. BH 5-22

SOIL DESCRIPTION	Depth of change (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE					
Asphaltic concrete	0.10				
FILL: Brown silty sand with gravel and crushed stone	0.43	AU	1		
Hard to very stiff, brown **SILTY CLAY**		SS	2		7
		SS	3	8	P
		SS	4	100	P
- stiff by 3.0m depth	3.66	SS	5	100	P
End of Borehole					
(BH dry upon completion)					

DEPTH (m)	ELEV. (m)
0	88.07
1	87.07
2	86.07
3	85.07

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

○ Water Content %



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

Piezometer Construction

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

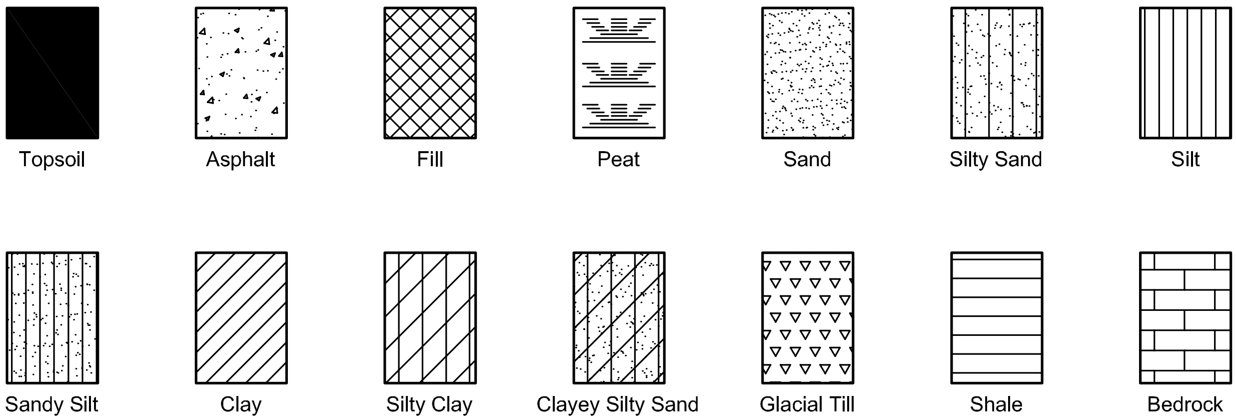
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void 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.

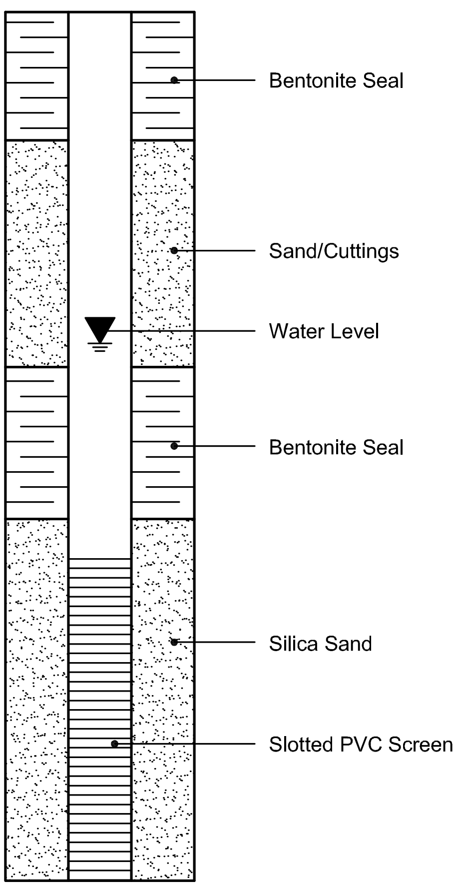
SYMBOLS AND TERMS (continued)

STRATA PLOT

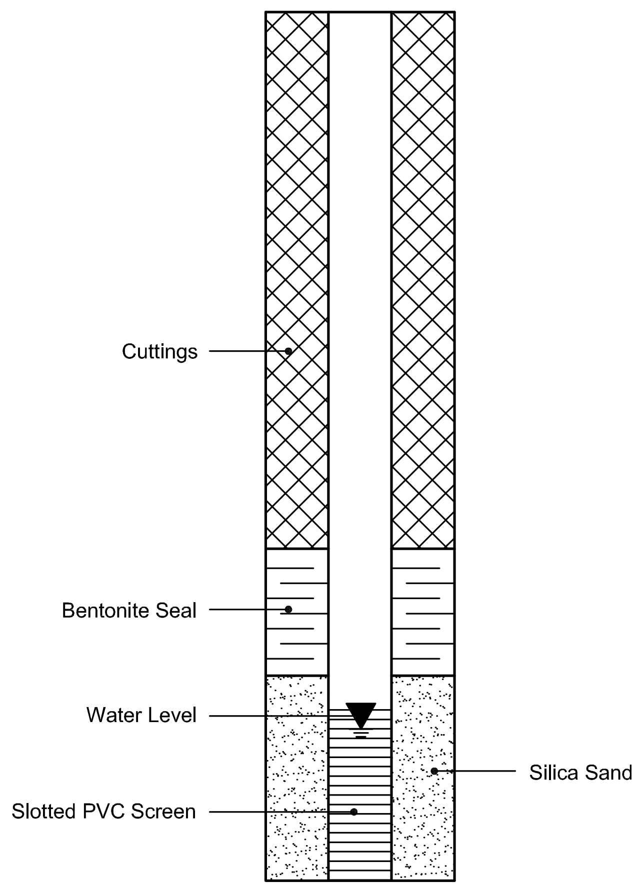


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Certificate of Analysis

Report Date: 03-Nov-2022

Client: Paterson Group Consulting Engineers

Order Date: 28-Oct-2022

Client PO: 56104

Project Description: PG6426

	Client ID:	BH2-22-SS3	-	-	-		
	Sample Date:	28-Oct-22 09:00	-	-	-	-	-
	Sample ID:	2244547-01	-	-	-		
	Matrix:	Soil	-	-	-		
	MDL/Units						
Physical Characteristics							
% Solids	0.1 % by Wt.	69.7	-	-	-	-	-
General Inorganics							
pH	0.05 pH Units	7.42	-	-	-	-	-
Resistivity	0.1 Ohm.m	7.22	-	-	-	-	-
Anions							
Chloride	5 ug/g	790	-	-	-	-	-
Sulphate	5 ug/g	127	-	-	-	-	-

APPENDIX 2

FIGURE 1 – KEY PLAN

DRAWING PG6426-1 – TEST HOLE LOCATION PLAN

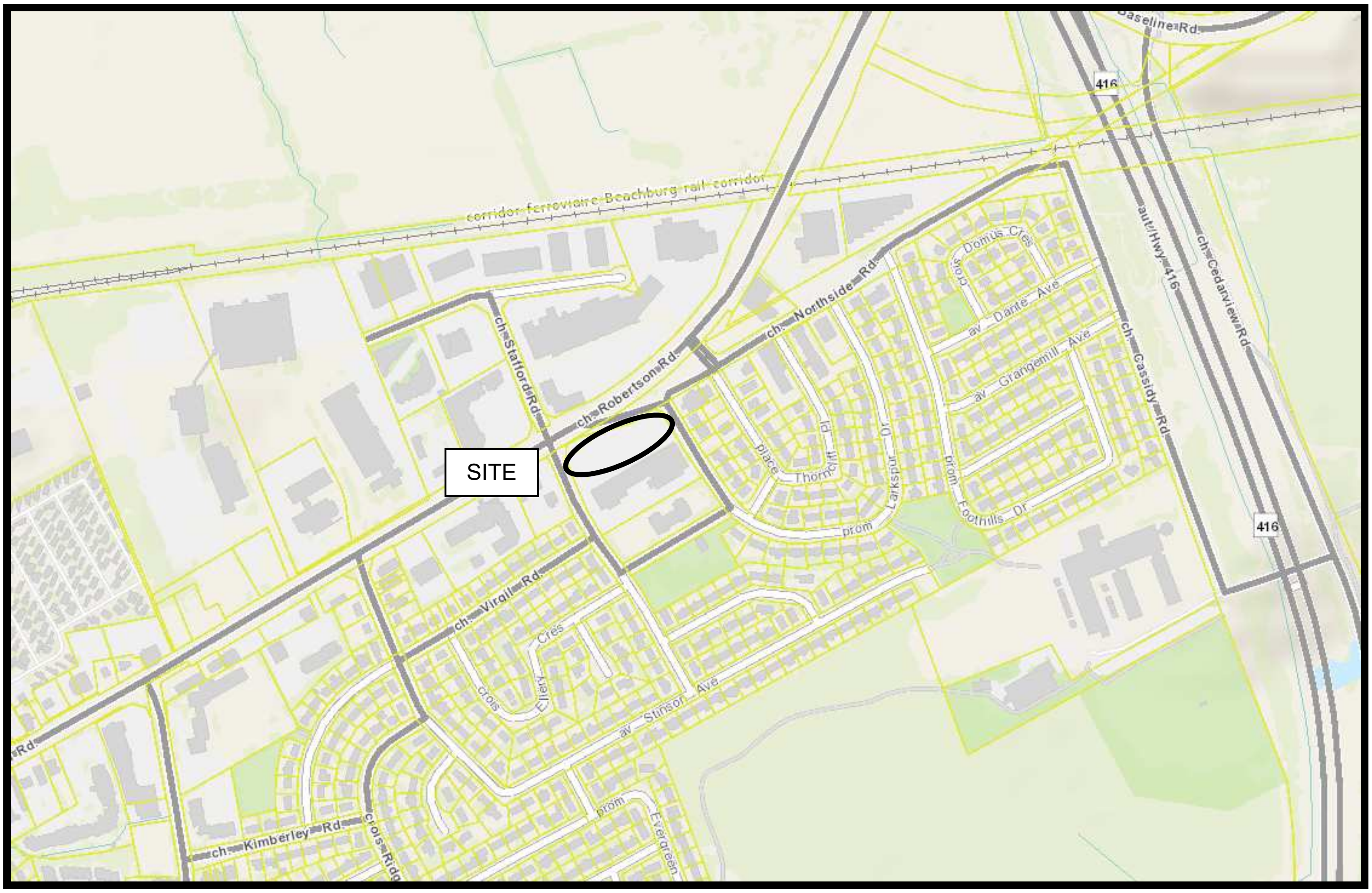
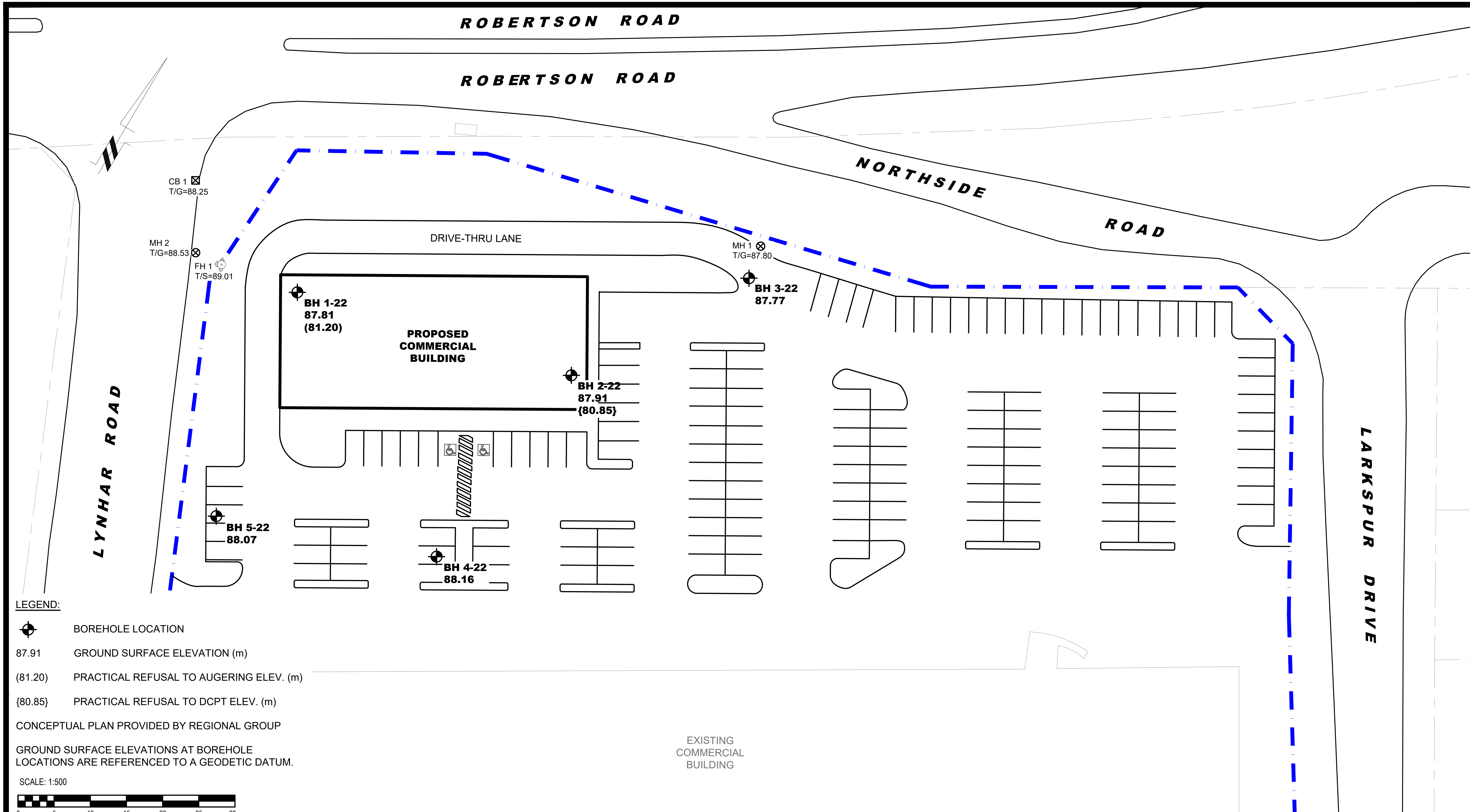


FIGURE 1

KEY PLAN

PATERSON GROUP



LEGEND:

⌖	BOREHOLE LOCATION
87.91	GROUND SURFACE ELEVATION (m)
(81.20)	PRACTICAL REFUSAL TO AUGERING ELEV. (m)
{80.85}	PRACTICAL REFUSAL TO DCPT ELEV. (m)

CONCEPTUAL PLAN PROVIDED BY REGIONAL GROUP

GROUND SURFACE ELEVATIONS AT BOREHOLE LOCATIONS ARE REFERENCED TO A GEODETIC DATUM.

SCALE: 1:500

0 5 10 15 20 25 30m

PATERSON GROUP
9 AURIGA DRIVE
OTTAWA, ON
K2E 7T9
TEL: (613) 226-7381

NO.	REVISIONS	DATE	INITIAL

REGIONAL GROUP

GEOTECHNICAL INVESTIGATION
PROPOSED COMMERCIAL BUILDING
1826 ROBERTSON ROAD

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:500	Date: 11/2022
Drawn by: JM	Report No.: PG6426-1
Checked by: FC	Dwg. No.: PG6426-1
Approved by: SD	Revision No.:

11x17

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