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Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

Materials Testing

Building Science

Archaeological Services

Geotechnical Investigation

Proposed Residential Development
Kanata - Block 344
620 Bobolink Ridge
Ottawa, Ontario

Prepared For

Richcraft Group of Companies

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March 9, 2021

Report: PG5701-1

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1.0 Introduction

Paterson Group (Paterson) was commissioned by the Richcraft Group of Companies to conduct a geotechnical investigation for Block 324 of the proposed residential development to be located at 620 Bobolink Ridge in the City of Ottawa (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 test pits.
- 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 conceptual site plan, it is understood that the proposed development at the subject site will consist of 7 townhouse blocks, each with a basement level. It is further understood that the proposed townhouses will be surrounded by asphalt-paved access lanes and parking areas with landscaped margins. It is anticipated that the proposed development site will be municipally serviced.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the current geotechnical investigation was carried out on February 25, 2021 and consisted of advancing a total of 8 test pits to a maximum depth of 4.4 m below existing ground surface. A previous geotechnical investigation in July 2013 also included 3 test pits at the subject site (TP 1-13 through TP 3-13). The test pit locations were distributed in a manner to provide general coverage of the subject site and taking into consideration underground utilities and site features. The test pit locations are shown on Drawing PG5701-1 - Test Hole Location Plan included in Appendix 2.

The test pits were completed using an excavator and backfilled with the excavated soil upon completion. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer. The test pit procedures consisted of excavating to the required depth at the selected location and sampling the overburden.

Sampling and In Situ Testing

Grab samples were collected from the test pits at selected intervals. The samples were initially classified on site, placed in sealed plastic bags and transported to our laboratory. The depths at which the grab samples were recovered from the test pits are shown as G on the Soil Profile and Test Data sheets in Appendix 1.

The subsurface conditions observed in the test pits 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 from the current geotechnical investigation will be stored in the laboratory for a period of 1 month after issuance of this report. They will then be discarded unless we are otherwise directed.

3.2 Field Survey

The test pit locations were selected by Paterson to provide general coverage of the proposed development, taking into consideration the existing site features and underground utilities. The test pit locations and ground surface elevation at each test pit location were surveyed by Paterson using a handheld GPS and referenced to a geodetic datum.

The location of the test pits and ground surface elevation at each test pit location are presented on Drawing PG5701–1 – 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.

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. The sample was analyzed to determine the concentration of sulphate and chloride, the resistivity and the pH of the sample. The results are discussed in Section 6.7 and shown in Appendix 1.

4.0 Observations

4.1 Surface Conditions

The subject site is currently undeveloped and generally vacant. The original ground surface was approximately level and at grade with neighboring roads and properties at approximate geodetic elevation of 106 m. However, an approximately 3 m high fill pile was placed within the north and north east portion of the site, extending up to approximate geodetic elevation 109 m. In addition, a small pond was also observed at the center of the site close to the vicinity of test pit TP 4-21. Currently, a site office trailer is also located at the northeast corner of the site.

The site is bordered by Robert Grant Avenue to the east, Bobolink Ridge to the north, Embankment Street to the west, and Cope Drive to the south.

4.2 Subsurface Profile

On the southern portion of the site, the soil profile at the test hole locations generally consists of topsoil and/or fill which extend to approximate depths of 0.1 to 0.4 m below existing ground surface. The fill in this portion of the site was generally observed to consist of brown silty sand with crushed stone and gravel, as well as topsoil and organics.

On the northern portion of the site, where the fill pile is present, the fill had an approximate thickness of 3.5 to 4 m. This fill varied from a silty sand to silty clay with gravel, brick fragments, wood, topsoil, and organics.

The topsoil or fill was underlain by a compact, brown sandy silt to silty sand, followed by a compact to dense glacial till deposit. The glacial till was observed to consist of a brown silty sand with gravel, cobbles, and boulders.

Refusal to excavation was encountered in all the test pits at depths varying between 2.2 and 4.4 m below existing ground surface, corresponding to geodetic elevations varying from approximately 102.4 m to 105.9 m. In general, the bedrock surface was found to generally slope downward from north to south across the site. Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for the details of the soil profile encountered at each test hole location.

Bedrock

Based on available geological mapping, the bedrock in the subject area consists of interbedded dolostone and limestone of the Gull River formation.

4.3 Groundwater

Groundwater infiltration levels were recorded within the open test pits at the time of excavation. Based on our observations, the groundwater table is not present within the overburden soils. The ground water observations are reported on the Soil Profile and Test Data sheets in Appendix 1.

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 suitable for the proposed development. It is recommended that the proposed buildings be founded using conventional spread footings bearing on undisturbed, compact sandy silt to silty sand, compact to dense glacial till, or clean surface sounded bedrock.

It is anticipated that bedrock removal will be required at some locations as part of the building excavations and servicing for the proposed development.

It is also anticipated that the soil in the existing fill pile on the northern portion of the site could be placed as general landscaping fill where settlement of the ground surface is of minor concern, provided the material is placed in an unfrozen state and at a suitable moisture content for compaction.

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

5.2 Site Grading and Preparation

Stripping Depth

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

Bedrock Removal

Bedrock removal can be accomplished by hoe ramming where only a small quantity of bedrock needs 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.

As a general guideline, peak particle velocities (measured at the structures) should not exceed 25 mm/s during the blasting program to reduce the risks of damage to the existing surrounding structures. The blasting operations should be planned and conducted under the supervision of a licensed professional engineer who is also an experienced blasting consultant.

Vibration Considerations

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

Two parameters determine the recommended vibration limit, 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). These guidelines are for current construction standards. These guidelines are above perceptible human level and, in some cases, could be very disturbing to some people. A pre-construction survey is recommended to minimize the risks of claims during or following the construction of the proposed building.

Fill Placement

Fill placed 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. The imported fill material should be tested and approved prior to delivery. The fill should be placed in maximum 300 mm thick loose lifts and compacted by suitable compaction equipment. Fill placed beneath the building should be compacted to a minimum of 98% of the standard Proctor maximum dry density (SPMDD).

Non-specified existing fill along with site-excavated soil could be placed as general landscaping fill where settlement of the ground surface is of minor concern. These materials should be spread in lifts with a maximum thickness of 300 mm and compacted by the tracks of the spreading equipment to minimize voids. Non-specified existing fill and site-excavated soils are not suitable for placement as backfill against foundation walls, unless used in conjunction with a geocomposite 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. This material should be used structurally only to build up the subgrade for pavements. 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 Resistance Values

As noted above, based on the subsurface profile encountered in the test pits, it is recommended that the proposed buildings be founded on conventional spread footings placed on undisturbed, compact brown sandy silt to silty sand, compact to dense glacial till, or clean, surface sounded bedrock.

Overburden Bearing Surface

Footings placed on an undisturbed, compact sandy silt to silty sand, compact to dense glacial till, or on engineered fill which is placed directly over the undisturbed, compact sandy silt to silty or compact to dense glacial till, can be designed using a bearing resistance value at SLS of **150 kPa** and a factored bearing resistance value at ULS of **250 kPa,** incorporating a geotechnical factor of 0.5.

An undisturbed soil bearing surface consists of one from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, have been removed, in the dry, prior to the placement of concrete footings.

Footings bearing on an undisturbed soil bearing surface and designed using the bearing resistance values provided herein will be subjected to potential post-construction total and differential settlements of 25 and 20 mm, respectively.

Bedrock Bearing Surface

Footings placed on clean, surface sounded bedrock can be designed using a bearing resistance value at ultimate limits states (ULS) of **1,000 kPa**. A geotechnical factor of 0.5 was applied to the above noted bearing resistance value.

A clean, surface-sounded bedrock bearing surface should be free of loose materials, and have no near surface seams, voids, fissures or open joints which can be detected from surface sounding with a rock hammer.

Footings bearing on an acceptable bedrock bearing surface and designed for the bearing resistance values provided herein will be subjected to negligible potential post-construction total and differential settlements.

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 above noted overburden soils bearing media when a plane extending down and out from the bottom edges of the footing, at a minimum of 1.5H:1V, passes only through in situ soil of the same or higher capacity as that of the bearing medium. In unfractured bedrock, a plane with a slope of 1H:6V can be used.

Bedrock/Soil Transition

Where a building is founded partly on bedrock and partly on soil, it is recommended to decrease the soil bearing resistance value by 25% for the footings placed on soil bearing media to reduce the potential long term total and differential settlements. Also, at the soil/bedrock and bedrock/soil transitions, it is recommended that the upper 0.5 m of the bedrock be removed for a minimum length of 2 m (on the bedrock side) and replaced with nominally compacted OPSS Granular A or Granular B Type II material. The width of the sub-excavation should be at least the proposed footing width plus 0.5 m. Steel reinforcement, extending at least 3 m on both sides of the 2 m long transition, should be placed in the top part of the footings and foundation walls.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class C** for foundations constructed at the subject site. A higher site class, such as Class A or B, may be provided for foundations placed on or within 3 m of the bedrock surface. However, the higher site class will need to be confirmed by a site-specific seismic shear wave velocity test. 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 Basement Slab

With the removal of all topsoil and deleterious fill within the footprints of the proposed buildings, the existing fill, native soil or bedrock surface approved by Paterson will be considered an acceptable subgrade upon which to commence backfilling for floor slab construction.

Where existing fill is encountered below the basement slab, provisions should be made to proof-rolling the soil subgrade using heavy vibratory compaction equipment, under the observation of Paterson, prior to placing any fill. Any soft areas should be removed and backfilled with OPSS Granular B Types I or II, with a maximum particle size of 50 mm.

It is recommended that the upper 200 mm of sub-floor fill consists of 19 mm clear crushed stone.

5.6 Pavement Design

Car only parking and local residential roadways are expected at this site. The subgrade material will consist of native soil and fill. The proposed pavement structures are presented in Tables 1 and 2.

Table 1 – Recommended Pavement Structure – Car only parking

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 placed over in-situ soil or fill.	

Table 2 – Recommended Pavement Structure – Local Residential Roadways

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

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type I or II material.

Minimum Performance Graded (PG) 64-28 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 98% of the material's SPMDD using suitable compaction equipment.

The pavement granular (base and subbase) should be placed in maximum 300 mm thick lifts and compacted to a minimum of 100% of the material's SPMDD using suitable compaction equipment.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Foundation Drainage

It is recommended that a perimeter foundation drainage system be provided for the proposed buildings. The system should consist of a 100 to 150 mm diameter perforated and corrugated plastic pipe, surrounded on all sides by 150 mm of 10 mm clear crushed stone, which is placed at the footing level around the exterior perimeter of the structure. The clear crushed stone should be wrapped in a non-woven geotextile. The pipe should have a positive outlet, such as a gravity connection to the storm sewer.

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, unless used in conjunction with a drainage geocomposite, such as Delta Drain 6000, connected to the perimeter foundation drainage system. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should otherwise be used for this purpose.

6.2 Protection 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 combination of soil cover and foundation insulation, should be provided in this regard.

Other exterior unheated footings, such as those for isolated exterior piers and retaining walls, are more prone to deleterious movement associated with frost action. These should be provided with a minimum 2.1 m thick soil cover, 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 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 assumed that sufficient room will be available for the greater part of the excavation to be undertaken by open-cut methods (i.e. unsupported excavations).

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

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

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

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

6.4 Pipe Bedding and Backfill

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

It should generally be possible to re-use the glacial till above the cover material if the excavation and filling operations are carried out in dry weather conditions. However, this would need to be reviewed and approved by Paterson at the time of construction. Any stones greater than 200 mm in their longest dimension should be removed from these materials prior to placement. Well fractured bedrock should be acceptable as backfill for the lower portion of the trenches when the excavation is within bedrock provided the rock fill is placed only from at least 300 mm above the top of the service pipe and that all stones are 300 mm or smaller in their longest dimension.

The backfill material within the frost zone (about 1.8 m below finished grade) should match the soils exposed at the trench walls to reduce potential differential frost heaving. The backfill should be placed in maximum 225 mm thick loose lifts and compacted to a minimum of 95% of the material’s SPMDD.

6.5 Groundwater Control

Based on our observations, it is anticipated that groundwater infiltration into the excavations should be low to moderate 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.

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

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

6.6 Winter Construction

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

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

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

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

7.0 Recommendations

It is a requirement for the foundation design data provided herein to be applicable that the following recommendations be completed by the geotechnical consultant.

- 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.

8.0 Statement of Limitations

The recommendations provided herein are in accordance with our 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 Richcraft Group of Companies 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.

Maha Saleh, Prov. P.Eng.

LICENSED PROFESSIONAL ENGINEER
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Report Distribution:

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APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TEST RESULTS

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Kanata Block 344
620 BoboLink Ridge - Ottawa, Ontario

DATUM Geodetic

FILE NO. PG5701

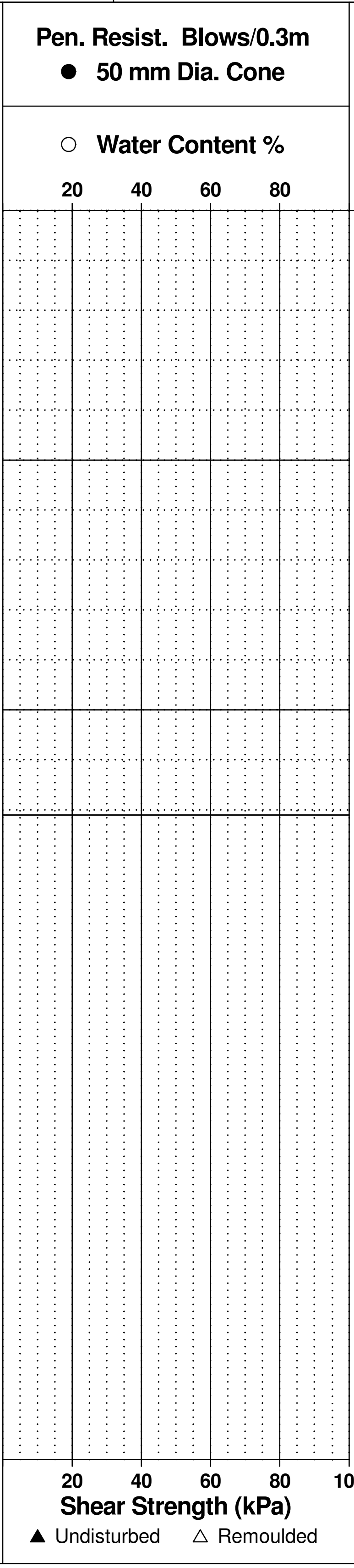
REMARKS

HOLE NO. TP 1-21

BORINGS BY Excavator

DATE 2021 February 25

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	106.18
FILL: Brown silty sand some gravel, crushed stone, cobbles, boulders, trace organics 0.11		G	1				
Compact brown **SANDY SILT** with clay some gravel and cobbles		G	2				
0.70							
GLACIAL TILL: Compact to dense brown silty sand with gravel, cobbles and boulders						1	105.18
						2	104.18
		G	3				
2.42							
End of Test Pit Refusal to excavation on bedrock surface at 2.42 m depth (TP dry upon completion)							



Piezometer Construction

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

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Kanata Block 344
620 BoboLink Ridge - Ottawa, Ontario

DATUM Geodetic
REMARKS
BORINGS BY Excavator
DATE 2021 February 25
FILE NO. PG5701
HOLE NO. TP 2-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	105.92
TOPSOIL 0.08		G	1				
Compact **SILTY SAND** trace clay 1.36						1	104.92
GLACIAL TILL: Compact to dense brown silty sand with gravel, cobbles, boulders, trace clay		G	2				
						2	103.92
		G	3				
2.48							
End of Test Pit Refusal to excavation on bedrock surface at 2.48 m depth (TP dry upon completion)							

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

○ Water Content %
20 40 60 80

Piezometer Construction

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

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Kanata Block 344
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DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE 2021 February 25

FILE NO. PG5701

HOLE NO. TP 3-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	105.93		
TOPSOIL 0.11		G	1						
Compact brown **SILTY SAND** trace clay						1	104.93		
1.53		G	2						
GLACIAL TILL: Compact to dense brown silty sand with gravel, cobbles and boulders		G	3			2	103.93		
2.42									

End of Test Pit

Refusal to excavation on bedrock surface at 2.42 m depth

(TP dry upon completion)

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

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SOIL PROFILE AND TEST DATA

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REMARKS

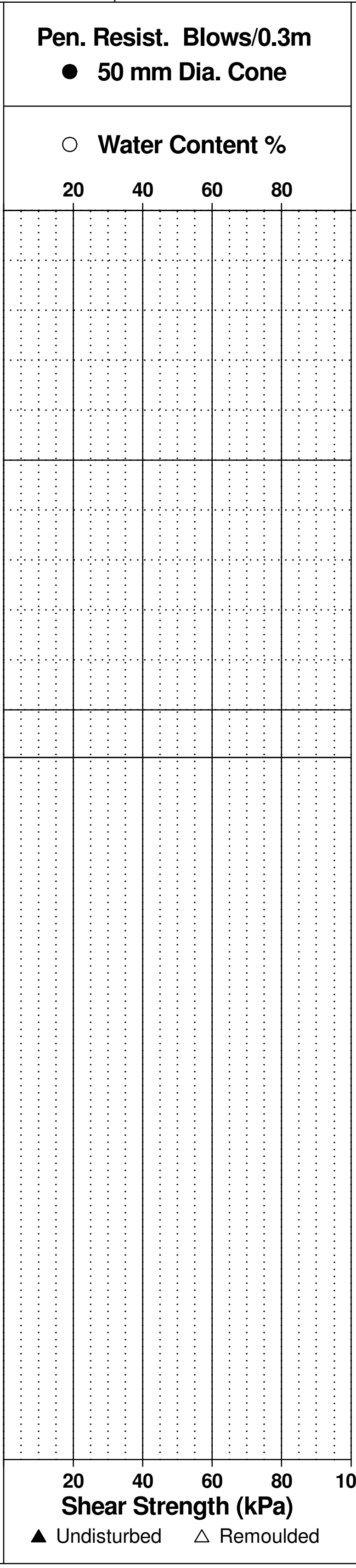
BORINGS BY Excavator

DATE 2021 February 25

FILE NO. PG5701

HOLE NO. TP 4-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Piezometer Construction
GROUND SURFACE						0	105.90	
TOPSOIL 0.43		G	1					
Compact brown **SILTY SAND** 1.26		G	2			1	104.90	
GLACIAL TILL: Compact to dense brown silty sand with gravel, cobbles and boulders 2.19		G	3			2	103.90	
End of Test Pit Refusal to excavation on bedrock surface at 2.19 m depth (TP dry upon completion)								



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SOIL PROFILE AND TEST DATA

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DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE 2021 February 25

FILE NO. PG5701

HOLE NO. TP 5-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20, 40, 60, 80)	Piezometer Construction
GROUND SURFACE						0	109.12		
TOPSOIL 0.40	■								
FILL: Brown silty clay to silty sand with gravel	▨	G	1			1	108.12		
	▨	G	2			2	107.12		
3.52	▨					3	106.12		
Compact brown **SILTY SAND** trace gravel 4.01		G	3						
GLACIAL TILL: Compact to dense brown silty sand with gravel, cobbles and boulders 4.36	^	G	4			4	105.12		
End of Test Pit Refusal to excavation on bedrock surface at 4.36 m depth (TP dry upon completion)									

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
Proposed Residential Development - Kanata Block 344
620 BoboLink Ridge - Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Excavator

DATE 2021 February 25

FILE NO. PG5701

HOLE NO. TP 6-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content % 20 40 60 80	Piezometer Construction
GROUND SURFACE						0	109.18		
FILL: Brown silty clay with gravel, topsoil and organics	▨								
		G	1						
						1	108.18		
		G	2						
						2	107.18		
		G	3			3	106.18		
		G	4						
3.97									
End of Test Pit Refusal to excavation on bedrock surface at 3.97 m depth (TP dry upon completion) Test Pit excavated through stockpiled material									

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

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154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Kanata Block 344
620 BoboLink Ridge - Ottawa, Ontario

DATUM Geodetic

FILE NO. PG5701

REMARKS

HOLE NO. TP 7-21

BORINGS BY Excavator

DATE 2021 February 25

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE									
FILL: Brown silty clay with sand, gravel, brick fragments, wood, topsoil and high organic content	▨	G	1			0	108.70		
		G	2			1	107.70		
						2	106.70		
		G	3						
3.66						3	105.70		
End of Test Pit Refusal to excavation on bedrock surface at 3.66 m depth (TP dry upon completion)									

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

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Residential Development - Kanata Block 344
620 BoboLink Ridge - Ottawa, Ontario

DATUM Geodetic

REMARKS

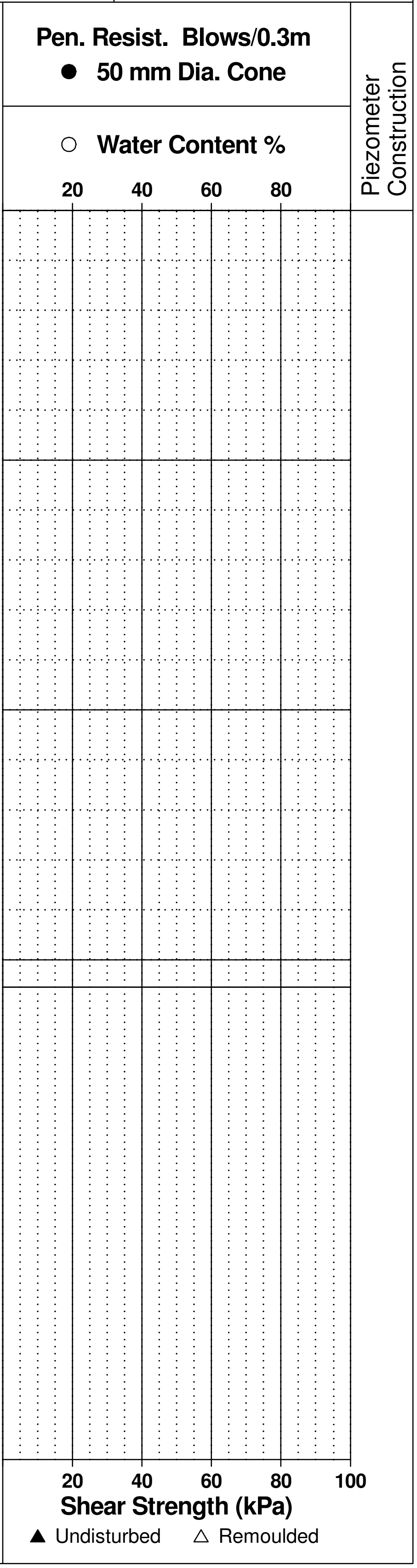
BORINGS BY Excavator

DATE 2021 February 25

FILE NO. PG5701

HOLE NO. TP 8-21

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	109.01
FILL: Brown to grey silty sand with clay, gravel, crushed stone, topsoil and organics		G	1				
		G	2				
0.45							
TOPSOIL		G	3				
0.61							
Compact brown **SILTY SAND** with gravel						1	108.01
		G	4				
1.92							
GLACIAL TILL: Brown silty sand with gravel, cobbles and boulders, some clay						2	107.01
		G	5				
						3	106.01
3.11							
End of Test Pit Refusal to excavation on bedrock surface at 3.11 m depth (TP dry upon completion)							



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Fernbank Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

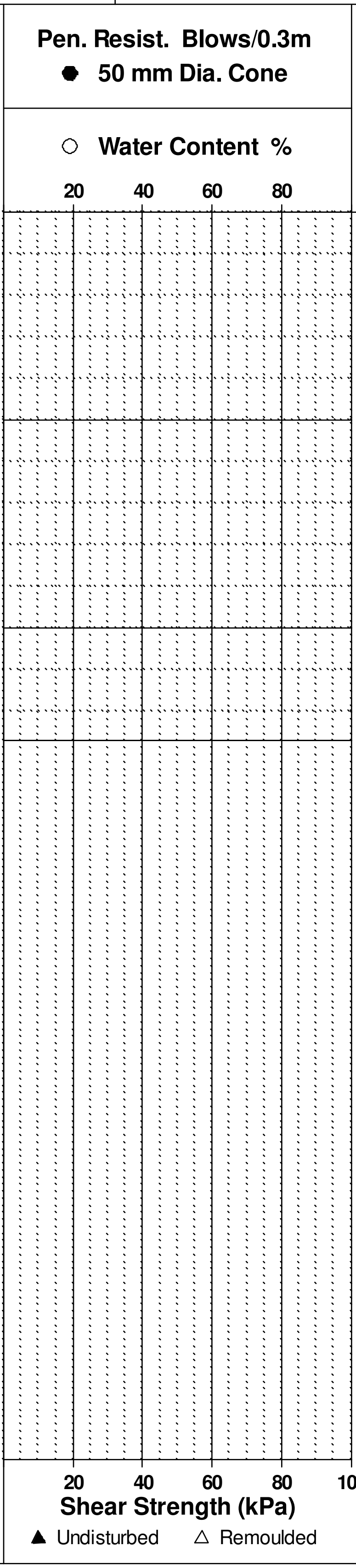
BORINGS BY Hydraulic Shovel

DATE July 5, 2013

FILE NO. PG2236

HOLE NO. TP 1-13

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	105.65
TOPSOIL 0.30	■						
Brown **SILTY CLAY** with sand and gravel 0.51	▨						
GLACIAL TILL: Very dense brown silty sand with gravel, cobbles and boulders 2.54	^^^					1	104.65
						2	103.65
End of Test Pit Refusal to excavation on bedrock surface @ 2.54m depth (TP dry upon completion)							



Piezometer Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Residential Development - Fernbank Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

REMARKS

BORINGS BY Hydraulic Shovel

DATE July 8, 2013

FILE NO. PG2236

HOLE NO. TP 2-13

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone / ○ Water Content % (20 40 60 80)	Piezometer Construction
GROUND SURFACE						0	105.41		
TOPSOIL 0.30	■	G	1						
Brown **SILTY SAND** 0.74	▨	G	2						
End of Test Pit Refusal to excavation on bedrock surface @ 0.74m depth (TP dry upon completion)									

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. Residential Development - Fernbank Road
Ottawa, Ontario

DATUM Ground surface elevations provided by Annis, O'Sullivan, Vollebekk Ltd.

FILE NO. **PG2236**

REMARKS

HOLE NO. **TP 3-13**

BORINGS BY Hydraulic Shovel

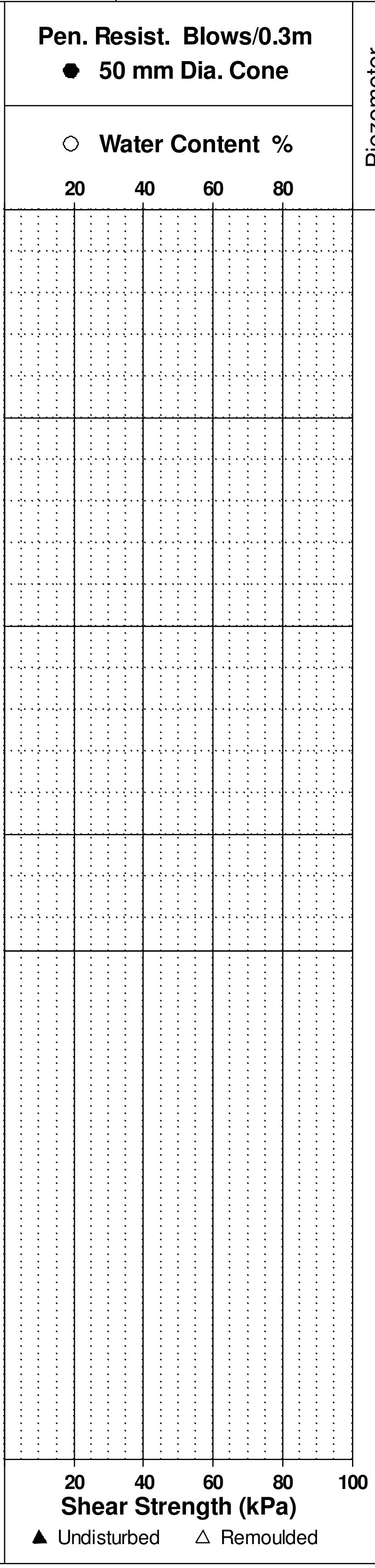
DATE July 8, 2013

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
Brown **SILTY SAND** with **TOPSOIL** 0.25		G	1			0	105.99
Brown **SILTY SAND** with trace **CLAY** 0.66		G	2				
						1	104.99
GLACIAL TILL: Brown-grey silty sand with clay, gravel, cobbles and boulders 3.56		G	3				
						2	103.99
						3	102.99

End of Test Pit

Refusal to excavation on bedrock surface @ 3.56m depth

(TP dry upon completion)



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 x 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)

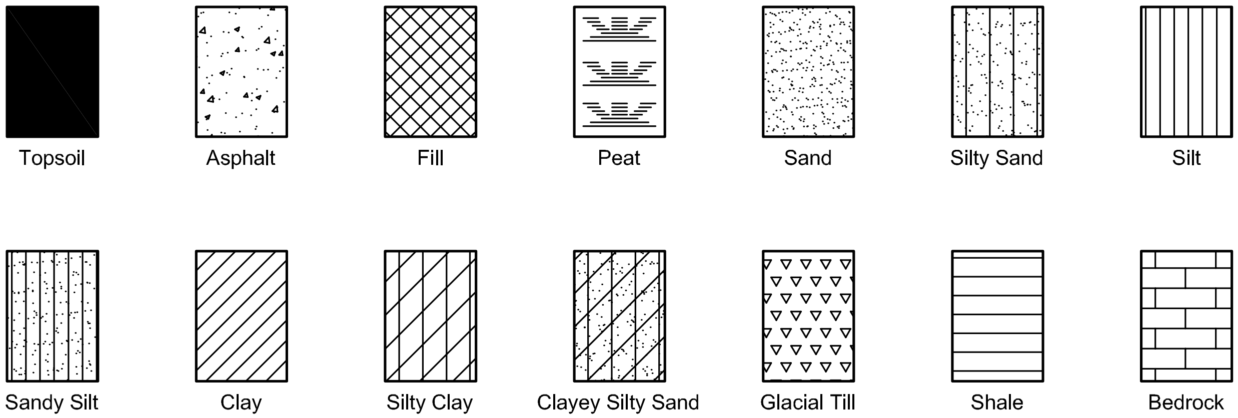
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

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.

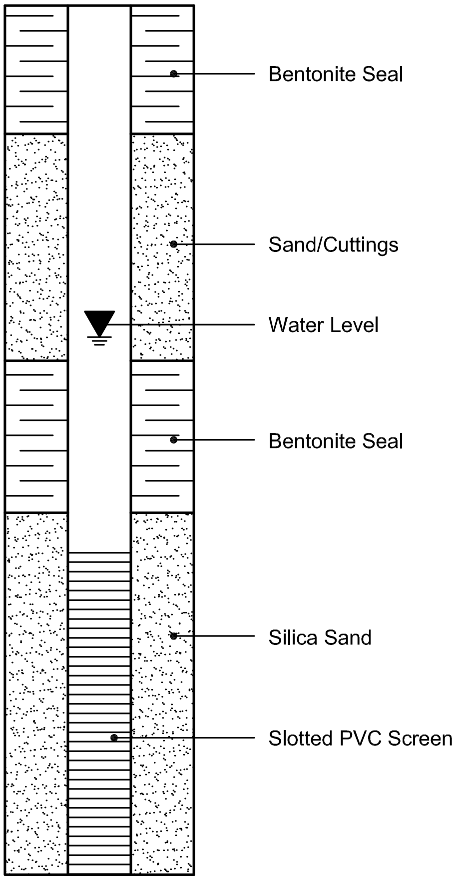
SYMBOLS AND TERMS (continued)

STRATA PLOT

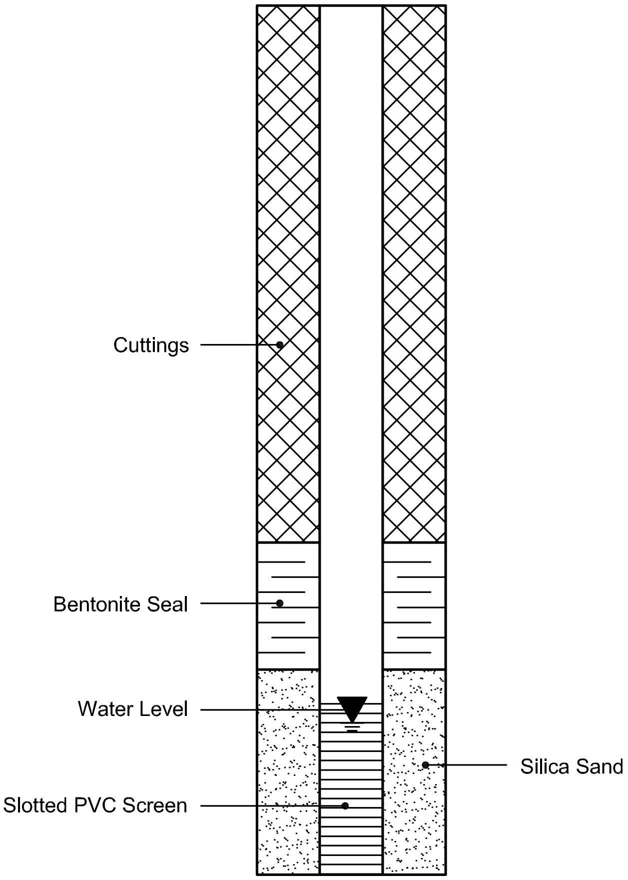


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 31953

Report Date: 02-Mar-2021

Order Date: 26-Feb-2021

Project Description: PG5701

	Client ID:	TP4-21-G3	-	-	-
	Sample Date:	25-Feb-21 09:00	-	-	-
	Sample ID:	2109637-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	90.2	-	-	-
General Inorganics					
pH	0.05 pH Units	7.57	-	-	-
Resistivity	0.10 Ohm.m	111	-	-	-
Anions					
Chloride	5 ug/g dry	<5	-	-	-
Sulphate	5 ug/g dry	6	-	-	-

APPENDIX 2

FIGURE 1 – KEY PLAN

DRAWING PG5701-1 – TEST HOLE LOCATION PLAN

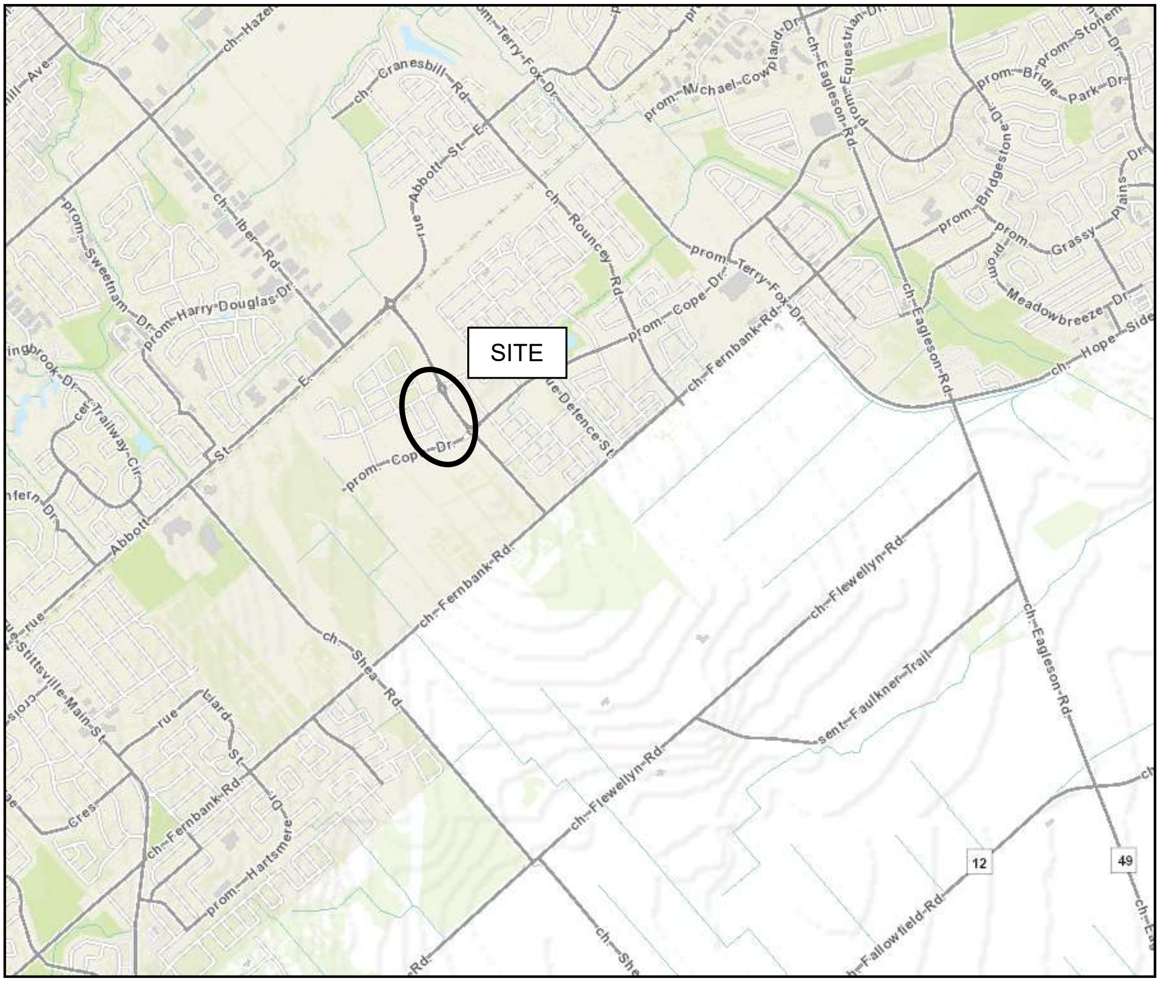
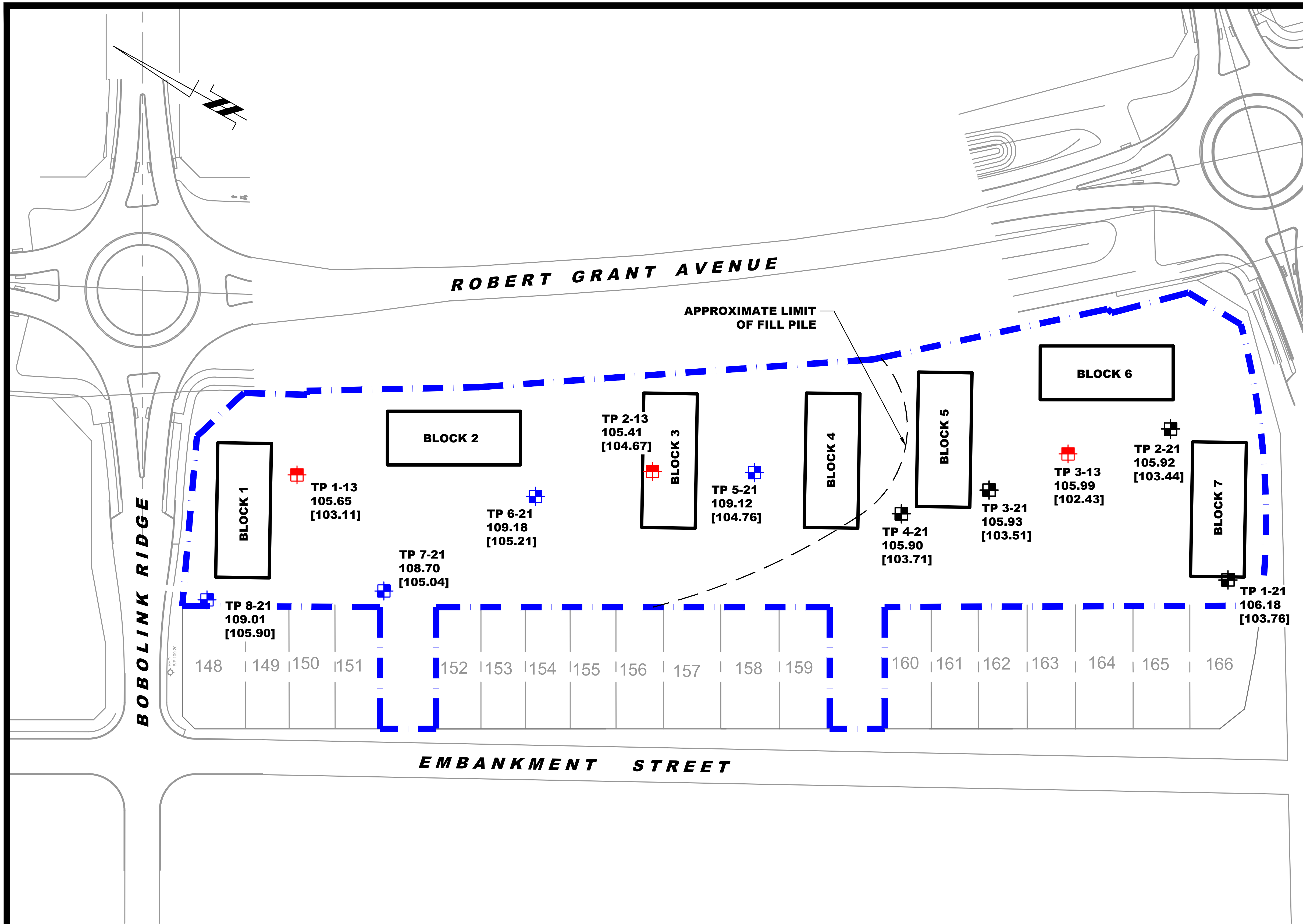


FIGURE 1

KEY PLAN

patersongroup



LEGEND:

⊞	TEST PIT LOCATION, FEBRUARY 25, 2021 (CURRENT INVESTIGATION)
⊞	TEST PIT LOCATION EXCAVATED FROM TOP OF FILL PILE (CURRENT INVESTIGATION)
⊞	TEST PIT LOCATION, PREVIOUS INVESTIGATION (PATERSON GROUP REPORT: PG2236 JULY, 2013) (TEST PIT EXCAVATED FROM ORIGINAL GROUND SURFACE)
105.92	GROUND SURFACE ELEVATION (m)
[103.44]	BEDROCK SURFACE ELEVATION (m)

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

SCALE: 1:1000

0 10 20 30 40 50m 75m

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NO.	REVISIONS	DATE	INITIAL

RICHCRAFT GROUP OF COMPANIES
GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT - KANATA BLOCK 344
620 BOBOLINK RIDGE
OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:1000
Date: 03/2021
Drawn by: JM
Report No.: PG5701-1
Checked by: MS
Dwg No.: PG5701-1
Approved by: SD
Revision No.:

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