

# **Geotechnical Investigation**

## **Proposed Commercial Development**

**3493 - 3499 Innes Road**  
Ottawa, Ontario

Prepared for **Lapenseé**

Report PG5775-1 dated July 10, 2023

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## 1.0 Introduction

Paterson Group (Paterson) was commissioned by Lapenseé to prepare a geotechnical investigation report for the proposed commercial development to be located at 3493 - 3499 Innes Road, Ottawa, Ontario (refer to Figure 1 - Key Plan presented in Appendix 2).

The objective of the geotechnical investigation was to:

- determine the subsoil and groundwater conditions at the site by means of test holes
- provide geotechnical recommendations for the design of the proposed development including construction considerations which may affect its design.

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

## 2.0 Proposed Development

Based on the available conceptual drawings, it is understood that the proposed development will consist of two (2) retail buildings of slab-on-grade construction, with building A occupying the western portion of the site and Building B occupying the eastern portion of the site. Associated access roads and parking areas will occupy the remainder of the site. It is further understood that the proposed residential buildings will be municipally serviced.

## **3.0 Method of Investigation**

### **3.1 Field Investigation**

#### **Field Program**

The field program for the current investigation was carried out on January 27, 2010. At that time, a total of **five (5) test pits** were excavated down to a maximum depth of 1.3 m below existing grade. The test holes were placed in a manner to provide general coverage of the subject site taking into consideration site features and underground utilities. The test hole locations for the current investigation are presented on Drawing PG5775-1 - Test Hole Location Plan included in Appendix 2.

The test pits were excavated using a rubber-tired backhoe at the selected locations across the site. All fieldwork was conducted under the full-time supervision of Paterson personnel under the direction of a senior engineer from the geotechnical division. The excavation procedure consisted of digging to the required depth at the selected locations, sampling and testing the overburden.

#### **Sampling and In Situ Testing**

Grab soil samples from the test pits were recovered from the side walls of the open excavation. The samples were initially classified on site, placed in sealed plastic bags, and transported to our laboratory. The depths at which the 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 holes were recorded in detail in the field. The soil profiles are logged on the Soil Profile and Test Data sheets in Appendix 1 of this report.

#### **Groundwater**

Groundwater infiltration rates were observed in the open test holes after the subsequent completion of the sampling procedure and are further discussed under subsection 4.3 below.

## **3.2 Field Survey**

The test hole locations were selected by Paterson to provide general coverage of the proposed commercial 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 high precision GPS and referenced to a temporary benchmark (TBM), consisting of the top spindle of the fire hydrant located south of the subject property, on the east side of Innes Road. An assumed elevation of 100.0 m was assigned to the TBM. The location of the test pits and ground surface elevation at each test pit location are presented on Drawing PG5775-1 - Test Hole Location Plan in Appendix 2.

## **3.3 Laboratory Review**

Soil samples were recovered from the subject site and visually examined in our laboratory to review the results of the field logging. No further laboratory testing is required from a geotechnical perspective.

## **3.4 Analytical Testing**

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

## **4.0 Observations**

### **4.1 Surface Conditions**

Currently, the site is occupied by a one storey-building at the centre, along with associated garage to the west, and landscaped areas for the remainder of the site. The ground surface across the subject site is relatively flat and at grade with the neighbouring roadways and properties, with a gentle slope from approximate geodetic elevation 91.5m at the west to approximate geodetic elevation 90.5 m at the east. Several trees were observed within the eastern portion and along the southwest corner of the subject site. Based on historical records, an old existing building was demolished to enable the construction of the current existing one-storey building in 2012.

The site is bound by residential dwellings to the north, a single house and associated garden to the east, Innes Road to the south, and by a one-storey commercial development to the west.

### **4.2 Subsurface Profile**

#### **Overburden**

Generally, the subsoil profile at the test hole locations consists of topsoil underlain by a loose to compact brown silty sand followed by bedrock.

Practical refusal to excavation was encountered at all test pits at depths ranging between 0.2 to 1.3m below ground surface.

A layer of very stiff brown silty clay was encountered below the topsoil only at the location of TP 1, excavated at the far-west corner of the subject site, outside the zone of influence of the proposed buildings.

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.

#### **Bedrock**

According to the available geological mapping and the depth of refusal to excavation encountered in the excavated test pits at the subject site, and based on our extensive experience in the area, the bedrock in the subject area consists of limestone bedrock of the Bobcaygeon formation, with a drift thickness of 0 to 1m for the overburden material above the bedrock (i.e. depth to bedrock is 0 to 1m below ground surface).

### **4.3 Groundwater**

Groundwater infiltration levels were recorded in the open test holes upon completion of the current investigation. All test holes were noted to be completely dry upon the completion of excavation. The groundwater observations obtained from the current field program are presented on the Soil Profile and Test Data sheets in Appendix 1. Based on our field observations, the long-term groundwater level is expected to be located below the bedrock surface.

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



## **5.0 Discussion**

### **5.1 Geotechnical Assessment**

From a geotechnical perspective, the subject site is considered suitable for the proposed development. The proposed development can be founded using conventional shallow footings placed on a clean, surface sounded bedrock bearing medium.

It is anticipated that bedrock removal will be required within the subject site. Bedrock removal can be accomplished by hoe ramming where only a small quantity of the bedrock needs to be removed. Sound bedrock may be removed by line drilling and controlled blasting and/or hoe ramming. The blasting operations should be planned and conducted under the guidance of a professional engineer with experience in blasting operations.

Due to founding the proposed buildings on bedrock bearing medium, the proposed development will not be subject to permissible grade raise restrictions or tree planting setbacks, from a geotechnical perspective.

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

### **5.2 Site Grading and Preparation**

#### **Stripping Depth**

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

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

#### **Fill Placement**

Fill used for grading beneath the building areas should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A, Granular B Type II. This material should be tested and approved prior to delivery to the site.

The fill should be placed in lifts no greater than 300 mm thick and compacted using suitable compaction equipment for the lift thickness. Fill placed beneath the building areas should be compacted to at least 98% of its standard Proctor maximum dry density (SPMDD).

Non-specified existing fill, along with site-excavated soil, can be used as general landscaping fill where settlement of the ground surface is of minor concern. These materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If these materials are to be used to build up the subgrade level for areas to be paved, they should be compacted in thin lifts to a minimum density of 95% of their respective SPMDD. Non-specified existing fill and site-excavated soils are not suitable for use as backfill against foundation walls unless used in conjunction with a geocomposite drainage membrane, such as Miradrain G100N or Delta Drain 6000.

### **Proof Rolling**

It is expected that site grading and preparation will consist of stripping of the soils containing significant amounts of organic materials. The contractor should take appropriate precautions to avoid disturbing the subgrade and bearing surfaces from construction and worker traffic. Any loose or disturbed areas within the subgrade level, below the paved areas is recommended to be proof-rolled **under dry conditions and above freezing temperatures** by an adequately sized roller making several passes to achieve optimum compaction levels. The compaction program should be reviewed and approved by the geotechnical consultant. In poor performing areas, consideration may be given to removing the poor performing soil and replace with an approved engineered fill such as OPSS Granular A or Granular B Type II compacted to a minimum 98% of the material's SPMDD.

### **Bedrock Removal**

Bedrock removal can be accomplished by hoe ramming where only a small quantity of the bedrock needs to be removed. Sound bedrock may be removed by line drilling and controlled blasting.

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 proximity of the blasting operations should be completed 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/claims related to the blasting operations.

As a general guideline, peak particle should not exceed 50 mm/s (measured at the structures) during the blasting program to reduce the risks of damage to the existing structures. Blasting close to freshly placed concrete should also be closely controlled.

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 are the cause of 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, as much as possible, a cooperative environment with the residents.

The following construction equipment could be the source of vibrations: hoe ram, compactor, dozer, crane, truck traffic, etc. Vibrations, whether caused by blasting operations or by construction operations, could be the source of detrimental vibrations on the nearby buildings and structures. Therefore, all vibrations are recommended to 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 outlined by City of Ottawa S.P. No: F-1201, vibrations limits should be limited to 20 mm/s for frequencies below or equal to 40 Hz and 50 mm/s for frequencies greater than 40 Hz. Considering that these guidelines are above perceptible human level and, in some cases, could be very disturbing to some people, a pre-construction survey is recommended be completed to minimize the risks of claims during or following the construction of the proposed building.

Should blasting be utilized a pre-blast survey must be completed for the surrounding area per City of Ottawa S.P. No: F-1201 and blast notices must be distributed 15 business days prior to the commencement of blasting work.

## **5.3 Foundation Design**

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

A clean, surface-sounded bedrock bearing surface should be free of all soil and 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 using the bearing resistance values provided herein will be subjected to negligible potential post-construction total and differential settlements.

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

### **Lateral Support**

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Adequate lateral support is provided to the encountered overburden material above the groundwater table when a plane extending down and out from the bottom edge of the footing at a minimum of 1.5H:1V passes only through in situ soil of the same or higher capacity as the bearing medium soil. Near vertical (1H:6V) slopes can be used for unfractured bedrock bearing media; a 1H:1V slope can be used for fractured bedrock.

## **5.4 Design for Earthquakes**

The site class for seismic site response can be taken as **Class C** for the shallow foundations considered at this site, according to Table 4.1.8.4.A of the 2012 Ontario Building Code (OBC 2012). A higher site class, such as Classes A or B could be applicable for this site but would have to be determined based on site-specific seismic testing, such as near-surface reflection/refraction.

The soils underlying the proposed shallow foundations 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 significant amounts of organic matter, within the footprints of the proposed building, the existing material, reviewed and approved by Paterson, will be considered acceptable subgrade on which to commence backfilling for floor slab construction. The upper 300 mm of sub-slab fill should consist of an OPSS Granular A crushed stone.

All backfill material within the footprint of the proposed buildings should be placed in maximum 300 mm thick loose lifts and compacted to at least 98% of its SPMDD. It is recommended that a minimum of 300mm thick layer (native soil plus crushed stone) be present between the floor slab and the bedrock surface to reduce the risks of bending stresses developing in the concrete slab. 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 Structure

Car only parking, heavy truck parking areas and access lanes are expected for the proposed development. The proposed pavement structures are presented in Tables 1 and 2.

<b>Table 1 - Recommended Pavement Structure - Car Only Parking Areas</b>	
<b>Thickness mm</b>	<b>Material Description</b>
50	<b>WEAR COURSE</b> - HL-3 or Superpave 12.5 Asphaltic Concrete
150	<b>BASE</b> - OPSS Granular A Crushed Stone
300	<b>SUBBASE</b> - OPSS Granular B Type II
<b>SUBGRADE</b> - Either in situ soil, bedrock or OPSS Granular B Type II material placed over in situ soil or bedrock.	

<b>Table 2 - Recommended Pavement Structure - Heavy Truck Parking and Access Lanes</b>	
<b>Thickness (mm)</b>	<b>Material Description</b>
40	<b>Wear Course</b> - HL-3 or Superpave 12.5 Asphaltic Concrete
50	<b>Binder Course</b> - HL-8 or Superpave 19.0 Asphaltic Concrete
150	<b>BASE</b> - OPSS Granular A Crushed Stone
400	<b>SUBBASE</b> - OPSS Granular B Type II
<b>SUBGRADE</b> - Either in situ soil, bedrock or OPSS Granular B Type I or II material placed over in situ soil or bedrock	

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 98% of the material's SPMDD using suitable compaction equipment.

Where the subgrade is observed to be in a loose state of compactness, proof-rolling using suitably sized equipment, completed under dry conditions and at above freezing temperature should be done under the supervision of Paterson personnel.

## **6.0 Design and Construction Precautions**

### **6.1 Foundation Drainage and Backfill**

#### **Foundation Drainage**

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

#### **Foundation Backfilling**

Backfill against the exterior sides of the foundation walls should consist of free draining non frost susceptible granular materials. The greater part of the site excavated materials will be frost susceptible and, as such, are not recommended for re-use as backfill against the foundation walls, unless a composite drainage system (such as Delta Drain 6000) is used. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should 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 of 1.5 m of soil cover alone, or a minimum of 0.6 m of soil cover, in conjunction with foundation insulation, should be provided in this regard.

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

### **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 room will be available for the greater part of the excavation to be undertaken by open-cut methods (i.e. unsupported excavations).

## **Unsupported Excavations**

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

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

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

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

In bedrock, almost vertical side slopes can be used provided that all loose rock and blocks with unfavourable weak planes are removed or stabilized.

## **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 99% of the material's standard Proctor maximum dry density.

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

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



## 6.5 Groundwater Control

### Groundwater Control for Building Construction

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

### Permit to Take Water

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

For typical ground or surface water volumes being pumped during the construction phase (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.

## 6.6 Winter Construction

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

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

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

The trench excavations should be carried out in a manner to avoid the introduction of frozen materials, snow or ice into the trenches. As well, pavement construction is difficult during winter. The subgrade consists of frost susceptible soils which will experience total and differential frost heaving as the work takes place. Also, the introduction of frost, snow or ice into the pavement materials, which is difficult to avoid, could adversely affect the performance of the pavement structure.

## **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 material testing and observation program be performed by the geotechnical consultant.

- Review detailed grading plan from a geotechnical perspective.
- Observation of all bearing surfaces prior to the placement of concrete.
- Sampling and testing of the concrete and fill materials.
- Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.
- Observation of all subgrades prior to backfilling.
- Field density tests to ensure that the specified level of compaction has been achieved.
- Sampling and testing of the bituminous concrete including mix design reviews.

All excess soils generated by construction activities should be handled as per *Ontario Regulation 406/19: On-Site and Excess Soil Management*.

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

## 8.0 Statement of Limitations

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

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

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

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

### Paterson Group Inc.



Zubaida Al-Moselly, P.Eng.



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

### Report Distribution:

- Lapenseé (email copy)
- Paterson Group (1 copy)

# APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TESTING RESULTS

**DATUM** TBM - Top spindle of fire hydrant located at the southwest corner of subject site.  
Assumed elevation = 100.00m.

**REMARKS**

**BORINGS BY** Backhoe

**DATE** January 27, 2010

**FILE NO.**  
**PG5775**

**HOLE NO.**  
**TP 1**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction	
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			○ Water Content %					
Ground Surface								20	40	60	80		
TOPSOIL	[REDACTED]	G	1			0	98.93						
Very stiff, brown <b>SILTY CLAY</b>	[Hatched Pattern]	G	2										
End of Test Pit													
TP terminated on bedrock surface @ 0.90m depth (TP dry upon completion)													

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

**DATUM** TBM - Top spindle of fire hydrant located at the southwest corner of subject site.  
Assumed elevation = 100.00m.

**REMARKS**

**BORINGS BY** Backhoe

**DATE** January 27, 2010

**FILE NO.**  
**PG5775**

**HOLE NO.**  
**TP 2**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction	
		TYPE	NUMBER	RECOVERY	N VALUE or RQD			○ Water Content %					
Ground Surface								20	40	60	80		
TOPSOIL	0.10	G	1			0	98.63						
Loose to compact, brown <b>SILTY SAND</b>	0.50	G	2										
End of Test Pit TP terminated on bedrock surface @ 0.50m depth (TP dry upon completion)													

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

**DATUM** TBM - Top spindle of fire hydrant located at the southwest corner of subject site.  
Assumed elevation = 100.00m.

**REMARKS**

**BORINGS BY** Backhoe

**DATE** January 27, 2010

**FILE NO.**  
**PG5775**

**HOLE NO.**  
**TP 3**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			○ Water Content %				
Ground Surface								20	40	60	80	
TOPSOIL	[REDACTED]	G	1			0	98.21					
	0.25											
Loose, brown <b>SILTY SAND</b>		G	2			1	97.21					
	1.30											
End of Test Pit TP terminated on bedrock surface @ 1.30m depth (TP dry upon completion)												

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



**DATUM** TBM - Top spindle of fire hydrant located at the southwest corner of subject site.  
Assumed elevation = 100.00m.

**REMARKS**

**BORINGS BY** Backhoe

**DATE** January 27, 2010

**FILE NO.**  
**PG5775**

**HOLE NO.**  
**TP 4**

SOIL DESCRIPTION	STRATA PLOT	SAMPLE				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone				Piezometer Construction	
		TYPE	NUMBER	RECOVERY %	N VALUE or RQD			○ Water Content %					
Ground Surface								20	40	60	80		
TOPSOIL	[REDACTED]	G	1			0	97.80						
0.20													
Loose, brown <b>SILTY SAND</b> , trace cobbles		G	2										
0.70													
End of Test Pit TP terminated on bedrock surface @ 0.70m depth (TP dry upon completion)													

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



# 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.

<b>RQD %</b>	<b>ROCK QUALITY</b>
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 = $(D_{30})^2 / (D_{10} \times D_{60})$
Cu	-	Uniformity coefficient = $D_{60} / D_{10}$

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		Overconsolidation 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.
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# SYMBOLS AND TERMS (continued)

## STRATA PLOT



Topsoil



Asphalt



Fill



Peat



Sand



Silty Sand



Silt



Sandy Silt



Clay



Silty Clay



Clayey Silty Sand



Glacial Till



Shale



Bedrock

## MONITORING WELL AND PIEZOMETER CONSTRUCTION

### MONITORING WELL CONSTRUCTION



### PIEZOMETER CONSTRUCTION



Certificate of Analysis

Report Date: 24-Mar-2022

Client: Paterson Group Consulting Engineers

Order Date: 21-Mar-2022

Client PO: 33939

Project Description: PG6152

<b>Client ID:</b>	TP3-22 G3	-	-	-
<b>Sample Date:</b>	15-Mar-22 09:00	-	-	-
<b>Sample ID:</b>	2213100-01	-	-	-
<b>MDL/Units</b>	Soil	-	-	-

**Physical Characteristics**

% Solids	0.1 % by Wt.	71.1	-	-	-
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**General Inorganics**

pH	0.05 pH Units	7.05	-	-	-
Resistivity	0.10 Ohm.m	92.8	-	-	-

**Anions**

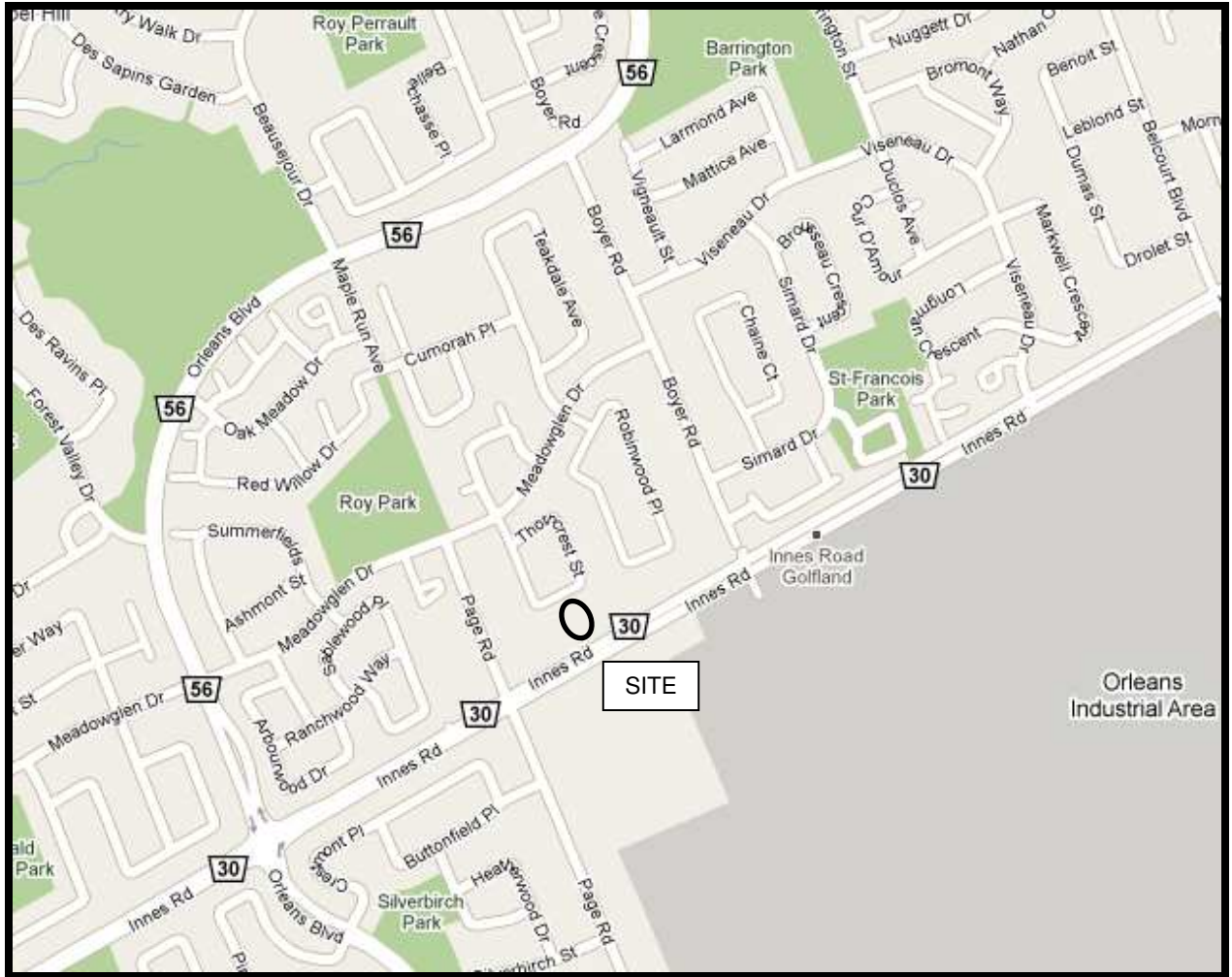
Chloride	5 ug/g dry	18	-	-	-
Sulphate	5 ug/g dry	25	-	-	-

# APPENDIX 2

FIGURE 1 – KEY PLAN

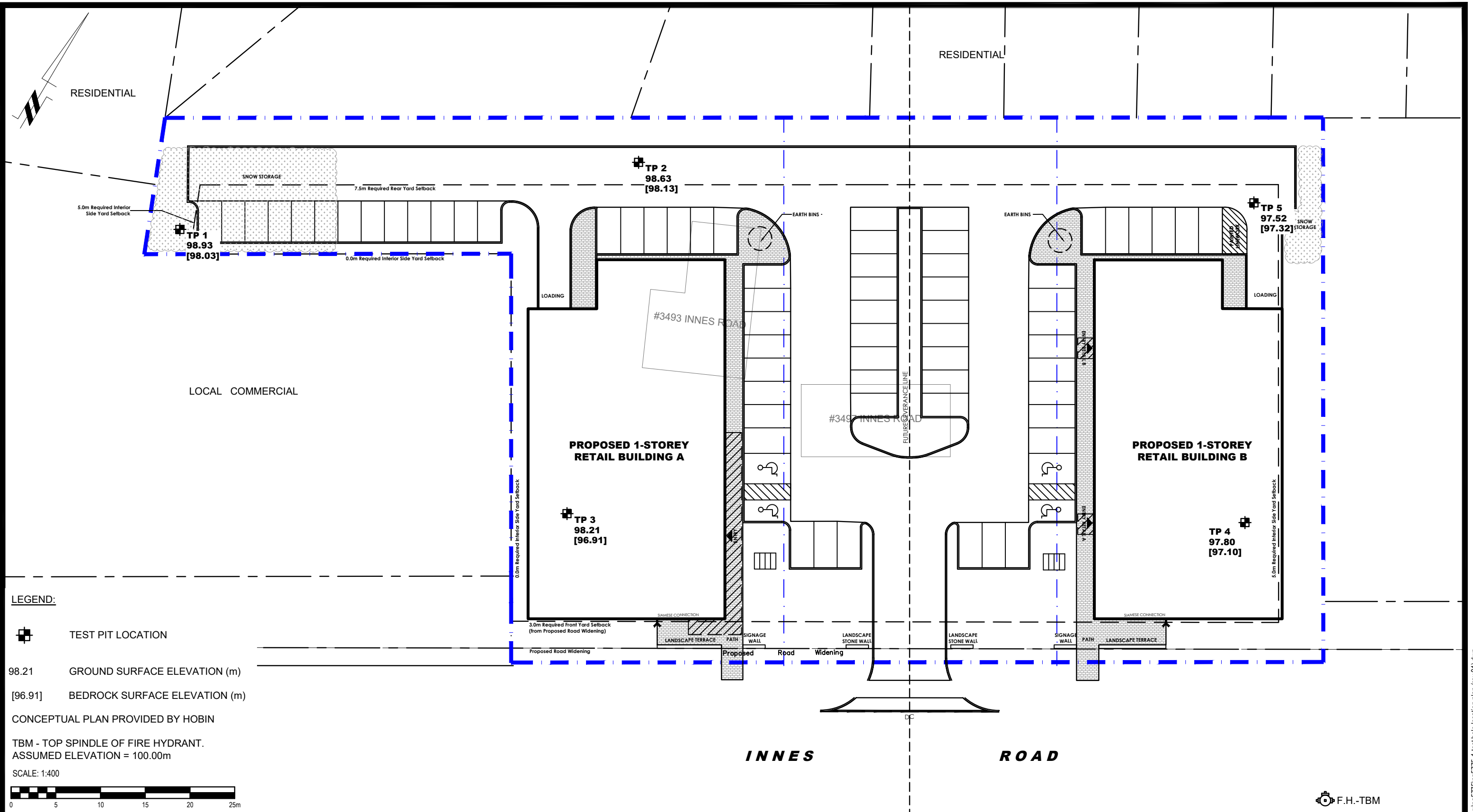
DRAWING PG5775-1 – TEST HOLE LOCATION PLAN





**FIGURE 1**

**KEY PLAN**



**LEGEND:**

TEST PIT LOCATION  
 98.21 GROUND SURFACE ELEVATION (m)  
 [96.91] BEDROCK SURFACE ELEVATION (m)

CONCEPTUAL PLAN PROVIDED BY HOBIN

TBM - TOP SPINDLE OF FIRE HYDRANT.  
 ASSUMED ELEVATION = 100.00m

SCALE: 1:400

F.H.-TBM

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

NO.	REVISIONS	DATE	INITIAL
1	UPDATED TO NEW CONCEPTUAL PLAN	05/06/2023	GA

**LAPENSEE**  
**GEOTECHNICAL INVESTIGATION**  
**PROPOSED COMMERCIAL DEVELOPMENT**  
**3439-3499 INNES ROAD**

OTTAWA, ONTARIO  
 Title: **TEST HOLE LOCATION PLAN**

Scale:	1:400	Date:	04/2021
Drawn by:	NFRV	Report No.:	PG5775-1
Checked by:	ZA	Dwg. No.:	<b>PG5775-1</b>
Approved by:	MSA	Revision No.:	1