

# Geotechnical Investigation

## Proposed Building Addition

2628 Edinburgh Place  
Ottawa, Ontario

Prepared for BBS Construction (Ontario) Ltd.

Report PG6279-1 dated August 17, 2022

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## 1.0 Introduction

Paterson Group (Paterson) was commissioned by BBS Construction (Ontario) Ltd. to conduct a geotechnical investigation for the proposed building addition to be located at 2628 Edinburgh Place 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 boreholes.
- ❑ Provide geotechnical recommendations pertaining to the design of the proposed development including construction considerations which may affect the design.

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

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

## 2.0 Proposed Development

Based on the available drawings, it is understood that the proposed building addition will be located along the western side of the existing commercial structure, and will consist of a single-storey structure with a slab-on-grade and an approximate footprint of 1,000 m<sup>2</sup>.

## **3.0 Method of Investigation**

### **3.1 Field Investigation**

#### **Field Program**

The field investigation was carried out on July 12, 2022, and consisted of advancing a total of 3 boreholes to a maximum depth of 3.1 m below the existing ground surface. The borehole locations were determined in the field by Paterson personnel taking into consideration site features and underground services. The locations of the boreholes are shown on Drawing PG6279-1 – Test Hole Location Plan in Appendix 2.

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

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

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

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

## **3.2 Field Survey**

The borehole locations were selected by Paterson to provide general coverage of the proposed development, taking into consideration the existing site features and underground utilities. The borehole locations and ground surface elevation at each borehole location were surveyed by Paterson using a GPS unit with respect to a geodetic datum. The locations of the boreholes and ground surface elevation at each borehole location are presented on Drawing PG6279-1 - 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 from the current investigation will be stored in the laboratory for a period of one month after issuance of this report. They will then be discarded unless we are otherwise directed.

## **3.4 Analytical Testing**

One soil sample was submitted for analytical testing to assess the corrosion potential for exposed ferrous metals and the potential of sulphate attacks against subsurface concrete structures. The sample was 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 are discussed further in Section 6.7.

## **4.0 Observations**

### **4.1 Surface Conditions**

The subject site is currently occupied by an existing commercial building which is located within the northwest corner of the property. Asphalt-paved parking areas and access lanes are located within the northern half of the subject site, while the southern half of the site consists of a gravel-surfaced vehicle yard. Temporary structures and shipping containers are located within the southwest corner of the subject site.

The site is bordered on all sides by various commercial buildings and associated parking areas. The site is further bordered to the north by Edinburgh Place. The subject site is at-grade with the surrounding roadways at approximate geodetic elevation 69 m.

### **4.2 Subsurface Profile**

Generally, the soil profile encountered at the test hole locations consists of fill underlain by silty sand, silty clay to clayey silt, and/or glacial till. The fill material was generally observed to extend to depths ranging from 1.2 to 1.8 m below the existing ground surface, and consists of brown silty sand with gravel and trace amounts of concrete and organics.

A loose, brown silty sand layer was encountered underlying the fill material in borehole BH 1-22 and extends to a maximum depth of 2.2 m below the existing ground surface.

A very stiff to hard, brown silty clay to clayey silt deposit was encountered underlying the fill and/or silty sand at all boreholes. The silty clay to clayey silt deposit was observed to extend to maximum depths ranging from 2.2 to 3.1 m.

The glacial till deposit was encountered underlying the silty clay to clayey silt at boreholes BH 2-22 and BH 3-22. The glacial till generally consists of loose to compact, brown silty clay with sand, gravel, cobbles, and boulders.

Practical refusal to augering was encountered at all boreholes at approximate depths of 2.8 to 3.1 m below the existing ground surface.

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 shale of the Carlsbad Formation with a drift thickness of 10 to 15 m.

## 4.3 Groundwater

The groundwater levels were measured in the piezometers on July 19, 2022. The observed groundwater levels are summarized in Table 1 below.

<b>Table 1 - Summary of Groundwater Level Readings</b>				
<b>Test Hole Number</b>	<b>Ground Surface Elevation (m)</b>	<b>Groundwater Level (m)</b>	<b>Groundwater Elevation (m)</b>	<b>Recording Date</b>
BH 1-22	69.06	2.39	66.67	July 19, 2022
BH 2-22	68.68	1.73	66.95	July 19, 2022
BH 3-22	68.72	1.92	66.80	July 19, 2022

**Note:** Ground surface elevations at borehole locations are referenced to a geodetic datum.

It should be noted that groundwater levels could be influenced by surface water infiltrating the backfilled boreholes. The long-term groundwater levels can also be estimated based on the observed colour, moisture content and consistency of the recovered samples.

Based on these observations, the long-term groundwater level is expected to range between approximately 1.5 to 2.5 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**

The subject site is considered suitable for the proposed development, from a geotechnical perspective. It is recommended that the proposed building addition be founded on conventional spread footings placed on the undisturbed, compact silty sand, very stiff to hard silty clay to clayey silt, and/or compact glacial till.

Where fill is encountered at the underside of footing elevation, it should be sub-excavated to the surface of the undisturbed, compact silty sand, very stiff to hard silty clay to clayey silt, and/or compact glacial till and replaced with engineered fill to the proposed founding elevation. The lateral limits of the engineered fill placement should be in accordance with our lateral support recommendations provided herein.

Where the footings of the proposed building addition abut the existing building, they should match the existing footing elevations.

Due to the presence of a silty clay deposit, the proposed development will be subjected to grade raise restrictions. The permissible grade raise recommendations are discussed in subsection 5.3.

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

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

#### **Stripping Depth**

Topsoil and deleterious fill should be stripped from under any buildings and other settlement sensitive structures. It is anticipated that the existing fill within the proposed building addition footprint, free of deleterious material and significant amounts of organics, can be left in place below the proposed building slab-on-grade, outside of the lateral support zones for the footings.

It is recommended that the existing fill layer be proof-rolled with several passes of a vibratory drum roller, under dry conditions and above freezing temperatures, and which is 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

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

Non-specified existing fill, along with site-excavated soil, can be used as general landscaping fill where settlement of the ground surface is of minor concern. This material should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If this material is to be used to build up the subgrade level for areas to be paved, it should be compacted in thin lifts to at least 95% of the material's SPMDD.

## 5.3 Foundation Design

### Bearing Resistance Values

Pad footings, up to 5 m wide, and strip footings up to 3 m wide, placed on a compact silty sand, very stiff to hard silty clay to clayey silt, and/or compact glacial till, can be designed using a bearing resistance value at serviceability limit states (SLS) of **150 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **225 kPa**. A geotechnical resistance factor of 0.5 was applied to the bearing resistance value at ULS.

If the silty sand subgrade is observed to be in a loose state of compactness, the material should be proof rolled using suitable vibratory equipment making several passes under dry conditions and above freezing temperatures and approved by Paterson at the time of construction.

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

The bearing resistance value at SLS will be subjected to potential post-construction total and differential settlement of 25 and 20 mm, respectively.

As a general procedure, it is recommended that the footings for the proposed building addition that are located adjacent to the existing structure be founded at the same level as the existing footings. This accomplishes three objectives. First, the behaviour of the two structures at their connection will be similar due to the similar bearing medium. Second, there will be minimal stress added to the existing structure from the new structure. Third, the bearing of the new structure will not be influenced by any backfill from the existing structure.

### **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 a silty clay, silty sand and/or glacial till bearing medium 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.

### **Permissible Grade Raise Restrictions**

Due to the presence of the silty clay deposit, a permissible grade raise restriction of **2.0 m** is recommended for grading at 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** as defined in Table 4.1.8.4.A of the Ontario Building Code (OBC) 2012 for foundations considered at this site. Soils underlying the subject site are not susceptible to liquefaction. Reference should be made to the latest revision of the OBC 2012 for a full discussion of the earthquake design requirements.

## **5.5 Slab on Grade Construction**

With the removal of any topsoil and fill, such as those containing significant amounts of deleterious materials, the existing fill or native soil subgrade approved by the geotechnical consultant at the time of excavation will be considered an acceptable subgrade surface on which to commence backfilling for floor slab construction.

It is recommended that the slab-on-grade subgrade be proof-rolled with a suitably sized roller making several passes under dry conditions prior to fill placement, and which is approved by the geotechnical consultant. Any poor performing areas should be removed and replaced with an engineered fill, such as OPSS Granular A or B Type II.

It is further recommended that the upper 200 mm of sub-floor fill consist of OPSS Granular A crushed stone. All backfill material required to raise grade within the footprint of the proposed building should be placed in a maximum 300 mm thick loose lifts and compacted to 98% of its SPMDD.

## 5.6 Pavement Design

The pavement structures for car only parking areas and access lanes are presented in Tables 2 and 3 below, should they be required at the subject site.

<b>Table 2 - Recommended Pavement Structure - Car Only Parking Areas</b>	
<b>Thickness (mm)</b>	<b>Material Description</b>
50	<b>Wear Course</b> - 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> – Existing imported fill, or OPSS Granular B Type I or II material placed over in situ soil.	

<b>Table 3 - Recommended Asphalt Pavement Structure - Access Lanes</b>	
<b>Thickness (mm)</b>	<b>Material Description</b>
40	<b>Wear Course</b> - Superpave 12.5 Asphaltic Concrete
50	<b>Binder Course</b> - Superpave 19.0 Asphaltic Concrete
150	<b>BASE</b> - OPSS Granular A Crushed Stone
450	<b>SUBBASE</b> - OPSS Granular B Type II
<b>SUBGRADE</b> – Existing imported fill, or OPSS Granular B Type I or II material placed over in situ soil.	

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

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type II material. The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 99% of the SPMDD using suitable vibratory equipment.

## **6.0 Design and Construction Precautions**

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

#### **Foundation Drainage**

Should the proposed building addition contain any below-grade space, it is recommended that a perimeter foundation drainage system be provided for the below-grade areas. Should it be required, the system should consist of a 100 to 150 mm diameter, perforated and corrugated plastic pipe which is surrounded on all sides by 150 mm of 19 mm clear crushed stone, placed at the footing level around the exterior perimeter of the structure. The pipe should have a positive outlet, such as 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 recommended to be insulated against the deleterious effects of frost action. A minimum 1.5 m thick soil cover, or an equivalent combination of soil cover and foundation insulation, should be provided in this regard.

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

## 6.3 Excavation Side Slopes

The side slopes of shallow excavations anticipated at this site should either be cut back at acceptable slopes or should be retained by temporary 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.

## 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.

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

It should generally be possible to re-use the site materials above the cover material if the operations are carried out in dry weather conditions.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) and above the cover material should match the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in maximum 225 mm thick loose lifts and compacted to a minimum of 95% of the material's SPMDD. All cobbles larger than 200 mm in their longest direction should be segregated from re-use as trench backfill.

## **6.5 Groundwater Control**

It is anticipated that groundwater infiltration into the excavations should be 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.

### **Groundwater Control for Building Construction**

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

For typical ground or surface water volumes being pumped during the construction phase, typically between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified 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 into the subgrade or in the excavation walls and bottoms. Precautions should be taken if such activities are to be carried out during freezing conditions.

## **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 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.
- Field density tests to determine the level of compaction achieved.
- Sampling and testing of the bituminous concrete including mix design reviews.

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

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

## 8.0 Statement of Limitations

The recommendations provided herein 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 BBS Construction (Ontario) Ltd., 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.**



Kevin A. Pickard, EIT



Scott S. Dennis, P.Eng

**Report Distribution:**

- BBS Construction (email copy)
- Paterson Group (1 copy)

# APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TESTING RESULTS

## SOIL PROFILE AND TEST DATA

Geotechnical Investigation  
Proposed Building Addition - 2628 Edinburgh Place  
Ottawa, Ontario

DATUM Geodetic

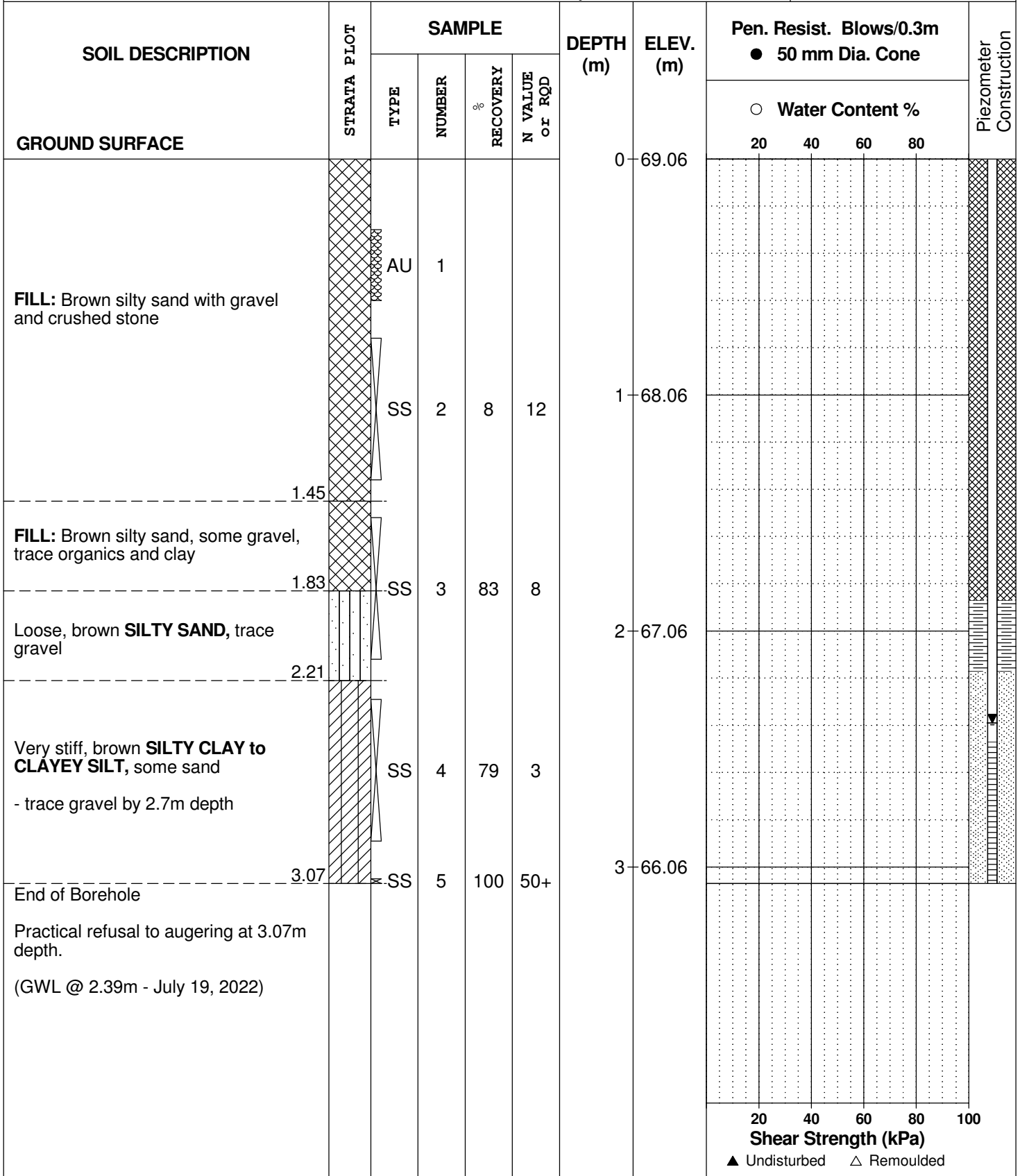
REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE July 12, 2022

FILE NO.  
**PG6279**

HOLE NO.  
**BH 1-22**



DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE July 12, 2022

FILE NO.  
**PG6279**

HOLE NO.  
**BH 2-22**

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			20	40	60	80	
<b>GROUND SURFACE</b>												
FILL: Brown silty sand with crushed stone	0.13					0	68.68					
FILL: Brown silty sand with gravel	0.69	AU	1									
FILL: Brown silty sand with gravel, trace concrete - some topsoil and wood by 1.5m depth	1.83	SS	2	33	9	1	67.68					
Very stiff, brown <b>SILTY CLAY to CLAYEY SILT</b> , some sand	2.21	SS	3	75	4							
<b>GLACIAL TILL</b> : Brown silty clay with sand, gravel, cobbles and boulders	2.80	SS	4	100	8	2	66.68					
End of Borehole Practical refusal to augering at 2.80m depth. (GWL @ 1.73m - July 19, 2022)												

○ Water Content %

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

DATUM Geodetic

REMARKS

BORINGS BY CME-55 Low Clearance Drill

DATE July 12, 2022

FILE NO.  
**PG6279**

HOLE NO.  
**BH 3-22**

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			20	40	60	80		
GROUND SURFACE								○ Water Content %					
								20	40	60	80		
Asphaltic concrete 0.05 FILL: Brown silty sand with crushed stone 0.20						0	68.72						
FILL: Brown silty sand with gravel and crushed stone, some topsoil		AU	1										
1.22													
Hard to very stiff, brown SILTY CLAY to CLAYEY SILT, trace sand		SS	2	58	8	1	67.72						
2.21													
GLACIAL TILL: Brown silty clay with sand, gravel, cobbles and boulders		SS	3	83	3	2	66.72						
2.87													
End of Borehole Practical refusal to augering at 2.87m depth. (GWL @ 1.92m - July 19, 2022)													
								20	40	60	80		
								<b>Shear Strength (kPa)</b>					
								▲ 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 relative strength of cohesionless soils is the compactness condition, 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. An SPT N value of "P" denotes that the split-spoon sampler was pushed 300 mm into the soil without the use of a falling hammer.

Compactness Condition	'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 shear vane tests, unconfined compression tests, or occasionally by the Standard Penetration Test (SPT). Note that the typical correlations of undrained shear strength to SPT N value (tabulated below) tend to underestimate the consistency for sensitive silty clays, so Paterson reviews the applicable split spoon samples in the laboratory to provide a more representative consistency value based on tactile examination.

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,  $S_t$ , is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil. The classes of sensitivity may be defined as follows:

Low Sensitivity:	$S_t < 2$
Medium Sensitivity:	$2 < S_t < 4$
Sensitive:	$4 < S_t < 8$
Extra Sensitive:	$8 < S_t < 16$
Quick Clay:	$S_t > 16$

### 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 NQ or larger size core. However, it can be used on smaller core sizes, such as BQ, 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, generally recovered using a piston sampler
G	-	"Grab" sample from test pit or surface materials
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size BQ, NQ, HQ, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

## SYMBOLS AND TERMS (continued)

### PLASTICITY LIMITS AND GRAIN SIZE DISTRIBUTION

WC%	-	Natural water 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)
D <sub>xx</sub>	-	Grain size at 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
D <sub>10</sub>	-	Grain size at which 10% of the soil is finer (effective grain size)
D <sub>60</sub>	-	Grain size at which 60% of the soil is finer
C <sub>c</sub>	-	Concavity coefficient = $(D_{30})^2 / (D_{10} \times D_{60})$
C <sub>u</sub>	-	Uniformity coefficient = $D_{60} / D_{10}$

C<sub>c</sub> and C<sub>u</sub> are used to assess the grading of sands and gravels:

Well-graded gravels have:  $1 < C_c < 3$  and  $C_u > 4$

Well-graded sands have:  $1 < C_c < 3$  and  $C_u > 6$

Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.

C<sub>c</sub> and C<sub>u</sub> 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' <sub>o</sub>	-	Present effective overburden pressure at sample depth
p' <sub>c</sub>	-	Preconsolidation pressure of (maximum past pressure on) sample
C <sub>cr</sub>	-	Recompression index (in effect at pressures below p' <sub>c</sub> )
C <sub>c</sub>	-	Compression index (in effect at pressures above p' <sub>c</sub> )
OC Ratio		Overconsolidation ratio = $p'_c / p'_o$
Void Ratio		Initial sample void ratio = volume of voids / volume of solids
W <sub>o</sub>	-	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)

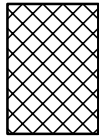
### STRATA PLOT



Topsoil



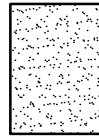
Asphalt



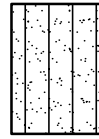
Fill



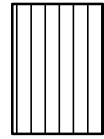
Peat



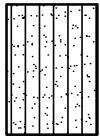
Sand



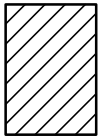
Silty Sand



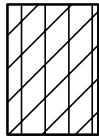
Silt



Sandy Silt



Clay



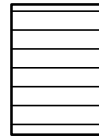
Silty Clay



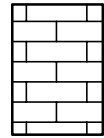
Clayey Silty Sand



Glacial Till



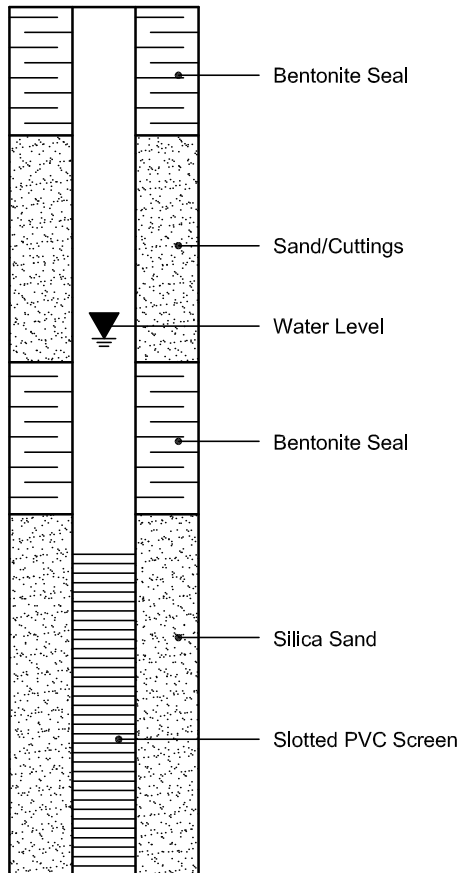
Shale



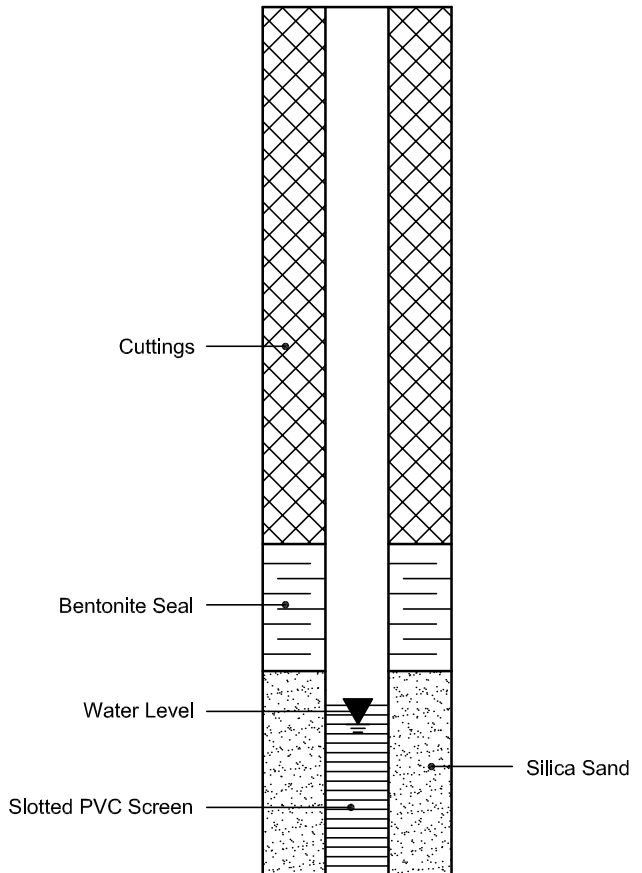
Bedrock

### MONITORING WELL AND PIEZOMETER CONSTRUCTION

#### MONITORING WELL CONSTRUCTION



#### PIEZOMETER CONSTRUCTION



Certificate of Analysis

Report Date: 18-Jul-2022

Client: Paterson Group Consulting Engineers

Order Date: 12-Jul-2022

Client PO: 55258

Project Description: PG6279

<b>Client ID:</b>	BH3-22-SS3	-	-	-	-
<b>Sample Date:</b>	12-Jul-22 09:00	-	-	-	-
<b>Sample ID:</b>	2229282-01	-	-	-	-
<b>Matrix:</b>	Soil	-	-	-	-
<b>MDL/Units</b>					

**Physical Characteristics**

% Solids	0.1 % by Wt.	73.7	-	-	-	-
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**General Inorganics**

pH	0.05 pH Units	7.40	-	-	-	-
Resistivity	0.1 Ohm.m	6.57	-	-	-	-

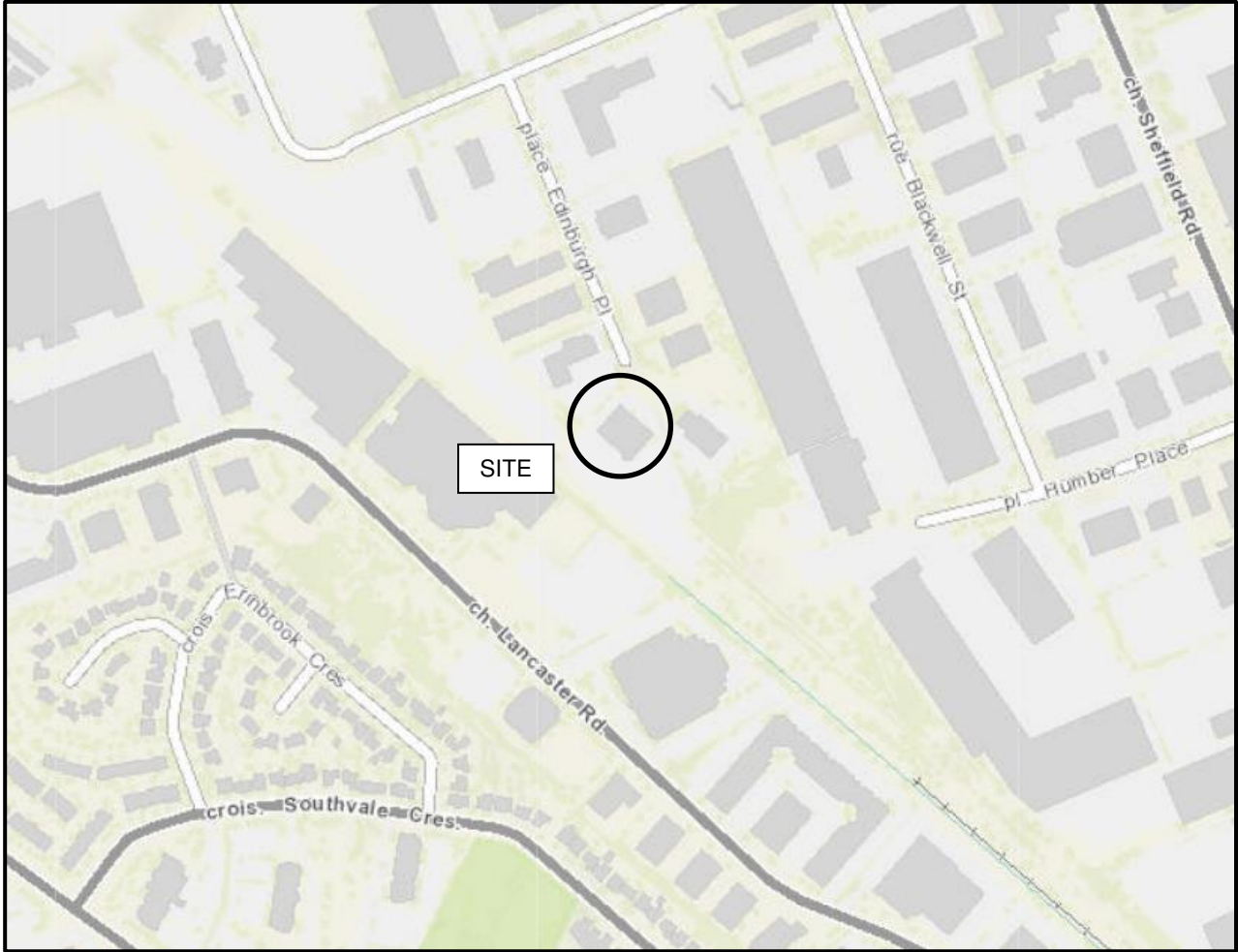
**Anions**

Chloride	5 ug/g	664	-	-	-	-
Sulphate	5 ug/g	149	-	-	-	-

# APPENDIX 2

FIGURE 1 – KEY PLAN

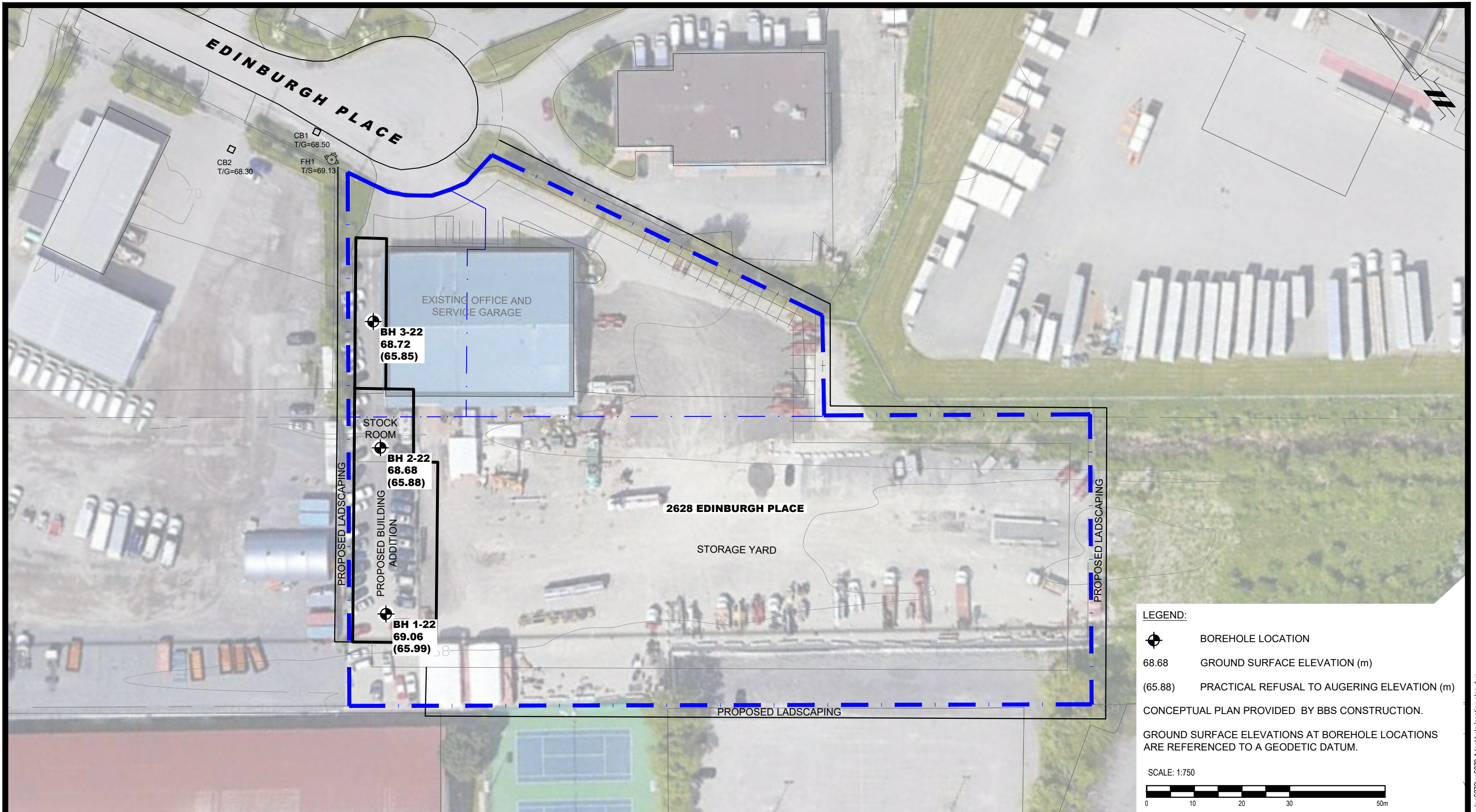
DRAWING PG6279-1 – TEST HOLE LOCATION PLAN



# FIGURE 1

## KEY PLAN





**PATERSON GROUP**  
SOLUTION ORIENTED ENGINEERING

NO.	REVISIONS	DATE	INITIAL

**BBS CONSTRUCTION**  
**GEOTECHNICAL INVESTIGATION**  
**PROPOSED BUILDING ADDITION**  
**2628 EDINBURGH PLACE**

**OTTAWA, ONTARIO**

Title: **TEST HOLE LOCATION PLAN**

Scale:	1:750	Date:	08/2022
Drawn by:	GK	Report No.:	PG6279-1
Checked by:	KP	Dwg. No.:	<b>PG6279-1</b>
Approved by:	SD	Revision No.:	