PATERSON GROUP

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Geotechnical Engineering
Environmental Engineering
Hydrogeology
Materials Testing
Building Science
Rural Development Design
Retaining Wall Design
Noise and Vibration Studies

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September 27, 2023
PG6812-LET.01 Revision 1

Harbour Environmental Group
1850 Bantree Street,
Ottawa, ON
K1B 4L6

Attention: **Mr. Sean Yaehne**
Subject: **Geotechnical Investigation**
Proposed Hydrovac Slurry Processing Facility
1850 Bantree Street, Ottawa, Ontario

Dear Sir,

Further to your request and authorization, Paterson Group (Paterson) completed a geotechnical investigation for the installation of the proposed temporary boiler plants at the aforementioned site.

The objectives of the assessment were to:

❑ Determine the subsoil and groundwater conditions at this site by means of test pits.

❑ Provide geotechnical recommendations pertaining to the design of the proposed development including construction considerations.

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.

1.0 Background Information

It is understood that the proposed development will be comprised of a hydrovac slurry processing facility. The exiting sedimentation pond and a temporary drying sedimentation storage area are to be removed and backfilled as part of the project. The southern portion of the site is being operated as a construction yard, owned by Laurent Leblanc Ltd. Based on our review of the proposed plans, it is understood that the proposed structure will be comprised of a series of hydrovac slurry processing equipment and a one storey shed structure along the northeast corner of the site.

2.0 Field Investigation

2.1 Field Program

The field program for the geotechnical investigation was carried out on September 6, 2023, which consisted of extending a total of seven (7) test pits, out of which four (4) of the test pits were within the footprints of the (TP 1-23, 3-23, 5-23 & 6-23). The test pits were terminated within 1.85 to 2.81 m below the ground surface, due to practical refusal of the shovel on bedrock. Furthermore, three (3) boreholes advanced to a maximum depth of 5.4 m below the existing ground surface, completed on September 5, 2023, as a part of the Phase II Environmental Site Assessment (ESA) program.

Previously, Paterson completed four (4) boreholes, within the subject site, advanced to a maximum depth of 6.15 m below the existing ground surface, on February 10, 2023, as a part of the Phase II ESA for Laurent Leblanc. The borehole locations were distributed in a manner to provide general coverage of the subject site and taking into consideration underground utilities and site features. The borehole locations are shown on Drawing PG6812-1 - Test Hole Location Plan, attached to the end of this report.

The boreholes were drilled using a track-mounted auger drill rig operated by a two-person crew. The test pits were excavated using hydraulic shovel. 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, sampling and testing the overburden.

2.2 Sampling and In Situ Testing

Soil samples from the test pits were recovered from the side walls of the open excavation. 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 and boreholes are shown as G on the Soil Profile and Test Data sheets in Appendix 1.

Soil samples were collected from the boreholes using two different techniques, namely, sampled directly from the auger flights (AU) or collected using a 50 mm diameter split-spoon

(SS) sampler. All samples were visually inspected and initially classified on site. The auger and split-spoon samples were placed in sealed plastic bags and transported to our laboratory for further examination and classification. The depths at which the auger and split spoon samples were recovered from the boreholes are shown as AU and SS, respectively, on the Soil Profile and Test Data sheets, attached to the end of this report.

A Standard Penetration Test (SPT) was conducted in conjunction with the recovery of the split spoon samples. The SPT results are recorded as "N" values on the Soil Profile and Test Data sheets. The "N" value is the number of blows required to drive the split spoon sampler 300 mm into the soil after a 150 mm initial penetration using a 63.5 kg hammer falling from a height of 760 mm.

The findings of our site visit and field investigation are discussed under Section 3 - Field Observations, provided below.

2.3 Permeameter Testing

In-situ permeameter testing was conducted using a Pask (Constant Head Well) Permeameter to confirm infiltration rates of the surficial soils within the excavated test pits. A total of six (6) pask permeameter tests were completed within the test pits 1-23, 3-23 and 6- 23

The permeameter reservoir was filled with water and inverted into the hole, ensuring that it was relatively vertical and rested on the bottom of the hole. As the water infiltrated into the soil, the water level of the reservoir was monitored at various time intervals until the rate of fall reached equilibrium, known as “quasi steady state” flow rate. Quasi steady state flow can be considered to have been obtained after measuring 3 to 5 consecutive rate of fall readings with identical values. The values for the steady state rate of fall were recorded for each location.

The results of testing are further discussed in Subsection 3.4.

2.4 Lab Testing

Soil samples were recovered from the subject site and visually examined in our laboratory to review the results of the field logging.

All samples will be stored in the laboratory for 1 month after this report is completed. They will then be discarded unless we are otherwise directed.

3.0 Field Observations

3.1 Surface Conditions

The site ground surface consists primarily of gravelly fill that has been imported to create the storage yard. The site topography slopes slightly from west to east. The site is surrounded by Bantree Street along the north, parking lot along the south and two -store commercial buildings along the east and west. An infiltration swale/piping system is located along the eastern property boundary to intercept surface water from flowing off-site to the east. This drainage structure was constructed to manage melt water from the former snow depot operate at the southern end of the property. No significant slope were noted near or on the subject site.

3.2 Subsurface Conditions

Generally, the subsurface profile encountered within the test pit and borehole locations consists of a brown silty sand fill with gravel and crushed stone. Some shale particles and traces of clay were observed within some of the test pits. Fill material comprised of granular crushed stone with some sand was observed above the silty sand layer within BH 2-23, completed on September 5, 2023.

The fill was generally underlain by a compact to dense glacial till comprised of brown silty clay with some sand, shale fragments and traces of gravel, underlain by a weathered shale bedrock. Based on our review of the split spoon samples within the boreholes, the shale bedrock was observed to be very poor to poor quality within BH 1-23 and very poor to fair quality within BH 2-23, completed on September 5, 2023.

Based on the geological mapping of the area, the bedrock is comprised of black shale, with some brown shale of the Billings Formation, with an overburden drift thickness of 4 to 7 m.

3.3 Groundwater

The groundwater levels were measured within the monitoring wells installed in February 2023 and August 2023, during the environmental site investigation. The observed groundwater levels are summarized in Table 1. The long-term groundwater level 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 3 to 4 m below the existing 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.

Table 1 - Summary of Groundwater Level Readings

Test Hole Number	Ground Surface Elevation (m)	Groundwater Level (m)	Groundwater Elevation (m)	Recording Date
BH 1-23*	68.90	2.05	66.85	September 13, 2023
BH 2-23*	69.41	3.10	66.31	September 13, 2023
BH 3-23*	70.23	4.15	66.08	September 13, 2023

Note: -Ground surface elevations at borehole locations were surveyed by Paterson and are referenced to a geodetic datum.
-* indicates borehole was instrumented with a groundwater monitoring well.

3.4 Permeameter Testing

The permeameter field program was conducted by using a Pask (constant head) Permeameter by Paterson on September 6, 2023. At that time, three (3) test hole locations were selected for permeameter testing. Each test pit was excavated in approximately 0.5 m increments to allow for safe entry into the pits as well as permeameter testing to be conducted at different elevations. Permeameter tests were conducted at approximately 0.4 to 1.8 m bgs. At approximately 0.3 m above the desired testing elevation, an 83 mm diameter hole was excavated using a Riverside/Bucket auger to the desired testing depth. All soil from the auger flights were visually inspected and initially classified on site. An aggregated soil sample was gathered at each test location. The test was conducted by filling the permeameter reservoir water and inverting it into the hole, ensuring it was relatively vertical and rested at the bottom of the hole. The water level of the reservoir was monitored at 0.5 to 5 minute intervals until the rate of fall out of the permeameter reached equilibrium, known as a quasi “steady state” flow rate. Quasi steady state flow was obtained after measuring 3 to 5 consecutive rate of fall readings with identical values. The values for the steady state rate of fall were recorded for each location. The steady state rate of fall was converted to a field saturated hydraulic conductivity value (K_{fs}) using the Engineering Technology Canada Ltd. conversion tables. Unfactored infiltration rates and design infiltration rates were calculated based on the methodology outlined in Appendix C of the Credit Valley Conservation’s Low Impact Development Stormwater Management Planning and Design Guide.

The test hole locations were selected by Paterson and distributed in a manner to provide general coverage of the proposed development while taking into consideration site features. The permeameter test locations are presented on Drawing PG6812-1 – Test Hole Location Plan attached to this report. Field saturated hydraulic conductivity values and their respective unfactored infiltration rates are presented below in Table 2.

Table 2 – Summary of Field Saturated Hydraulic Conductivity Values and Estimated Unfactored Infiltration Rates

Test Location ID	Ground Surface Elevation (m)	Depth of Permeameter Testing (m bgs)	K$_{fs}$ (m/sec)	Unfactored Infiltration Rate (mm/hr)	Soil Type
TP 1-23	69.57	1	1.1 x 10^{-6}	47	Fill
		1.5	5.3 x 10^{-7}	39	
TP 3-23	69.53	1.3	2.7 x 10^{-7}	33	Glacial till
		1.8	2.7 x 10^{-7}	33	
TP 6-23	69.18	0.37	2.7 x 10^{-7}	33	Fill
		1.37	2.7 x 10^{-7}	33	Glacial till.

Note: -Ground surface elevations at test locations were surveyed by Paterson and are referenced to a geodetic datum. Detailed soil descriptions can be found on the attached Soil Profile and Test Data sheets.

The testing results yielded field saturated hydraulic conductivity values between 2.7 x 10^{-7} to 1.1 x 10^{-6} m/s with unfactored infiltration rates ranging between 33 to 47 mm/hr. Based on the methodology outlined in Appendix C of the Credit Valley Conservation's Low Impact Development Stormwater Management Planning and Design Guide, a 2.5 safety correction factor was deemed appropriate to apply to the fill and glacial till infiltration rates. Therefore, applying the safety correction factor to the most conservative unfactored infiltration rate of 33 mm/hr, both the fill and glacial till materials have a design infiltration rate of 13 mm/hr.

4.0 Discussion

4.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is considered suitable for the proposed development. It is expected that the proposed shed structure will be comprised of a slab on grade with conventional shallow foundation, placed over an undisturbed, glacial till , bedrock surface or engineered fill pad.

4.2 Site Grading and Preparation

Stripping Depth

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

It is anticipated that the existing fill within the footprints of the proposed structures, free of deleterious material and significant amounts of organics, can be left in place. However, the existing fill should be proof rolled under dry conditions, with Paterson's supervision. Any poor performing soil will be replaced with engineered fill such as OPSS stone Granular A or Granular B type II.

Fill Placement

Fill used for grading beneath the proposed building 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 proposed structures and paved areas should be compacted to at least 98% of the material's standard Proctor maximum dry density (SPMDD).

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

Non-specified existing fill and site-excavated soils are not suitable for use as backfill against foundation walls unless used in conjunction with a composite drainage membrane.

Proof Rolling

It is expected that all the structure will be placed on a glacial till subgrade or granular pad. All the existing fill below the foundations, should be stripped of any deleterious materials and the native bearing surface should be proof rolled under the supervision of a geotechnical consultant, prior to the placement of any footings or engineered fill. The contractor should take appropriate precautions to avoid disturbing the subgrade and bearing surfaces from construction and worker traffic. Any loose or disturbed areas of the bearing, below the proposed footings 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 it 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.

4.3 Foundation Design

Conventional Spread Footings

It is anticipated that all the footings and equipment will be placed over the upper fill subgrade comprised of silty sand and gravel. Footings placed directly on an undisturbed, glacial till or engineered fill can be designed using a bearing resistance value at SLS of **250 kPa** and a factored bearing resistance value at ULS of **350 kPa**. A geotechnical factor of 0.5 was incorporated to the bearing resistance value at ULS.

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

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

4.4 Lateral Support

The bearing medium under structures are required to be provided with adequate lateral support with respect to any excavations in close proximity to these structures. Adequate lateral support is provided to a compacted silty sand bearing medium or severely weathered shale bedrock bearing medium when a plane extending down and out from the bottom edge of the footing at a minimum of 1.5 H:1V (or flatter) passes only through a material of the same or higher capacity as the bearing medium soil.

4.5 Slab-on-Grade Construction

With the removal of all topsoil and deleterious materials, within the proposed building footprint, the existing fill material, free of deleterious materials, approved by the geotechnical consultant at the time of construction is considered to be an acceptable subgrade surface on which to commence backfilling for the floor slab. The approved fill surface should be proof rolled under the supervision of Paterson. The upper 200 mm of sub-slab fill should consist of an OPSS Granular A crushed stone material for slab-on-grade construction. All backfill material within the proposed building footprint should be placed in a maximum 300 mm thick loose lifts and compacted to a minimum of 98% of the SPMDD.

Any soft areas in the subgrade should be removed and backfilled with appropriate backfill material. OPSS Granular A or Granular B Type II, with a maximum particle size of 50 mm, are recommended for backfilling below the floor slab.

4.6 Design for Earthquakes

The site class for seismic site response can be taken as **Class C**, as presented in Table 4.1.8.4.A of the Ontario Building Code 2012. Soils underlying the subject site are not susceptible to liquefaction. Reference should be made to the latest revision of the Ontario Building Code 2012 for a full discussion of the earthquake design requirements.

4.7 Pavement Design

For design purposes, the pavement structures presented in Tables 3 to 5 on the following page are recommended for the design of any future or proposed pavement structures.

Table 3 - Recommended Pavement Structure - Car Only Parking Areas/Driveways

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 in situ soils 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.	

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

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

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 I or II material.

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

5.0 Design and Construction Precautions

5.1 Protection of Footings Against Frost Action

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

Exterior unheated footings, such as isolated piers, are more prone to deleterious movement associated with frost action than the exterior walls of the structure, and require additional protection, such as soil cover of 2.1 m, or an equivalent combination of soil cover and foundation insulation. Details for foundation insulation can be provided upon request if the soil cover is insufficient and needs to be supplemented with insulation. It is important to note that the black shale bedrock encountered onsite is frost sensitive and should be considered similar to native glacial till.

5.2 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.

Unsupported Excavations

The subsurface soil 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.

A trench box is recommended to protect personnel working in trenches with steep or vertical sides. Services are expected to be installed by “cut and cover” methods and excavations should not remain open for extended periods of time.

5.3 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 is generally 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 a maximum of 225 mm thick loose lifts and compacted to a minimum of 98% of the material's SPMDD. All cobbles larger than 200 mm in their longest direction should be segregated from re-use as trench backfill.

5.5 Winter Construction

Precautions must be taken if winter construction is considered for this project. The subsoil conditions at this site consist of frost susceptible materials. In the presence of water and freezing conditions, ice could form within the soil mass. Heaving and settlement upon thawing could occur.

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

Trench excavations and pavement construction are also difficult activities to complete during freezing conditions without introducing frost into the subgrade or in the excavation walls and bottoms. Precautions should be taken if such activities are to be carried out during freezing conditions. Additional information could be provided, if required.

6.0 Recommendations

It is a requirement for the foundation data provided herein to be applicable that the following material testing, and observation program be performed by the geotechnical consultant.

- Observation of all bearing surfaces during proof roll, 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.
- Field density tests to determine the level of compaction achieved.
- Sampling and testing of the bituminous concrete including mix design reviews.

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*.

A report confirming that these works have been conducted in general accordance with our recommendations could be issued upon request, following the completion of a satisfactory material testing and observation program by Paterson.

7.0 Statement of Limitations

The recommendations made in this report are in accordance with our present understanding of the project. Our recommendations should be reviewed when the drawings and specifications are complete.

The client should be aware that any information pertaining to soils and all test hole logs are furnished as a matter of general information only and test hole descriptions or logs are not to be interpreted as descriptive of conditions at locations other than those of the test holes.

A soils investigation of this nature is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test locations, we request that we be notified immediately in order to permit reassessment of our recommendations.

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 Harbour Environmental Group 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.

We trust that the current submission meets your immediate requirements.

Best Regards,

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
September 27, 2023
J. R. VILLENEUVE
100504344
PROVINCE OF ONTARIO

Pratheep Thirumoolan, M.Eng.

Joey R. Villeneuve, M.A.Sc., P.Eng.

Attachments

- ☐ Soil Profile and Test Data Sheets
- ☐ Symbols and Terms
- ☐ Figure -1 - Key Plan
- ☐ Drawing PG6812-1 - Test Hole Location Plan

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SOIL PROFILE AND TEST DATA

GEOTECHNICAL INVESTIGATION

185 Bantree Street, Ottawa, Ontario

DATUM: Geodetic **EASTING:** 374112.941 **NORTHING:** 5029604.357 **ELEVATION:** 69.57

PROJECT: Proposed Hydrovac Slurry Processing Facility

BORINGS BY: Excavator

REMARKS:

DATE: September 6, 2023

FILE NO. PG6812

HOLE NO. TP 1-23

SAMPLE DESCRIPTION	STRATA PLOT	SAMPLE		SAMPLE % RECOVERY	N VALUE or RQD	WATER CONTENT %	DEPTH (m)	Remoulded Shear Strength (kPa) 0 25 50 75 100	Peak Shear Strength (kPa) 0 25 50 75 100	Pen. Resist. Blows/0.3m (50 mm Dia. Cone) 0 25 50 75 100	Piezometer Construction
		No.	Type								
Ground Surface EL 69.57 m							0				No Data
FILL: Brown silty sand with gravel and crushed stone		G1	[#]								
		G2	[#]								
1 m EL 68.57 m							1				
FILL: Brown silty sand with clay and gravel		G3	[#]								
1.7 m EL 67.87 m											
GLACIAL TILL: Compact, brown silty sand with clay, gravel and shale fragments		G4	[#]								
1.95 m EL 67.62 m							2				
End of Test Pit Test pit terminated on bedrock surface at 1.95m depth. (TP dry upon completion)											
							3				
							4				

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SOIL PROFILE AND TEST DATA

GEOTECHNICAL INVESTIGATION

185 Bantree Street, Ottawa, Ontario

DATUM: Geodetic **EASTING:** 374042.118 **NORTHING:** 5029636.097 **ELEVATION:** 70.52

PROJECT: Proposed Hydrovac Slurry Processing Facility

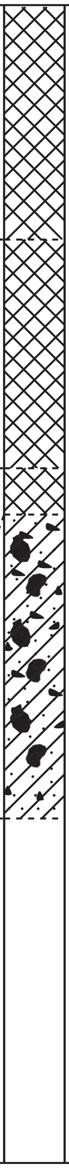
BORINGS BY: Excavator

REMARKS:

DATE: September 6, 2023

FILE NO. PG6812

HOLE NO. TP 2-23



SAMPLE DESCRIPTION	STRATA PLOT	SAMPLE No.	SAMPLE Type	SAMPLE % RECOVERY	N VALUE or RQD	WATER CONTENT %	DEPTH (m)	Remoulded Shear Strength (kPa) 0 25 50 75 100	Peak Shear Strength (kPa) 0 25 50 75 100	Pen. Resist. Blows/0.3m (50 mm Dia. Cone) 0 25 50 75 100	Piezometer Construction
Ground Surface EL 70.52 m							0				No Data
FILL: Brown silty sand with gravel and crushed stone		G1	[#]								
0.81 m EL 69.71 m		G2	[#]				1				
FILL: Brown silty sand with gravel and organics											
1.6 m EL 68.92 m		G3	[#]								
FILL: Brown silty clay with sand, some gravel											
1.76 m EL 68.76 m		G4	[#]				2				
GLACIAL TILL: Brown silty sand with gravel, some clay and shale fragments, occasional cobbles											
2.81 m EL 67.71 m		G5	[#]								
End of Test Pit Test pit terminated on bedrock surface at 2.81m depth. (TP dry upon completion)							3				
							4				

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SOIL PROFILE AND TEST DATA

GEOTECHNICAL INVESTIGATION

185 Bantree Street, Ottawa, Ontario

DATUM: Geodetic **EASTING:** 374136.292 **NORTHING:** 5029613.479 **ELEVATION:** 69.53

PROJECT: Proposed Hydrovac Slurry Processing Facility

BORINGS BY: Excavator

REMARKS:

DATE: September 6, 2023

FILE NO. **PG6812**

HOLE NO. TP 3-23

SAMPLE DESCRIPTION	STRATA PLOT	SAMPLE No.	SAMPLE Type	SAMPLE % RECOVERY	N VALUE or RQD	WATER CONTENT %	DEPTH (m)	Remoulded Shear Strength (kPa) 0 25 50 75 100	Peak Shear Strength (kPa) 0 25 50 75 100	Pen. Resist. Blows/0.3m (50 mm Dia. Cone) 0 25 50 75 100	Piezometer Construction
Ground Surface EL 69.53 m							0				No Data
FILL: Brown silty sand with gravel and crushed stone		G1	[#]								
		G2	[#]								
1.05 m EL 68.48 m							1				
GLACIAL TILL: Compact, brown silty sand with gravel and clay, some shale fragments		G3	[#]								
		G4	[#]				2				
		G5	[#]								
2.42 m EL 67.11 m											
End of Test Pit Test pit terminated on bedrock surface at 2.42m depth. (TP dry upon completion)							3				
							4				

RSLog / Geotechnical Borehole - Geodetic / paterson-group / admin / September 08, 2023 11:16 AM

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SOIL PROFILE AND TEST DATA

GEOTECHNICAL INVESTIGATION

185 Bantree Street, Ottawa, Ontario

DATUM: Geodetic **EASTING:** 373995.008 **NORTHING:** 5029692.514 **ELEVATION:** 70.8

PROJECT: Proposed Hydrovac Slurry Processing Facility

BORINGS BY: Excavator

REMARKS:

DATE: September 6, 2023

FILE NO. **PG6812**

HOLE NO. TP 4-23

SAMPLE DESCRIPTION	STRATA PLOT	SAMPLE No.	SAMPLE Type	SAMPLE % RECOVERY	N VALUE or RQD	WATER CONTENT %	DEPTH (m)	Remoulded Shear Strength (kPa) 0 25 50 75 100	Peak Shear Strength (kPa) 0 25 50 75 100	Pen. Resist. Blows/0.3m (50 mm Dia. Cone) 0 25 50 75 100	Piezometer Construction
Ground Surface EL 70.8 m											
FILL: Brown silty sand with crushed stone							0				No Data
		G1	[#]								
		G2	[#]								
0.82 m EL 69.98 m											
							1				
GLACIAL TILL: Compact, brown silty sand with clay and gravel, some shale, occasional cobles		G3	[#]								
		G4	[#]								
		G5	[#]								
							2				
2.1 m EL 68.7 m											
End of Test Pit Test pit terminated on bedrock surface at 2.10m depth. (TP dry upon completion)											
							3				
							4				

PATERSON GROUP

SOIL PROFILE AND TEST DATA

GEOTECHNICAL INVESTIGATION

185 Bantree Street, Ottawa, Ontario

DATUM: Geodetic **EASTING:** 374097.765 **NORTHING:** 5029637.245 **ELEVATION:** 69.5

PROJECT: Proposed Hydrovac Slurry Processing Facility

BORINGS BY: Excavator

REMARKS:

DATE: September 6, 2023

FILE NO. PG6812

HOLE NO. TP 5-23

SAMPLE DESCRIPTION	STRATA PLOT	SAMPLE No.	SAMPLE Type	SAMPLE % RECOVERY	N VALUE or RQD	WATER CONTENT %	DEPTH (m)	Remoulded Shear Strength (kPa) 0 25 50 75 100	Peak Shear Strength (kPa) 0 25 50 75 100	Pen. Resist. Blows/0.3m (50 mm Dia. Cone) 0 25 50 75 100	Piezometer Construction
Ground Surface EL 69.5 m							0				No Data
FILL: Brown silty sand with crushed stone		G1 G2	[#] [#]								
0.75 m EL 68.75 m											
GLACIAL TILL: Compact, brown silty sand with gravel, some clay and shale fragments, occasional cobbles		G3 G4 G5	[#] [#] [#]				1				
2.02 m EL 67.48 m							2				
End of Test Pit Test pit terminated on bedrock surface at 2.02m depth. (TP dry upon completion)							3 4				

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PATERSON GROUP

SOIL PROFILE AND TEST DATA

GEOTECHNICAL INVESTIGATION

185 Bantree Street, Ottawa, Ontario

DATUM: Geodetic **EASTING:** 374097.512 **NORTHING:** 5029697.37 **ELEVATION:** 69.18

PROJECT: Proposed Hydrovac Slurry Processing Facility

BORINGS BY: Excavator

REMARKS:

DATE: September 6, 2023

FILE NO. PG6812

HOLE NO. TP 6-23

SAMPLE DESCRIPTION	STRATA PLOT	SAMPLE No.	SAMPLE Type	SAMPLE % RECOVERY	N VALUE or RQD	WATER CONTENT %	DEPTH (m)	Remoulded Shear Strength (kPa)	Peak Shear Strength (kPa)	Pen. Resist. Blows/0.3m (50 mm Dia. Cone)	Piezometer Construction
								0 25 50 75 100	0 25 50 75 100	0 25 50 75 100	
Ground Surface EL 69.18 m							0				No Data
FILL: Brown silty sand with gravel and crushed stone	▨	G1	[#]								
	▨	G2	[#]				1				
1.1 m EL 68.08 m											
GLACIAL TILL; Compact, dark brown silty sand with gravel, some clay and shale fragments, occasional cobbles	▨	G3	#								
	▨	G4	[#]								
1.85 m EL 67.33 m											
End of Test Pit Test pit terminated on bedrock surface at 1.85m depth. (TP dry upon completion)							2				
							3				
							4				

PATERSON GROUP

SOIL PROFILE AND TEST DATA

GEOTECHNICAL INVESTIGATION

185 Bantree Street, Ottawa, Ontario

DATUM: Geodetic **EASTING:** 373988.473 **NORTHING:** 5029730.994 **ELEVATION:** 70.62

PROJECT: Proposed Hydrovac Slurry Processing Facility

BORINGS BY: Excavator

REMARKS:

DATE: September 6, 2023

FILE NO. PG6812

HOLE NO. TP 7-23

SAMPLE DESCRIPTION	STRATA PLOT	SAMPLE No.	SAMPLE Type	SAMPLE % RECOVERY	N VALUE or RQD	WATER CONTENT %	DEPTH (m)	Remoulded Shear Strength (kPa) 0 25 50 75 100	Peak Shear Strength (kPa) 0 25 50 75 100	Pen. Resist. Blows/0.3m (50 mm Dia. Cone) 0 25 50 75 100	Piezometer Construction
Ground Surface EL 70.62 m							0				No Data
FILL: Brown silty sand gravel and crushed stone		G1	[#]								
		G2	[#]								
0.85 m EL 69.77 m											
GLACIAL TILL: Compact, brown silty sand with gravel, some clay and shale fragments, occasional cobbles		G3	[#]				1				
		G4	[#]								
		G5	[#]				2				
2.1 m EL 68.52 m											
End of Test Pit Test pit terminated on bedrock surface at 2.10m depth. (TP dry upon completion)							3				
							4				

PATERSON GROUP

SOIL PROFILE AND TEST DATA

GEOTECHNICAL INVESTIGATION

185 Bantree Street, Ottawa, Ontario

DATUM: Geodetic **EASTING:** 0 **NORTHING:** 0 **ELEVATION:** 68.9

PROJECT: Proposed Hydrovac Slurry Processing Facility

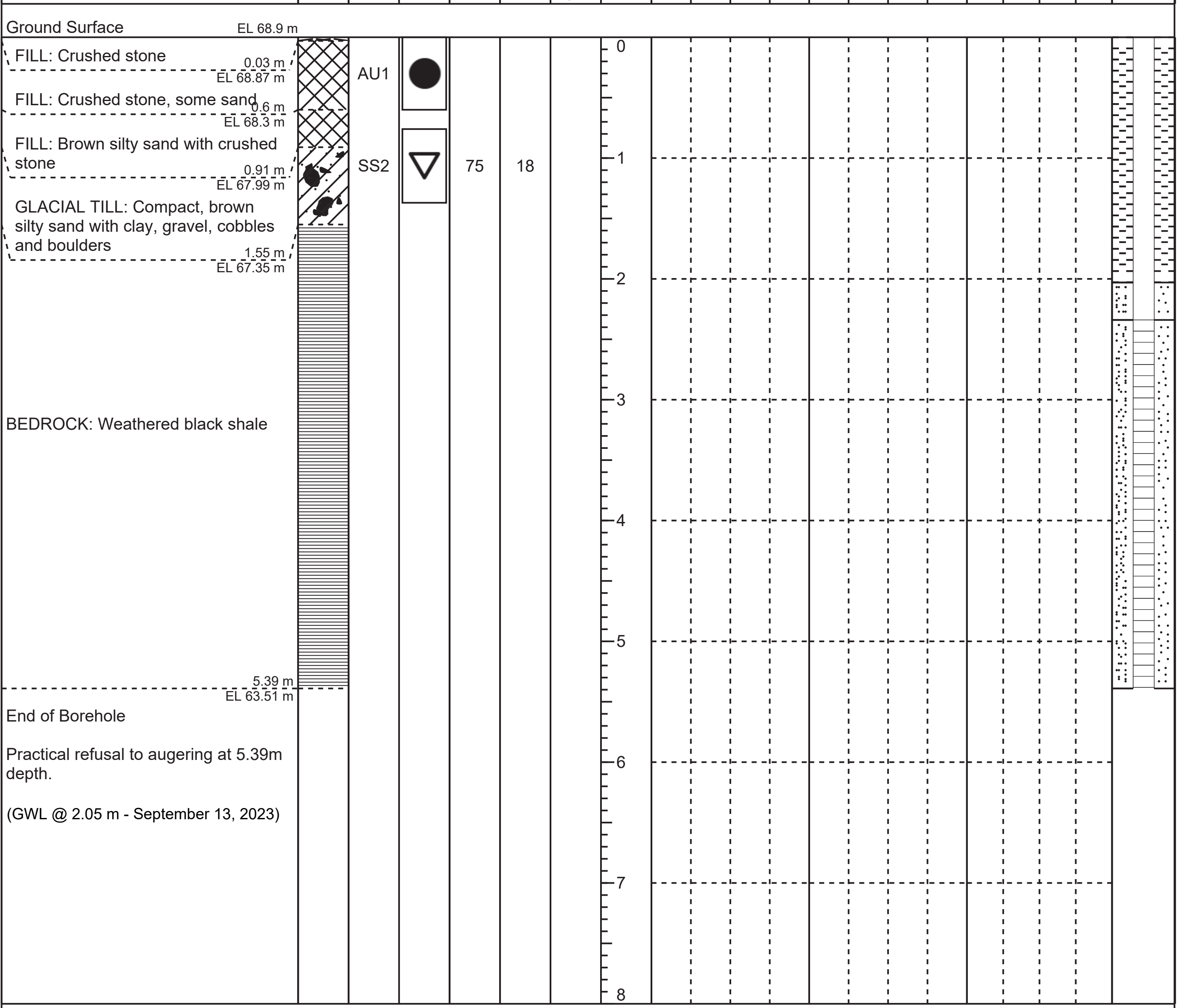
BORINGS BY: CME 55 Low Clearance Power Auger

REMARKS:

DATE: September 5, 2023

FILE NO. PG6812

HOLE NO. BH 1-23



SAMPLE DESCRIPTION	STRATA PLOT	SAMPLE No.	SAMPLE Type	SAMPLE % RECOVERY	N VALUE or RQD	WATER CONTENT %	DEPTH (m)	Remoulded Shear Strength (kPa) 0 25 50 75 100	Peak Shear Strength (kPa) 0 25 50 75 100	Pen. Resist. Blows/0.3m (50 mm Dia. Cone) 0 25 50 75 100	Monitoring Well Construction
Ground Surface EL 68.9 m							0				
FILL: Crushed stone 0.03 m EL 68.87 m		AU1	●								
FILL: Crushed stone, some sand 0.6 m EL 68.3 m											
FILL: Brown silty sand with crushed stone 0.91 m EL 67.99 m		SS2	▽	75	18		1				
GLACIAL TILL: Compact, brown silty sand with clay, gravel, cobbles and boulders 1.55 m EL 67.35 m											
BEDROCK: Weathered black shale 5.39 m EL 63.51 m							2 3 4 5				
End of Borehole Practical refusal to augering at 5.39m depth. (GWL @ 2.05 m - September 13, 2023)							6 7 8				

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SOIL PROFILE AND TEST DATA

GEOTECHNICAL INVESTIGATION

185 Bantree Street, Ottawa, Ontario

DATUM: Geodetic **EASTING:** 374150.642 **NORTHING:** 5029624.042 **ELEVATION:** 69.41

PROJECT: Proposed Hydrovac Slurry Processing Facility

BORINGS BY: CME 55 Low Clearance Power Auger

REMARKS:

DATE: September 5, 2023

FILE NO. PG6812

HOLE NO. BH 2-23

SAMPLE DESCRIPTION	SAMPLE No.	SAMPLE Type	SAMPLE % RECOVERY	N VALUE or RQD	WATER CONTENT %	Remoulded Shear Strength (kPa) 0 25 50 75 100	Peak Shear Strength (kPa) 0 25 50 75 100	Pen. Resist. Blows/0.3m (50 mm Dia. Cone) 0 25 50 75 100
Ground Surface EL 69.41 m								
FILL: Brown silty sand with gravel and crushed stone, occasional cobbles	AU1	●						
	SS2	▽	67	17				
1.22 m EL 68.19 m								
GLACIAL TILL: Compact, brown silty sand with clay, occasional shale fragments	SS3	▽	83	27				
	SS4	▽	33	50+				
2.34 m EL 67.07 m								
BEDROCK: Weathered black shale								
4.88 m EL 64.53 m								
End of Borehole								
(GWL @ 3.10 m - September 13, 2023)								

DEPTH (m): 0, 1, 2, 3, 4, 5, 6, 7, 8

SOIL PROFILE AND TEST DATA

GEOTECHNICAL INVESTIGATION

185 Bantree Street, Ottawa, Ontario

DATUM: Geodetic **EASTING:** 373912.929 **NORTHING:** 5029812.09 **ELEVATION:** 70.23

PROJECT: Proposed Hydrovac Slurry Processing Facility

BORINGS BY: CME 55 Low Clearance Power Auger

REMARKS:

DATE: September 5, 2023

FILE NO. **PG6812**

HOLE NO. BH 3-23

SAMPLE DESCRIPTION	STRATA PLOT	SAMPLE No.	SAMPLE Type	SAMPLE % RECOVERY	N VALUE or RQD	WATER CONTENT %	DEPTH (m)	Remoulded Shear Strength (kPa) 0 25 50 75 100	Peak Shear Strength (kPa) 0 25 50 75 100	Pen. Resist. Blows/0.3m (50 mm Dia. Cone) 0 25 50 75 100	Monitoring Well Construction
Ground Surface EL 70.23 m											
FILL: Brown silty sand with gravel and crushed stone, occcasional cobbles		AU1	●				0				
0.69 m EL 69.54 m											
GLACIAL TILL: Dense, brown silty sand with clay, some gravel		SS2	▽	27	50+		1				
1.07 m EL 69.16 m											
BEDROCK: Weathered black shale							2 3 4 5 6				
6.4 m EL 63.83 m											
End of Borehole							7				
(GWL @ 4.15 m - September 13, 2023)							8				

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SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
1850 Bantree Street
Ottawa, Ontario

DATUM Geodetic

FILE NO. PE5579

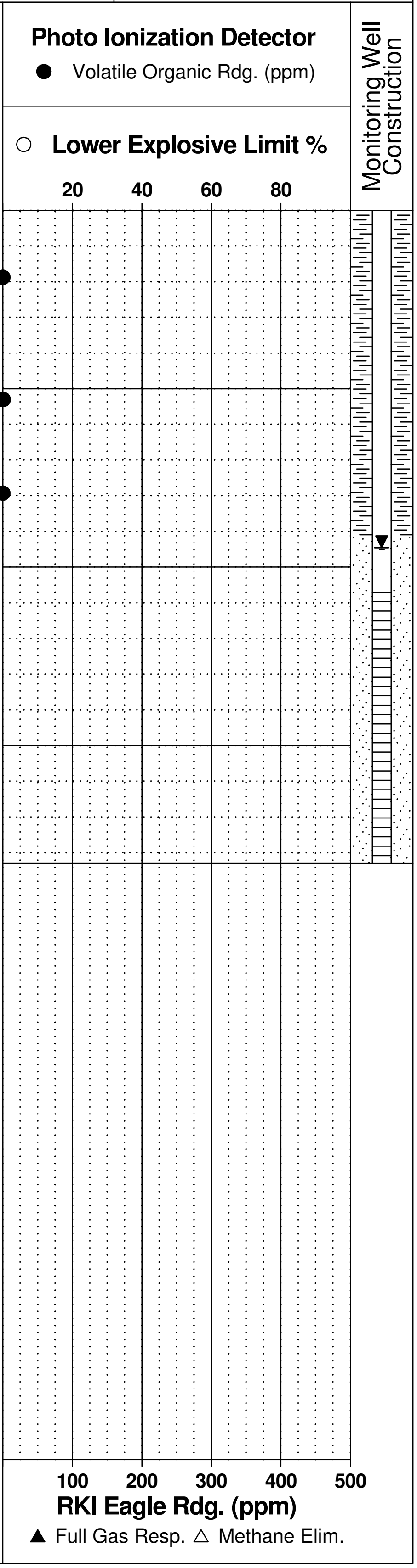
REMARKS

HOLE NO. BH 1

BORINGS BY Track-Mount Power Auger

DATE February 9, 2023

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	68.77
FILL: Brown silty sand with gravel	▨	AU	1				
0.60							
GLACIAL TILL: Brown silty clay, some sand, trace gravel and shale		SS	2	100	28	1	67.77
- grey by 1.6m depth		SS	3	100	50+		
1.62							
BEDROCK: Weathered shale	☰					2	66.77
						3	65.77
3.66							
End of Borehole							
(GWL @ 1.89m - Feb. 14, 2023)							



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SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
1850 Bantree Street
Ottawa, Ontario

DATUM Geodetic

FILE NO. **PE5579**

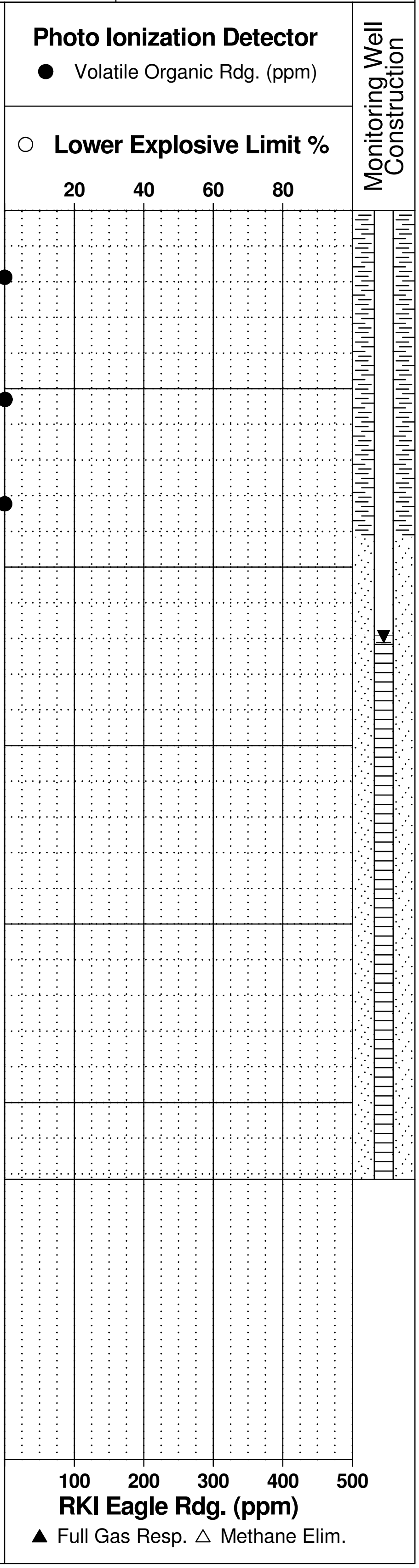
REMARKS

HOLE NO. **BH 2**

BORINGS BY Track-Mount Power Auger

DATE February 9, 2023

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	68.89
FILL: Brown silty sand with gravel	AU	1				
1.12	SS	2	71	22	1	67.89
GLACIAL TILL: Brown silty clay with sand and shale fragments - grey by 1.7m depth						
1.75	SS	3	90	50+		
BEDROCK: Very poor quality, black shale					2	66.89
					3	65.89
					4	64.89
	RC	4	100	17	5	63.89
5.43						
End of Borehole (GWL @ 2.42m - Feb. 14, 2023)						



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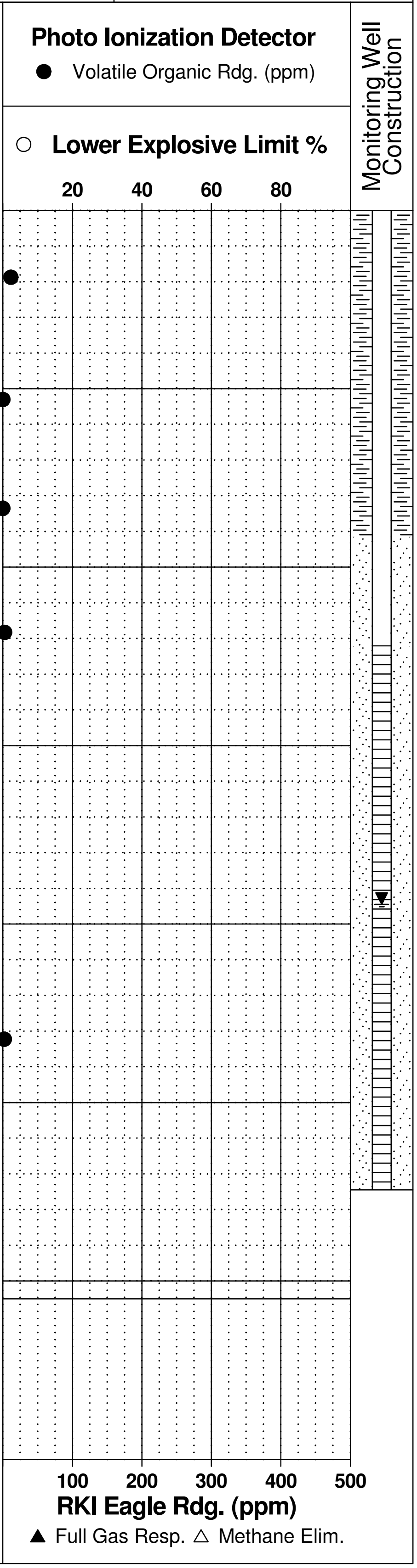
SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
1850 Bantree Street
Ottawa, Ontario

DATUM Geodetic
REMARKS
BORINGS BY Track-Mount Power Auger
DATE February 10, 2023
FILE NO. PE5579
HOLE NO. BH 3

SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD
GROUND SURFACE				
FILL: Brown silty sand with gravel and crushed stone	AU	1		
- some shale, trace clay by 0.6m depth	SS	2	71	33
1.37				
GLACIAL TILL: Brown silty clay with sand, trace gravel	SS	3	50	50+
1.68				
BEDRCK: Weathered shale	G	4		
	G	5		
6.10				
End of Borehole (GWL @ 3.89m - Feb. 21, 2023)				

DEPTH (m)	ELEV. (m)
0	68.90
1	67.90
2	66.90
3	65.90
4	64.90
5	63.90
6	62.90



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9 Auriga Drive, Ottawa, Ontario K2E 7T9

SOIL PROFILE AND TEST DATA

Phase II - Environmental Site Assessment
1850 Bantree Street
Ottawa, Ontario

DATUM Geodetic

REMARKS

BORINGS BY Track-Mount Power Auger

DATE February 10, 2023

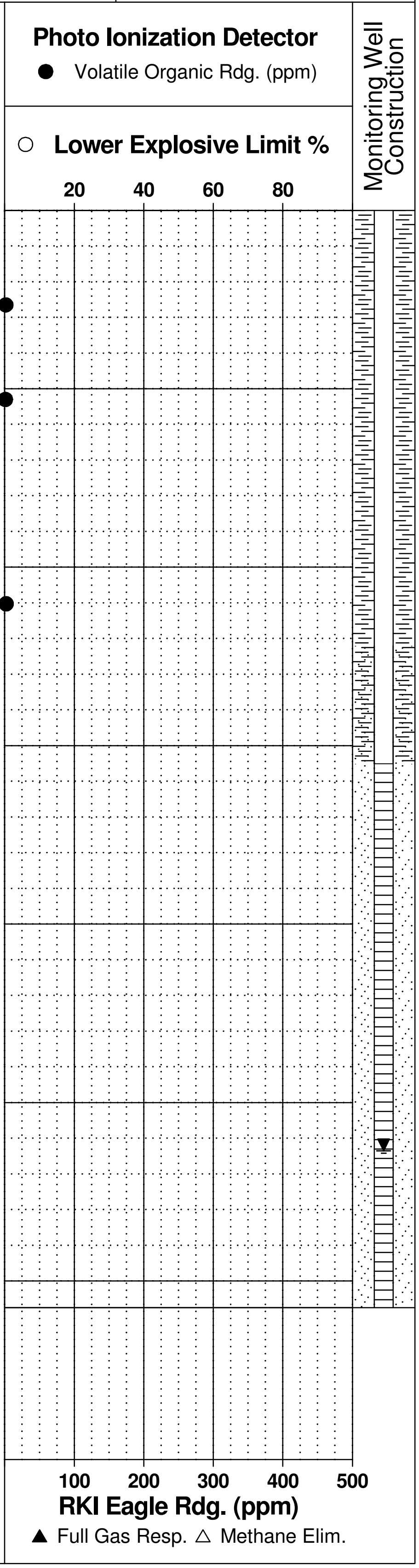
FILE NO. **PE5579**

HOLE NO. **BH 4**

SOIL DESCRIPTION	
GROUND SURFACE	
FILL: Brown silty sand with gravel and crushed stone	0.60
FILL: Brown silty sand with clay and shale	1.37
BEDROCK: Weathered shale	2.29
BEDROCK: Poor to good quality, black shale	6.15
End of Borehole (GWL @ 5.27m - Feb. 14, 2023)	

SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD
AU	1		
SS	2	50	32
G	3		
RC	1	100	44
RC	2	100	84
RC	3	100	84

DEPTH (m)	ELEV. (m)
0	71.04
1	70.04
2	69.04
3	68.04
4	67.04
5	66.04
6	65.04



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)

Dxx - 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
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)

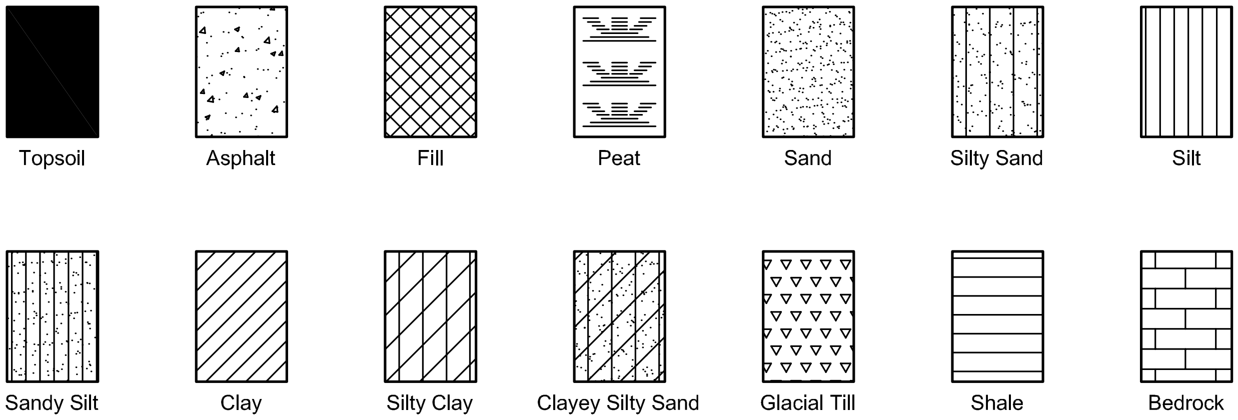
OC Ratio Overconsolidaton ratio = p'_c / p'_o
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

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.

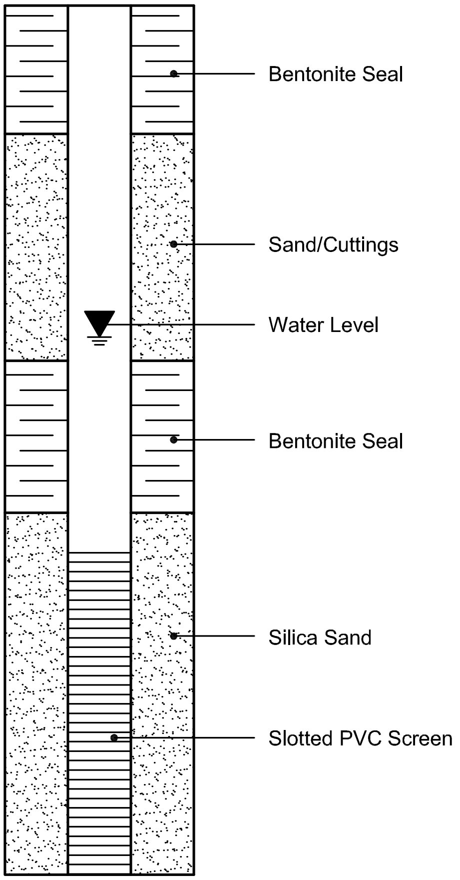
SYMBOLS AND TERMS (continued)

STRATA PLOT

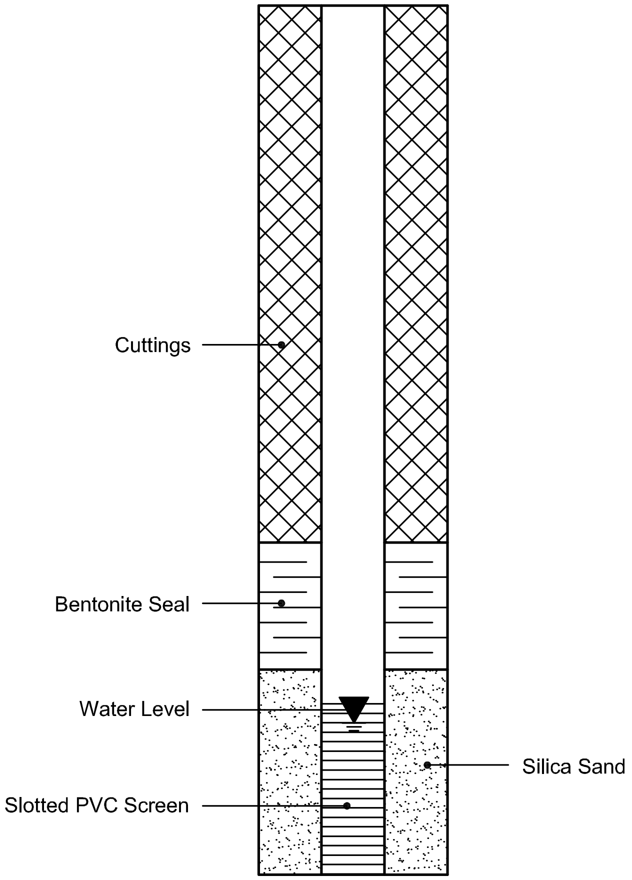


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



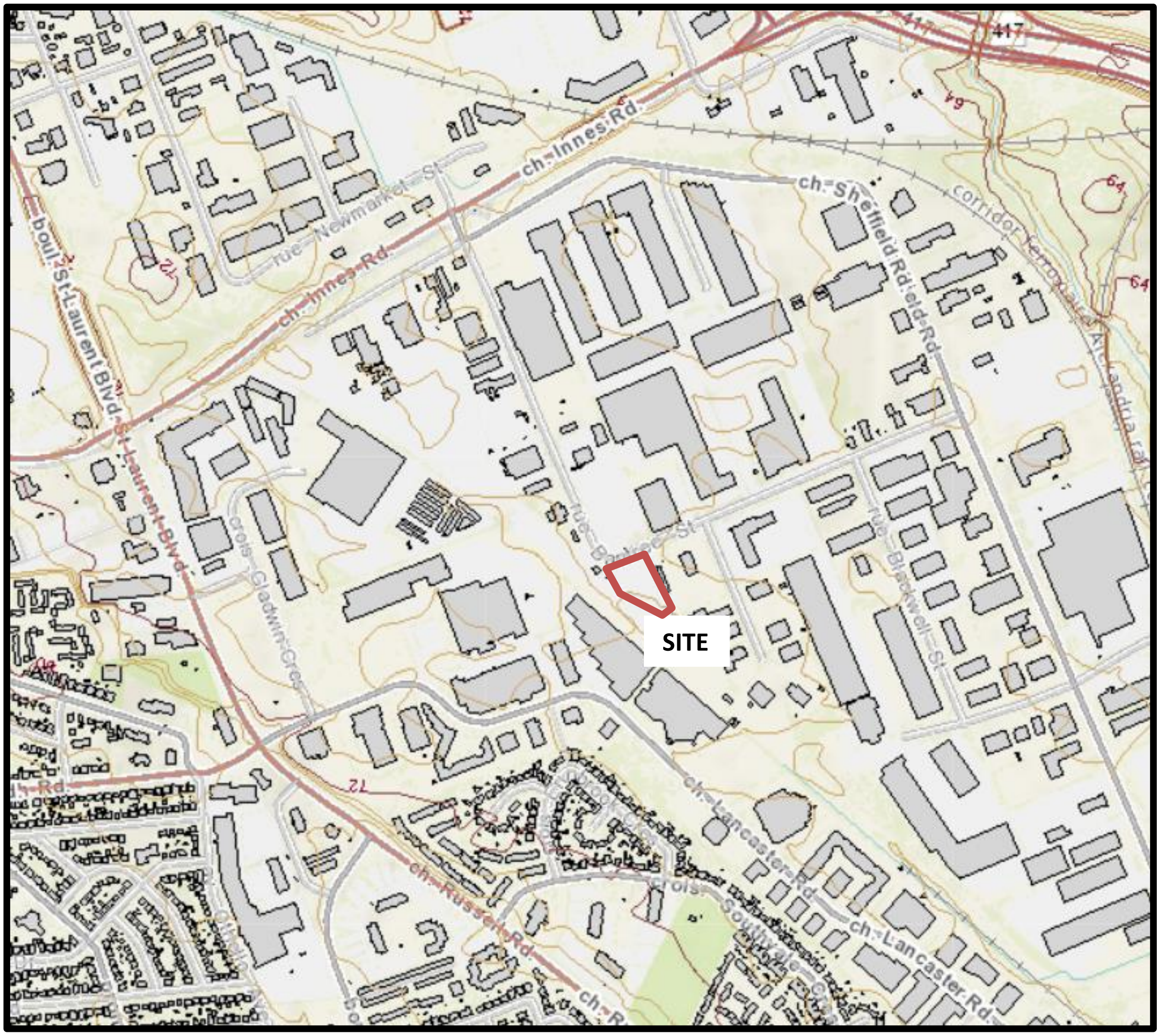
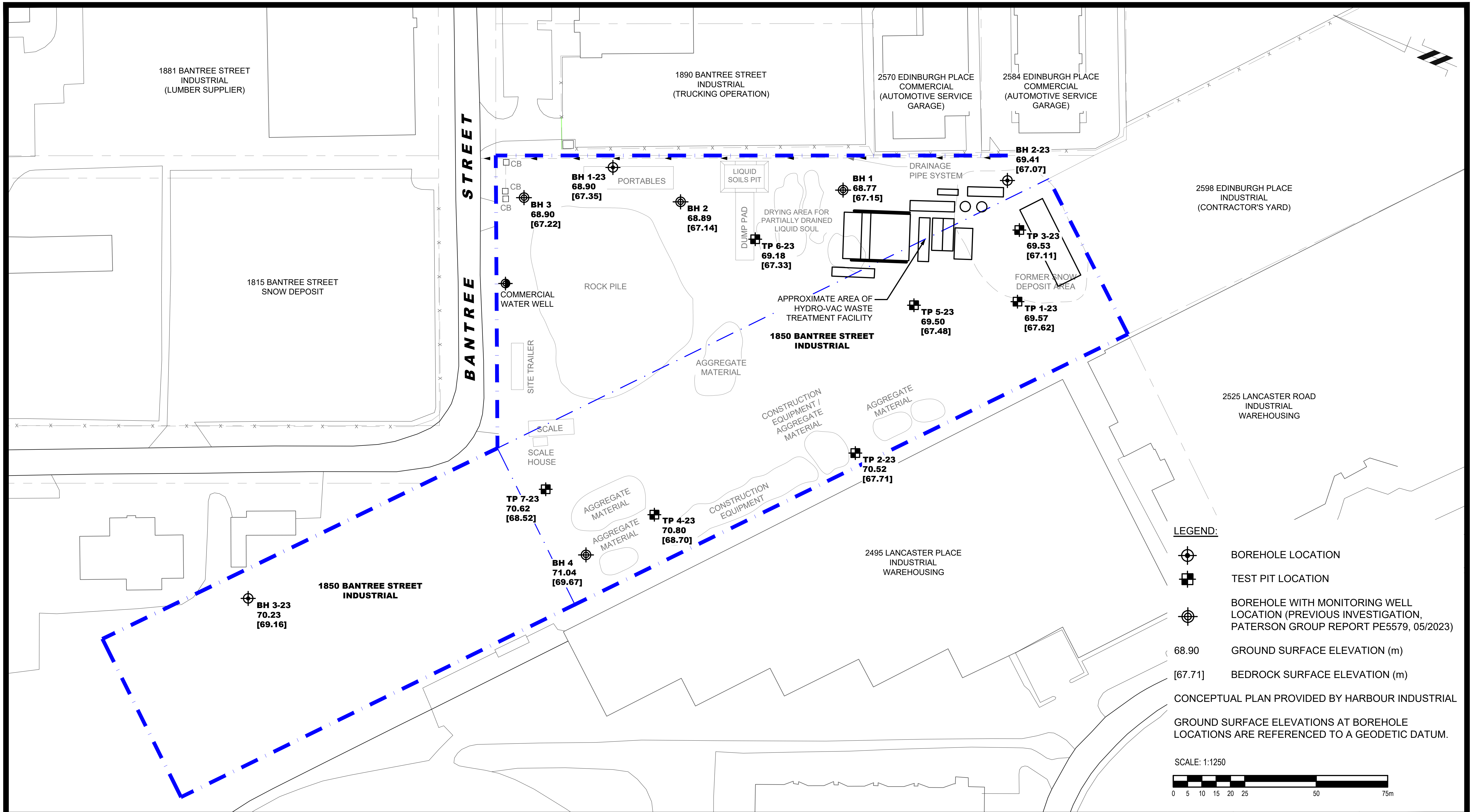


FIGURE 1

KEY PLAN

PATERSON
GROUP



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TEL: (613) 226-7381

NO.	REVISIONS	DATE	INITIAL

HARBOUR ENVIRONMENTAL GROUP LTD.
GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
1850 BANTREE STREET

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:1250	Date: 09/2023
Drawn by: ZS	Report No.: PG6812-1
Checked by: PT	Dwg. No.: PG6812-1
Approved by: JV	Revision No.:

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