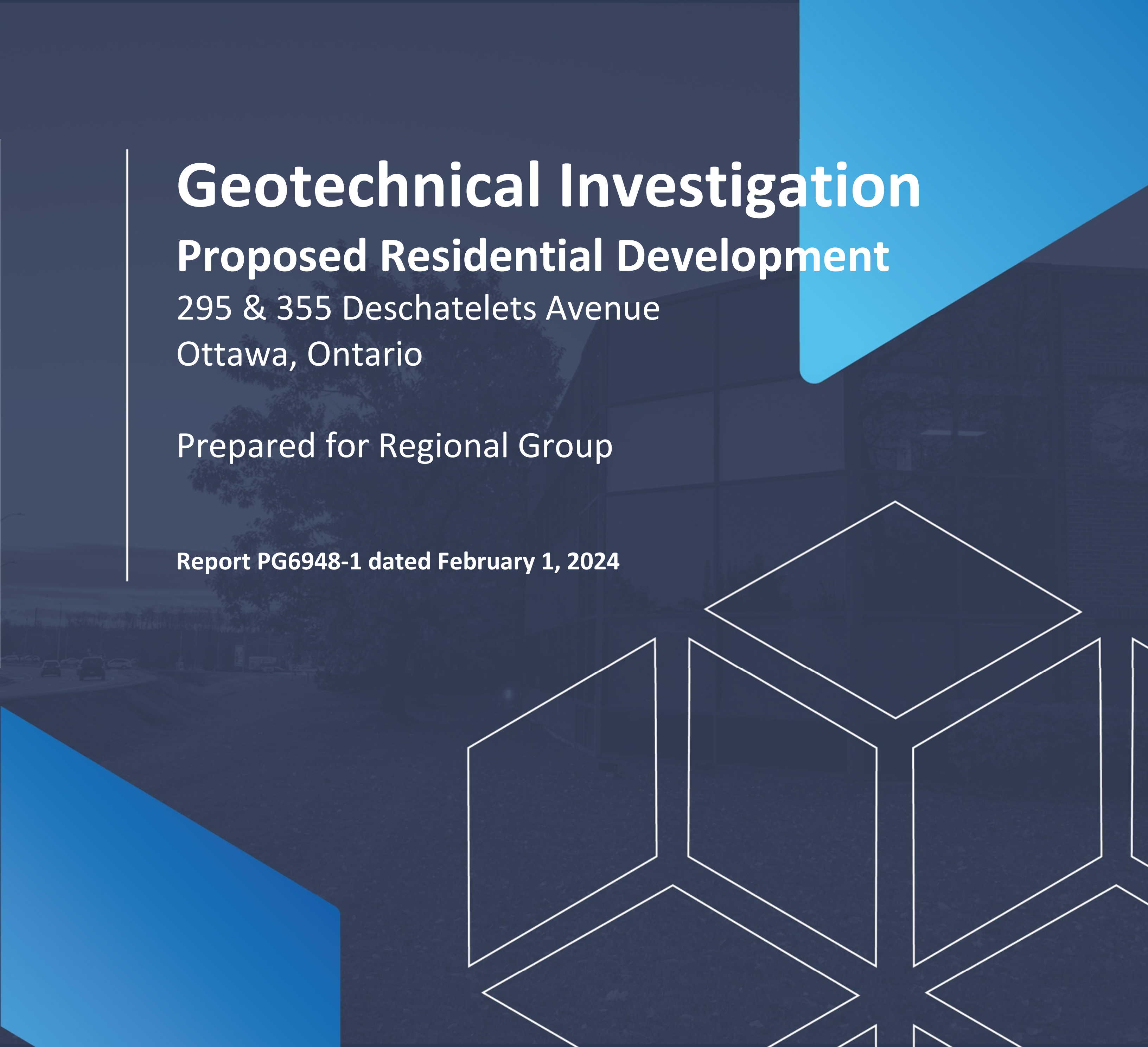

# Geotechnical Investigation

## Proposed Residential Development

295 & 355 Deschatelets Avenue
Ottawa, Ontario

Prepared for Regional Group

**Report PG6948-1 dated February 1, 2024**

# Table of Contents

# Appendices

# 1.0 Introduction

Paterson Group (Paterson) was commissioned by Regional Group to conduct a geotechnical investigation for the proposed residential buildings to be located at 295 & 355 Deschatelets Avenue in the City of Ottawa (reference should be made 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 conceptual plan, it is understood that the proposed development will consist of townhouse-style residential dwellings, each with a slab-on-grade. The proposed buildings will be surrounded by the associated asphalt-paved access lanes and landscaped areas.

It is also expected that the subject site will be municipally serviced.

# 3.0 Method of Investigation

## 3.1 Field Investigation

### Field Program

The field program for the current geotechnical investigation was carried out on January 5, 2024, and consisted of advancing a total of 3 boreholes to a maximum depth of 6.55 m below existing ground surface. Previous boreholes were also drilled by others (14-2 & 14-207) between March and July 2018, extending to a maximum depth of 20 m. The borehole locations were distributed in a manner to provide general coverage of the subject site, taking into consideration underground utilities and site features.

The approximate borehole locations are shown on Drawing PG6948-1 – Test Hole Location Plan included in Appendix 2.

The boreholes were completed using a low clearance 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 testing procedure consisted of augering and excavating to the required depth at the selected location and sampling the overburden.

### Sampling and In Situ Testing

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.

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.

Undrained shear strength testing was carried out at regular depth intervals in cohesive soils.

The overburden thickness was evaluated by completing dynamic cone penetration test (DCPT) at boreholes BH 3-24 and 14-2. The DCPT testing consisted of driving a steel drill rod, equipped with a 50 mm diameter cone at the tip, using a 63.5 kg hammer falling from a height of 760 mm. The number of blows required to drive the cone into the soil is recorded for each 300 mm increment.

The subsurface conditions observed in the boreholes 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

Flexible standpipe piezometers were installed in all boreholes to permit monitoring of the groundwater levels subsequent to the completion of the sampling program. The groundwater level readings were obtained after a suitable stabilization period subsequent to the completion of the field investigation. Groundwater monitoring devices had also been installed in the previous borehole 14-2 by others.

## 3.2 Field Survey

The borehole locations, and ground surface elevation at each borehole location, were surveyed by Paterson using a handheld GPS and referenced to a geodetic datum. The locations of the boreholes, and the ground surface elevations at each borehole location, are presented on Drawing PG6948-1 – 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. Additionally, one (1) shrinkage test, one (1) grain size distribution analysis and two (2) Atterberg Limits tests were completed on selected soil samples. The results are discussed in Section 4.2 and are provided in Appendix 1 of this report. All samples will be stored in the laboratory for a period of one (1) month after issuance of this report. They will then be discarded unless we are directed otherwise.

## 3.4 Analytical Testing

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

# 4.0 Observations

## 4.1 Surface Conditions

Currently, the subject site has a gravel surface and is used primarily for vehicle parking and equipment storage, with a modular structure located in the southeastern corner of the site.

The site is bordered to the north by Oblats Avenue, to the east by the Deschatelets Building, and to the south and west by Deschatelets Avenue. The ground surface across the subject site is relatively flat at approximate geodetic elevation of 64 to 65 m.

## 4.2 Subsurface Profile

Generally, the subsoil profile encountered at the borehole locations consists of a layer of fill material, composed of brown silty sand with gravel, crushed stone, clay and trace organics extending to approximate depths of 0.6 to 1.2 m below the existing ground surface.

A deposit of loose to compact, brown silty sand was encountered underlying the fill material. At depths of about 1.5 to 2.1 m, the silty sand was underlain by a deposit of hard to stiff, brown silty clay, which became stiff and grey in colour at approximate depths ranging from 2.9 m to 4.4 m below the existing ground surface.

Practical refusal to the DCPT was encountered at an approximate depth of 19.25 m at borehole BH 3-24 and at 20.04 m at borehole 14-2.

Reference should be made to the Log of Borehole Sheets by Others and 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, bedrock in the area of the subject site transitions from west to east across the site, and consists of Shale of the Billings Formation and Shale of the Carlsbad Formation. The overburden drift thickness is estimated to be between 15 and 25 m depth.

### Grain Size Distribution and Hydrometer Testing

One (1) hydrometer test was completed to further classify a select soil sample. The result is summarized in Table 1 on the next page and is presented in Appendix 1.

**Table 1 – Summary of Grain Size Distribution Analysis**

| Test Hole | Sample | Gravel (%) | Sand (%) | Silt (%) | Clay (%) |
|---|---|---|---|---|---|
| BH 2-24 | SS5 | 0.0 | 0.1 | 21.9 | 78.0 |

### Atterberg Limit Tests

A total of two (2) silty clay samples were submitted for Atterberg Limits testing. The test results indicate that the silty clay is generally classified as an Inorganic Clay of Low Plasticity (CL). These classifications are in accordance with the Unified Soil Classification System. The results are summarized in Table 2 below.

**Table 2 – Summary of Atterberg Limits Results**

| Borehole | Sample | Depth (m) | LL (%) | PL (%) | PI (%) | Classification |
|---|---|---|---|---|---|---|
| BH 1-24 | SS6 | 3.0 – 3.6 | 39 | 17 | 22 | CL |
| BH 3-24 | SS3 | 1.5 - 2.1 | 44 | 21 | 23 | CL |
| Notes: LL: Liquid Limit; PL: Plastic Limit; PI: Plasticity Index; CL: Inorganic Clay of Low Plasticity | | | | | | |

### Shrinkage Test

The results of the shrinkage limit test indicate a shrinkage limit of 16.56 and a shrinkage ratio of 1.861.

## 4.3 Groundwater

Groundwater levels were measured within the installed piezometers at the time of the investigation. The measured groundwater levels noted at that time are presented in Table 3 and are also presented in Appendix 1.

**Table 3 – Summary of Groundwater Levels**

| Borehole Number | Ground Surface Elevation (m) | Measured Groundwater Level | | Dated Recorded |
|---|---|---|---|---|
| | | Depth (m) | Elevation (m) | |
| BH 1-24 | 64.92 | 3.91 | 61.01 | January 12, 2024 |
| BH 2-24 | 64.78 | 2.85 | 61.93 | |
| BH 3-24 | 64.67 | 3.15 | 61.52 | |
| 14-2 | 64.46 | 5.47 | 58.99 | September 9, 2014 |
| **Note:** Ground surface elevations at borehole location are referenced to a geodetic datum. | | | | |

Long-term groundwater levels can also be estimated based on the observed colour and consistency of the recovered soil samples. Based on these observations, the long-term groundwater table can be expected at approximately 3 to 4 m below ground surface.

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

# 5.0 Discussion

## 5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is considered suitable for the proposed development. It is recommended that the proposed structures be founded on conventional spread footings placed on the undisturbed, hard to stiff silty clay bearing surface.

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

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

## 5.2 Site Grading and Preparation

### Stripping Depth

Topsoil and fill, such as those containing organic or deleterious materials, should be stripped from under any buildings and other settlement sensitive structures. It is anticipated that the existing fill within the proposed building footprints, free of deleterious material and significant amounts of organics, can be left in place below the proposed building footprints outside of lateral support zones for the footings. However, it is recommended that the existing fill layer be proof-rolled several times under dry conditions and above freezing temperatures and approved by Paterson personnel at the time of construction. Any poor performing areas noted during the proof-rolling operation should be removed and replaced with an approved fill.

### Fill Placement

Fill used for grading beneath the building areas should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. 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 building areas should be compacted to at least 98% of its standard Proctor maximum dry density (SPMDD).

Non-specified existing fill along with site-excavated soil can be used as general landscaping fill and beneath exterior parking areas where settlement of the ground surface is of minor concern. In landscaped areas, 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.

## 5.3 Foundation Design

### Bearing Resistance Values

Strip footings, up to 3 m wide, and pad footings, up to 5 m wide, founded on an undisturbed, hard to very stiff silty clay bearing surface can be designed can be designed using a bearing resistance value at serviceability limit states (SLS) of **200 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **300 kPa**. A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance value at ULS.

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

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

### Lateral Support

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Above the groundwater level, adequate lateral support is provided to the in-situ bearing medium soils 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.

### Permissible Grade Raise Recommendations

Due to the presence of the silty clay deposit at the site, a permissible grade raise restriction of **2 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 D** for the 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 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 fill, containing significant amounts of deleterious or organic materials, the native soil or approved fill is considered to be an acceptable subgrade surface on which to commence backfilling for slab on grade construction.

Where the subgrade consists of existing fill, a vibratory drum roller should complete several passes over the subgrade surface as a proof-rolling program, which should be observed and approved by Paterson. Any poor performing areas should be removed and reinstated with an engineered fill such as OPSS Granular A, Granular B Type II with a maximum particle size of 50 mm. All backfill material within the footprints of the proposed buildings should be placed in maximum 300 mm thick loose layers and compacted to a minimum of 98% of the SPMDD.

It is recommended that the upper 200 mm sub-floor fill consists of OPSS Granular A crushed stone. All backfill materials within the footprint of the proposed building should be placed in a maximum of 300 mm thick loose layers and compacted to at least 98% of the SPMDD.

## 5.6 Pavement Design

For design purposes, the pavement structures presented in the following Table 4 is recommended for the design of the driveways/car courts.

**Table 4 - Recommended Pavement Structure – Driveways/Car Courts**

| Thickness (mm) | Material Description |
|---|---|
| 50 | **Wear Course** – HL-3 or Superpave 12.5 Asphaltic Concrete |
| 150 | **BASE** - OPSS Granular A Crushed Stone |
| 300 | **SUBBASE** - OPSS Granular B Type II |
| **SUBGRADE** - Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or fill. | |

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 material's SPMDD using suitable vibratory equipment.

# 6.0 Design and Construction Precautions

## 6.1 Foundation Backfill

Backfill against the exterior sides of the foundation walls should consist of free draining, non-frost susceptible granular materials. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, can be used for this purpose.

Excavated on-site fill could also be re-used for backfilling the exterior sides of the foundation walls. However, this material would need to be maintained in an unfrozen state and at a suitable moisture content for compaction if it is to be re-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, 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 temporary excavation side slopes anticipated should either be excavated to acceptable slopes or retained by shoring systems from the beginning of the excavation until the structure is backfilled. It is expected that sufficient room will be available for the greater part of the excavation to be undertake 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 subsurface soil 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 maintain safe working distance 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 moist (not wet) site-generated fill above the cover material if the excavation and filling 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) should match the soils exposed at the trench walls to minimize differential frost heaving. The trench backfill should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the material’s SPMDD. 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 low to moderate and controllable using open sumps. The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

Paterson has previously obtained a temporary Ministry of the Environment, Conservation and Parks (MECP) permit to take water (PTTW), valid until 2029, for the larger Greystone development area which includes the subject site,

## 6.6 Winter Construction

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

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

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

## 6.7 Corrosion Potential and Sulphate

The results of analytical testing show that the sulphate content is less than 0.1%. This result is indicative that Type 10 Portland cement (GU – General Use cement) would be appropriate for this site. The chloride content and pH of the sample indicate that they are not a significant factor in creating a corrosive environment for exposed ferrous metals at this site, whereas the resistivity is indicative of a moderate to very aggressive corrosive environment.

## 6.8 Landscaping Considerations

### Tree Planting Restrictions

In accordance with the City of Ottawa Tree Planting in Sensitive Marine Clay Soils (2017 Guidelines), Paterson completed a soils review of the site to determine applicable tree planting setbacks. Atterberg Limits testing was completed for recovered silty clay samples at selected locations throughout the subject site. Grain size distribution and hydrometer testing were also completed on selected soil samples. The above-noted soil samples were recovered from elevations below the anticipated design underside of footing elevation and 3.5 m depth below anticipated finished grade. The results of our testing are presented in Section 4.2 and in Appendix 1.

Based on the results of our review, a low/medium sensitivity clay soil was encountered between anticipated underside of footing elevations and 3.5 m below anticipated finished grade, as the Atterberg Limits test results indicated plasticity indices less than 40%.

The following tree planting setbacks are therefore recommended for the low to medium sensitivity area. Large trees (mature height over 14 m) can be planted within these areas provided a tree to foundation setback equal to the full mature height of the tree can be provided (e.g. in a park or other green space). Tree planting setback limits may be reduced to 4.5 m for small (mature tree height up to 7.5m) and medium size trees (mature tree height 7.5 m to 14 m) provided that the conditions noted below are met:

☐ The underside of footing (USF) is 2.1 m or greater below the lowest finished grade must be satisfied for footings within 10 m from the tree, as measured from the center of the tree trunk and verified by means of the Grading Plan.

☐ A small tree must be provided with a minimum of 25 $m^3$ of available soil volume while a medium tree must be provided with a minimum of 30 $m^3$ of available soil volume, as determined by the Landscape Architect. The developer is to ensure that the soil is generally un-compacted when backfilling in street tree planting locations.

☐ The tree species must be small (mature tree height up to 7.5 m) to medium size (mature tree height 7.5 m to 14 m) as confirmed by the Landscape Architect.

☐ The foundation walls are to be reinforced at least nominally (minimum of two upper and two lower 15M bars in the foundation wall).
☐ Grading surrounding the tree must promote drainage to the tree root zone (in such a manner as not to be detrimental to the tree), as noted on the subdivision Grading Plan.

# 7.0 Recommendations

A materials testing and observation services program is a requirement for the provided foundation design data to be applicable. The following aspects of the program should be performed by the geotechnical consultant:

☐ Review of the 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 used.

☐ 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 soil must be handled as per ***Ontario Regulation 406/19: On-Site and Excess Soil Management*****.**

# 8.0 Statement of Limitations

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

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

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

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Regional Group, 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.**

Mrunmayi Anvekar, M.Eng.

LICENSED PROFESSIONAL ENGINEER
Feb. 1, 2024
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Scott Dennis

Scott S. Dennis, P.Eng.

**Report Distribution:**

☐ Regional Group (Email Copy)
☐ Paterson Group (1 Copy)

# APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

LOG OF BOREHOLE SHEETS BY OTHERS

GRAIN SIZE DISTURBUTION AND HYDROMETER TESTING RESULTS

ATTERBERG LIMIT TESTING RESULTS

ANALYTICAL TESTING RESULTS

# SOIL PROFILE AND TEST DATA

**Geotechnical Investigation**
**Prop. Residential Buildings - 295 & 355 Deschatelets Ave.**
**Ottawa, Ontario**

**EASTING:** 369277.068 **NORTHING:** 5030329.184 **ELEVATION:** 64.92

**DATUM:** Geodetic

**REMARKS:**

**BORINGS BY:** CME 55 Low Clearance Power Auger **DATE:** January 5, 2024

**FILE NO.** PG6948

**HOLE NO.** BH 1-24

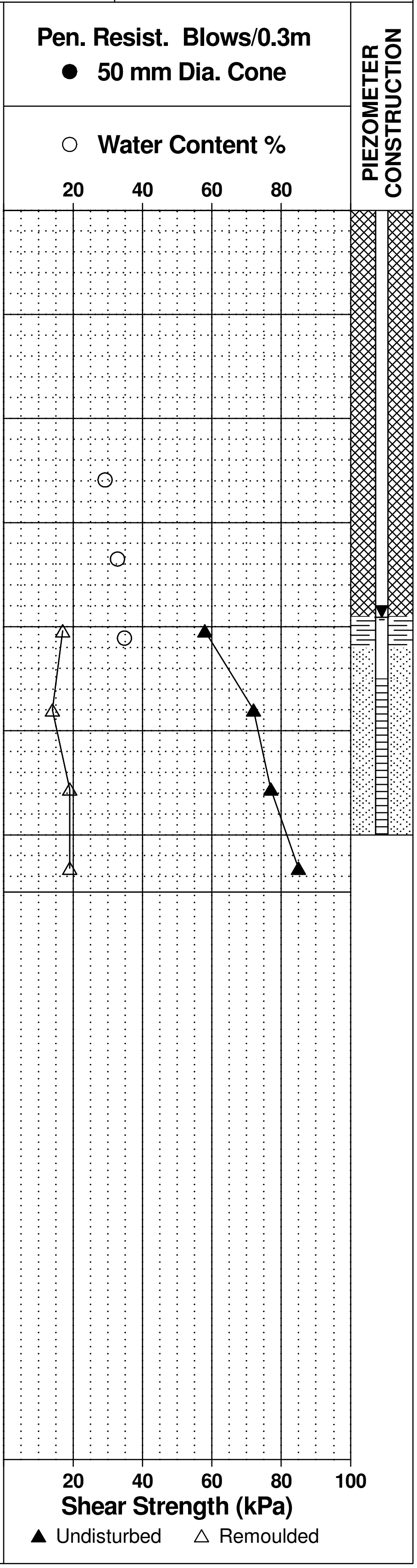
**Ground Surface**

| SAMPLE DESCRIPTION | | TYPE | NUMBER | % RECOVERY | N VALUE or RQD |
|---|---|---|---|---|---|
| **FILL**: Brown silty sand with crushed stones and gravel, trace organics | 0.46 | AU | 1 | | |
| **FILL**: Brown silty clay, some sand and gravel, trace organics and crushed stones | 0.69 | AU | 2 | | |
| | 1.22 | SS | 3 | 46 | 8 |
| Hard, brown **SILTY CLAY**, trace sand | | | | | |
| Loose, brown **SILTY SAND**, trace to some clay | 2.13 | SS | 4 | 100 | 6 |
| Very stiff, brown **SILTY CLAY**, trace to some sand | | SS | 5 | 100 | 3 |
| | 3.73 | SS | 6 | 100 | 2 |
| Stiff, grey **SILTY CLAY**, trace sand | 6.55 | SS | 7 | 100 | P |

End of Borehole

(GWL @ 3.91m - Jan. 12, 2024)

| DEPTH (m) | ELEV. (m) |
|---|---|
| 0 | 64.92 |
| 1 | 63.92 |
| 2 | 62.92 |
| 3 | 61.92 |
| 4 | 60.92 |
| 5 | 59.92 |
| 6 | 58.92 |



**patersongroup** Consulting Engineers
9 Auriga Drive, Ottawa, Ontario K2E 7T9

# SOIL PROFILE AND TEST DATA

**Geotechnical Investigation**
**Prop. Residential Buildings - 295 & 355 Deschatelets Ave.**
**Ottawa, Ontario**

**EASTING:** 369309.696 **NORTHING:** 5030386.764 **ELEVATION:** 64.78
**DATUM:** Geodetic
**REMARKS:**
**BORINGS BY:** CME 55 Low Clearance Power Auger **DATE:** January 5, 2024

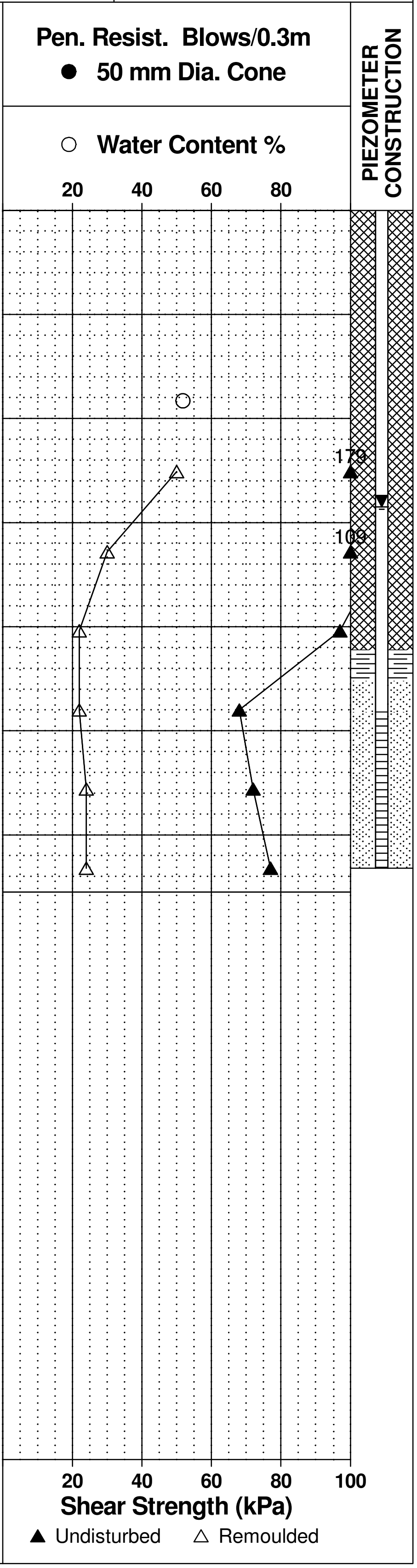
**FILE NO.** PG6948
**HOLE NO.** BH 2-24

| SAMPLE DESCRIPTION | | SAMPLE | | | |
|---|---|---|---|---|---|
| | | TYPE | NUMBER | % RECOVERY | N VALUE or RQD |
| **Ground Surface** | | | | | |
| **FILL**: Brown silty sand with crushed stones and gravel | 0.48 | AU | 1 | | |
| **FILL**: Brown silty sand, some gravel, clay, organics and crushed stones | 0.76 | AU | 2 | | |
| Compact, brown **SILTY SAND**, some clay | 1.45 | AU<br>SS | 3<br>4 | 0 | 15 |
| Hard to stiff, brown **SILTY CLAY** | 4.42 | SS | 5 | 100 | 7 |
| Stiff, grey **SILTY CLAY**, trace sand | 6.55 | G | 6 | | |

End of Borehole

(GWL @ 2.85m - Jan. 12, 2024)

| DEPTH (m) | ELEV. (m) |
|---|---|
| 0 | 64.78 |
| 1 | 63.78 |
| 2 | 62.78 |
| 3 | 61.78 |
| 4 | 60.78 |
| 5 | 59.78 |
| 6 | 58.78 |



**patersongroup** Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

# SOIL PROFILE AND TEST DATA

**Geotechnical Investigation**
**Prop. Residential Buildings - 295 & 355 Deschatelets Ave.**
**Ottawa, Ontario**

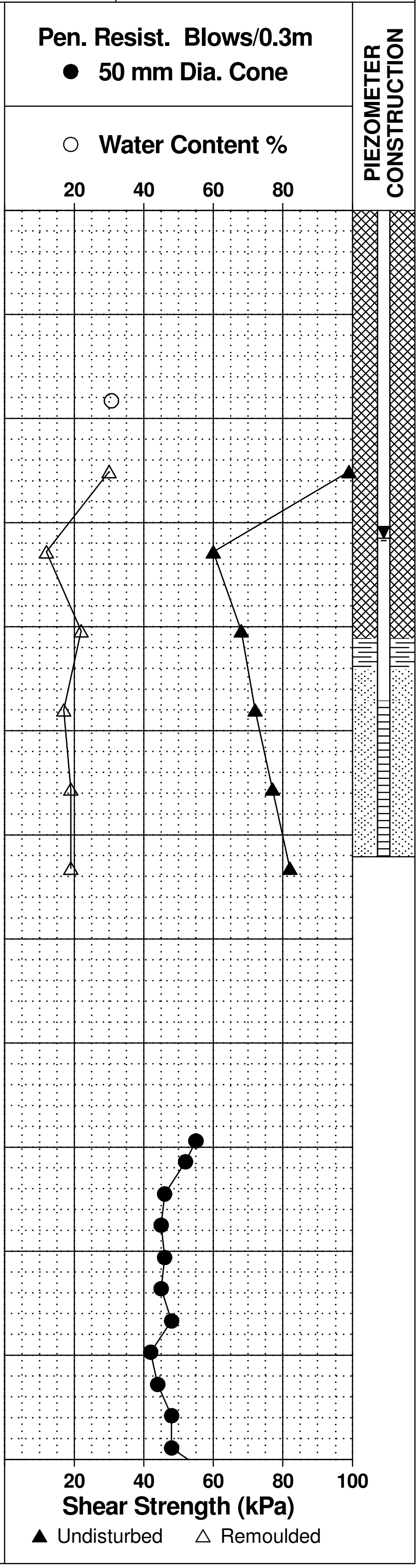
**EASTING:** 369333.055 **NORTHING:** 5030267.918 **ELEVATION:** 64.67
**DATUM:** Geodetic
**REMARKS:**
**BORINGS BY:** CME 55 Low Clearance Power Auger **DATE:** January 5, 2024

**FILE NO.** PG6948
**HOLE NO.** BH 3-24

| SAMPLE DESCRIPTION | Depth to base (m) | SAMPLE TYPE | NUMBER | % RECOVERY | N VALUE or RQD |
|---|---|---|---|---|---|
| Ground Surface | | | | | |
| **FILL**: Brown silty sand with crushed stones, gravel and clay | 0.30 | AU | 1 | | |
| | 0.69 | AU | 2 | | |
| **FILL**: Brown silty sand, some clay, trace gravel | | SS | 3 | | 11 |
| Compact, brown **SILTY SAND**<br>- trace to some clay by 1.1m depth | 1.45 | | | | |
| Very stiff to stiff, brown **SILTY CLAY**, trace sand | 2.90 | SS | 4 | | 4 |
| Stiff, grey **SILTY CLAY**, trace sand | 6.55 | G | 5 | | |
| | | G | 6 | | |

| DEPTH (m) | ELEV. (m) |
|---|---|
| 0 | 64.67 |
| 1 | 63.67 |
| 2 | 62.67 |
| 3 | 61.67 |
| 4 | 60.67 |
| 5 | 59.67 |
| 6 | 58.67 |
| 7 | 57.67 |
| 8 | 56.67 |
| 9 | 55.67 |
| 10 | 54.67 |
| 11 | 53.67 |
| 12 | 52.67 |

Dynamic Cone Penetration Test commenced at 6.10m depth. The cone was pushed until resistance was attained at the depth which our field personnel started counting blow counts.



**patersongroup** Consulting Engineers

9 Auriga Drive, Ottawa, Ontario K2E 7T9

# SOIL PROFILE AND TEST DATA

**Geotechnical Investigation**
**Prop. Residential Buildings - 295 & 355 Deschatelets Ave.**
**Ottawa, Ontario**

**EASTING:** 369333.055 **NORTHING:** 5030267.918 **ELEVATION:** 64.67

**DATUM:** Geodetic

**REMARKS:**

**BORINGS BY:** CME 55 Low Clearance Power Auger **DATE:** January 5, 2024

**FILE NO.** PG6948

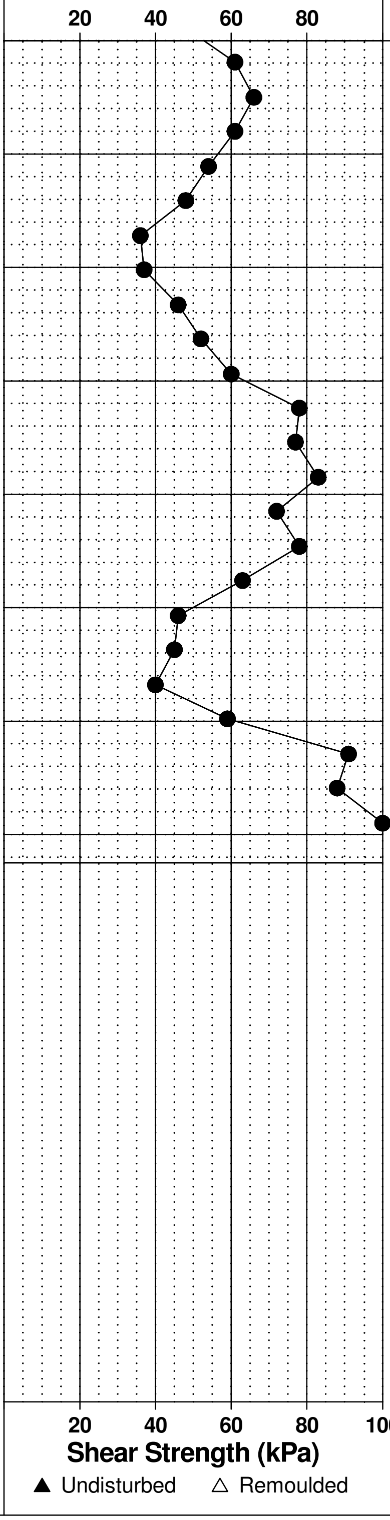
**HOLE NO.** BH 3-24

| SAMPLE DESCRIPTION | STRATA PLOT | SAMPLE | | | | DEPTH (m) | ELEV. (m) |
|---|---|---|---|---|---|---|---|
| | | TYPE | NUMBER | % RECOVERY | N VALUE or RQD | | |
| Ground Surface | | | | | | 12 | 52.67 |
| | | | | | | 13 | 51.67 |
| | | | | | | 14 | 50.67 |
| | | | | | | 15 | 49.67 |
| | | | | | | 16 | 48.67 |
| | | | | | | 17 | 47.67 |
| | | | | | | 18 | 46.67 |
| 19.25 | | | | | | 19 | 45.67 |
| End of Borehole<br>Practical DCPT refusal at 19.25m depth<br>(GWL @ 3.15m - Jan. 12, 2024) | | | | | | | |

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

○ **Water Content %**

**PIEZOMETER CONSTRUCTION**



# SYMBOLS AND TERMS

## SOIL DESCRIPTION

Behavioural properties, such as structure and strength, take precedence over particle gradation in describing soils. Terminology describing soil structure are as follows:

| | | |
|---|---|---|
| Desiccated | - | having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc. |
| Fissured | - | having cracks, and hence a blocky structure. |
| Varved | - | composed of regular alternating layers of silt and clay. |
| Stratified | - | composed of alternating layers of different soil types, e.g. silt and sand or silt and clay. |
| Well-Graded | - | Having wide range in grain sizes and substantial amounts of all intermediate particle sizes (see Grain Size Distribution). |
| Uniformly-Graded | - | Predominantly of one grain size (see Grain Size Distribution). |

The standard terminology to describe the strength of cohesionless soils is the relative density, usually inferred from the results of the Standard Penetration Test (SPT) 'N' value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm.

| Relative Density | 'N' Value | Relative Density % |
|---|---|---|
| Very Loose | <4 | <15 |
| Loose | 4-10 | 15-35 |
| Compact | 10-30 | 35-65 |
| Dense | 30-50 | 65-85 |
| Very Dense | >50 | >85 |

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory vane tests, penetrometer tests, unconfined compression tests, or occasionally by Standard Penetration Tests.

| Consistency | Undrained Shear Strength (kPa) | 'N' Value |
|---|---|---|
| Very Soft | <12 | <2 |
| Soft | 12-25 | 2-4 |
| Firm | 25-50 | 4-8 |
| Stiff | 50-100 | 8-15 |
| Very Stiff | 100-200 | 15-30 |
| Hard | >200 | >30 |

# SYMBOLS AND TERMS (continued)

## SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their “sensitivity”. The sensitivity is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil.

Terminology used for describing soil strata based upon texture, or the proportion of individual particle sizes present is provided on the Textural Soil Classification Chart at the end of this information package.

## ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NXL size core. However, it can be used on smaller core sizes, such as BX, if the bulk of the fractures caused by drilling stresses (called “mechanical breaks”) are easily distinguishable from the normal in situ fractures.

| **RQD %** | **ROCK QUALITY** |
|---|---|
| 90-100 | Excellent, intact, very sound |
| 75-90 | Good, massive, moderately jointed or sound |
| 50-75 | Fair, blocky and seamy, fractured |
| 25-50 | Poor, shattered and very seamy or blocky, severely fractured |
| 0-25 | Very poor, crushed, very severely fractured |

## SAMPLE TYPES

| | | |
|---|---|---|
| SS | - | Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT)) |
| TW | - | Thin wall tube or Shelby tube |
| PS | - | Piston sample |
| AU | - | Auger sample or bulk sample |
| WS | - | Wash sample |
| RC | - | Rock core sample (Core bit size AXT, BXL, etc.). Rock core samples are obtained with the use of standard diamond drilling bits. |

# SYMBOLS AND TERMS (continued)

## GRAIN SIZE DISTRIBUTION

MC% - Natural moisture content or water content of sample, %
LL - Liquid Limit, % (water content above which soil behaves as a liquid)
PL - Plastic limit, % (water content above which soil behaves plastically)
PI - Plasticity index, % (difference between LL and PL)

Dxx - Grain size which xx% of the soil, by weight, is of finer grain sizes
These grain size descriptions are not used below 0.075 mm grain size
D10 - Grain size at which 10% of the soil is finer (effective grain size)
D60 - Grain size at which 60% of the soil is finer

Cc - Concavity coefficient = $(D30)^2 / (D10 \times D60)$
Cu - Uniformity coefficient = D60 / D10

Cc and Cu are used to assess the grading of sands and gravels:
Well-graded gravels have: $1 < Cc < 3$ and $Cu > 4$
Well-graded sands have: $1 < Cc < 3$ and $Cu > 6$
Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.
Cc and Cu are not applicable for the description of soils with more than 10% silt and clay
(more than 10% finer than 0.075 mm or the #200 sieve)

## CONSOLIDATION TEST

$p'_o$ - Present effective overburden pressure at sample depth
$p'_c$ - Preconsolidation pressure of (maximum past pressure on) sample
Ccr - Recompression index (in effect at pressures below $p'_c$)
Cc - Compression index (in effect at pressures above $p'_c$)

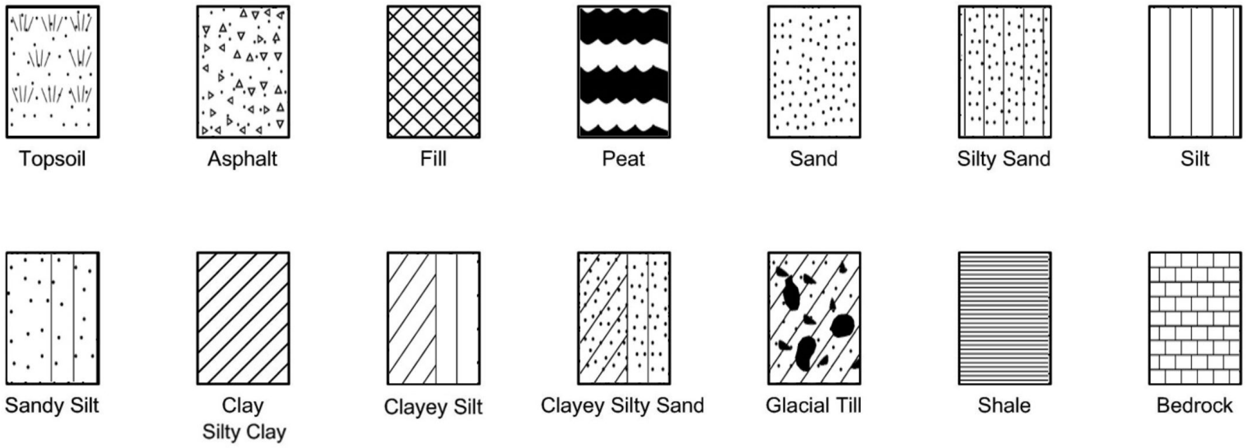
OC Ratio Overconsolidaton ratio = $p'_c / p'_o$
Void Ratio Initial sample void ratio = volume of voids / volume of solids
Wo - Initial water content (at start of consolidation test)

## PERMEABILITY TEST

k - Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during the test.

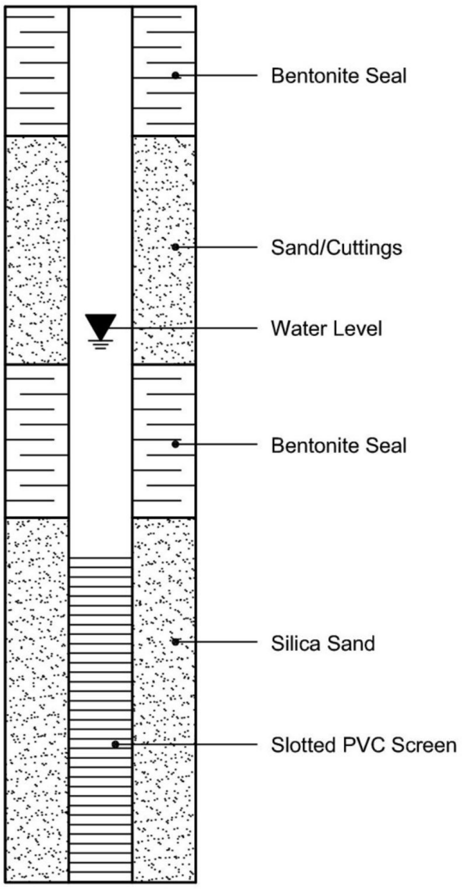
## SYMBOLS AND TERMS (continued)

### STRATA PLOT

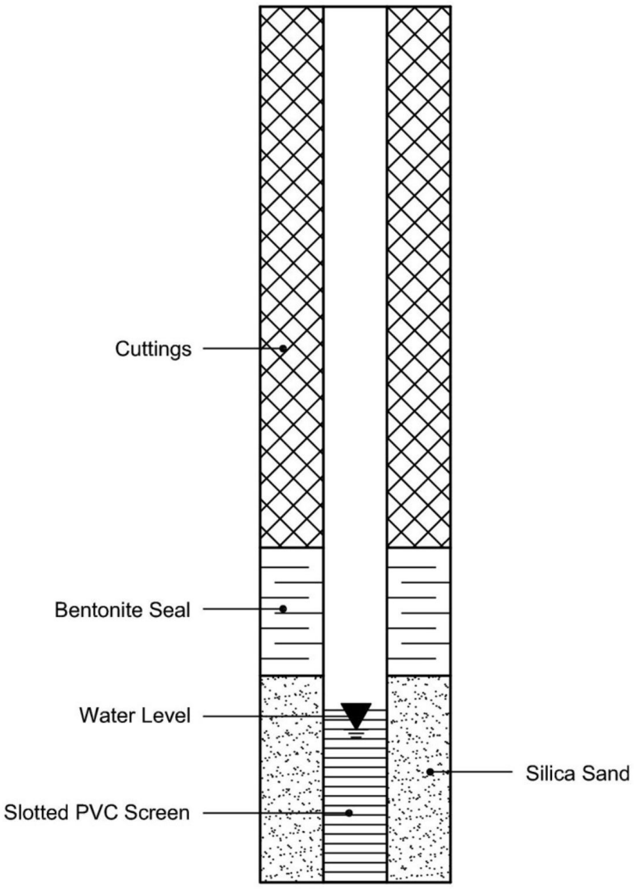


### MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



PROJECT: 14-1122-0005-5000

# RECORD OF BOREHOLE: 14-2

SHEET 1 OF 2

LOCATION: See Site Plan

BORING DATE: March 24-25, 2014

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

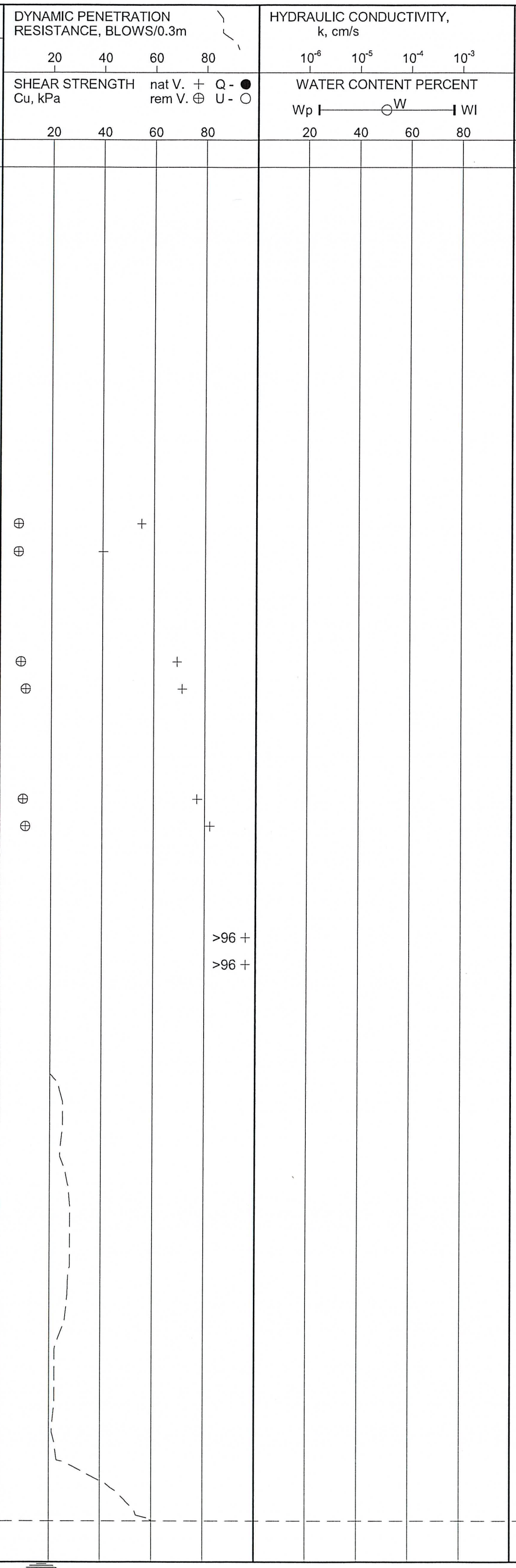
BORING METHOD: Power Auger 200 mm Diam. (Hollow Stem); DCPT

**SOIL PROFILE**

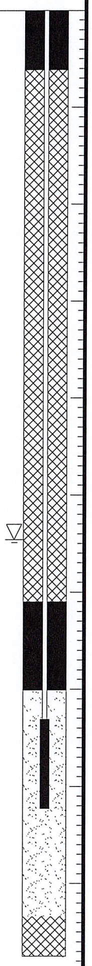
| DESCRIPTION | ELEV. DEPTH (m) |
|---|---|
| GROUND SURFACE | 64.46 |
| FILL - TOPSOIL | 0.05 |
| FILL - (CI/CH) SILTY CLAY; brown, with organic matter; cohesive, w<PL | 63.85<br>0.61 |
| FILL - (ML) sandy SILT; brown; non-cohesive, moist, loose | 62.94<br>1.52 |
| (CI/CH) SILTY CLAY; grey brown, fissured, with silty sand seams (WEATHERED CRUST); cohesive, w>PL, stiff to very stiff | 61.57<br>2.89 |
| (CI/CH) SILTY CLAY; grey with black mottling; cohesive, w>PL, firm to very stiff | 55.01<br>9.45 |
| (SM) SILTY SAND, fine; grey; non-cohesive, wet, compact | 54.71<br>9.75 |
| Possible Sand or Glacial Till | 49.83<br>14.63 |
| Possible Glacial Till | |

**SAMPLES**

| NUMBER | TYPE | BLOWS/0.30m |
|---|---|---|
| 1 | SS | 5 |
| 2 | SS | 7 |
| 3 | SS | 2 |
| 4 | SS | 3 |
| 5 | SS | WH |
| 6 | SS | PH |
| 7 | SS | WH |
| 8 | SS | 2 |
| 9 | SS | 16 |



**PIEZOMETER OR STANDPIPE INSTALLATION**



- Bentonite Seal
- Native Backfill
- Bentonite Seal
- Silica Sand
- Standpipe
- Silica Sand
- Cave

WL in Standpipe at Elev. 58.99 m on Sept. 9, 2014

CONTINUED NEXT PAGE

DEPTH SCALE 1 : 75

Golder Associates

LOGGED: DWM

CHECKED: CK

PROJECT: 14-1122-0005-5000

# RECORD OF BOREHOLE: 14-2

SHEET 2 OF 2

LOCATION: See Site Plan

BORING DATE: March 24-25, 2014

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

| DEPTH SCALE METRES | BORING METHOD | SOIL PROFILE DESCRIPTION | STRATA PLOT | ELEV. DEPTH (m) | SAMPLES NUMBER | TYPE | BLOWS/0.30m | DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80) | HYDRAULIC CONDUCTIVITY, k, cm/s ($10^{-6}$ $10^{-5}$ $10^{-4}$ $10^{-3}$); WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (20 40 60 80) | ADDITIONAL LAB. TESTING | PIEZOMETER OR STANDPIPE INSTALLATION |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *--- CONTINUED FROM PREVIOUS PAGE ---* | | | | | | | | | |
| 15 | DCPT | Possible Glacial Till | ▨ | | | | | | | | |
| 16 | | | | | | | | | | | |
| 17 | | | | | | | | | | | |
| 18 | | | | | | | | | | | |
| 19 | | | | | | | | | | | |
| 20 | | End of Borehole<br>Dynamic Cone Penetration Test Refusal | | 44.42<br>20.04 | | | | | | | |
| 21 | | | | | | | | | | | |
| 22 | | | | | | | | | | | |
| 23 | | | | | | | | | | | |
| 24 | | | | | | | | | | | |
| 25 | | | | | | | | | | | |
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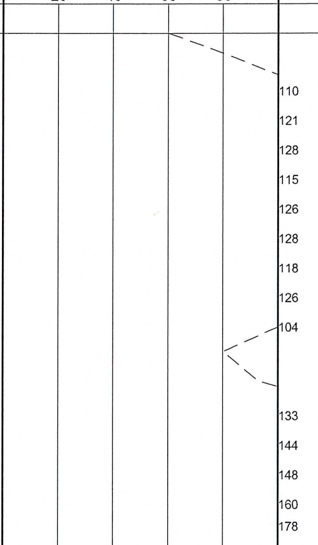
| 30 | | | | | | | | | | | |



DEPTH SCALE

1 : 75

Golder Associates

LOGGED: DWM

CHECKED: CK

MIS-BHS 001 1411220005-5000.GPJ GAL-MIS.GDT 12/12/14 JM

PROJECT: 14-1122-0005-5100

# RECORD OF BOREHOLE: 14-207

SHEET 1 OF 1

LOCATION: See Site Plan

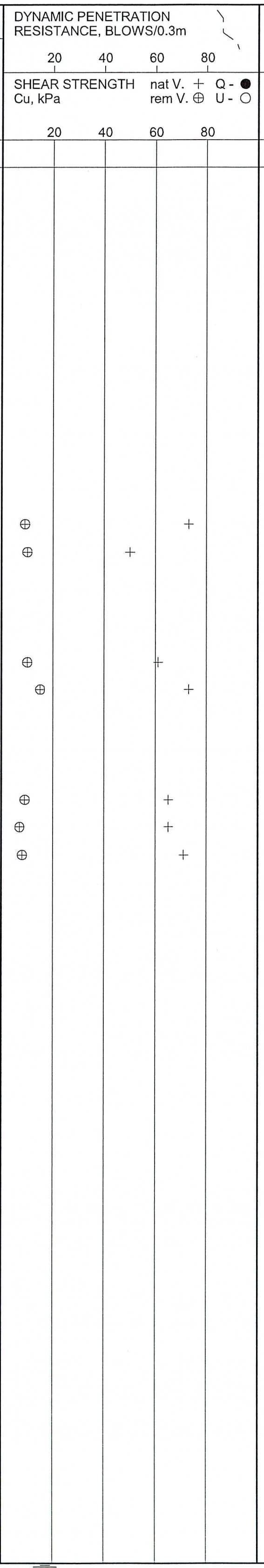
BORING DATE: July 30, 2014

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

| BORING METHOD | SOIL PROFILE DESCRIPTION | STRATA PLOT | ELEV. | DEPTH (m) | SAMPLES NUMBER | TYPE | BLOWS/0.30m |
|---|---|---|---|---|---|---|---|
| | GROUND SURFACE | | 64.63 | 0.00 | | | |
| Power Auger<br>200 mm Diam. (Hollow Stem) | FILL - (SM) SILTY SAND, trace organics; brown; non-cohesive, dry, compact | ▨ | | | 1 | SS | 13 |
| | FILL - (SM) SILTY SAND, trace clayey silt layers; light brown; non-cohesive, dry, compact | ▨ | 64.02 | 0.61 | 2 | SS | 13 |
| | (CL-ML) SILTY CLAY to sandy CLAYEY SILT; grey brown (WEATHERED CRUST); cohesive, w<PL, very stiff to stiff | ▨ | 63.41 | 1.22 | 3<br>4 | SS<br>SS | 6<br>2 |
| | (ML) CLAYEY SILT, trace to some fine sand; grey brown; cohesive, w>PL, stiff to firm | ▨ | 61.58 | 3.05 | 5 | SS | 3 |
| | (CI/CH) SILTY CLAY to CLAY, trace sand; grey; cohesive, w>PL, stiff | ▨ | 60.06 | 4.57 | 6<br>7 | SS<br>SS | PM<br>PM |
| | End of Borehole | | 57.01 | 7.62 | | | |



HYDRAULIC CONDUCTIVITY, k, cm/s: $10^{-6}$ $10^{-5}$ $10^{-4}$ $10^{-3}$

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl; 20 40 60 80

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE METRES

DEPTH SCALE 1 : 75

Golder Associates

LOGGED: DWM

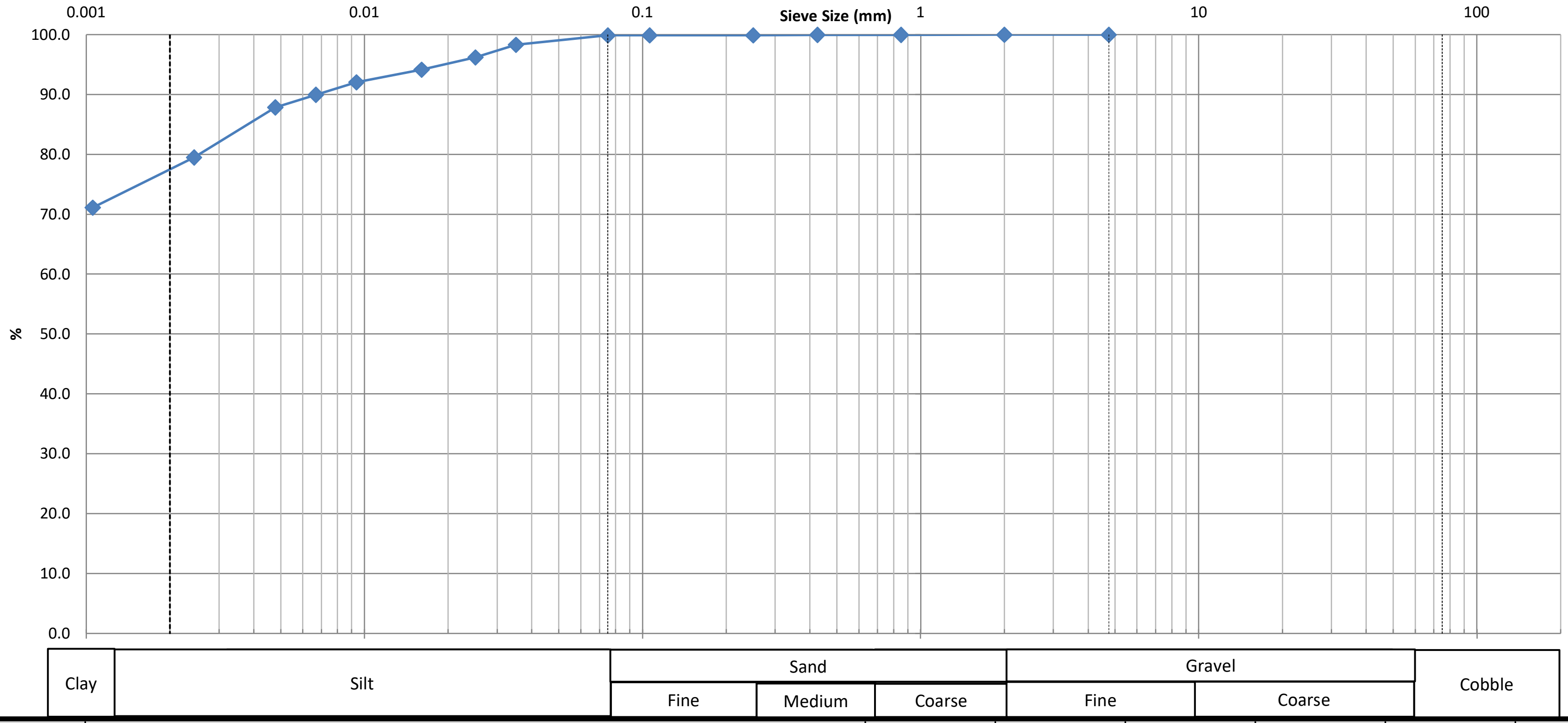
CHECKED: CK

MIS-BHS 001 1411220005-5000.GPJ GAL-MIS.GDT 12/12/14 JM

PATERSON GROUP

# SIEVE ANALYSIS
ASTM C136

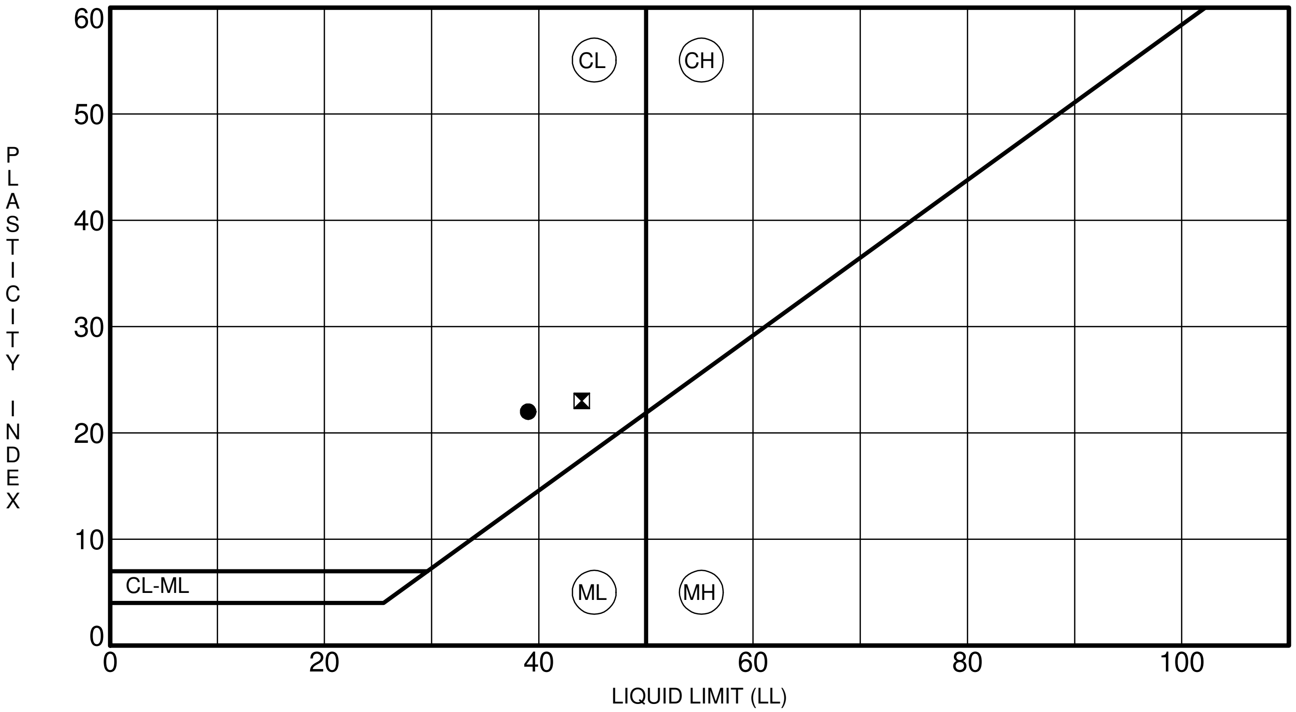
| | | | | | |
|---|---|---|---|---|---|
| CLIENT: | Regional Group | DEPTH: | 5' - 7' | FILE NO: | PG6948 |
| CONTRACT NO.: | | BH OR TP No.: | BH2-23 SS5 | LAB NO: | 50843 |
| PROJECT: | 295 & 355 Deschalates Avenue | | | DATE RECEIVED: | 10-Jan-24 |
| | | | | DATE TESTED: | 11-Jan-24 |
| DATE SAMPLED: | 5-Jan-24 | | | DATE REPORTED: | 16-Jan-24 |
| SAMPLED BY: | J.P | | | TESTED BY: | D.K |



| Identification | Soil Classification | | | | MC(%) | LL | PL | PI | Cc | Cu |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 42.0% | | | | | |
| | D100 | D60 | D30 | D10 | Gravel (%) | Sand (%) | | Silt (%) | Clay (%) | |
| | | | | | 0.0 | 0.1 | | 21.9 | 78.0 | |

**Comments:**

| | | |
|---|---|---|
| **REVIEWED BY:** | **Curtis Beadow** | **Joe Forsyth, P. Eng.** |



| | Specimen Identification | | LL | PL | PI | Fines | Classification |
|---|---|---|---|---|---|---|---|
| ● | **BH 1-24** | **SS 6** | **39** | **17** | **22** | | **CL - Inorganic clays of low plasticity** |
| ⧗ | **BH 3-24** | **SS 4** | **44** | **21** | **23** | | **CL - Inorganic clays of low plasticity** |
| | | | | | | | |
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CLIENT **Regional Group**

PROJECT **Geotechnical Investigation - Prop. Residential Buildings - 295 & 355 Deschatelets Ave.**

FILE NO. **PG6948**

DATE **5 Jan 24**

**patersongroup** **Consulting Engineers**

**9 Auriga Drive, Ottawa, Ontario K2E 7T9**

## ATTERBERG LIMITS' RESULTS

Certificate of Analysis

Report Date: 15-Jan-2024

**Client: Paterson Group Consulting Engineers (Ottawa)**

Order Date: 9-Jan-2024

**Client PO: 59202**

**Project Description: PG6948**

|  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|
|  | **Client ID:** | BH1-23-SS5 | - | - | - | - | - |
|  | **Sample Date:** | 05-Jan-24 09:00 | - | - | - |  |  |
|  | **Sample ID:** | 2402158-01 | - | - | - |  |  |
|  | **Matrix:** | Soil | - | - | - |  |  |
|  | **MDL/Units** |  |  |  |  |  |  |
| **Physical Characteristics** |  |  |  |  |  |  |  |
| % Solids | 0.1 % by Wt. | 77.2 | - | - | - | - | - |
| **General Inorganics** |  |  |  |  |  |  |  |
| pH | 0.05 pH Units | 7.39 | - | - | - | - | - |
| Resistivity | 0.1 Ohm.m | 25.2 | - | - | - | - | - |
| **Anions** |  |  |  |  |  |  |  |
| Chloride | 10 ug/g | 137 | - | - | - | - | - |
| Sulphate | 10 ug/g | 110 | - | - | - | - | - |

# APPENDIX 2

FIGURE 1 - KEY PLAN

DRAWING PG6948-1 - TEST HOLE LOCATION PLAN

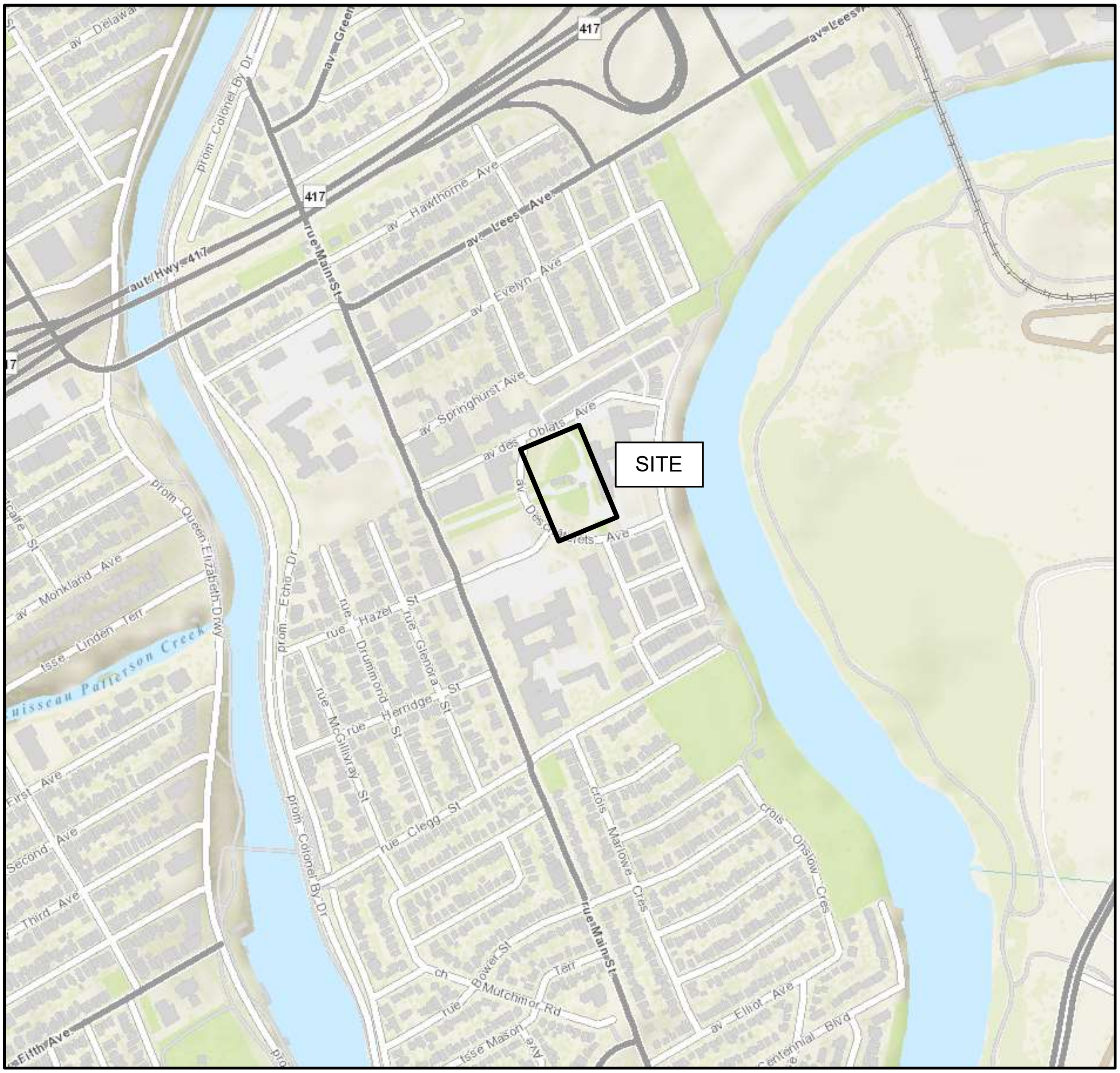
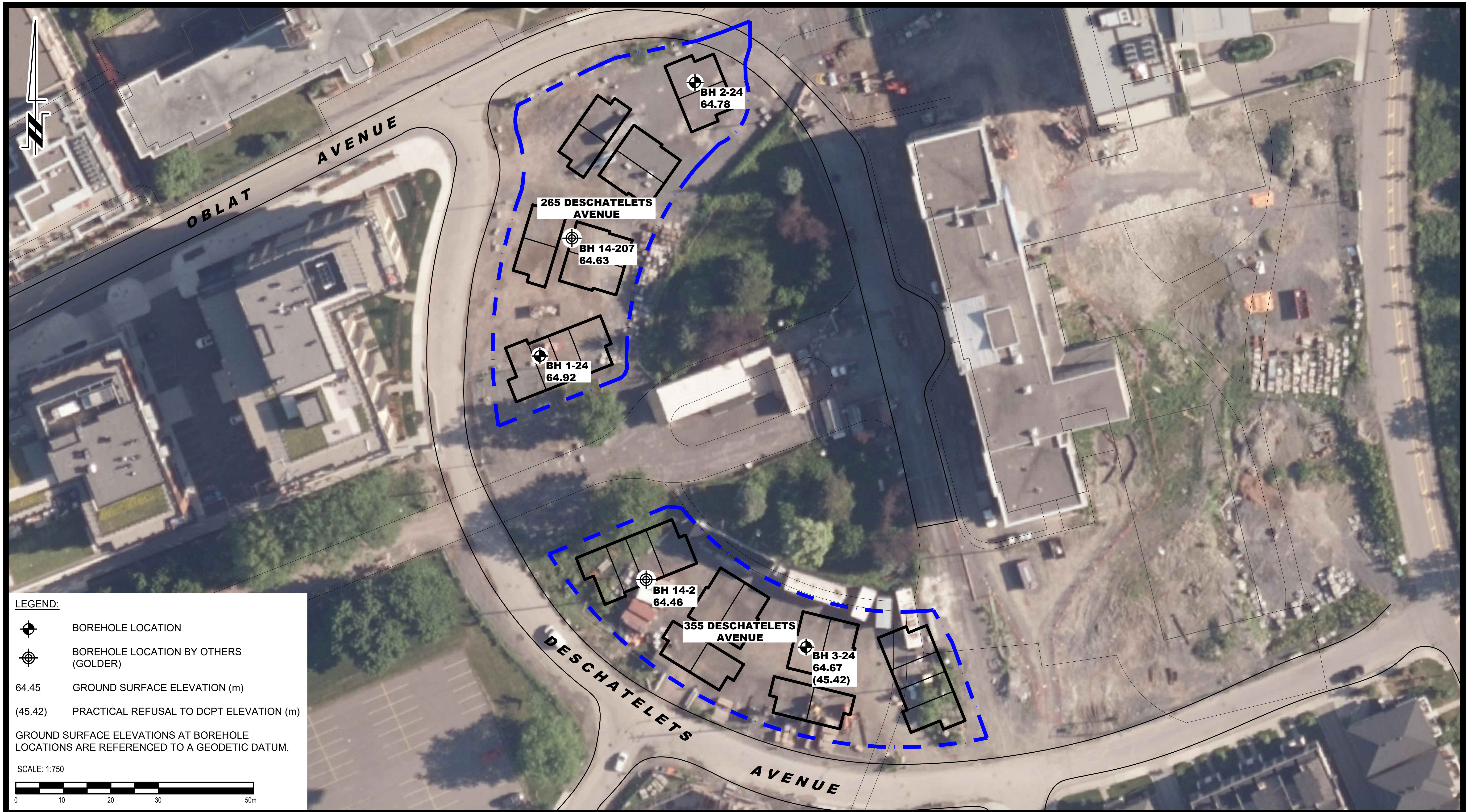


**FIGURE 1**

**KEY PLAN**

PATERSON
GROUP



LEGEND:

| | |
|---|---|
| ⌖ | BOREHOLE LOCATION |
| ⊕ | BOREHOLE LOCATION BY OTHERS (GOLDER) |
| 64.45 | GROUND SURFACE ELEVATION (m) |
| (45.42) | PRACTICAL REFUSAL TO DCPT ELEVATION (m) |

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

SCALE: 1:750

0 10 20 30 50m

**PATERSON GROUP**

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

| NO. | REVISIONS | DATE | INITIAL |
|---|---|---|---|

REGIONAL GROUP
GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL DEVELOPMENT
295 & 355 DESCHATELETS AVENUE

OTTAWA, ONTARIO

Title:

# TEST HOLE LOCATION PLAN

Scale: 1:750
Drawn by: ZS
Checked by: MR
Approved by: SD

Date: 01/2024
Report No.: PG6948-1
Dwg. No.: **PG6948-1**
Revision No.:

11x17

p:\autocad drawings\geotechnical\pg69xx\pg6948\pg6948-1-test hole location plan.dwg