



**Geotechnical Investigation  
Proposed Residential Development  
349 Danforth Avenue, Ottawa, Ontario**

**Client:**

Mr. Fernando Matos  
337 Sunnyside Avenue, Suite 101  
Ottawa, Ontario K1S 0R9  
fernando@ottawacarletonconstruction.com

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**Prepared By:**

Ismail M. Taki, M.Eng. P.Eng.  
Manager, Geotechnical Services

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## Executive Summary

A geotechnical investigation was undertaken at the site of the proposed three (3) storey without a basement residential building to be located at 349 Danforth Avenue, City of Ottawa, Ontario. Terms and conditions of the assignment were outlined in EXP's Proposal dated March 12, 2020.

The fieldwork for the geotechnical investigation was completed on June 29 to 30, 2020 and comprised the drilling of three (3) boreholes, i.e., Borehole Nos. 1 to 3, to depths ranging between 9.5 m and 10.2 m below the existing ground surface. The boreholes were drilled using truck-mounted drill-rig equipment operated by a drilling specialist subcontracted to EXP and was supervised on a full-time basis by a representative of EXP.

The investigation has revealed that the subsurface conditions comprise of very loose to loose fill underlain by bedrock encountered at depths ranging from 0.6 m and 0.8 m below ground surface. Wash boring and core drilling used to advance all boreholes into bedrock to depths ranging from 9.5 m to 10.2 m below ground surface.

Water level measurements were made in the monitoring wells installed in all boreholes upon and after installation. The measurements revealed that the groundwater table to be at a depth ranging between 5.0 m and 6.0 m below the existing ground surface or elevations 95.4 m to 93.8 m.

A significant grade raise is not expected at the site. However, for design purposes, a maximum grade raise of 1 m is permissible at the site from a geotechnical point of view.

Based on the results of the investigation, the proposed building may be founded on the limestone bedrock below any weathered or fractured zones and designed for a bearing pressure at Ultimate Limit State (ULS) of 1000 kPa.

All the footing beds should be examined by a senior geotechnician to ensure that they are prepared properly, and they are able to support the ULS bearing pressure.

The basement slab of the proposed building may be set on a bed of 300 mm of clear stone set over bedrock or engineered fill. Perimeter drainage systems is recommended for the proposed building with one basement level.

Excavations at the site in the overburden may be undertaken as open-cut provided they are cut back at a slope of 1H to 1V. Excavation of the bedrock would require the use of hoe-ramming and/or line drilling and may be undertaken with near vertical sides. Vibrations should be monitored during construction to prevent damage to adjacent structures and services. A pre-condition survey of all the structures and services situated within proximity of the site will be required prior to commencement of construction and during the excavation of the bedrock. Care must be undertaken to ensure that the footings of the neighbouring properties are not undermined or damaged during construction.

Seepage of surface water into the excavations should be anticipated. It should be possible to collect the water entering the excavation in perimeter ditches and to remove it by pumping from sumps.

The subject site has been classified as Class C for seismic site response in relation to Section 4.1.8.4 of the 2012 Ontario Building Code (OBC 2012). A higher site class for the site may be obtained if a shear-wave measurement is completed at the site.

Sensitive marine clays were not encountered on-site, therefore there no restriction to tree planting from a geotechnical point of view, however, a landscaped architect must be consulted regarding the presence of shallow bedrock on-site and adequacy of tree planting.

The above and other related considerations are discussed in greater detail in the report.

## 1 Introduction

A geotechnical investigation was undertaken at the site of the proposed three (3) storey basementless residential building at 349 Danforth Avenue, City of Ottawa, Ontario (Figure 1). Terms and conditions of the assignment were outlined in EXP's Proposal dated March 12, 2020.

Design site grades as well design ground floor/basement elevations were not available at the time of preparation of the report. The building currently existing on-site will be demolished to allow the new construction.

The geotechnical investigation was undertaken to:

- a) Establish the subsurface soil, bedrock and groundwater conditions at the location of the boreholes drilled at the site;
- b) Comment on grade-raise restrictions for the site;
- c) Make recommendations on the most suitable type of foundations, founding depth and Serviceability Limit State (SLS) bearing pressures and Ultimate Limit State (ULS) factored geotechnical resistances for the proposed addition as well as anticipated total and differential settlements;
- d) Provide lateral earth pressure parameters for subsurface basement wall design;
- e) Comment on backfilling requirements and suitability of the on-site soils for backfilling purposes;
- f) Discuss excavation conditions and dewatering requirements during construction; and
- g) Provide classification of the site for seismic design in accordance with requirements of the 2012 Ontario Building Code (OBC) and assess the liquefaction potential of the on-site soils in a seismic event.

The comments and recommendations given in this report assume that the above-described design concept will proceed into construction. If changes are made either in the design phase or during construction, this office must be retained to review these modifications. The result of this review may be a modification of our recommendations or it may require additional field or laboratory work to check whether the changes are acceptable from a geotechnical viewpoint.

## 2 Site Description

The subject site is a narrow rectangular parcel of land roughly 10 m wide by 30 m long, occupied by an existing two storey residential building (Figure 2). It is understood that the existing building will be demolished prior to the construction of the proposed building. The site is bounded by Danforth Avenue to the southeast and by industrial buildings and parking lots on all other sides. The site is generally flat.

### 3 Procedure

The fieldwork for the geotechnical investigation was completed on June 29 and 30, 2020 and comprised the drilling of three (3) boreholes, i.e., Borehole Nos. 1 to 3, to depths ranging between 9.5 m and 10.2 m below the existing ground surface. The boreholes were drilled using truck-mounted drill-rig equipment operated by a drilling specialist subcontracted to EXP and was supervised on a full-time basis by a representative of EXP.

The locations of the boreholes were established in the field by EXP and are shown on Figure 2. Their elevations were established using a temporary benchmark being the top of storm sewer manhole adjacent to front of the property at Danforth Avenue with an assumed elevation of 100.00 m. Therefore, convergence to geodetic elevations will be required once available.

Prior to the fieldwork, the locations of the boreholes were cleared of any public and private underground services. Standard penetration tests were performed in all the boreholes at continuous depth intervals and soil samples retrieved by split-barrel sampler in accordance with ASTM 1586. Wash-boring and core-drilling techniques were used to advance all boreholes beyond the refusal depth.

Long-term groundwater monitoring installations consisting of 32 mm diameter polyvinyl chloride (PVC) monitoring wells were installed in all boreholes in accordance with EXP standard practice. The installation configuration is documented on the respective borehole log.

All the soil samples were visually examined in the field for textural classification, logged, preserved in plastic bags and identified. Similarly, all the rock cores were visually examined, placed in core boxes, identified and logged. On completion of the fieldwork, all the soil and rock samples were transported to the EXP laboratory in the City of Ottawa, Ontario, where they were visually examined by a geotechnical engineer, and borehole logs prepared. The engineer also assigned the laboratory testing which consisted of performing the following tests on soil and rock samples:

- Natural Moisture Content.....4 Tests
- Unit Weight and Unconfined Compressive Strength Tests on Rock Cores.....3 Tests



## 4 Subsurface Soil and Groundwater Conditions

A detailed description of the geotechnical conditions encountered in the boreholes is given on the borehole logs, Figures 3 to 5 inclusive. The borehole logs and related information depict subsurface conditions only at the specific locations and times indicated. Subsurface conditions and water levels at other locations may differ from conditions at the locations where sampling was conducted. The passage of time may also result in changes in the conditions interpreted to exist at the locations where sampling was conducted.

It should be noted that the soil and rock boundaries indicated on the borehole logs are intended to reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. The “Notes on Sample Descriptions” preceding borehole logs form an integral part of this report and should be read in conjunction with this report.

A review of the borehole logs indicates the following subsurface soil and groundwater conditions with depth.

### 4.1 Fill

Fill was encountered from the ground surface in all boreholes and extended to bedrock surface at 0.6 m to 0.8 m below ground surface.

The fill is very loose to loose, heterogeneous in nature and consists of a 100 mm to 150 mm layer of crushed stone type (sand and gravel) underlain by silty sand with gravel.

### 4.2 Bedrock

The shallow deposit of fill is underlain by bedrock which was investigated to depths of 9.5 m to 10.2 m below ground surface (Elevation 90.2 m to Elevation 89.6 m).

A review of the recovered bedrock cores and published geology maps indicate that the bedrock underlying the site comprises of limestone and shale of the Billings Formation of the Upper Ordovician Period.

A Total Core Recovery (TCR) and Rock Quality Designation (RQD) of 98 to 100 percent and 28 to 95 percent respectively were obtained from the recovered bedrock cores. On this basis, the bedrock quality within the depth investigated may be classified as poor to excellent quality.

A total of three (3) rock core samples were selected for unconfined compressive strength testing and the test results are presented in Table I. A review of the test results indicates a bedrock with compressive strength ranging between 105 MPa and 161 MPa. Based on these values, the rock can be classified with respect to intact strength as “very strong”, (Canadian Foundation engineering manual, 4th edition, 2006). The unit weight of the bedrock ranged between 2707 kg/m<sup>3</sup> and 2714 kg/m<sup>3</sup>.

Table 1: Results of Unconfined Compression Tests on Rock Core Samples			
Borehole No. Run No.	Depth (m)	Compressive Strength (MPa)	Unit Weight of Bedrock (Kg/m <sup>3</sup> )
BH/MW1 – Run 1	1.3 – 1.4	133.2	2673
BH/MW2 – Run 1	0.8 – 0.9	87.1	2651
BH/MW3 – Run 1	0.8 – 0.9	234.4	2386

Photographs of the bedrock core recovered are presented in Figure 6 to 8.

### 4.3 Groundwater

Water level measurements were made in the monitoring wells installed in all boreholes upon installation, one (1) day after installation, seven (7) days after installation, and eleven (11) days after installation. The measurements revealed that the groundwater table to be at a depth ranging between 5.0 m and 6.0 m below the existing ground surface or elevations 95.4 m to 93.8 m.

Water levels were determined in the boreholes at the times and under the conditions stated in the scope of services. Note that fluctuations in the level of groundwater may occur due to a seasonal variation such as precipitation, snowmelt, rainfall activities, and other factors not evident at the time of measurement and therefore may be at a higher level during wet weather periods.

## **5 Grade Raise**

The investigation has revealed the site to be underlain by a shallow deposit of overburden (less than 1.0 m) overlying limestone with shale partings to shale bedrock.

Based on the geotechnical findings a grade raise of up to 1 m is considered acceptable from a geotechnical point of view. However, significant grade raise is not expected at the site as the results of the proposed building.

## 6 Foundation Considerations

Floor Plans call for the construction of the proposed three (3) storey basementless residential building. It is understood that the existing building will be demolished prior to the construction of the proposed building.

Based on the results of the investigation, the proposed building may be founded on the limestone bedrock below any weathered or fractured zones and designed for a bearing pressure at Ultimate Limit State (ULS) of 1000 kPa. Since the footings will be founded on sound bedrock, factored geotechnical resistance at ULS will govern the design. Settlement for footings founded on sound bedrock is expected to be minimal.

All footing beds should be examined by a geotechnical engineer to ensure that the founding surfaces can support the design bearing pressure and that the footing beds have been properly prepared as described above. A minimum of 1.2 m of earth cover should be provided to the footings of a heated structure founded on bedrock to protect them from damage due to frost penetration. The frost cover should be increased to 1.5 m for unheated structures.

The recommended bearing pressures have been calculated by EXP from the borehole information for the design stage only. The investigation and comments are necessarily on-going as new information of underground conditions becomes available. For example, more specific information is available with respect to conditions between the boreholes when foundation construction is underway. The interpretation between the boreholes and the recommendations of this report must therefore be checked through field monitoring provided by an experienced geotechnical engineer to validate the information for use during the construction stage.

## **7 Floor Slab and Drainage Requirements**

The lowest basement floor slab of the proposed building may be constructed provided they are set on beds of well-compacted 19 mm clear stone at least 300 mm thick placed on bedrock or on well-compacted engineered fill. The clear stone would prevent the capillary rise of moisture to the floor slab. Adequate saw cuts should be provided in the floor slab to control cracking.

It is anticipated that perimeter drainage system would be required for the proposed building with basement. The perimeter drainage system may consist of 100 mm diameter perforated pipe wrapped with filter cloth (sock) and set on the footings and surrounded with 150 mm of 19 mm clear stone and properly connected to an outflow. The subsurface walls should be adequately damp proofed.

The finished exterior grade should be sloped away from the buildings to prevent surface ponding of water close to the exterior walls.

## **8 Pipe Bedding Requirement**

It is recommended that the bedding for the underground services including material specification, thickness of cover material and compaction requirements conform to the local requirements of the municipality and/or Ontario provincial Standard Specification and Drawings (OPSS and OPSD).

For guidance, the pipe bedding may consist of 150 mm of OPSS 1010 Granular A for services founded on bedrock. The bedding material should be also placed along the sides and on top of the pipes to provide a minimum cover of 300 mm. The bedding, spring line and cover should be compacted to at least 98 percent the Standard Proctor Maximum Dry Density (SPMDD).

## 9 Lateral Earth Pressure against Basement Walls

The subsurface wall should be backfilled with free draining material, such as OPSS 1010 for Granular B, Type II and equipped with a perimeter drainage system to prevent the buildup of hydrostatic pressure behind the walls. The walls will be subjected to lateral static and dynamic (seismic) earth forces.

For design purposes, the lateral static earth thrust against the subsurface walls may be computed from the following equation:

$$P = K_0 H (q + \frac{1}{2} \gamma H)$$

where  $P$  = lateral earth thrust acting on the subsurface wall; kN/m

$K_0$  = lateral earth pressure coefficient for 'at rest' condition for Granular B Type II backfill material = 0.5

$\gamma$  = unit weight of free draining granular backfill; Granular B = 22 kN/m<sup>3</sup>

$H$  = Height of backfill adjacent to foundation wall, m

$q$  = surcharge load, kPa

The lateral seismic thrust may be computed from the equation given below:

$$\Delta P_E = 0.32 \gamma H^2$$

where  $\Delta P_E$  = resultant thrust due to seismic activity; kN/m

$\gamma$  = unit weight of free draining granular backfill; Granular B Type II = 22 kN/m<sup>3</sup>

$H$  = height of backfill behind wall, (m)

The  $\Delta P_E$  value does not take into account the surcharge load. The resultant load should be assumed to act at 0.6 H from the bottom of the wall.

## **10 Excavations and De-Watering Requirements**

Excavations for the construction of the proposed building and underground services will likely be undertaken through the shallow fill and into bedrock to a maximum depth of 1.0 m below ground surface and are expected to be above the prevailing groundwater table.

Excavations at the site must comply with the latest version of Ontario Occupational Health and Safety Act, Ontario Regulations 213/91 (January 11, 2014).

Excavations at the site in the overburden may be undertaken as open-cut provided they are cut back at a slope of 1H to 1V. Excavation of the bedrock is not anticipated however if needed would be minimal up to 1 m and will require the use of hoe-ramming and/or line drilling and may be undertaken with near vertical sides. Vibrations should be monitored during construction to prevent damage to adjacent structures and services. A pre-condition survey of all the structures and services situated within the proximity of the site will be required prior to the commencement of construction and during the excavation of the bedrock. Care must be undertaken to ensure that the footings of the neighbouring properties are not undermined or damaged during construction.

Surface water inflow into the excavation should be expected. However, it should be possible to adequately handle this inflow by collecting the water in perimeter ditches and pumping from properly filtered sumps.



## 11 Seismic Site Classification

### 11.1 Liquefaction Potential

The investigation has revealed that the proposed building will be founded on bedrock.

Based on the results of the investigation, there is no liquefaction potential of the subsurface soil during a seismic event.

### 11.2 Seismic Classification

Based on the subsurface conditions, the site is classified as **Class C for seismic site response** in accordance with Section 4.1.8.4 of the 2012 Ontario Building Code (ONBC 2012).

A higher site class will likely be obtained if a shear-wave velocity testing is completed at the site.

## **12 Backfilling Requirements and Suitability of on-Site Soils for Backfilling Purposes**

The material to be excavated from the site will be comprised of heterogenous fill of limited quantity and bedrock.

It is anticipated that all the material required for backfilling purposes will need to be imported and should preferably conform to OPSS 1010 Granular B Type II.

The on-site fill may be used for grading purposes provided it is free of organics and foreign debris. Excavated bedrock is not suitable for backfilling and should be discarded.

### 13 Subsurface Concrete Conditions

Two bedrock core samples were submitted for Chemical tests limited to pH, chloride, sulphate testing and electrical resistivity and the results are summarized in table II below.

Table II: Chemical Test Results on Soil Sample						
Borehole No.	Soil Type	Depth (m)	pH	Sulphate (%)	Chloride (%)	Resistivity (ohm-cm)
MW-2-Run 1	Bedrock	0.7	7.60	0.0039	0.0031	4670
MW-2-Run 2	Bedrock	1.1	7.49	0.082	0.0060	746

A review of Table II indicates that the sulphate content in the bedrock is less than 0.1 percent which would have negligible potential of sulphate attack on subsurface concrete. The concrete should be designed in accordance with Table Nos. 3 and 6 of CSA A.23.1-19. However, the concrete should be dense, well compacted and cured.

Based on a review of the resistivity test result, the bedrock is considered mildly corrosive to corrosive to bare steel as per the National Association of Corrosion Engineers (NACE). Appropriate measures should be undertaken to protect buried steel elements from corrosion. However, buried steel is not expected to be installed in the bedrock at the site.

Certificate of the laboratory analysis is attached in Appendix A..

## **14 Potential Impact on OLRT Station**

The geotechnical investigation revealed that the subsurface conditions comprise of very loose to loose fill underlain by bedrock encountered at depths ranging from 0.6 m and 0.8 m below ground surface. The groundwater table was established in the bedrock at depths ranging from 5.0 m to 6.0 m below the existing ground surface.

The footing for the proposed building will be set at the surface of the sound bedrock and therefore, excavation and removal of the bedrock is not anticipated. However, removal of some weathered or broken rock may be required for founding purposes. Also, the excavation work will be undertaken above the prevailing groundwater table. Therefore, it is EXP's opinion that the proposed construction and excavation of up to 1m in the bedrock will not have any impact from a geotechnical point of view on the closest Ottawa Light Rail Transit (OLRT) station being the Dominion station situated at a distance of approximately 500 m northwest from the subject site.

## **15 Legal Notification**

This report was prepared by EXP Services Inc. (EXP) for the account of Mr. Fernando Matos.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. EXP accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this project

## 16 General Comments

The comments given in this report are intended only for the guidance of the design engineers. The number of boreholes required to determine the localized underground conditions, especially bedrock elevations between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc., would be much greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should in this light, decide on their own investigations, as well as their own interpretation of the factual borehole and test pit results to draw their own conclusions as to how the subsurface conditions may affect them.

The information contained in this report is not intended to reflect on environmental aspects of the soils and groundwater and is strictly address their geotechnical aspects.

*Mr. Fernando Matos  
Geotechnical Investigation. Proposed Residential Development  
349 Danforth Avenue, Ottawa, Ontario  
OTT-00259161-A0.  
May 15, 2022 (Updated)*

## 17 Signatures

We trust that this information is satisfactory for your purposes. Should you have any questions, please contact this office.

Sincerely



Ismail Taki, M.Eng, P.Eng  
Senior Manager, Eastern Region  
Earth and Environment

*Mr. Fernando Matos  
Geotechnical Investigation. Proposed Residential Development  
349 Danforth Avenue, Ottawa, Ontario  
OTT-00259161-A0.  
May 15, 2022 (Updated)*

## 17 Signatures

We trust that this information is satisfactory for your purposes. Should you have any questions, please contact this office.

Sincerely



Ismail Taki, M.Eng, P.Eng  
Senior Manager, Eastern Region  
Earth and Environment



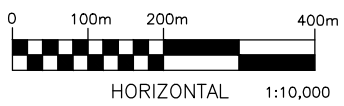


EXP Services Inc.

*Mr. Fernando Matos  
Geotechnical Investigation. Proposed Residential Development  
349 Danforth Avenue, Ottawa, Ontario  
OTT-00259161-A0.  
May 15, 2022 (Updated)*

# Figures

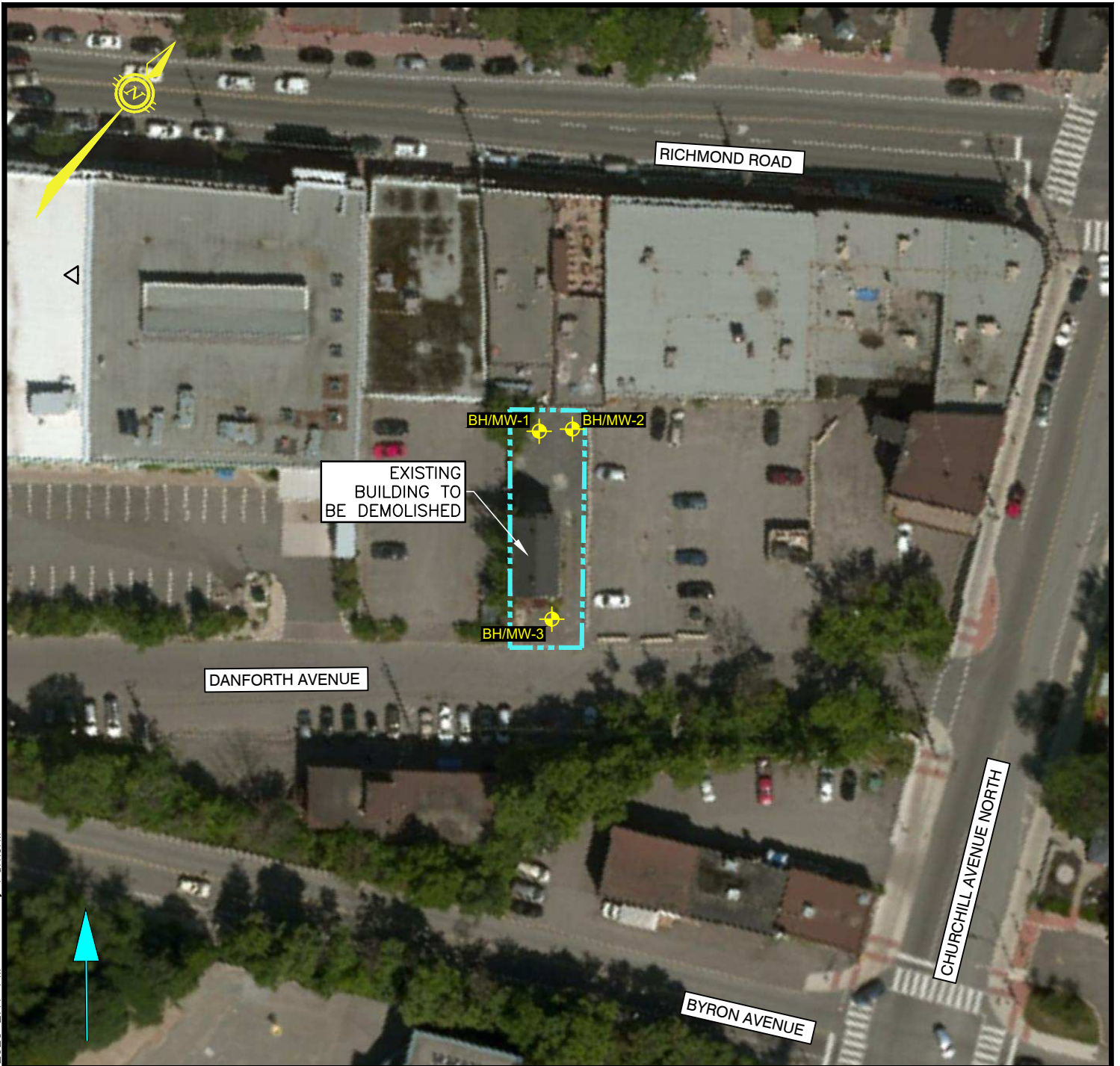
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**EXP Services Inc. [www.exp.com](http://www.exp.com)**  
 t: +1.613.688.1899 | f: +1.613.225.7337  
 2650 Queensview Drive, Suite 100  
 Ottawa, ON K2B 8H6, Canada

DATE JULY 2020		CLIENT: <b>OTTAWA CARLETON CONSTRUCTION GROUP LTD.</b>	project no. OTT-00259161-A0
DESIGN O.V.	CHECKED P.S.		scale 1:10,000
DRAWN BY M.P.		TITLE: <b>SITE LOCATION PLAN</b> 349 DANFORTH AVENUE, OTTAWA, ON	<b>FIG 1</b>





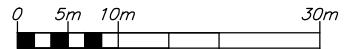
**LEGEND**



PROPERTY BOUNDARY



BOREHOLE/MONITORING WELL LOCATION & NUMBER



HORIZONTAL 1:750



EXP Services Inc. [www.exp.com](http://www.exp.com)

t: +1.613.688.1899 | f: +1.613.225.7337  
 2650 Queensview Drive, Suite 100  
 Ottawa, ON K2B 8H6, Canada

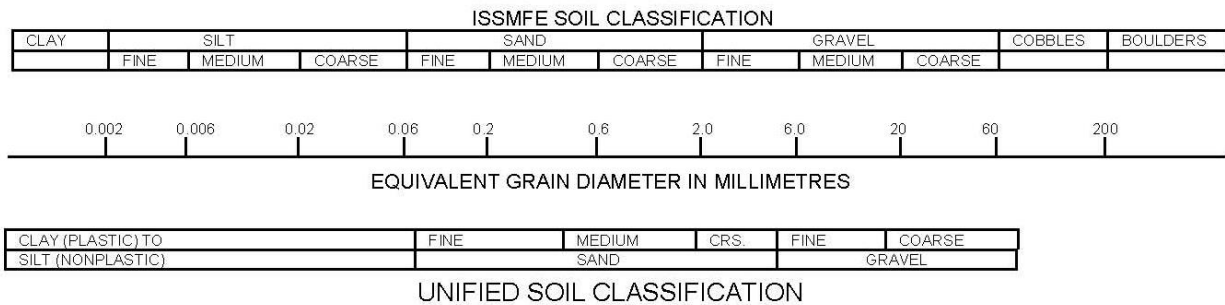
DATE AUGUST 2020		CLIENT: OTTAWA CARLETON CONSTRUCTION GROUP LTD.	project no. OTT-00259161-A0
DESIGN A.N.	CHECKED P.S.	TITLE: GEOTECHNICAL INVESTIGATION 349 DANFORTH AVENUE, OTTAWA, ON	scale 1:750
DRAWN BY M.P.			<b>FIG 2</b>

E:\OTT\00259161-A0\60 Execution\65 Drawings\7-28-2020\349 DANFORTH - FIG1-3.dwg  
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## Notes On Sample Descriptions

- All sample descriptions included in this report follow the Canadian Foundations Engineering Manual soil classification system. This system follows the standard proposed by the International Society for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by **exp** Services Inc. also follow the same system. Different classification systems may be used by others; one such system is the Unified Soil Classification. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.



- Fill:** Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.
- Till:** The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

# Log of Borehole BH/MW1



Project No: OTT-00259161-A0

Figure No. 3

Project: Geotechnical Investigation - Proposed Residential Development

Page. 1 of 1

Location: 349 Danforth Avenue, Ottawa, Ontario

Date Drilled: June 29th, 2020

Split Spoon Sample

Combustible Vapour Reading

Drill Type: CME 55 (truck mount)

Auger Sample

Natural Moisture Content

SPT (N) Value

Atterberg Limits

Datum: Assumed

Dynamic Cone Test

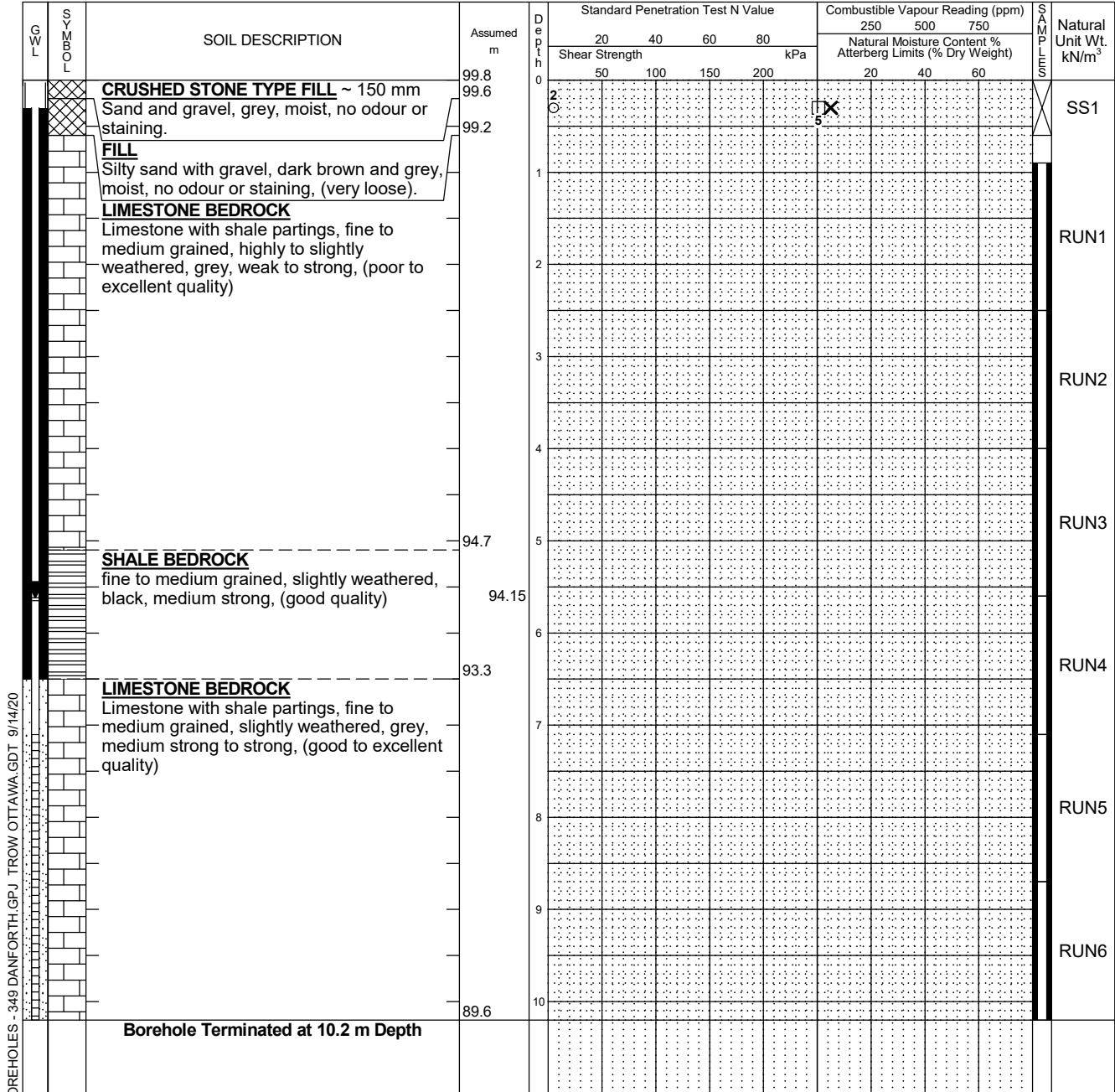
Undrained Triaxial at % Strain at Failure

Shelby Tube

Shear Strength by Penetrometer Test

Logged by: MD Checked by: PS/IT

Shear Strength by Vane Test



NOTES:

- Borehole data requires interpretation by EXP before use by others
- A 32 mm monitoring well with flushmount was installed in the borehole upon completion.
- Field work was supervised by an EXP representative.
- See Notes on Sample Descriptions
- Log to be read with EXP Report OTT-00259161-A0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)
completion	1.0	-
1 day	6.0	-
7 days	6.0	-
11 days	5.7	-

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %
1	0.92 - 2.54	100	49
2	2.54 - 4.04	100	78
3	4.04 - 5.56	100	94
4	5.56 - 7.09	99	88
5	7.09 - 8.66	100	91
6	8.66 - 10.16	100	95

LOG OF BOREHOLE - 349 DANFORTH.GPJ TROW OTTAWA.GDT 9/14/20

# Log of Borehole BH/MW2



Project No: OTT-00259161-A0

Figure No. 4

Project: Geotechnical Investigation - Proposed Residential Development

Page. 1 of 1

Location: 349 Danforth Avenue, Ottawa, Ontario

Date Drilled: June 29th, 2020

Split Spoon Sample

Combustible Vapour Reading

Drill Type: CME 55 (truck mount)

Auger Sample

Natural Moisture Content

SPT (N) Value

Atterberg Limits

Datum: Assumed

Dynamic Cone Test

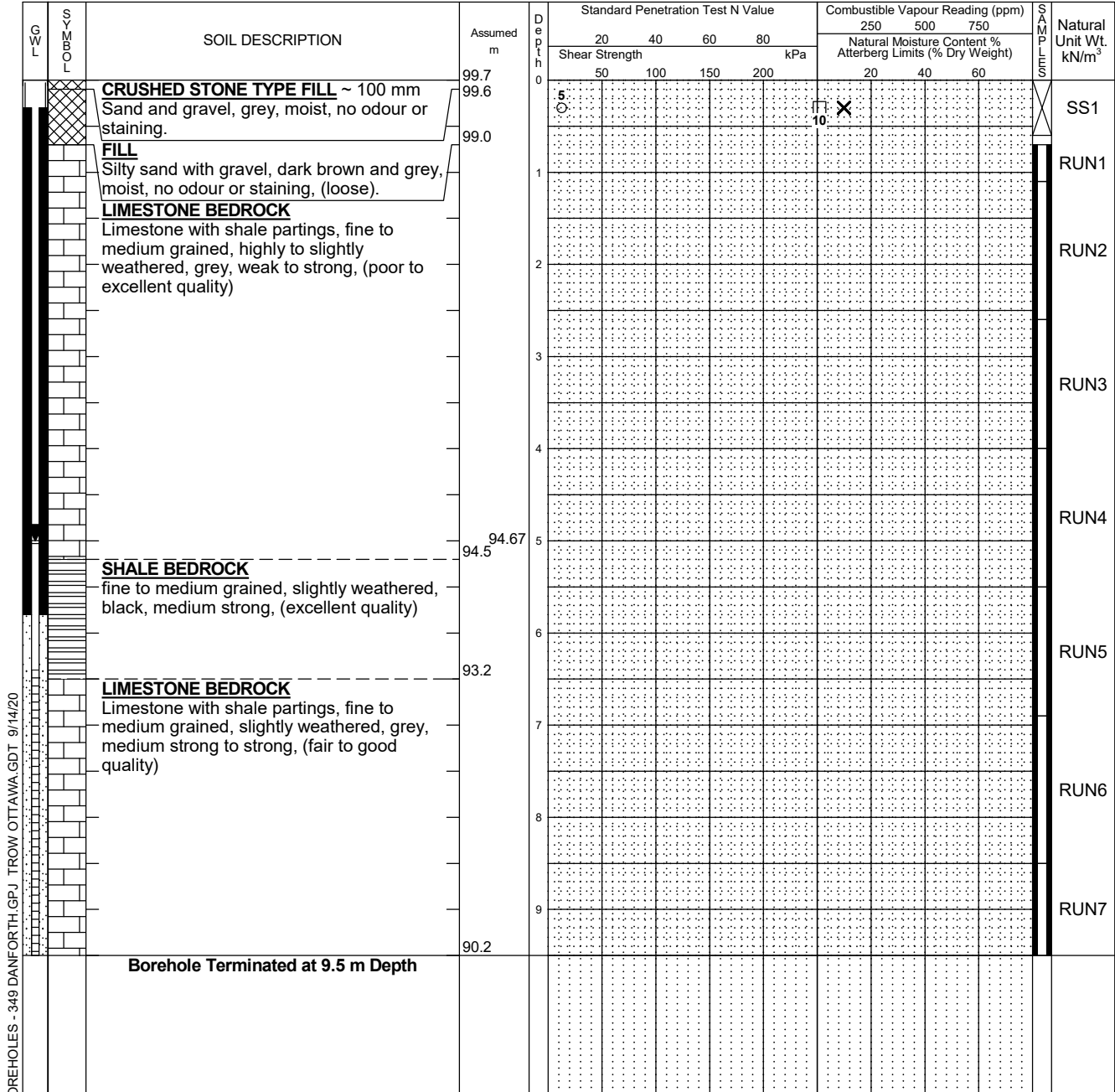
Undrained Triaxial at % Strain at Failure

Shelby Tube

Shear Strength by Penetrometer Test

Logged by: MD Checked by: PS/IT

Shear Strength by Vane Test



- LOG OF BOREHOLE - 349 DANFORTH.GPJ TROW OTTAWA.GDT 9/14/20
- NOTES:
- Borehole data requires interpretation by EXP before use by others
  - A 32 mm monitoring well with flushmount was installed in the borehole upon completion.
  - Field work was supervised by an EXP representative.
  - See Notes on Sample Descriptions
  - Log to be read with EXP Report OTT-00259161-A0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)
1 day	1.9	-
7 days	5.6	-
11 days	5.0	-

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %
1	0.71 - 1.09	100	28
2	1.09 - 2.64	100	51
3	2.64 - 3.97	100	91
4	3.97 - 5.46	100	92
5	5.46 - 6.93	100	82
6	6.93 - 8.54	100	81
7	8.54 - 9.47	100	60

# Log of Borehole BH/MW3



Project No: OTT-00259161-A0

Figure No. 5

Project: Geotechnical Investigation - Proposed Residential Development

Page. 1 of 1

Location: 349 Danforth Avenue, Ottawa, Ontario

Date Drilled: June 30th, 2020

Split Spoon Sample

Combustible Vapour Reading

Drill Type: CME 55 (truck mount)

Auger Sample

Natural Moisture Content

SPT (N) Value

Atterberg Limits

Datum: Assumed

Dynamic Cone Test

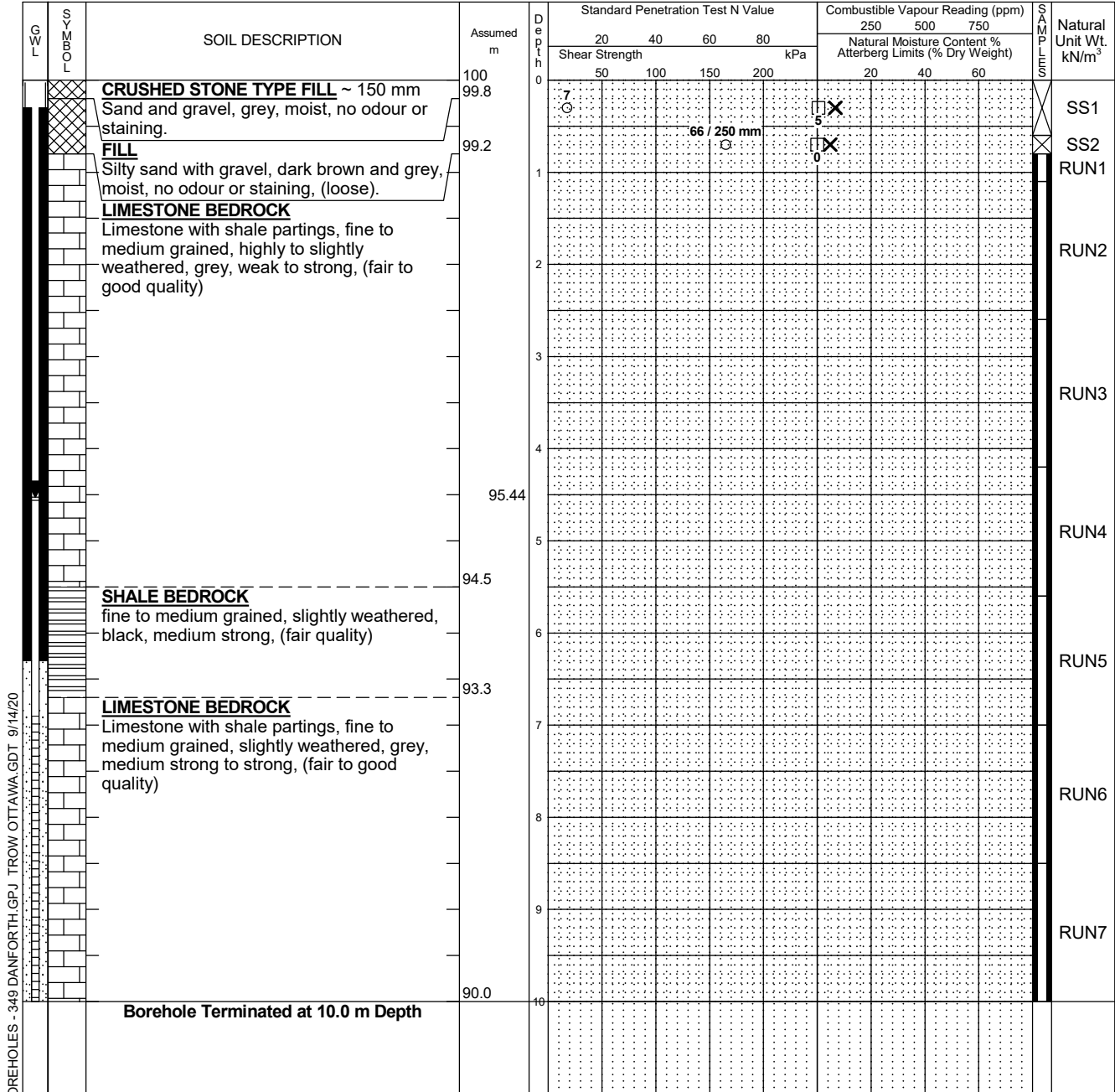
Undrained Triaxial at % Strain at Failure

Shelby Tube

Shear Strength by Penetrometer Test

Logged by: MD Checked by: PS/IT

Shear Strength by Vane Test



LOG OF BOREHOLE - 349 DANFORTH.GPJ TROW OTTAWA.GDT 9/14/20

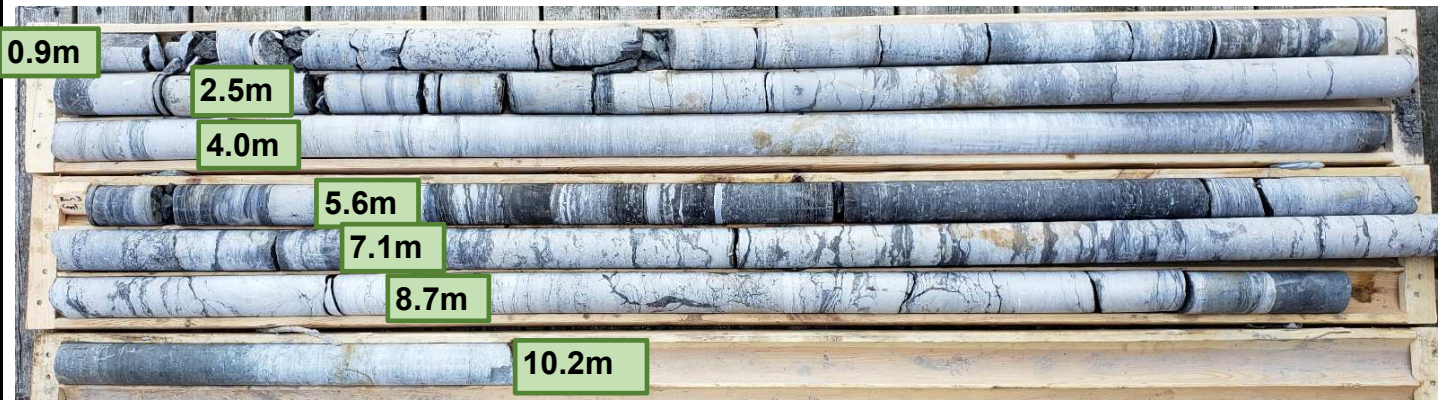
NOTES:

- Borehole data requires interpretation by EXP before use by others
- A 32 mm monitoring well with flushmount was installed in the borehole upon completion.
- Field work was supervised by an EXP representative.
- See Notes on Sample Descriptions
- Log to be read with EXP Report OTT-00259161-A0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)
completion	1.7	-
6 days	5.5	-
10 days	4.6	-

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %
1	0.79 - 1.12	100	77
2	1.12 - 2.59	98	61
3	2.59 - 4.17	100	65
4	4.17 - 5.61	98	58
5	5.61 - 7.04	100	78
6	7.04 - 8.48	98	88
7	8.48 - 10.03	100	77





**exp Services Inc.**

t: +1.613.688.1899 | f: +1.613.225.7337  
 2650 Queensview Drive, Suite 100  
 Ottawa, ON K2B 8H6  
 Canada

[www.exp.com](http://www.exp.com)

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borehole no. <b>MW1</b>	core runs Run 1: 0.9m-2.5m Run 2: 2.5m-4.0m Run 3: 4.0m-5.6m Run 4: 5.6m-7.1m Run 5: 7.1m-8.7m Run 6: 8.7m-10.2m	PROJECT PIIESA and Geotechnical Investigation 349 Danforth Avenue, Ottawa, Ontario	project no. OTT-00259161-A0
date cored  Jun 29, 2020		ROCK CORE PHOTOGRAPHS	FIG. 6





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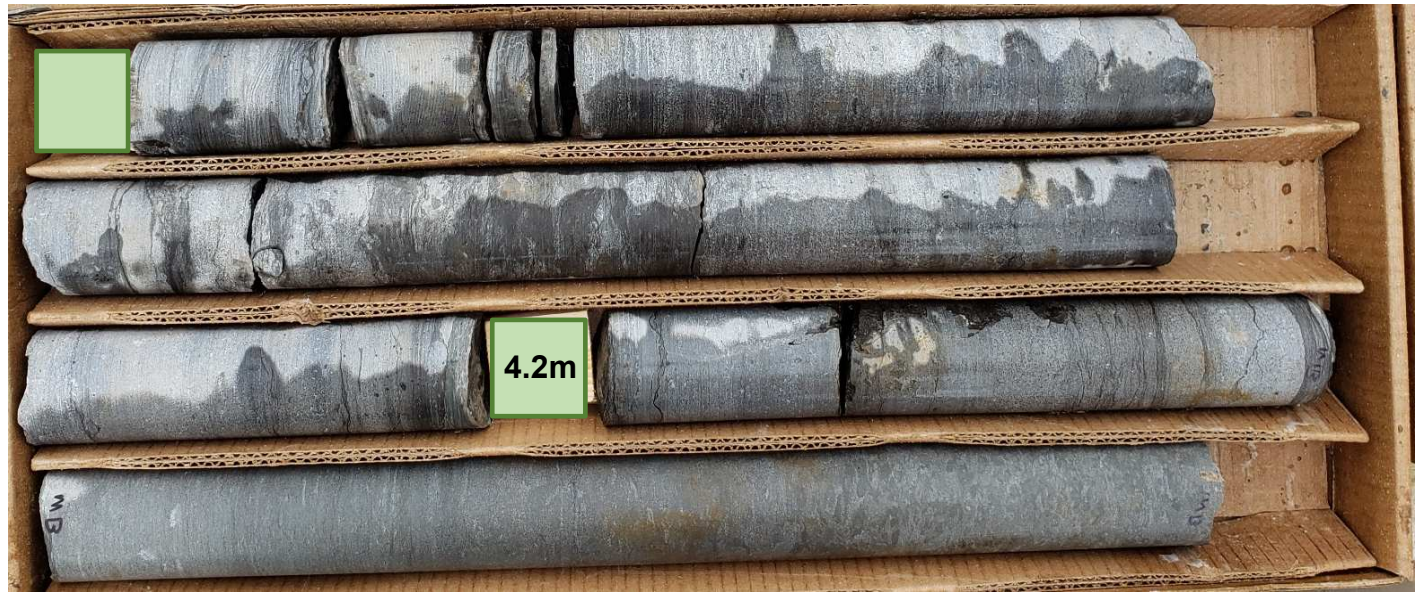
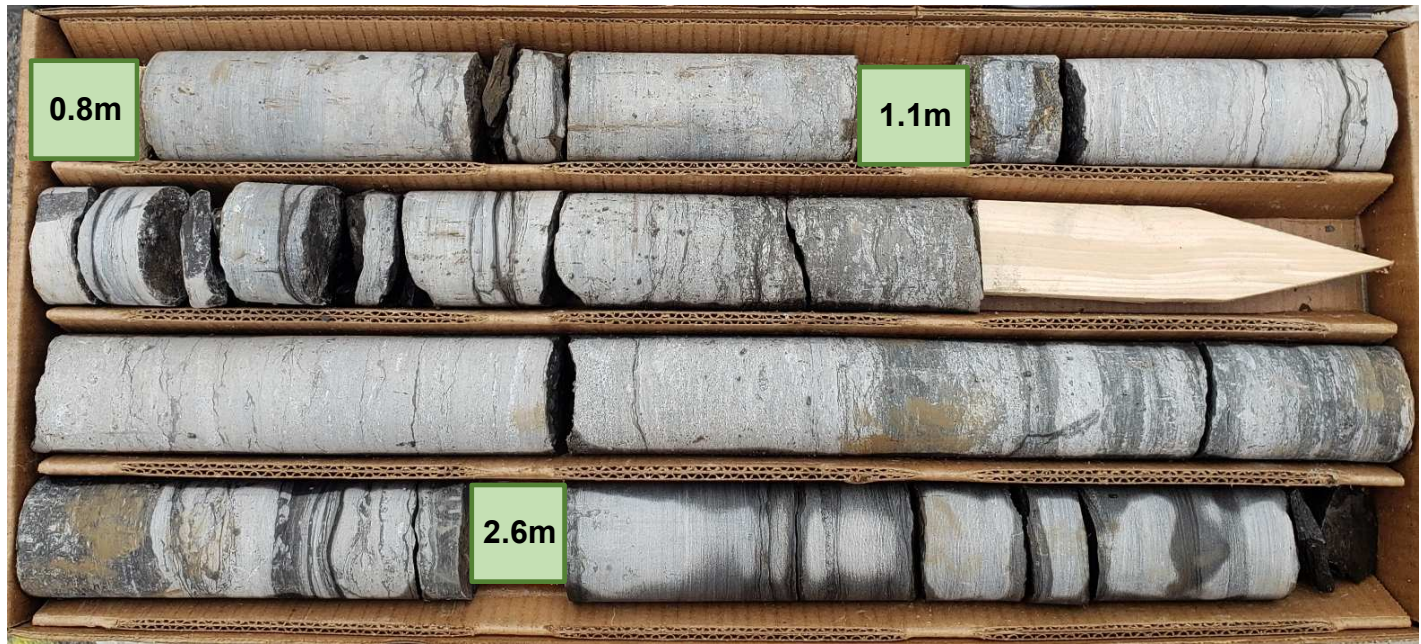
t: +1.613.688.1899 | f: +1.613.225.7337  
 2650 Queensview Drive, Suite 100  
 Ottawa, ON K2B 8H6  
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borehole no. <b>MW2</b>	core runs Run 1: 0.7m-1.1m Run 2: 1.1m-2.6m Run 3: 2.6m-4.0m Run 4: 4.0m-5.5m Run 5: 5.5m-6.9m Run 6: 6.9m-8.5m Run 7: 8.5m-9.5m	PROJECT PIIESA and Geotechnical Investigation 349 Danforth Avenue, Ottawa, Ontario	project no. OTT-00259161-A0
date cored Jun 29, 2020		ROCK CORE PHOTOGRAPHS	FIG. 7



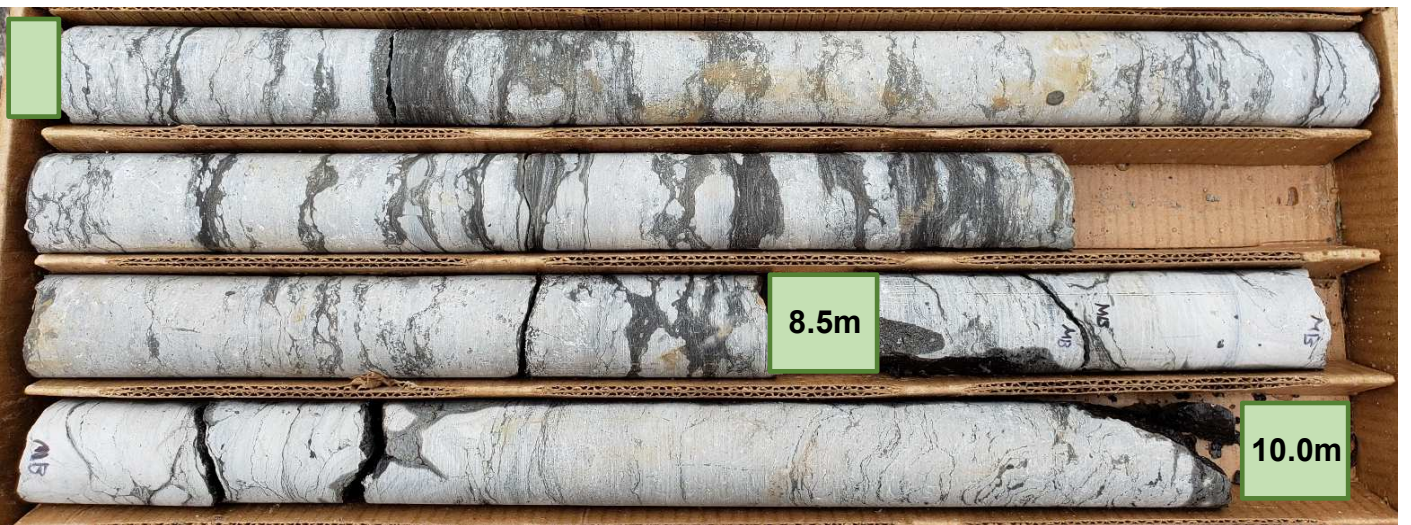


**exp Services Inc.**  
 t: +1.613.688.1899 | f: +1.613.225.7337  
 2650 Queensview Drive, Suite 100  
 Ottawa, ON K2B 8H6  
 Canada  
 www.exp.com

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borehole no. <b>MW3</b>	core runs Run 1: 0.8m-1.1m Run 2: 1.1m-2.6m Run 3: 2.6m-4.2m Run 4: 4.2m-5.6m	PROJECT PIIESA and Geotechnical Investigation 349 Danforth Avenue, Ottawa, Ontario	project no. OTT-00259161-A0
date cored Jun 30, 2020		ROCK CORE PHOTOGRAPHS	FIG. 8A





**exp Services Inc.**

t: +1.613.688.1899 | f: +1.613.225.7337  
 2650 Queensview Drive, Suite 100  
 Ottawa, ON K2B 8H6  
 Canada

[www.exp.com](http://www.exp.com)

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borehole no. <b>MW3</b>	core runs Run 4: 4.2m-5.6m Run 5: 5.6m-7.0m Run 6: 7.0m-8.5m Run 7: 8.5m-10.0m	PROJECT PIIESA and Geotechnical Investigation 349 Danforth Avenue, Ottawa, Ontario	project no. OTT-00259161-A0
date cored Jun 30, 2020		ROCK CORE PHOTOGRAPHS	FIG. 8B

EXP Services Inc.

*Mr. Fernando Matos  
Geotechnical Investigation. Proposed Residential Development  
349 Danforth Avenue, Ottawa, Ontario  
OTT-00259161-A0.  
May 15, 2022 (Updated)*

# Appendix A

## Laboratory Test Certificates (Chemical Testing)



**CLIENT NAME: EXP SERVICES INC**  
**2650 QUEENSVIEW DRIVE, UNIT 100**  
**OTTAWA, ON K2B8H6**  
**(613) 688-1899**

**ATTENTION TO: Ismail M. Taki**  
**PROJECT: OTT-259161-A0**  
**AGAT WORK ORDER: 21Z788737**

**SOIL ANALYSIS REVIEWED BY: Nivine Basily, Inorganics Report Writer**  
**DATE REPORTED: Aug 24, 2021**  
**PAGES (INCLUDING COVER): 6**  
**VERSION\*: 1**

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

**\*Notes**

**Disclaimer:**

- All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.
- All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.
- AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.
- This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
- The test results reported herewith relate only to the samples as received by the laboratory.
- Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.
- All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.



## Certificate of Analysis

AGAT WORK ORDER: 21Z788737

PROJECT: OTT-259161-A0

5835 COOPERS AVENUE  
MISSISSAUGA, ONTARIO  
CANADA L4Z 1Y2  
TEL (905)712-5100  
FAX (905)712-5122  
<http://www.agatlabs.com>

CLIENT NAME: EXP SERVICES INC  
SAMPLING SITE: 349 Danforth, Ottawa

ATTENTION TO: Ismail M. Taki  
SAMPLED BY: EXP

### Corrosivity Package

DATE RECEIVED: 2021-08-16

DATE REPORTED: 2021-08-24

Parameter	Unit	SAMPLE DESCRIPTION:		MW2 Run1	MW2 Run2
		G / S	RDL	2860321	2860378
Chloride (2:1)	µg/g	2	2	31	60
Sulphate (2:1)	µg/g	2	2	39	820
pH (2:1)	pH Units	NA	NA	7.60	7.49
Resistivity (2:1) (Calculated)	ohm.cm	1	1	4670	746

**Comments:** RDL - Reported Detection Limit; G / S - Guideline / Standard

**2860321-2860378** EC, pH, Chloride and Sulphate were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil). Resistivity is a calculated parameter.

Analysis performed at AGAT Toronto (unless marked by \*)

**Certified By:**



*Nvine Dasly*





## Certificate of Analysis

AGAT WORK ORDER: 21Z788737

PROJECT: OTT-259161-A0

5835 COOPERS AVENUE  
 MISSISSAUGA, ONTARIO  
 CANADA L4Z 1Y2  
 TEL (905)712-5100  
 FAX (905)712-5122  
<http://www.agatlabs.com>

CLIENT NAME: EXP SERVICES INC  
 SAMPLING SITE: 349 Danforth, Ottawa

ATTENTION TO: Ismail M. Taki  
 SAMPLED BY: EXP

### Inorganic Chemistry (Soil) %

DATE RECEIVED: 2021-08-16

DATE REPORTED: 2021-08-24

Parameter	Unit	SAMPLE DESCRIPTION:		MW2 Run1	MW2 Run2
		G / S	RDL	2860321	2860378
Chloride (2:1)	%	0.0002	0.0031	0.0031	0.006
Sulphate (2:1)	%	0.0002	0.0039	0.0039	0.082

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

**2860321-2860378** Chloride and Sulphate were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil). Analysis performed at AGAT Toronto (unless marked by \*)

**Certified By:**



*Nivine Basly*

## Quality Assurance

**CLIENT NAME:** EXP SERVICES INC  
**PROJECT:** OTT-259161-A0  
**SAMPLING SITE:** 349 Danforth, Ottawa

**AGAT WORK ORDER:** 21Z788737  
**ATTENTION TO:** Ismail M. Taki  
**SAMPLED BY:** EXP

### Soil Analysis

RPT Date: Aug 24, 2021			DUPLICATE				Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Measured Value		Acceptable Limits			Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper	Lower		Upper	Lower		Upper	

**Corrosivity Package**

Chloride (2:1)	2860321	2860321	31	30	2.2%	< 2	93%	70%	130%	99%	80%	120%	98%	70%	130%
Sulphate (2:1)	2860321	2860321	39	39	0.1%	< 2	96%	70%	130%	98%	80%	120%	102%	70%	130%
pH (2:1)	2860321	2860321	7.60	7.63	0.4%	NA	101%	80%	120%						

Comments: NA signifies Not Applicable.  
 pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.

**Inorganic Chemistry (Soil) %**

Chloride (2:1)	2860321	2860321	0.0031	0.003	3.3%	<0.0002	93%	70%	130%	99%	80%	120%	98%	70%	130%
Sulphate (2:1)	2860321	2860321	0.0039	0.0039	0.0%	<0.0002	96%	70%	130%	98%	80%	120%	102%	70%	130%

Certified By:



Nivine Basily





## Method Summary

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 21Z788737

PROJECT: OTT-259161-A0

ATTENTION TO: Ismail M. Taki

SAMPLING SITE:349 Danforth, Ottawa

SAMPLED BY:EXP

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
<b>Soil Analysis</b>			
Chloride (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	modified from EPA 9045D and MCKEAGUE 3.11	PH METER
Resistivity (2:1) (Calculated)	INOR-93-6036	McKeague 4.12, SM 2510 B,SSA #5 Part 3	CALCULATION