Geotechnical Investigation
Proposed Residential Development
116 and 118 Carruthers Avenue, Ottawa, Ontario

Client:
MA Precision Holding Inc.
116 and 118 Carruthers Avenue
Ottawa, Ontario
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Table of Contents

List of Figures

List of Tables

List of Appendices

Executive Summary

EXP Services Inc. (EXP) is pleased to present the results of the geotechnical investigation completed for the proposed residential development to be located at 116 and 118 Carruthers Avenue, Ottawa, Ontario. (Figure 1). Terms and conditions of the assignment have been outlined in EXP's Proposal dated May 15, 2024. Authorization to proceed with the work was given by Majid Ahangaran on behalf MA Precision Holding Inc. This report supersedes the geotechnical report submitted on November 20, 2024.

The proposed residential development will consist of a 4.5 storey residential apartment building with one basement level. The development will be complete with sidewalks, driveway, and parking lot areas. The design elevation of the basement floor, ground floor and final exterior grades were not available at the time of this geotechnical investigation.

EXP completed Phase One and Two Environmental Site Assessments (ESAs) in conjunction with this geotechnical investigation and the results are provided in separate reports.

The fieldwork for the geotechnical investigation was undertaken on August 20, and 21, 2024 and comprised the drilling of four (4) boreholes (Borehole Nos. 24-01 to 24-04) to termination and casing refusal depths of 0.4 m to 4.5 m below existing grade. Monitoring wells were installed in selected boreholes for the long-term monitoring of groundwater levels and for groundwater sampling as part of the Phae Two ESA.

The borehole information indicates the subsurface conditions at the site consist of a surficial silty sand and gravel fill that extends to 0.5 m and 0.6 m depths (Elevation 62.0 m and Elevation 61.4 m) underlain by limestone bedrock contacted at 0.5 m and 0.6 m depths (Elevation 62.0 m and Elevation 61.4 m). The upper 1.2 m of the bedrock in Borehole No. 24-01 is highly weathered becoming sound below the 1.7 m depth (Elevation 60.2 m). Based on a review of the groundwater level measurements, the groundwater level is at 1.9 m and 2.0 m depths (Elevation 60.5 m to Elevation 60.0 m).

Since compressible clay was not encountered on the site, there is no restriction to raising the grades at the site from a geotechnical perspective.

It is recommended to support the proposed building by footings set on the competent sound bedrock and in accordance with Table 4.1.8.4 A of the 2012 Ontario Building Code (OBC) (as amended January 1,2022), the site is classified as **Class C** for seismic site response. A higher site class of B or A may be obtained if a multi-channel analysis shear wave survey is undertaken at the site. The subsurface soils are not considered to be liquefiable during a seismic event.

The geotechnical investigation has revealed that the subsurface conditions at the site are well suited to supporting the proposed building by strip and spread footings set on the competent sound limestone bedrock free of loose pieces (soil and bedrock) and soft seams and located below any weathered and fractured/detached zones of the bedrock. Footings founded on the competent sound bedrock may be designed for a factored geotechnical resistance at ultimate limit state (ULS) of 1000 kPa. Settlements of footing designed for the above recommended factored geotechnical resistance at ULS and properly constructed are expected to be less than 10 mm.

The depth to competent sound bedrock away from the borehole locations may vary from that indicated on the borehole logs. For example, the fill thickness and depth to bedrock may be deeper or shallower than shown on the borehole logs close to and/or within the footprint of the existing building and underground service trenches. Sub-excavation below the design elevation of the underside of new footings to reach the competent sound bedrock may be backfilled from the sound bedrock to the design elevation of the underside of the footing with structural concrete having a compressive strength of 15 MPa. In this case, an allowance should be made in the contract for the use of structural concrete. Alternatively, the footings may be stepped down to the competent sound bedrock.

The basement floor slab of the proposed building may be designed as a slab-on-grade provided it is set on a bed of well compacted 19 mm clear stone at least 200 mm thick placed directly on the competent sound bedrock. The clear stone would prevent the capillary rise of moisture to the floor slab. Alternatively, the clear stone layer may be replaced with Ontario Provincial Standard Specification (OPSS) Granular A compacted to 98 percent standard Proctor maximum dry density (SPMDD) and overlain by a vapour barrier. Adequate saw cuts should be provided in the floor slab to control cracking.

A perimeter drainage system is recommended to be installed around the proposed building and should be suitably outletted. The need for an underfloor drainage system should be assessed once the design elevation of the basement floor is known and compared with the groundwater level.

Excavation of the fill may be undertaken using conventional equipment. All excavation work should be completed in accordance with the Occupational health and Safety Act (OHSA). Excavations within the fill soil may be undertaken as open cut provided the sidewalls of the excavation are cut back at 1H:1V from the bottom of the excavation.

Excavation of the limestone bedrock may be undertaken using a hoe ram for removal of small quantities of the bedrock; however, this process is expected to be very slow. Alternatively, the bedrock may be excavated by line drilling and blasting technique. Contractors bidding on this project should decide on their own the most preferred rock removal method; hoe ramming or line drilling and blasting.

The bedrock is expected to be weathered and fractured in the upper levels. The excavation side slope in the weathered and fractured bedrock should be cut back at 1H:1V from the bottom of the weathered zone of the bedrock. The sound bedrock may be excavated at near vertical slope, subject to examination by a geotechnical engineer. Depending on the excavation depth within the bedrock, rock slope stabilization measures such as rock bolting in combination with a wire mesh system and/or shotcrete may be required.

Excavations may be dewatered by conventional sump pumping method.

It is anticipated that the majority of the material required for backfilling purposes in the interior and exterior of the proposed building and in the service trenches will need to be imported and should preferably conform to the specifications provided in the attached geotechnical report.

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

This executive summary is a brief synopsis of the report and should not be read in lieu of reading the attached geotechnical report in its entirety.

1.0 Introduction

EXP Services Inc. (EXP) is pleased to present the results of the geotechnical investigation completed for the proposed residential development to be located at 116 and 118 Carruthers Avenue, Ottawa, Ontario. (Figure 1). Terms and conditions of the assignment have been outlined in EXP's Proposal dated May 15, 2024. Authorization to proceed with the work was given by Majid Ahangaran on behalf of MA Precision Holding Inc. This report supersedes the geotechnical report submitted on November 20, 2024.

The proposed residential development will consist of a 4.5 storey residential apartment building with one basement level. The development will be complete with sidewalks, driveway and parking lot areas. The design elevation of the basement floor, ground floor and final exterior grades were not available at the time of this geotechnical investigation.

EXP completed Phase One and Two Environmental Site Assessments (ESAs) in conjunction with this geotechnical investigation and the results are provided in separate reports.

This geotechnical investigation was undertaken to:

a) Establish the subsurface soil, bedrock and groundwater conditions at four (4) boreholes located on site,
b) Classify the site for seismic site response in accordance with the requirements of the 2012 Ontario Building Code (OBC), as amended January 1,2022 and assess the potential for liquefaction of the subsurface soils during a seismic event,
c) Comment on grade-raise restrictions for the site,
d) Make recommendations on the most suitable type of foundations, founding depth and bearing pressure at Serviceability Limit State (SLS) and factored geotechnical resistance at Ultimate Limit State (ULS) of the founding strata and comment on the anticipated total and differential settlements of the recommended foundation type for the proposed building,
e) Comment on slab-on-grade construction and permanent drainage requirements,
f) Provide lateral earth pressure parameters (for static and seismic conditions) for the subsurface basement walls of the proposed building,
g) Discuss excavation conditions and dewatering requirements during construction,
h) Comment on pipe bedding requirements for the proposed underground services,
i) Comment on backfilling requirements and suitability of the on-site soils for backfilling purposes,
j) Comment on subsurface concrete requirements and corrosion potential of subsurface soil and bedrock to buried metal structures/members; and
k) Discuss pavement structures for the driveway and parking lot.

The comments and recommendations given in this report are based on the assumption 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.

2.0 Site Description

The subject site is located at 116 and 118 Carruthers Avenue, Ottawa, Ontario and is currently occupied by a 2-storey multiplex residential building with no basement and attached garage at the back of the of the building (west end of site). The remainder of the lot is occupied by gravel driveways and a paving stone patio. The existing building will be demolished to allow for the construction of the proposed building. The site borders on Carruthers Avenue to the east, and residential properties to the north, west, and south.

The site is generally flat with ground surface elevations ranging from Elevation 61.85 m to Elevation 62.75 m as depicted in the topographic plan titled*, Survey of Lot 15 West Carruthers Avenue Registered Plan 35, City of Ottawa* dated March 7,2024 and prepared by Annis, O'Sullivan, Vollebekk Ltd. (AOV). The site gently slopes in an easterly direction towards Carruthers Avenue.

3.0 Procedure

The fieldwork for the geotechnical investigation was undertaken on August 20, and 21, 2024 and comprised the drilling of four (4) boreholes (Borehole Nos. 24-01 to 24-04) extending to termination and casing refusal depths of 0.4 m to 4.5 m below existing grade. The fieldwork was supervised on a full-time basis by a representative from EXP.

The borehole locations and geodetic elevations were determined on site by EXP. The borehole locations are shown on the Borehole Location Plan, Figure 2.

Prior to drilling the boreholes, the borehole locations were cleared of public and private underground services.

The boreholes were drilled using a portable drill rig equipped with soil sampling and rock coring capabilities. Standard penetration tests (SPTs) were performed using the one-third weight hammer in all the boreholes on a continuous basis and soil samples retrieved by the split-barrel sampler. The presence of the bedrock was proven in Borehole Nos. 24-01 and 24-03 by conventional coring techniques using an NQ size core barrel. A record of the wash water return, colour of wash water and any sudden drops of the core barrel were kept during rock coring operations.

The subsurface soil conditions in each borehole were logged and each soil sample placed in labelled plastic bags. Similarly, the bedrock cores were visually examined, placed in core boxes, identified and logged.

A 32 m diameter monitoring well was installed in Borehole Nos. 24-01 and 24-03 for long-term monitoring of the groundwater level and for groundwater sampling as part of the Phase Two ESA. The monitoring wells were installed in accordance with EXP standard practice and the installation configuration is documented on the respective borehole log. The boreholes were backfilled upon completion of drilling and the installation of the monitoring wells.

On completion of the fieldwork, all the soil samples and rock cores were transported to the EXP laboratory located in Ottawa, Ontario. The soil samples were classified by their main constituents using soil group name and symbol in accordance with the Unified Soil Classification System (USCS) and by the modified Burmister soil classification method for the classification of the minor constituents of the soil using adjectives and modifiers such as trace and some.

The bedrock cores were logged in general accordance with the 2023 Fifth Edition of the Canadian Foundation Engineering Manual (CFEM).

The laboratory testing program for the soil samples and rock cores is shown in Table I.

Table I: Summary of Laboratory Testing Program	
Type of Test	**Number of Tests Completed**
Soil Samples	
Moisture Content Determination	4
Grain Size Analysis	1
Bedrock Cores	
Unit Weight Determination	4
Unconfined Compressive Strength Test	4
Corrosion Analyses (pH, sulphate, chloride and resistivity)	1

4.0 Subsurface Conditions

A detailed description of the subsurface conditions encountered in the four (4) boreholes is given on the borehole logs, Figure Nos. 3 to 6. 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 also may result in changes in the conditions interpreted to exist at the locations where sampling was conducted.

Boreholes were drilled to provide representation of subsurface conditions as part of a geotechnical exploration program and are not intended to provide evidence of potential environmental conditions. Reference is made to the Phase One and Two ESAs regarding the environmental condition of the subsurface soils and groundwater.

It should be noted that the soil and bedrock boundaries indicated on the borehole logs are inferred from observations during drilling operations. These boundaries 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 the 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 bedrock conditions with depth and groundwater levels.

Granular Fill

A surficial silty sand and gravel fill was contacted in the boreholes and extends to 0.5 m and 0.6 m depths (Elevation 62.0 m and Elevation 61.4 m). The granular fill is in a loose to compact state based on SPT N-values of 6 to 27. The SPT N-values indicated on the borehole logs are the corrected values for the standard hammer weight. The moisture content of the granular fill is 3 percent to 7 percent.

Grain size analysis was conducted on one (1) composite sample of the granular fill which was combined from all four (4) boreholes. The grain size curve is shown in Figure 7 and the results are summarized in Table II.

Table II: Summary of Results from Grain-size Analysis – Granular Fill Sample

Borehole/Monitoring Well No. (BH/MW) - Sample No.	Depth (m)	Grain-size Analysis (%)			Soil Classification (USCS)
		Gravel	Sand	Fines (Silt and Clay)	
All BHs - SS1 (Composite Sample)	0.0 – 0.6	37	50	13	Silty Sand with Gravel (SM)

Based on a review of the results from the grain size analysis, the granular fill may be classified as a silty sand with gravel (SM).

Limestone Bedrock

Refusal to casing was met in Borehole Nos. 24-02 and 24-04 at 0.4 m and 0.7 m depths (Elevation 61.9 m and Elevation 61.8 m) on inferred cobbles, boulders or bedrock.

The presence of the bedrock was confirmed in Borehole Nos. 24-01 and 24- 03 at 0.5 m and 0.6 m depths (Elevation 62.0 m and Elevation 61.4 m). A summary of the bedrock depth (elevation) in Borehole Nos. 24-01 and 24-03 is presented in Table III.

Table III: Summary of Bedrock Depths (Elevations)			
Borehole/Monitoring Well No. (BH/MW)	Ground Surface Elevation	Bedrock Depth (m)	Bedrock Elevation (m)
BH/MW24-01	61.88	0.5 – 1.7: Highly Weathered Bedrock 1.7: Sound Bedrock	61.4 – 60.2: Highly Weathered Bedrock 60.2: Sound Bedrock
BH/MW240-3	62.59	0.6	62.0

The bedrock geology map (Map 1508A – Generalized Bedrock Geology, Ottawa-Hull, Ontario and Quebec, Geological Survey of Canada, printed by the Surveys and Mapping Branch, 1979) indicates the site is underlain by limestone bedrock (with some shaley partings) of the Ottawa formation.

Based on examination of the bedrock cores, the Total Core Recovery (TCR) ranges from 73 percent to 100 percent and the Rock Quality Designation (RQD) ranges from 0 percent to 98 percent indicating the bedrock quality is very poor to excellent. The bedrock in Borehole No. 24-01 is highly weathered from the contact depth of 0.5 m (Elevation 61.4 m) to a 1.7 m depth (Elevation 60.2 m). Also, the rock core barrel dropped within the zone of the highly weathered bedrock from 1.3 m to 1.5 m depths (Elevation 60.6 m to Elevation 60.4 m), suggesting a possible void within the highly weathered bedrock zone. The TCR of the highly weathered zone of the bedrock is 73 percent and the RQD is 0 percent indicating the highly weathered bedrock zone is of a very poor quality. The bedrock below the highly weathered zone in Borehole No. 24-01 and in Borehole No. 24-03 is sound and of a good to excellent quality as indicated by RQD values of 83 percent to 98 percent. Photographs of the rock cores are shown in Appendix A.

Results of the unconfined compressive strength and unit weight determination tests conducted on four (4) selected sections of rock cores are summarized in Table IV.

Table IV: Unconfined Compressive Strength and Unit Weight of Rock Core Sections			
Borehole/Monitoring Well No. (BH/MW) RUN No.	Depth (m)	Unconfined Compressive Strength (MPa)	Unit Weight (kN/m^3)
BH24-01 – Run 2	2.0 – 2.2	153	26.6
BH24-01 – Run 4	3.3 – 3.6	159	26.6
BH24-03 – Run 1	1.6 – 1.8	150	26.9
BH24-03 – Run 2	3.0 – 3.2	171	26.7

The unconfined compressive strength test results range from 150 MPa to 171 MPa and the rock may be classified as very strong (R5) in accordance with the 2023 Fifth Edition of the Canadian Foundation Engineering Manual (CFEM).

Groundwater Levels

Groundwater level measurements taken in monitoring wells installed in two (2) boreholes on September 6, 2024, are summarized in Table V.

Table V: Summary of Groundwater Level Measurements			
Borehole/Monitoring Well No. (BH/MW)	Ground Surface Elevation (m)	Date of Measurement (Elapsed Time in Days from Date of Installation)	Groundwater Depth Below Ground Surface (Elevation), m
BH/MW24-01	61.88	September 6, 2024 (16 days)	1.9 (60.0)
BH/MW24-03	62.52	September 6, 2024 (17 days)	2.0 (60.5)

Based on a review of the groundwater level measurements, the groundwater level is at 1.9 m and 2.0 m depths (Elevation 60.5 m to 60.0 m).

Water levels were determined in the boreholes at the times and under the conditions stated in this report. . 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.

5.0 Grade Raise Restrictions

Since compressible clays were not encountered at the site, there is no restriction to raising the grades at the site from a geotechnical perspective.

6.0 Seismic Site Classification and Liquefaction Potential of Subsurface Soils

It is recommended to support the proposed building by footings set on the sound bedrock and in accordance with Table 4.1.8.4 A of the 2012 Ontario Building Code (OBC) (as amended January 1,2022), the site is classified as **Class C** for seismic site response. A higher site class of B or A may be obtained if a multi-channel analysis shear wave survey is undertaken at the site.

The subsurface soils are not considered to be liquefiable during a seismic event.

7.0 Foundation Considerations

The geotechnical investigation revealed that the subsurface conditions at the site are well suited to support the proposed building by strip and spread footings set on the competent sound limestone bedrock contacted in the boreholes at 0.6 m and 1.7 m depths (Elevation 62.0 m and Elevation 60.2 m).

Strip and spread footings founded on the competent sound limestone bedrock that is free of loose pieces (soil and bedrock) and soft seams and is located below any weathered and fractured/detached zones of the bedrock, may be designed for a factored geotechnical resistance at ultimate limit state (ULS) of 1000 kPa. The factored geotechnical resistance value at ULS includes a resistance factor of 0.5. The Serviceability Limit State (SLS) bearing pressure of the bedrock, required to produce 25 mm settlement of the structure will be much larger than the recommended value for factored geotechnical resistance at ULS. Therefore, the factored geotechnical resistance at ULS will govern the design.

Settlements of footings designed for the above recommended factored geotechnical resistance at ULS and properly constructed are expected to be less than 10 mm.

The depth to competent sound bedrock away from the borehole locations may vary from that indicated on the borehole logs. For example, the fill thickness and depth to bedrock may be deeper or shallower than shown on the borehole logs close to and/or within the footprint of the existing building and underground service trenches. Sub-excavation below the design elevation of the underside of new footings to reach the competent sound bedrock may be backfilled from the competent sound bedrock to the design elevation of the underside of the footing with structural concrete having a compressive strength of 15 MPa. In this case, an allowance should be made in the contract for the use of structural concrete. Alternatively, the footings may be stepped down to the competent sound bedrock.

All the footing beds should be examined by a geotechnical engineer to ensure that the founding surfaces are capable of supporting the recommended factored ULS value and that the footing beds have been properly prepared.

A minimum of 1.2 m of earth cover for heated structures should be provided to the footings founded on sound bedrock to protect them from damage due to frost penetration. The frost cover should be increased to 1.5 m for unheated structures if snow will not be removed from their vicinity. If snow will be removed from the vicinity of the unheated structures, the frost cover should be increased to 1.8 m. Equivalent rigid insulation may be used instead of the required soil cover or a combination of rigid insulation and soil cover may be used to achieve the required frost protection.

8.0 Floor Slab and Drainage Requirements

The basement floor slab of the proposed building may be designed as a slab-on-grade provided it is set on a bed of well compacted 19 mm clear stone at least 200 mm thick placed directly on the competent sound bedrock. The clear stone would prevent the capillary rise of moisture to the floor slab. Alternatively, the clear stone layer may be replaced with Ontario Provincial Standard Specification (OPSS) Granular A compacted to 98 percent standard Proctor maximum dry density (SPMDD) and overlain by a vapour barrier. Adequate saw cuts should be provided in the floor slab to control cracking.

A perimeter drainage system is recommended to be installed around the proposed building and should be suitably outletted. The need for an underfloor drainage system should be assessed once the design elevation of the basement floor is known and compared with the groundwater level.

The finished ground floor should be set at least 150 mm higher than the finished exterior grade.

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

9.0 Lateral Earth Pressure Against Subsurface Walls

The subsurface basement walls should be backfilled with free-draining granular material, such as OPSS Granular B Type II material and equipped with a perimeter drainage system.

If the space between the subsurface basement walls and the rock face is to be backfilled, the subsurface walls will be subjected to lateral static earth pressure as well as lateral dynamic earth pressure during a seismic event. The lateral static earth pressure that the subsurface walls would be subjected to may be computed from equations (i) and (ii) below and the lateral dynamic earth force from equation (iii) given below.

The equations given below assume that the backfill against the subsurface walls will be free-draining granular material and that a perimeter drainage system will be provided to prevent build-up of hydrostatic pressure. Equation (i) will be applicable to the portion of the subsurface wall in the overburden (soil). Equation (ii) will be applicable to the portion of the subsurface wall in the bedrock where the earth pressure will be considerably reduced due to the narrow backfill between the subsurface wall and the rock face resulting in an arching effect (Spangler & Handy, 1984). The weight of the overburden (soil) and any surcharge applied at the ground surface should be considered as surcharge when computing lateral pressure using equation (ii).

Lateral static earth pressure, p:

p = k (γh + q) ---------- (i)

where:

k = lateral earth pressure coefficient for 'at rest' condition = 0.50

γ = unit weight of backfill = 22 kN/m^3

h = depth of interest below ground surface (m)

q = any surcharge acting at ground surface (kPa)

Lateral static earth pressure due to narrow earth backfill between subsurface wall and rock face at depth z; σ_n:

$$\sigma_n = \frac{\gamma B}{2\tan\delta}\left(1 - e^{-2k\frac{z}{B}\tan\delta}\right) + kq \text{ ---------- (ii)}$$

where:

γ = unit weight of backfill = 22 kN/m^3

B = backfill width (m)

z = depth from top of wall (m)

δ = friction angle between the backfill and wall and rock (assumed to be equal) = 17 degrees

k = lateral earth pressure coefficient for 'at rest' condition = 0.50

q = surcharge pressure including pressures from overburden (soil), traffic at ground surface and foundations from existing adjacent buildings (kPa)

The lateral dynamic earth force (dynamic thrust) due to seismic loading may be computed from the equation given below:

$$\Delta_{Pe} = \gamma h^2 \frac{a_h}{g} F_b \quad \text{---------- (iii)}$$

where:

Δ_{Pe} = dynamic thrust in kN/m of wall

h = height of basement wall against soil above the bedrock surface (m)

γ = unit weight of soil = 22 kN/m^3

$\frac{a_h}{g}$ = seismic coefficient = 0.281 (2012 OBC (amended January 1, 2022))

F_b = thrust factor = 1.0

The dynamic thrust acts approximately at 0.63h.

For basement walls cast directly against the bedrock, a vertical drainage membrane or board such as Terrain 200 or equivalent should be installed on the face of the bedrock and connected to the perimeter drainage system. The top of the drainage board should be covered with a filter fabric to prevent the loss of overlying soil into the drainage board.

All subsurface walls should be damp-proofed.

10.0 Excavations and Dewatering Requirements

10.1 Excess Soil Management

Ontario Regulation 406/19 specifies protocols that are required for the management and disposal of excess soils. As set forth in the regulation, specific analytical testing protocols need to be implemented and followed based on the volume of soil to be managed and the requirements of the receiving site. The testing protocols are specific as to whether the soils are stockpiled or in situ. In either scenario, the testing protocols are far more onerous than have been historically carried out as part of standard industry practices. These decisions should be factored in and accounted for prior to the initiation of the project-defined scope of work. EXP would be pleased to assist with the implementation of a soil management and testing program that would satisfy the requirements of Ontario Regulation 406/19.

For the environmental aspects of the subsurface soils, reference is made to the EXP Phase Two ESA report.

10.2 Excavations

Excavations for the construction of the proposed building are anticipated to extend through the fill and into the limestone bedrock and may or may not be below the groundwater level.

Following the demolition of the existing building on site, excavations should include the excavation and removal of existing items such as foundations, foundation walls and floor slabs that may be reinforced form the existing building and underground piping.

The excavation of the granular fill may be undertaken using conventional heavy equipment capable of removing cobbles and boulders and debris within the fill.

All excavation work should be completed in accordance with the Occupational Health and Safety Act (OHSA). Excavations within the fill soil may be undertaken as open cut provided the sidewalls of the excavation are cut back at 1H:1V from the bottom of the excavation.

If space restrictions prevent open cut excavations, the excavations may be undertaken within the confines of a prefabricated support system (trench box) for the installation of underground services and an engineered support system (shoring system) for the proposed building excavations.

The contractor must review the site plan and surrounding properties to determine if a shoring system for the excavation is required for the construction of the proposed buildings. The contractor must also determine if underpinning of foundations of adjacent existing buildings and infrastructure is required. The prefabricated support system and engineered support system should be designed and installed in accordance with the OHSA and the 2023 Fifth Edition Canadian Foundation Engineering Manual.

The shoring system as well as adjacent settlement sensitive structures should be monitored for movement on a periodic basis prior to, during and following construction operations.

It is anticipated that test pit excavations at the site may be required to establish the founding level of foundations of some of the existing adjacent structures for underpinning/shoring requirements.

Excavation of the limestone bedrock may be undertaken using a hoe ram for removal of small quantities of the bedrock; however, this process is expected to be very slow. Alternatively, the bedrock may be excavated by line drilling and blasting technique. Contractors bidding on this project should decide on their own the most preferred rock removal method; hoe ramming or line drilling and blasting.

The bedrock is expected to be weathered and fractured in the upper levels. The excavation side slope in the weathered and fractured bedrock should be cut back at 1H:1V from the bottom of the weathered zone of the bedrock. The sound bedrock may be excavated at near vertical slope, subject to examination by a geotechnical engineer. Depending on the excavation depth within the bedrock, rock slope stabilization measures such as rock bolting in combination with a wire mesh system and/or shotcrete may be required.

To prevent damage to adjacent surrounding structures and infrastructure, the hoe ramming and blasting operations should be carefully planned and closely monitored. For blasting, it is recommended that the blasting contractor should retain the services of a blasting specialist to provide a blasting plan. The contractor should have a licensed blaster on site at all times during the blasting operations and a vibration engineer on retainer.

Vibration monitoring during the blasting operations should be carried out in the adjacent surrounding structures and infrastructure to ensure that the blasting meets the limiting vibration criteria at all times. Blasting operations should be carried out in accordance with City of Ottawa Special Provisions (S.P.) No. F-1201, which also provides limiting vibration criteria. A pre-construction and pre-blast condition survey of all adjacent surrounding structures and infrastructure should be conducted prior to start of construction and blasting operations. If adjacent structures are deemed to be heritage buildings, special limiting vibration criteria is required.

10.3 Dewatering Requirements

Seepage of surface water and subsurface water into the excavations are anticipated. It should be possible to collect water entering the excavations at low points and to remove it by conventional sump pumping techniques. In areas of high infiltration or in areas where more permeable soils may exist, a higher seepage rate should be anticipated. Therefore, high-capacity pumps to keep the excavation dry may be required.

Many geologic materials deteriorate rapidly upon exposure to meteorological elements. Unless otherwise specifically indicated in this report, walls and floors of excavations must be protected from moisture, desiccation, and frost action throughout the course of construction.

For construction dewatering, an Environmental Activity and Sector Registry (EASR) approval may be obtained for water takings greater than 50 m^3 and less than 400 m^3 per day. If more than 400 m^3 per day of groundwater are generated for dewatering purposes, then a Category 3 Permit to Take Water (PTTW) must be obtained from the Ministry of the Environment, Conservation and Parks (MECP). A Category 3 PTTW would require a complete hydrogeological assessment and would take at least 90 days for the MECP to process once the application is submitted.

Although this investigation has estimated the groundwater levels at the time of the field work, and commented on de-watering and general construction problems, conditions may be present that are difficult to establish from standard boring techniques. These conditions may affect the type and nature of de-watering procedures used by the contractor. These conditions include local and seasonal fluctuations in the groundwater table, erratic changes in the soil profile, thin layers of soil with large or small permeabilities compared with the soil mass, fissures or seams in rock, etc. Only carefully controlled tests using pumped wells and observation wells will yield the quantitative data on groundwater volumes and pressures that are necessary to adequately engineer construction de-watering systems.

11.0 Backfilling Requirements and Suitability of On-Site Soils for Backfilling Purposes

The material to be excavated from the site is anticipated to consist of granular fill and limestone bedrock. Portions of the on-site granular fill may be re-used as select subgrade material pending additional testing during construction. Otherwise, the granular fill may be used for landscaping purposes provided it is free of organics, cobbles, boulders and debris. Excavated bedrock is not suitable for use as backfill and should be discarded.

Therefore, it is anticipated that the majority of the material required for backfilling purposes in the interior and exterior of the proposed building and in the service trenches will need to be imported and should preferably conform to the following specifications:

- Engineered fill, underfloor fill including backfilling in service trenches inside the building – OPSS 1010 for Granular B Type II (50 mm minus) placed in 300 mm thick lifts with each lift compacted to 98 percent SPMDD beneath the floor slab,
- Backfill against exterior subsurface walls - OPSS 1010 Granular B Type II placed in 300 mm thick lifts and compacted to 95 percent SPMDD,
- Trench backfill outside building area, and fill placement to subgrade level for pavement – Approved on-site material or imported OPSS 1010 Select Subgrade Material (SSM), free of organics, debris and with a natural moisture content within 2 percent of the optimum moisture content. It should be placed in 300 mm thick lifts compacted to minimum 95 percent SPMDD; and
- Landscaped areas - Clean fill that is free of organics and deleterious material and is placed in 300 mm thick lifts with each lift compacted to 92 percent of the SPMDD.

12.0 Pipe Bedding Requirements

It is anticipated that underground municipal services will be founded to a maximum depth of 3.0 m below existing grade and the subgrade will consist of limestone bedrock.

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

The pipe bedding should consist of 150 mm thick of OPSS Granular A bedding material. The bedding material should be compacted to at least 98 percent SPMDD.

To minimize the potential for bending stresses within the pipe, a transition zone treatment should be provided in areas where the pipe subgrade changes from overburden to bedrock and vice versa. In areas where the surface of the bedrock slopes at a steeper gradient than 3H:1V, the bedrock should be excavated and additional bedding material placed to create a 3H:1V transition zone.

The underground services should be installed in short open trench sections that are excavated and backfilled the same day.

13.0 Subsurface Concrete Requirements and Corrosion Potential of Subsurface Soils

Chemical tests limited to pH, sulphate, chloride and resistivity were undertaken on a selected section of the bedrock cores and the results are shown in Table VI. The laboratory certificate of analysis report is provided in Appendix B.

Table VI: Results of Corrosion Analyses on Section of Rock Core					
Borehole/Monitoring Well No. – Run Number	Depth (m)	pH	Sulphate (%)	Chloride (%)	Resistivity (ohm-cm)
BH24-01 – Run 2	2.2 - 2.3	9.12	0.0034	0.0047	5050

The results indicate the limestone bedrock core section has a negligible sulphate attack on subsurface concrete. The concrete mix design should be in accordance with CSA A.23.1-19.

Based on a review of the resistivity test results, the limestone bedrock core section is considered to be mildly 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.

14.0 Pavement Structure

It is our understanding that the development will have paved driveway and parking lot. It is anticipated that the pavement structures will be exposed to light-duty traffic only.

The subgrade for the parking lot and driveway at the site is anticipated to consist of the existing fill, limestone bedrock, OPSS Granular B Type II material and/or OPSS select subgrade material (SSM). Pavement structure thicknesses required for light-duty traffic on driveways and parking areas were computed and are shown in Table VII. The pavement structure thicknesses are based upon an estimate of the properties of the anticipated subgrade and functional design life of eight (8) to ten (10) years. The proposed functional design life represents the number of years to the first rehabilitation, assuming regular maintenance is carried out.

Table VII: Recommended Pavement Structure Thicknesses		
Pavement Layer	Compaction Requirements	Light Duty Traffic (Cars)
Asphaltic Concrete (PG 58-34)	92 percent to 97 percent MRD	65 mm – SP12.5 Cat B or HL3
Granular A Base (OPSS 1010) (crushed limestone)	100 percent SPMDD	150 mm
Granular B Sub-base, Type II (OPSS 1010)	100 percent SPMDD	300 mm
SPMDD denotes Standard Proctor Maximum Dry Density, ASTM-D698-12e2 MRD denotes Maximum Relative Density, ASTM D2041		

The foregoing design assumes that construction is carried out during dry periods and that the subgrade is stable under the load of construction equipment. If construction is carried out during wet weather, and heaving or rolling of the subgrade is experienced, additional thickness of granular material may be required.

Additional comments on the construction of the driveway and parking areas are as follows:

(1) As part of the subgrade preparation, the proposed driveway and parking lot areas should be stripped of any topsoil, organic stained soil, and other obviously unsuitable material. After all the underground services have been installed and in areas with no service trenches, the subgrade should be properly shaped, crowned and proofrolled with a heavy roller in the presence of a geotechnician and approved before placement of the granular materials for the pavement structure or subgrade material to raise the grades. Any soft or spongy subgrade areas detected should be sub-excavated and properly replaced with suitable approved backfill compacted to 95 percent SPMDD. Fill required to raise the grades to the design subgrade elevation should consist of OPSS select subgrade material (SSM) compacted to 95 percent SPMDD.

(2) The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure that uniform subgrade moisture and density conditions are achieved. The need for adequate drainage cannot be over-emphasized. Sub-drains should be installed on both sides of the proposed driveway. In parking areas, they should be installed at low points and should be suitably outletted to intercept excess surface and subsurface moisture and to prevent subgrade softening. This will ensure no water collects in the granular course, which could result in pavement failure during the spring thaw. The location and extent of subdrainage required within the paved areas should be reviewed by this office in conjunction with the proposed site grading.

(3) The finished pavement surface should be free of depressions and should be sloped (preferably at a minimum cross fall of 2 percent) to provide effective surface drainage towards ditches or catch basins. Surface water should not be allowed to pond adjacent to the outside edges of paved areas.

(4) The granular materials used for pavement construction should conform to Ontario Provincial Standard Specifications (OPSS) for Granular A and Granular B Type II and should be compacted to 100 percent SPMDD. The asphaltic concrete and its placement should meet OPSS 1151 requirements. It should be placed and compacted to OPSS 311 and 313.

15.0 Tree Planting Restrictions

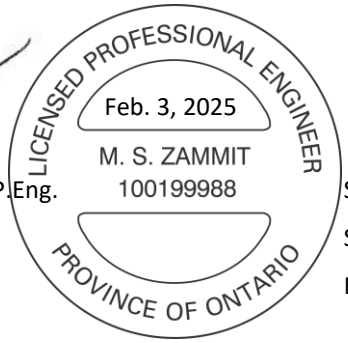
Since sensitive marine clay soils were not encountered on the site, the 2017 City of Ottawa Guidelines for tree planting do not apply for this site.

16.0 General Comments

The comments and recommendations given in this report are based on the assumption that the above-described design concepts 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.

The information contained in this report is not intended to reflect on environmental aspects of the soils. Reference is made to the EXP Phase One and Two Environmental Site Assessment reports completed for this site by EXP and presented in separate reports.

We trust that the information contained in this geotechnical report will be satisfactory for your purposes. Should you have any questions, please do not hesitate to contact this office.



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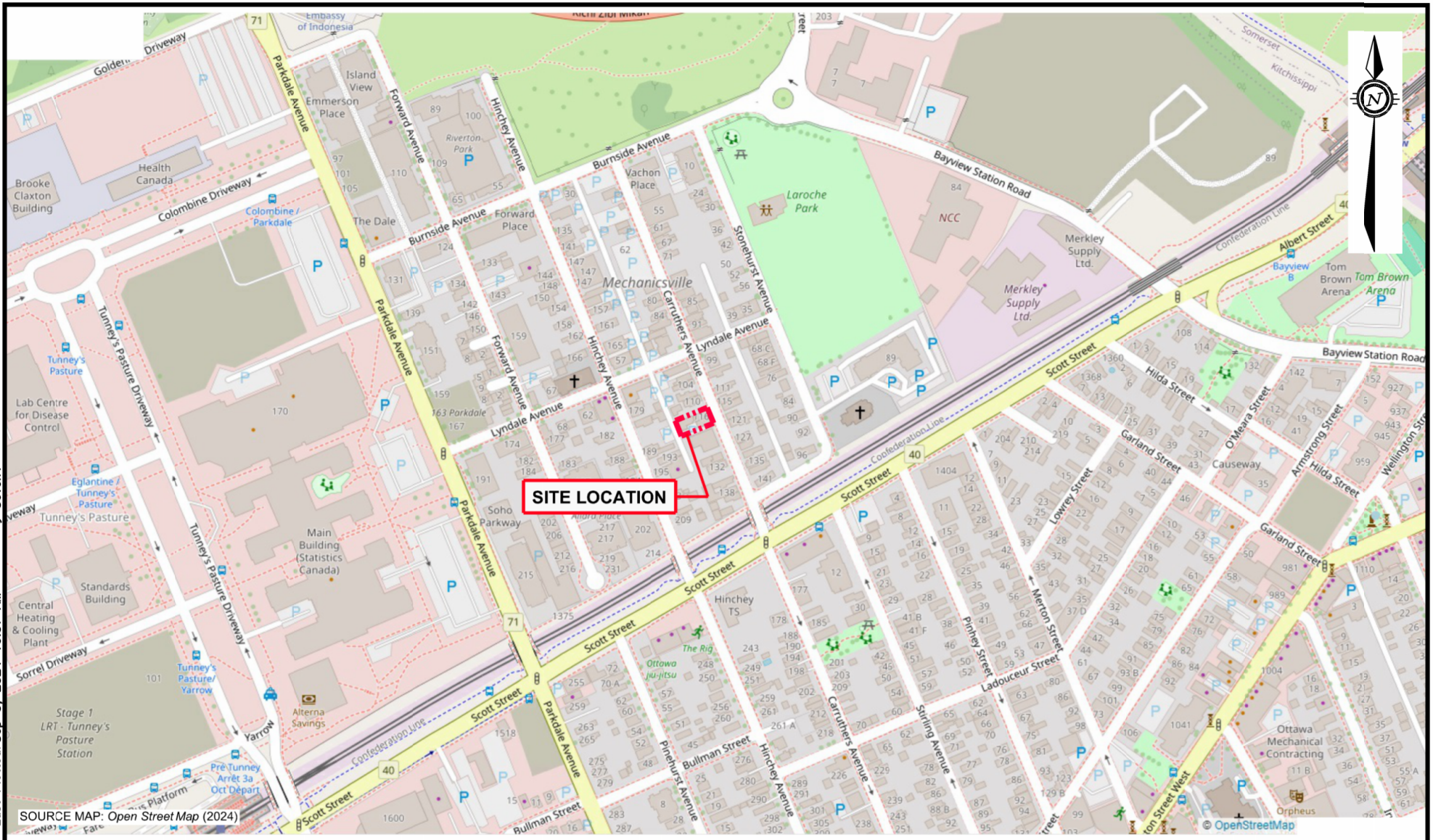
Figures



LEGEND

APPROXIMATE PROPERTY BOUNDARY

0 50m 100m 200m

HORIZONTAL 1:5,000

EXP Services Inc. www.exp.com
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2650 Queensview Drive, Suite 100
Ottawa, ON K2B 8H6, Canada

DATE: SEPTEMBER 2024	Client: MA Precision Holding Inc.116-118 Carruthers Ave.OTT		project no. OTT-24006545-B0
DESIGN: SL / CHECKED: IT	PROJECT: GEOTECHNICAL INVESTIGATION		scale 1:5,000
DRAWN BY: AS	TITLE: SITE LOCATION PLAN		FIG 1

Filename: E:\OTT\OTT-24006545-B0\60 Execution\65 Drawings\OTT-24006545-B0_Geo_116-118-Carruthers-Ave.dwg
Last Saved: Sep 5, 2024 10:37 AM Last Plotted: Sep 5, 2024 10:37 AM Plotted by: SeverA

AERIAL PHOTOGRAPH SOURCE: *Google Earth* (2022)

LEGEND

	PROPERTY BOUNDARY
BH/MW24-01	BOREHOLE / MONITORING WELL NO. AND LOCATION
BH24-02	BOREHOLE NO. AND LOCATION
(61.88m)	GROUND SURFACE ELEVATION (m)
[BR = 0.5m (61.4m)]	BEDROCK DEPTH (ELEVATION) (m)
[CR = 0.7m (61.8m)]	CASING REFUSAL DEPTH (ELEVATION) ON INFERRED COBBLES, BOULDERS OR BEDROCK (m)

GENERAL NOTES:

1. THE BOUNDARIES, SOIL AND ROCK TYPES HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. BETWEEN BOREHOLES THEY ARE ASSUMED AND MAY BE SUBJECT TO CONSIDERABLE ERROR.
2. SOIL SAMPLES AND ROCK CORES WILL BE RETAINED IN STORAGE FOR THREE MONTHS AND THEN DESTROYED UNLESS THE CLIENT ADVISES THAT AN EXTENDED TIME PERIOD IS REQUIRED.
3. BOREHOLE ELEVATIONS SHOULD NOT BE USED TO DESIGN BUILDING(S) OR FLOOR SLABS OR PARKING LOT(S) GRADES.
4. THIS DRAWING FORMS PART OF THE REPORT PROJECT NUMBER AS REFERENCED AND SHOULD BE USED ONLY IN CONJUNCTION WITH THIS REPORT.
5. BASE TOPOGRAPHIC SURVEY PLAN PRODUCED BY: *ANNIS, O'SULLIVAN, VOLLEBEKK LTD.*, LOT 15 WEST CARRUTHERS AVE., REGISTERED PLAN 35 CITY OF OTTAWA, DATED: MARCH 7, 2024

EXP Services Inc. **www.exp.com**
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2650 Queensview Drive, Suite 100
Ottawa, ON K2B 8H6, Canada

DATE: OCTOBER 2024	**Client: MA Precision Holding Inc.116-118 Carruthers Ave.OTT**	project no.: OTT-24006545-B0
DESIGN: SP / SL; CHECKED: IT	PROJECT: GEOTECHNICAL INVESTIGATION	scale: 1:250
DRAWN BY: AS	TITLE: BOREHOLE LOCATION PLAN	FIG 2

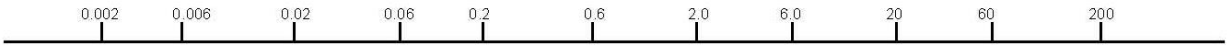
Filename: E:\OTT\OTT-24006545-B0\60 Execution\65 Drawings\OTT-24006545-B0_Geo_116-118-Carruthers-Ave.dwg
Last Saved: Oct 2, 2024 11:54 AM Last Plotted: Oct 2, 2024 11:54 AM Plotted by: SeverA

Notes On Sample Descriptions

1. 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 Societv 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.

ISSMFE SOIL CLASSIFICATION

CLAY	SILT			SAND			GRAVEL			COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE		



EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

CLAY (PLASTIC) TO	FINE	MEDIUM	CRS.	FINE	COARSE
SILT (NONPLASTIC)	SAND			GRAVEL	

UNIFIED SOIL CLASSIFICATION

2. 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.

3. 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/MW24-01

Project No: OTT-24006545-B0

Project: Proposed Residential Development

Location: 116 & 118 Carruthers Avenue, Ottawa, ON

Figure No. 3

Page. 1 of 1

Date Drilled: 'August 21, 2024

Drill Type: Portable Drill Rig

Datum: Geodetic Elevation

Logged by: J.E. Checked by: M.Z.

Split Spoon Sample ⊠ | Auger Sample ◧ | SPT (N) Value ○ | Dynamic Cone Test —— | Shelby Tube ■ | Shear Strength by Vane Test +S

Combustible Vapour Reading □ | Natural Moisture Content × | Atterberg Limits ⊢○ | Undrained Triaxial at % Strain at Failure ⊕ | Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value (20 40 60 80) / Shear Strength kPa (50 100 150 200)	Combustible Vapour Reading (ppm) (250 500 750) / Natural Moisture Content % Atterberg Limits (% Dry Weight) (20 40 60)	SAMPLES	Natural Unit Wt. kN/m³
		GRANULAR FILL ~500 mm thick Silty sand with gravel, brown, moist, no odours, no stains, (loose)	61.88	0	9	0	SS1	
		HIGHLY WEATHERED LIMESTONE BEDROCK Grey, very poor quality	61.4	1			RUN 1	
		Rock core barrel dropped from 1.3 m to 1.5 m depths due to possible 180 mm thick void at 1.3 m depth	60.2					
▽		**LIMESTONE BEDROCK** Grey, excellent quality	59.98	2			RUN 2 26.6	
				3			RUN 3	
			57.7	4			RUN 4 26.6	
		Borehole Terminated at 4.2 m Depth						

LOG OF BOREHOLE BH LOGS-116 CARRUTHERS.GPJ TROW OTTAWA.GDT 10/1/24

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 32 mm diameter monitoring well was installed as shown.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-24006545-B0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Sept. 6, 2024	1.9	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	0.5 - 1.7	73	0
2	1.7 - 2.3	96	93
3	2.3 - 3.3	97	97
4	3.3 - 4.2	94	94

Log of Borehole BH24-02

Project No: OTT-24006545-B0

Project: Proposed Residential Development

Location: 116 & 118 Carruthers Avenue, Ottawa, ON

Figure No. 4

Page. 1 of 1

Date Drilled: 'August 20, 2024

Drill Type: Portable Drill Rig

Datum: Geodetic Elevation

Logged by: J.E. Checked by: M.Z.

Split Spoon Sample ⊠
Auger Sample ◧
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits ⊢○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		GRANULAR FILL Silty sand with gravel, brown, moist, no odours, no stains, (loose)	62.52	0	6	0	SS1	
			61.8		50 for 127mm		SS2	
		Casing Refusal at 0.7 m Depth						

Standard Penetration Test N Value: 20 40 60 80
Shear Strength kPa: 50 100 150 200
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % / Atterberg Limits (% Dry Weight): 20 40 60

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. The borehole was backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-24006545-B0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE BH LOGS-116 CARRUTHERS.GPJ TROW OTTAWA.GDT 10/1/24

Log of Borehole BH/MW24-03

Project No: OTT-24006545-B0

Project: Proposed Residential Development

Location: 116 & 118 Carruthers Avenue, Ottawa, ON

Figure No. 5

Page. 1 of 1

Date Drilled: 'August 20, 2024

Drill Type: Portable Drill Rig

Datum: Geodetic Elevation

Logged by: J.E. Checked by: M.Z.

Split Spoon Sample ⊠ | Auger Sample ◧ | SPT (N) Value ○ | Dynamic Cone Test —— | Shelby Tube ■ | Shear Strength by Vane Test +S

Combustible Vapour Reading □ | Natural Moisture Content × | Atterberg Limits ⊢○⊣ | Undrained Triaxial at % Strain at Failure ⊕ | Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		GRANULAR FILL ~600 mm thick Silty sand with gravel, brown, damp, no odours, no stains, (compact)	62.59	0	22	0	SS1	
		LIMESTONE BEDROCK Grey, good to excellent quality	62.0	1			RUN 1	26.9
▽			60.59	2				
				3			RUN 2	26.7
				4				
		Borehole Terminated at 4.5 m Depth	58.1					

LOG OF BOREHOLE BH LOGS-116 CARRUTHERS.GPJ TROW OTTAWA.GDT 10/1/24

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 32 mm diameter monitoring well was installed as shown.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-24006545-B0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Sept. 6, 2024	2.0	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	0.6 - 2.4	100	83
2	2.4 - 4.5	100	98

Log of Borehole BH24-04

Project No: OTT-24006545-B0

Project: Proposed Residential Development

Location: 116 & 118 Carruthers Avenue, Ottawa, ON

Figure No. 6

Page. 1 of 1

Date Drilled: 'August 20, 2024

Drill Type: Portable Drill Rig

Datum: Geodetic Elevation

Logged by: J.E. Checked by: M.Z.

Split Spoon Sample ⊠
Auger Sample ▮▯
SPT (N) Value ○
Dynamic Cone Test ——
Shelby Tube ■
Shear Strength by Vane Test +S

Combustible Vapour Reading □
Natural Moisture Content ×
Atterberg Limits ⊢○
Undrained Triaxial at % Strain at Failure ⊕
Shear Strength by Penetrometer Test ▲

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		GRANULAR FILL Silty sand with gravel, brown, moist, no odours, no stains, (compact)	62.33	0	27	0	SS1	
			61.9					
		Casing Refusal at 0.4 m Depth						

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. The borehole was backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-24006545-B0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)

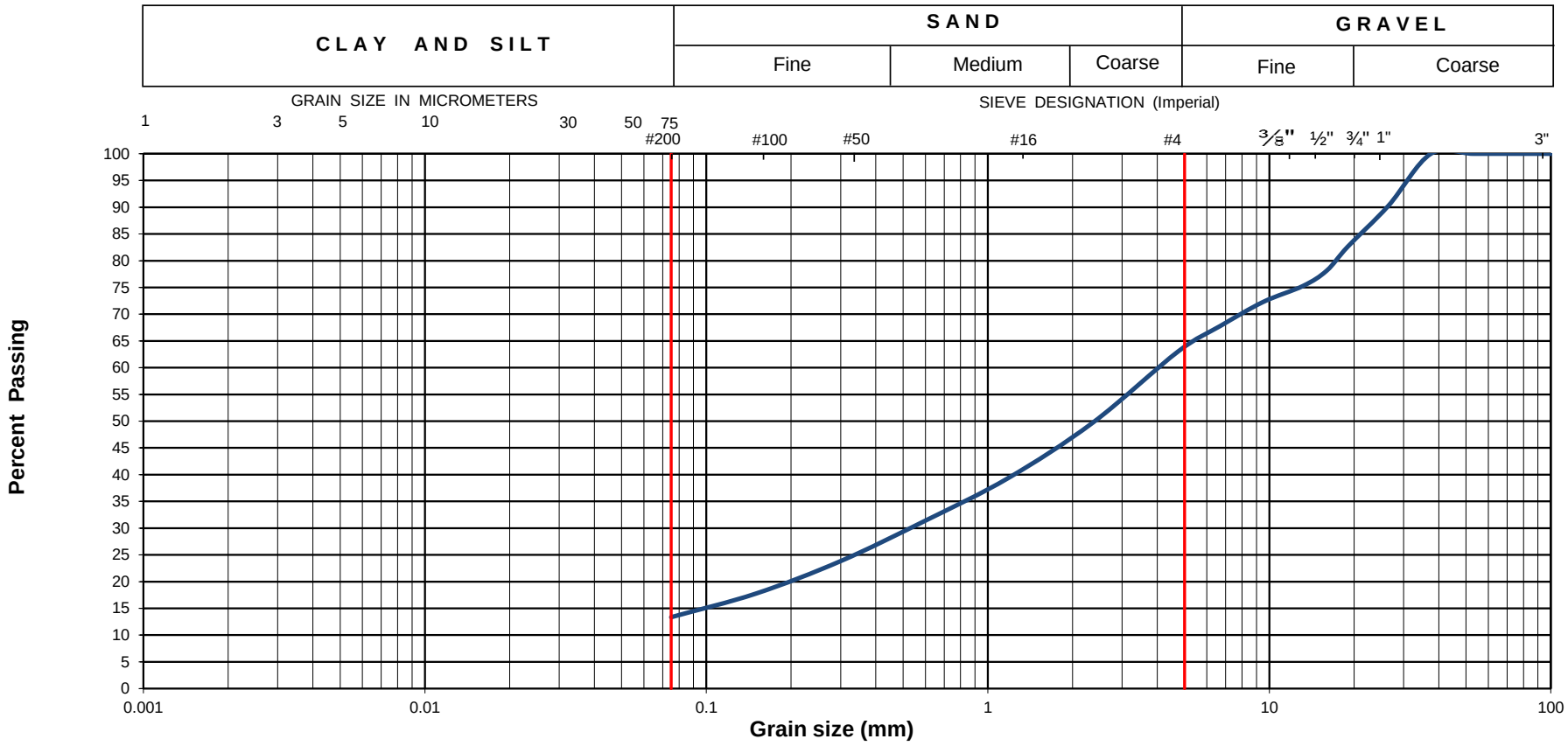
CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE BH LOGS-116 CARRUTHERS.GPJ TROW OTTAWA.GDT 10/1/24

EXP Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

Grain-Size Distribution Curve
Method of Test For Sieve Analysis of Aggregate
ASTM C-136

Unified Soil Classification System



EXP Project No.:	**OTT-24006545-B0**	**Project Name :**	**Geotechnical Investigation - Proposed Residential Development**						
Client :	**MA Precision Holding Inc.**	**Project Location :**	**116 and 118 Carruthers Avenue, Ottawa, ON**						
Date Sampled :	**August 20 - 21, 2024**	**Borehole No:**	**BH1 to BH4**	**Sample:**	**SS1**	**Depth (m) :**	**0 - 0.6**		
Sample Composition :		**Gravel (%)**	**37**	**Sand (%)**	**50**	**Silt & Clay (%)**	**13**	**Figure :**	**7**
Sample Description :	**GRANULAR FILL: Silty Sand with Gravel (SM)**								

Appendix A: Bedrock Core Photographs

DRY BEDROCK CORES

WET BEDROCK CORES

exp Services Inc.
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www.exp.com

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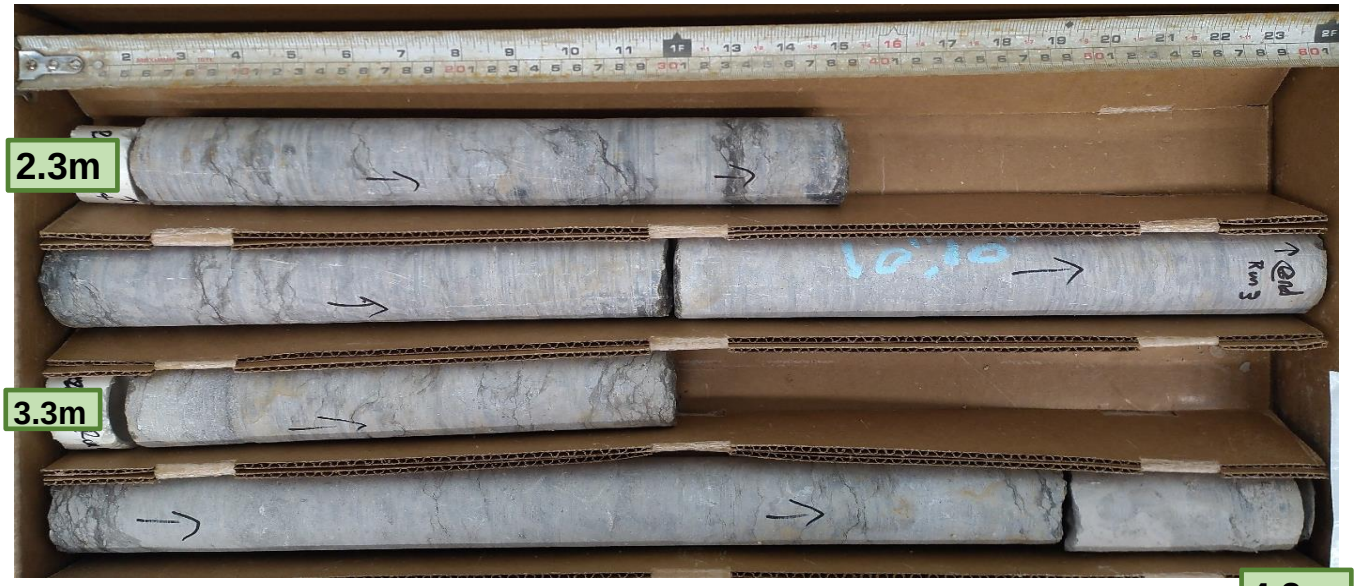
• INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

borehole no.	core runs	PROJECT	project no.
BH24-01	Run 1: 0.5m - 1.7m Run 2: 1.7m - 2.3m Run 3: 2.3m - 3.3m Run 4: 3.3m - 4.2m	Proposed Residential Development 116 and 118 Carruthers Avenue, Ottawa, Ontario	OTT-24006545-B0
date cored Aug 21, 2024		ROCK CORE PHOTOGRAPHS	FIG A1

DRY BEDROCK CORES



WET BEDROCK CORES

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borehole no.	core runs	PROJECT	project no.
BH24-01	Run 1: 0.5m - 1.7m Run 2: 1.7m - 2.3m Run 3: 2.3m - 3.3m Run 4: 3.3m - 4.2m	Proposed Residential Development 116 and 118 Carruthers Avenue, Ottawa, Ontario	OTT-24006545-B0
date cored Aug 21, 2024		ROCK CORE PHOTOGRAPHS	FIG A2

DRY BEDROCK CORES

WET BEDROCK CORES

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borehole no.	core runs	PROJECT	project no.
BH24-03	Run 1: 0.6m - 2.4m Run 2: 2.4m - 4.5m End of Borehole	Proposed Residential Development 116 and 118 Carruthers Avenue, Ottawa, Ontario	OTT-24006545-B0
date cored Aug 20, 2024		ROCK CORE PHOTOGRAPHS	FIG A3

DRY BEDROCK CORES

WET BEDROCK CORES

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• BUILDINGS • EARTH & ENVIRONMENT • ENERGY •
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borehole no.	core runs	PROJECT	project no.
BH24-03	Run 1: 0.6m - 2.4m Run 2: 2.4m - 4.5m End of Borehole	Proposed Residential Development 116 and 118 Carruthers Avenue, Ottawa, Ontario	OTT-24006545-B0
date cored Aug 20, 2024		ROCK CORE PHOTOGRAPHS	FIG A4

Appendix B: Laboratory Certificate of Analysis Report

AGAT Laboratories

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
2650 QUEENSVIEW DRIVE, UNIT 100
OTTAWA, ON K2B8H6
(613) 688-1899
ATTENTION TO: Matthew Zammit
PROJECT: OTT-24006545-B0
AGAT WORK ORDER: 24Z194433
SOIL ANALYSIS REVIEWED BY: Sukhwinder Randhawa, Inorganic Team Lead
DATE REPORTED: Sep 16, 2024
PAGES (INCLUDING COVER): 5
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 is available on request from AGAT Laboratories, in accordance with ISO/IEC 17025:2017, ISO/IEC 17025:2005 (Quebec), DR-12-PALA and/or NELAP Standards.*
- *This document is signed by an authorized signatory who meets the requirements of the MELCCFP, CALA, CCN and NELAP.*
- *For environmental samples in the Province of Quebec: The analysis is performed on and results apply to samples as received. A temperature above 6°C upon receipt, as indicated in the Sample Reception Notification (SRN), could indicate the integrity of the samples has been compromised if the delay between sampling and submission to the laboratory could not be minimized.*

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Certificate of Analysis

AGAT WORK ORDER: 24Z194433

PROJECT: OTT-24006545-B0

CLIENT NAME: EXP SERVICES INC

ATTENTION TO: Matthew Zammit

SAMPLING SITE:

SAMPLED BY:

(Soil) Inorganic Chemistry

DATE RECEIVED: 2024-09-09 **DATE REPORTED: 2024-09-16**

				BH24-1 Run 2
		SAMPLE DESCRIPTION:		7'3"-7'8"
		SAMPLE TYPE:		Rock
		DATE SAMPLED:		2024-09-06
Parameter	Unit	G / S	RDL	6129934
Chloride (2:1)	µg/g		2	47
Sulphate (2:1)	µg/g		2	34
pH (2:1)	pH Units		NA	9.12
Resistivity (2:1) (Calculated)	ohm.cm		1	5050

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

6129934 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:

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CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 24Z194433

PROJECT: OTT-24006545-B0

ATTENTION TO: Matthew Zammit

SAMPLING SITE:

SAMPLED BY:

Soil Analysis

RPT Date: Sep 16, 2024			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
(Soil) Inorganic Chemistry															
Chloride (2:1)	6127766		220	220	0.0%	< 2	95%	70%	130%	99%	80%	120%	90%	70%	130%
Sulphate (2:1)	6127766		51	51	0.0%	< 2	101%	70%	130%	101%	80%	120%	102%	70%	130%
pH (2:1)	6137005		7.69	8.23	6.8%	NA	98%	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.

Certified By:

AGAT Laboratories

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CANADA L4Z 1Y2
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Method Summary

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 24Z194433

PROJECT: OTT-24006545-B0

ATTENTION TO: Matthew Zammit

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
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

AGAT Laboratories

Have feedback? Scan here for a quick survey!

5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Laboratory Use Only

Work Order #: 24Z194433

Cooler Quantity: one - no ice packs

Arrival Temperatures: n/a

~~Depot~~ Temperatures: 5.9 | 6.5T | 6.3

Custody Seal Intact: ☐ Yes ☐ No ☐ N/A

Notes: B / I

Report Information:

Company: EXP Services Inc
Contact: Matthew Zammit
Address: 2650 Queensview drive, Suite 100
Ottawa, Ontario. K2B 8H6
Phone: 613-688-1899 Fax:
Reports to be sent to:
1. Email: Matthew.Zammit@exp.com
2. Email: ryan.digiuseppe@exp.com

Regulatory Requirements:

(Please check all applicable boxes)

☐ Regulation 153/04
Table (Indicate One) ☐ Ind/Com ☐ Res/Park ☐ Agriculture
Soil Texture (Check One) ☐ Coarse ☐ Fine

☐ Regulation 406
Table (Indicate One) ☐ Ind/Com ☐ Res/Park ☐ Agriculture
☐ Regulation 558
☐ CCME

☐ Sewer Use ☐ Sanitary ☐ Storm
(Region)
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
(Indicate One)

Is this submission for a **Record of Site Condition (RSC)**? ☐ Yes ☐ No

Report Guideline on *Certificate of Analysis* ☐ Yes ☐ No

Turnaround Time (TAT) Required:

Regular TAT ☑ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

For 'Same Day' analysis, please contact your AGAT CSR

Project Information:

Project: OTT-24006545-B0
Site Location: 116 Carruthers Ave, Ottawa
Sampled By: EXP
AGAT Quote #: PO:
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☑ No ☐

Company:
Contact:
Address:
Email:

Legal Sample ☐

Sample Matrix Legend

GW	Ground Water	**SD**	Sediment
O	Oil	**SW**	Surface Water
P	Paint	**R**	Rock/Shale
S	Soil		

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI, DOC (Y / N)	O. Reg 153: Metals & Inorganics	O. Reg 153: Metals - ☐ CrVI, ☐ Hg, ☐ HWSB	O. Reg 153: BTEX, F1-F4 PHCs	VOC	PAHs	PCBs: Aroclors ☐	O. Reg 406: Regulation 406 Characterization Package	O. Reg 406: pH, Metals, BTEX, F1-F4	O. Reg 406: EC, SAR	O. Reg 406: Regulation 406 SPLP Rainwater Leach	O. Reg 406: mSPLP- ☐ Metals ☐ VOCs ☐ SVOCs ☐ OC	O. Reg 558: Landfill Disposal Characterization TCLP: ☐ TCLP- ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Corrosivity: ☐ Moisture ☐ Sulphide	pH	Sulphates	Chlorides	Electro Resistivity			Potentially Hazardous or High Concentration (Y/N)
1. BH24-1 Run 2 7'3"-7'8"	Sept 6	AM/PM	1																	☑	☑	☑	☑			
2.		AM/PM																								
3.		AM/PM																								
4.		AM/PM																								
5.		AM/PM																								
6.		AM/PM																								
7.		AM/PM																								
8.		AM/PM																								
9.		AM/PM																								
10.		AM/PM																								
11.		AM/PM																								

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
			C Griffith	24/09/24	11h16
CC to Dino	24/09/24	15h00		Sept 10	9:10

Page ____ of ____

N°:

Pink Copy - Client | Yellow Copy - AGAT | White Copy - AGAT

Legal Notification

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