Geotechnical Investigation
Proposed Residential Development
316-332 Clifton Road, City of Ottawa, Ontario

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1. Introduction and Site Description

A geotechnical investigation was undertaken at the site of the residential development proposed at the property registered by the street address of 316-332 Clifton Road, City of Ottawa, Ontario (Figure 1). The proposed development will comprise of six (6) blocks of three-storey basementless two to six to townhome units with associated access roadways and parking areas. In addition, retaining walls are also proposed to be constructed as part of the proposed development. Terms and conditions of the assignment were outlined in EXP's Proposal P88074GM dated July 28, 2020.

Preliminary concept plans provided to EXP indicates that the finished garage floor elevations for the proposed blocks would range from 64.2 m to 65.7 whereas the finished grade along the exterior of the block would range from Elevation 64.9 m to 66.4 m (Figure No. 2).

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) Provide 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 buildings construction as well as anticipated total and differential settlements;

d) Discuss slab-on-grade construction;

e) Comment on backfilling requirements and suitability of the on-site soils for backfilling purposes;

f) Discuss subsurface concrete requirement;

g) Discuss excavation conditions and dewatering requirements during construction;

h) Provide classification of the site for seismic design in accordance with requirements of the 2012 Ontario Building Code (OBC) and assess the liquefication potential of the on-site soils in a seismic event; and

i) Provide pavement structure for the access roadways and parking areas.

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. It must be noted that this report does not include recommendations for the demolishing of the existing residential buildings.

2. Site Description

The subject site is bounded by Clifton Road on the east, residential buildings on the north and south, and commercial/residential buildings on the west. The site currently occupied by multiple two-storey residential buildings with basements accessible from Clifton Road which will be demolished to allow the proposed buildings construction. The site is generally flat lying with approximate ground elevations ranging between 64.0 and 64.8 m at the locations of the boreholes.

3. Procedure

The fieldwork for the geotechnical investigation was completed on September 3, 2020 and comprised the drilling of seven (7) boreholes, i.e., Borehole Nos. 1 to 7, to depths ranging between 1.5 m and 3.1 m below the existing ground surface. The boreholes were drilled using track-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 and geodetic elevations of the boreholes were established in the field by EXP and are shown on Figure 2.

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 Borehole No. 1 beyond the refusal depth.

Long-term groundwater monitoring installations consisting of 19 mm diameter polyvinyl chloride (PVC) pipes was installed in Borehole No. 1 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.....13 Tests
Grain Size Analysis.....2 Tests
Chemical Analysis (pH, sulphate, chloride and resistivity).....1 Test
Unit Weight and Unconfined Compressive Strength Tests on Rock Cores.....2 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 9 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 Topsoil

30 mm to 350 mm topsoil was contacted at the surface in Boreholes Nos. 1 to 6.

4.2 Fill

Fill was contacted beneath the topsoil in Boreholes Nos. 1 to 6 and at ground surface in Borehole No. 7. The fill material comprised of silty sand (SM). A 170 mm thick granular fill was contacted overlying the silty sand with gravel fill in Borehole No. 3. The fill material contained some gravel in all boreholes and some roots and organics in Boreholes Nos. 2 and 3 and was mixed with topsoil in Borehole No. 7 and contained inferred cobbles and boulders within the bottom levels of Boreholes Nos. 3 and. The fill material extended to the surface of the glacial till in Boreholes Nos. 1, 6, and 7 and to termination/auger depths in the remaining boreholes at depths of 0.8 m to 1.9 m below ground surface (Elevations 63.6 m to 62.5 m). The fill is loose to compact as indicated by the SPT N-values which ranged from 2 to 24 blows and has a natural moisture content ranging from 5 percent to 24 percent.

Grain size analysis was conducted on one (1) sample of the fill material and the results presented in Figure 10 and summarized in Table I below.

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

Borehole No. – Sample No.	Depth (m)	Grain-size Analysis (%)				Soil Classification (USCS)
		Gravel	Sand	Silt	Clay	
BH7 – SS1	0 - 0.6	4	47	35	14	Silty SAND (SM)

Based on the results of the grain size analysis, the soil may be classified as silty sand (SM) in accordance with the Unified Soil Classification System (USCS).

4.3 Silty Sand Glacial Till (SM)

Silty sand glacial till was contacted beneath the fill in Boreholes Nos. 1, 6, and 7. The till contained occasional cobbles and boulders based on auger grinding and extended to the boreholes termination at depths ranging from 1.5 m to 1.6 m below ground surface, i.e. Elevation 63.1 m to 62.5 m. It is compact as indicated by the SPT N-values which ranged from 15 to 27 blows and has a natural moisture content ranging from 2 percent to 7 percent.

Grain size analysis was conducted on one (1) sample of the till material and the results presented in Figure 11 and summarized in Table II below.

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

Borehole No. – Sample No.	Depth (m)	Grain-size Analysis (%)				Soil Classification (USCS)
		Gravel	Sand	Silt	Clay	
BH1 – SS2	0.8 – 1.4	23	42	30	5	Silty SAND with Gravel (SM)

Based on the results of the grain size analysis, the soil may be classified as silty sand with gravel (SM) in accordance with the Unified Soil Classification System (USCS).

4.4 Bedrock

Refusal to auger was met in all the boreholes at depths ranging from 1.5 m to 1.9 m, i.e elevations 63.1 m to 62.5 m. Wash-boring and core drilling techniques were used to advance Borehole No. 1 below the refusal depth and revealed that refusal was met on bedrock at 1.6 m below ground surface, i.e. elevation 62.8 m.

A summary of the inferred bedrock depths and elevations based on auger refusal is shown in Table III.

Table III: Summary of Inferred Bedrock Depths and Elevations in the Boreholes

Borehole No.	Ground Surface Elevation (m)	Depth (Elevation) of Inferred Bedrock (m)	Bedrock Proven by Coring
BH1	64.4	1.6 (62.8)	Yes
BH2	64.2	1.6 (62.6)	No
BH3	64.4	1.6 (62.8)	No
BH4	64.8	1.9 (62.9)	No
BH5	64.0	1.5 (62.5)	No
BH6	64.6	1.5 (63.1)	No
BH7	64.0	1.5 (62.5)	No

A review of the recovered bedrock cores and published geology maps indicate that the bedrock underlying the site comprises of limestone with shale partings of the Ottawa Group of the Shadow Lake Formation of the Middle Ordovician Period.

A Total Core Recovery (TCR) and Rock Quality Designation (RQD) of 100 percent and 0 to 44 percent respectively were obtained from the recovered bedrock cores. On this basis, the bedrock quality within the depth investigated may be classified as very poor to poor quality.

A total of two (2) rock core samples were selected for unconfined compressive strength testing and the test results are presented in Table III. A review of the test results indicates a bedrock with compressive strength of 164.7 MPa and 175.5 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 weights of the bedrock were 2668 kg/m^3 and 2679 kg/m^3. Photographs of the bedrock core recovered are presented in Figure 12.

Table IV: Results of Unconfined Compressive Tests on Rock Core Samples

Borehole No. – Run No.	Depth (m)	Compressive Strength (MPa)	Density (Kg/m^3)
BH1 – Run2	1.8 – 2.0	164.7	2679
BH1 – Run3	2.3 – 2.5	175.5	2668

4.5 Groundwater

Groundwater level measurements were made in all the open boreholes upon the completion of the drilling. All open boreholes were dry. One (1) groundwater level measurement was taken at the monitoring well installed in Borehole No. 1 on the 8th day after installation. The measurement revealed that the monitoring well was dry.

Groundwater 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 up to 1.9 m of fill and till overburden over limestone with shale partings bedrock.

Based on the geotechnical findings and floor elevations of the proposed blocks, a grade raise of up to 1.7 m is anticipated. This grade raise is considered acceptable from a geotechnical point of view.

6. Foundation Consideration

Based on the results of the investigation, the proposed buildings and retaining walls may be founded on the compact undisturbed till limestone or on engineered fill and designed for a bearing capacity at Serviceability limit State (SLS) and at ultimate limit state of 150 KPa and 250 KPa respectively. Settlement for footings founded on the till is expected to be withing tolerable limits of 25 mm total and 19 mm differential. A summary of ground surface elevations, ground floor elevations, and anticipated founding elevations and strata based on the nearest borehole is presented in Table V.

Table V: Summary of Elevations and Anticipated Founding Strata Based on an Estimated Founding level of 1.5 m below Finished Grade

Block No.	Ground Surface Elevation (m)	Ground Floor Elevation (m)	Anticipated Founding Elevation (m)	Anticipated Founding Strata	Reference Borehole No.
1	64.2-64.4	64.6	63.1	Engineered Fill	BH2 & BH3
2	64.2-64.8	64.5	63.0	Engineered Fill	BH2 & BH4
3	64.4	65.3	63.8	Engineered Fill & Till	BH1
4	64.2	64.2	62.7	Engineered Fill	BH2
5	64.0	64.4	62.9	Engineered Fill	BH5
6	64.0-64.6	65.7	64.2	Engineered Fill & Till	BH6 & BH7

In the areas of the existing buildings which will be demolished, all building material, footings, foundation walls, construction material must be removed and disposed of site and the excavation backfilled with engineered fill prepared as described below.

Preparation of the engineered pad should comprise of the excavation of all fill, deleterious material, construction material, old footings, etc. down to the surface of the glacial till or bedrock. The excavation may extend to deeper depths than indicated on the logs in the areas of the existing building footings and services which will be demolished. Following approval of the subgrade, OPSS 1010 Granular B Type II should be placed in 300 mm lifts and each lift compacted to 100 percent of the Standard Proctor Maximum Dry Density (SPMDD). The engineered pad must extend to a minimum of 0.6 m from the edge of the footing then slope down at 1H to 1V to the bottom of the pad. In-place density testing must be undertaken on each lift to ensure that the specified degree of compaction has been achieved.

Footings must not bear partly on bedrock and partly on engineered fill. If this is the case, transition zone or construction joints must be provided to reduce the potential of differential settlement between the two founding mediums.

Settlement for footings founded on engineered fill pad is expected to be withing tolerable limits of 25 mm total and 19 mm differential.

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 1.5 of earth cover should be provided to the footings of a heated structure founded on engineered fill or till to protect them from damage due to frost penetration. The frost cover should be increased to 1.8 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.

It is recommended that once the design underside of footings is established, they should be forwarded to EXP so any revision to the report can be made, if deemed required. It is also recommended that prior to tendering and following demolition, test pits should be completed at the site to collect additional data on the rock depths throughout the site.

7. Floor Slab and Drainage Requirements

The at-grade floor slab of the proposed buildings may be constructed provided they are set on beds of well-compacted 19 mm clear stone at least 300 mm thick placed on compact undisturbed till or on well-compacted engineered fill comprising of OPSS 1010 Granular B or A placed in 300 mm lift and each lift compacted to 98 % of the SPMDD. The clear stone would prevent the capillary rise of moisture to the floor slab. Adequate saw cuts should be provided in the slabs to control cracking. All fill materials must be removed from the envelope of the buildings and replaced with well compacted engineered fill as described in Section 12 of the report.

It is anticipated that perimeter drainage system would be required for the proposed buildings. 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. Retaining Walls

The retaining walls will be subjected to lateral static earth as well as lateral dynamic earth forces during a seismic event. Seismic loading will result in an increase in active lateral earth pressure on the wall. The seismic lateral earth pressure coefficients given below have been derived based on the peak horizontal ground acceleration (PGA) of 0.276g applicable for the site.

The expressions below assume the retaining walls are backfilled with free draining material, such as Ontario Provincial Standard Specification (OPSS) Granular B Type II and equipped with a permanent drainage system to prevent the buildup of hydrostatic pressure behind the wall.

The total active pressure distribution can be separated into a static component and a dynamic component and may be determined as follows (Mononobe and Matsuo, 1929):

$$\sigma_{AE}(z) = K_A\gamma z + (K_{AE} - K_A)\gamma(H - z) + q$$

Where $\sigma_{AE}(z)$ = the total combined active earth pressure (dynamic and static) at depth z, (kPa).

z = depth below the top of the retaining wall (m)
K_A = static lateral active earth pressure coefficient
K_{AE} = combined (static and dynamic) active earth pressure coefficient
γ = unit weight of the backfill soil (kN/m^3)
H = total height of the wall (m)
q = surcharge such as traffic and compaction pressure, where applicable (kPa)

For the total active earth pressure, the seismic (dynamic) pressure distribution is an inverted triangle with maximum pressure at the top of the wall and a minimum at the bottom of the wall. Therefore, the resultant of the static and seismic (dynamic) pressures on the retaining wall is assumed to be applied at depths ranging between 0.67z from the top of the backfill behind the wall and 0.67 (H-z) from the bottom of the wall, respectively.

The total passive pressure in front of the wall can similarly be separated into static and dynamic components as follows:

$$\sigma_{PE}(z) = K_p\gamma z + (K_{PE} - K_p)\gamma(z) + q$$

Where $\sigma_{PE}(z)$= the total combined passive earth pressure (dynamic and static) a depth z, (kPa)

z = depth below the ground surface in front of the wall (m)
K_p = static passive earth pressure coefficient
K_{PE} = combined (static and dynamic) passive earth pressure coefficient
γ = unit weight of the backfill soil (kN/m^3)

q = surcharge such as traffic and compaction pressure, where applicable (kPa)

The dynamic passive pressure acts in the opposite direction to the static passive pressure thereby reducing the available passive pressure. The resultant force of the static and dynamic components of the passive pressure acts at 0.67z from the top of final grade in front of the retaining wall.

The lateral earth pressure parameters are summarized in Table VI.

Table VI: Lateral Earth Pressure Parameters

Soil Type	OPSS Granular B Type II
Unit Weight of Soil (γ); kN/m^3	22
Angle of Internal Friction (ϕ'); degrees	30^o
Coefficient of Static Active Lateral Earth Pressure Coefficient, K_A	0.33
Coefficient of Static Passive Lateral Earth Pressure Coefficient, K_P	3.00
Combined Coefficient (Static and Dynamic) Active Lateral Earth Pressure, K_{AE}	0.42
Combined Coefficient of (Static and Dynamic) Passive Lateral Earth Pressure, K_{PE}	2.74

For the calculation of the active and passive dynamic (seismic) lateral earth pressure coefficients, the seismic coefficient in the horizontal direction, k_h, was taken as 0.5 times the PGA value of 0.276g (Appendix A). The calculated active and passive dynamic (seismic) lateral earth pressure coefficients assume the seismic coefficient in the vertical direction, k_v, is zero. If vertical acceleration is taken into consideration, the computed active and dynamic (seismic) lateral earth pressure coefficients values would be somewhat different.

The K_{AE} and K_{PE} value calculations assume the front and back faces of the wall are vertical, there is no friction between the concrete of the wall and the backfill soil (in front of and behind the wall) and the ground surface of the backfill (in front of and behind the wall) is level or flat and the ground surface of the backfill behind the wall is at the same level as the top of the retaining wall.

9. 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 or compact undisturbed till. 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).

10.Subsurface Excavation and De-Watering Requirements

Excavations for the construction of the proposed buildings and underground services will likely be undertaken through the shallow fill to a maximum depth of 1.9 m below ground surface or elevation 62.5 m. These excavations are expected to be above the 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 would require the use of hoe-ramming and/or line drilling and may be undertaken with near vertical sides. Contractor bidding on this project must review the available data and decide on their own the most suitable method to excavate the bedrock, i.e. line drilling, blasting, etc. It should be noted that lab testing has revealed the bedrock underlaying the site to be strong to very strong.

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.

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. It is possible that additional localized sumps may be required in areas where the seepage is more extensive.

11.Seismic Site Classification

11.1 Liquefaction Potential

The investigation has revealed that the proposed buildings will be founded on bedrock or compact undisturbed till or on engineered fill.

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 (OBC 2012) given that the buildings foundations or foundation pads will be placed directly on intact bedrock or compact undisturbed till.

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

It is anticipated that the majority of the material required for backfilling purposes will need to be imported and should preferably conform to the following specifications:

- Engineering fill under footing and basement floor– OPSS 1010 Granular B Type II placed in 300 mm thick lifts and compacted to 100 percent of the SPMDD (ASTM d-698-12e2) under footings and to 98 percent of the SPMDD under the floors;

- Backfilling against exterior basement walls – OPSS 1010 Granular B Type I or II, placed in 300 mm thick lifts and compacted to 95 percent of the SPMDD;

- Trench backfill and fill placement to subgrade level for pavement – OPSS 1010 Select Subgrade Material (SSM), or on-site approved material free of organics 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 of the SPMDD.

The on-site fill may be used for grading purposes in the landscaped area provided it is free of organics and foreign debris.

13.Subsurface Concrete Requirements

Chemical tests limited to pH, chloride, sulphate and resistivity were performed on one (1) selected soil sample. The certificate of the laboratory analysis is attached in Appendix A and the results are summarized in Table VII.

Table VII: Chemical Test Results on Soil Sample

Borehole No. (Sample No.)	Soil Type	Depth (m)	pH	Sulphate (%)	Chloride (%)	Resistivity (ohm-cm)
BH-4 (SS2)	Silty Sand Fill	0.8 – 1.4	7.8	0.0007	0.0003	6710

The test results indicate the sulphate and chloride content in the fill is 0.0007 percent and 0.0003 percent respectively.

The sulphate content is less than 0.1 percent. This concentration in the fill would have a negligible potential of sulphate attack on subsurface concrete. The concrete should be designed in accordance with Table Nos. 3 and 6 of CSA A.23.1-14. However, the concrete should be dense, well compacted and cured.

Based on a review of the resistivity test result, the fill sample is considered 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.Pavement Structure

Pavement structure thicknesses required for the access and local roads and parking areas to be used by light and heavy-duty traffic were computed. The pavement structures are shown on Table VIII. The thicknesses are based upon an estimate of the subgrade soil properties determined from visual examination and textural classification of the soil samples and pavement functional design life of ten (10) years. The proposed functional design life represents the number of years to the first rehabilitation, assuming regular maintenance is carried out. The subgrade is anticipated to consist of the compact undisturbed till or select subgrade material (SSM).

Table VIII: Recommended Pavement Structure Thicknesses

Pavement Layer	Compaction Requirements	Light Duty Traffic (Vehicle only)	Access Roads (trucks)
Asphaltic Concrete (PG 58-34)	92 - 97% MRD*	65 mm HL3 or SP12.5 Cat B	40 mm HL3 or SP12.5 Cat B 50 mm HL8 or SP 19 Cat B
OPSS 1010 Granular "A" Base	100% SPMDD**	150 mm	150 mm
OPSS 1010 Granular "B" Sub-Base, Type II	100% SPMDD**	300 mm	450 mm

**Denotes maximum relative density.*

*** Denotes standard Proctor maximum dry density, ASTM-D698-12e2.*

Any subgrade fill must be compacted as per Section 11.

Construction procedures for the pavement structure are discussed below.

The foregoing design assumes that construction is carried out during dry periods and that the subgrade is undisturbed 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 and/or geotextile may be required.

Additional comments on the construction of the parking lot and access and local roads are as follows:

- As part of the subgrade preparation, the proposed parking area and access and local roadways should be stripped of topsoil and other obviously unsuitable material such as organic materials. Fill required to raise the grades to design elevations should conform to the requirement as per Section 12 and should be placed and compacted to 95 percent of the SPMDD. The subgrade should be properly shaped, crowned, then proofrolled where possible in the full-time presence of a representative of this office. Any loose, soft, or spongy subgrade areas detected should be sub excavated and properly replaced with suitable approved backfill compacted to 98% SPMDD (ASTM D698-12e2).

- 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. Subdrains stubs are recommended to be installed at 3 m distance of the catchbaisn in all direction. This will ensure no water collects in the granular course, which could result in pavement failure during the spring thaw.

- 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 catch basins. Surface water should not be allowed to pond adjacent to the outside edges of paved areas.

- The granular materials used for pavement construction should conform to Ontario Provincial Standard Specifications (OPSS 1010) for Granular 'A' and Granular 'B' Type II and should be compacted to 100 percent of the SPMDD. The asphaltic concrete used and its placement should meet OPSS 1150 or 1151 requirements. It should be compacted 92 to 97 percent of the MRD (ASTM D2041).

- Asphalt placement should be in accordance with OPSS 310 and OPSS 313. It is recommended that **EXP** be retained to review the final pavement structure design and drainage plans prior to construction to ensure they are consistent with the recommendations of this report.

15.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.

It is recommended that once the design underside of footings is established, they should be forwarded to EXP so any revision to the report can be made, is deemed required. It is also recommended that prior to tendering and following demolition, test pits should be completed at the site to collect additional data on the rock depths throughout the site.

The information contained in this report is not intended to reflect on environmental aspects of the soils and groundwater. Should specific information be required, including for example, the presence of pollutants, contaminants or other hazards in the soil, additional testing may be required.

16.Legal Notification

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

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.

17.Signatures

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

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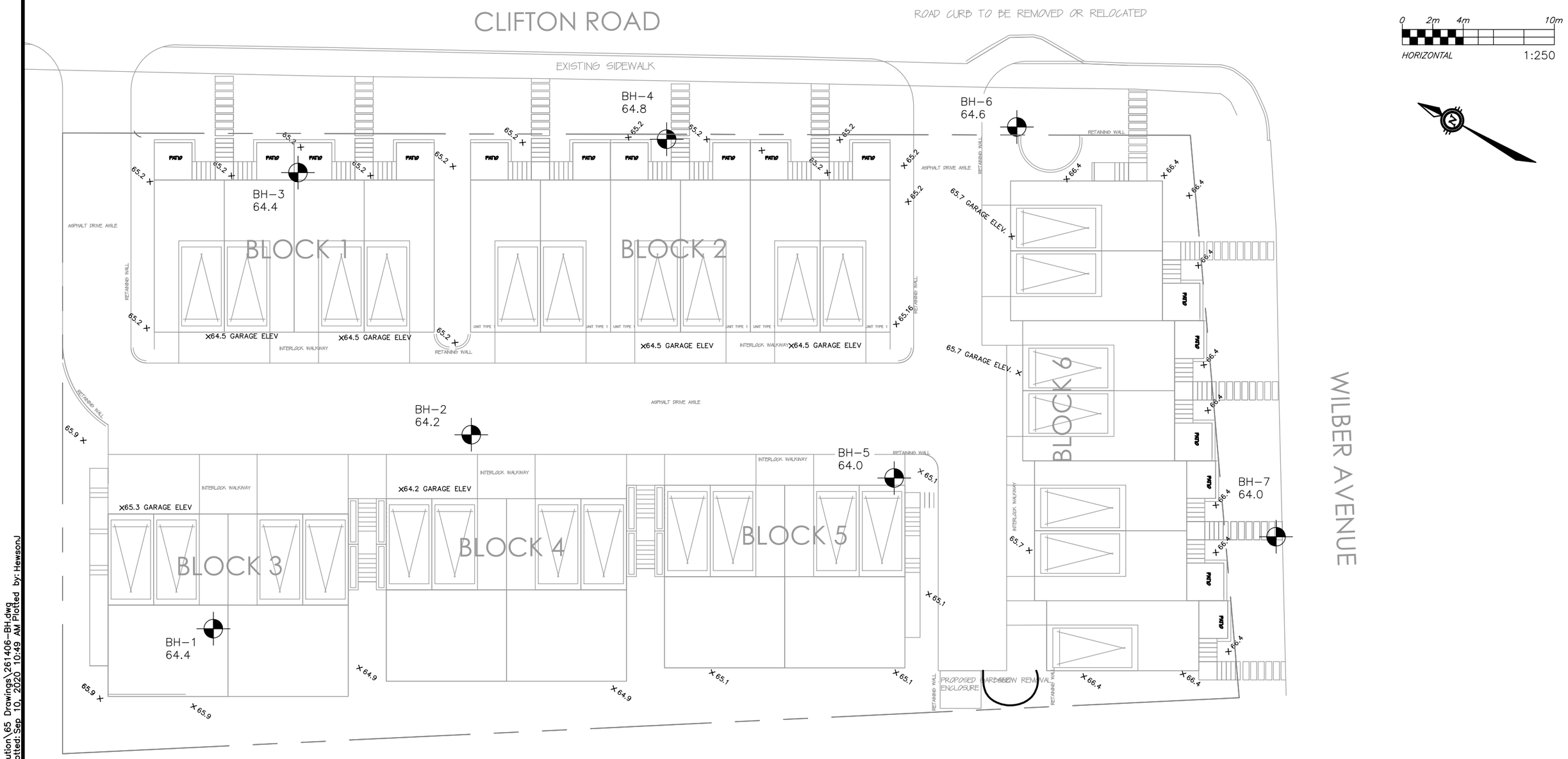
PROPOSED RESIDENTIAL DEVELOPMENT
CLIFTON PROPERTY DEVELOPMENT INC.
316-332 CLIFTON ROAD, OTTAWA, ONTARIO

GEOTECHNICAL INVESTIGATION
SITE LOCATION PLAN

SCALE: N.T.S.
SKETCH NO: FIG 1



LEGEND

BH-1 64.4 — BOREHOLE NO. & LOCATION, GROUND SURFACE ELEVATION

NOTES:

1. THE BOUNDARIES AND SOIL TYPES HAVE BEEN ESTABLISHED ONLY AT THE BOREHOLE LOCATIONS. BETWEEN BOREHOLES THEY ARE ASSUMED AND MAY BE SUBJECT TO CONSIDERABLE ERROR.
2. SOIL SAMPLES AND ROCK WILL BE RETAINED IN STORAGE FOR THREE MONTHS AND THEN DESTROYED UNLESS THE CLIENT ADVISES THAT AN EXTENDED TIME PERIOD IS REQUIRED.
3. TOPSOIL QUANTITIES SHOULD NOT BE ESTABLISHED FROM THE INFORMATION PROVIDED AT BOREHOLE LOCATIONS.
4. BOREHOLE ELEVATIONS SHOULD NOT BE USED TO DESIGN BUILDING(S) OR FLOOR SLABS OR PARKING LOT(S) GRADES.
5. THIS DRAWING FORMS PART OF THE REPORT PROJECT NUMBER AS REFERENCED AND SHOULD BE USED ONLY IN CONJUNCTION WITH THIS REPORT.
6. BASE PLAN OBTAINED FROM JANET ROSENBERG AND STUDIO, GLOBAL PLAN 1.

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

DESIGN	EXP
DRAWN	J.H.
DATE	SEP 2020
FILE NO	OTT-00261406-A0

PROPOSED RESIDENTIAL DEVELOPMENT
CLIFTON PROPERTY DEVELOPMENT INC.
316-332 CLIFTON ROAD, OTTAWA, ONTARIO

GEOTECHNICAL INVESTIGATION BOREHOLE PLAN

SCALE 1:250
SKETCH NO FIG 2

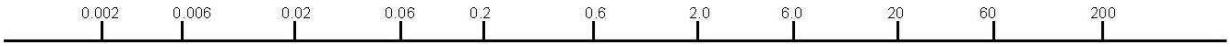
Filename: E:\OTT\OTT-00261406-A0\60 Execution\65 Drawings\261406-BH.dwg
Last Saved: Sep 10, 2020 10:49 AM Last Plotted: Sep 10, 2020 10:49 AM Plotted by: HewsonJ

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 BH1

Project No: OTT-00261406-A0

Project: Geotechnical Investigation, Proposed Residential Development

Location: 316-332 Clifton Road, City of Ottawa, Ontario

Figure No. 3

Page. 1 of 1

Date Drilled: 9/3/20

Drill Type: Multi-Power (track mount)

Datum: Geodetic

Logged by: ML Checked by: AN/IT

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 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
		TOPSOIL (350 mm)	64.4	0				
		FILL Silty sand (SM), some gravel, brown, moist, (loose)	64.1		5		SS1	
		TILL Silty sand wih gravel (SM), inferred occasional cobbles and boulders, light brown to grey, moist, (compact)	63.6	1	27		SS2	
		BEDROCK Limestone with shale partings, fine to medium grained, highly weathered and mixed with pebbles for the top 0.2 m, Highly to moderately weathered, grey, weak to strong, (very poor to poor quality)	62.8	2			RUN1 RUN2 RUN3	
		Borehole Terminated at 3.1 m Depth	61.3	3				

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa
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. Standpipe Installed
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00261406-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Complesion	N/A	-
September 11, 2020	Dry	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	1.6 - 1.8	100	0
2	1.8 - 2.2	100	44
3	2.2 - 3.1	100	43

LOG OF BOREHOLE LOGS OF BOREHOLES - 316-332 CLIFTON ROAD_REV0.GPJ TROW OTTAWA.GDT 9/14/20

Log of Borehole BH2

Project No: OTT-00261406-A0

Project: Geotechnical Investigation, Proposed Residential Development

Location: 316-332 Clifton Road, City of Ottawa, Ontario

Figure No. 4

Page. 1 of 1

Date Drilled: 9/3/20

Drill Type: Multi-Power (track mount)

Datum: Geodetic

Logged by: ML Checked by: AN/IT

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 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
		TOPSOIL (250 mm)	64.2	0				
		FILL Silty sand (SM), some gravel, some roots and organics, dark to light brown, moist, (loose to very loose)	64.0		2		SS1	
				1	8		SS2	
			62.6					
		Borehole Terminated at Auger Refusal at 1.6 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole Backfilled Upon Complesion
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00261406-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Complesion	Dry	1.4

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE LOGS OF BOREHOLES - 316-332 CLIFTON ROAD_REV0.GPJ TROW OTTAWA.GDT 9/14/20

Log of Borehole BH3

Project No: OTT-00261406-A0

Project: Geotechnical Investigation, Proposed Residential Development

Location: 316-332 Clifton Road, City of Ottawa, Ontario

Figure No. 5

Page. 1 of 1

Date Drilled: 9/3/20

Drill Type: Multi-Power (track mount)

Datum: Geodetic

Logged by: ML Checked by: AN/IT

Split Spoon Sample
Auger Sample
SPT (N) Value
Dynamic Cone Test
Shelby Tube
Shear Strength by Vane Test

Combustible Vapour Reading
Natural Moisture Content
Atterberg Limits
Undrained Triaxial at % Strain at Failure
Shear Strength by Penetrometer Test

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic 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
		TOPSOIL (30 mm)	64.4	0	20 40 60 80 / 50 100 150 200 kPa	250 500 750 / 20 40 60		
		GRANULAR FILL	64.4					
		FILL	64.2					
		Silty sand (SM), some gravel, some roots and organics, inferred cobbles and boulders at the bottom 0.1 m, brown to dark brown with black partings, moist, (loose)			14		SS1	
				1	6		SS2	
					50 for 50 mm		SS3	
			62.8					
		Borehole Terminated at Auger Refusal at 1.6 m Depth						

LOG OF BOREHOLE LOGS OF BOREHOLES - 316-332 CLIFTON ROAD_REV0.GPJ TROW OTTAWA.GDT 9/14/20

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole Backfilled Upon Complesion
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00261406-A0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)
Complesion	Dry	1.4

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

Log of Borehole BH4

Project No: OTT-00261406-A0

Project: Geotechnical Investigation, Proposed Residential Development

Location: 316-332 Clifton Road, City of Ottawa, Ontario

Figure No. 6

Page. 1 of 1

Date Drilled: 9/3/20

Drill Type: Multi-Power (track mount)

Datum: Geodetic

Logged by: ML Checked by: AN/IT

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 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
		TOPSOIL (200 mm)	64.8	0				
		FILL Silty sand (SM), some gravel, inferred cobbles and boulders at the bottom 0.2 m, brown to grey, moist, (loose to compact)	64.6		5		SS1	
				1	24		SS2	
					50 for 125 mm		SS3	
		Borehole Terminated at Auger Refusal at 1.9 m Depth	62.9					

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa
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. Borehole Backfilled Upon Complesion
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00261406-A0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)
Complesion	Dry	1.9

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

LOG OF BOREHOLE LOGS OF BOREHOLES - 316-332 CLIFTON ROAD_REV0.GPJ TROW OTTAWA.GDT 9/14/20

Log of Borehole BH5

Project No: OTT-00261406-A0

Project: Geotechnical Investigation, Proposed Residential Development

Location: 316-332 Clifton Road, City of Ottawa, Ontario

Figure No. 7

Page. 1 of 1

Date Drilled: 9/3/20

Drill Type: Multi-Power (track mount)

Datum: Geodetic

Logged by: ML Checked by: AN/IT

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 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
		TOPSOIL (150 mm)	64	0				
		FILL Silty sand (SM), some gravel, some roots and organics, brown to dark brown with black partings, moist, (loose to compact)	63.9		4		SS1	
				1	13		SS2	
			62.5					
		Borehole Terminated at Auger Refusal at 1.5 m Depth						

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. Borehole Backfilled Upon Complesion
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00261406-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Complesion	Dry	1.3

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE LOGS OF BOREHOLES - 316-332 CLIFTON ROAD_REV0.GPJ TROW OTTAWA.GDT 9/14/20

Log of Borehole BH6

Project No: OTT-00261406-A0

Project: Geotechnical Investigation, Proposed Residential Development

Location: 316-332 Clifton Road, City of Ottawa, Ontario

Figure No. 8

Page. 1 of 1

Date Drilled: 9/3/20

Drill Type: Multi-Power (track mount)

Datum: Geodetic

Logged by: ML Checked by: AN/IT

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 m	Depth	Standard Penetration Test N Value / Shear Strength kPa (20 40 60 80 / 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
		TOPSOIL (200 mm)	64.6	0				
		FILL Silty sand (SM), some gravel	64.4					
			63.4	1				
		TILL Silty sand wih gravel (SM), inferred occasional cobbles and boulders	63.1					
		Borehole Terminated at Auger Refusal at 1.5 m Depth						

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. Borehole Backfilled Upon Complesion
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00261406-A0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)
Complesion	Dry	1.5

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

LOG OF BOREHOLE LOGS OF BOREHOLES - 316-332 CLIFTON ROAD_REV0.GPJ TROW OTTAWA.GDT 9/14/20

Log of Borehole BH7

Project No: OTT-00261406-A0

Project: Geotechnical Investigation, Proposed Residential Development

Location: 316-332 Clifton Road, City of Ottawa, Ontario

Figure No. 9

Page. 1 of 1

Date Drilled: 9/3/20

Drill Type: Multi-Power (track mount)

Datum: Geodetic

Logged by: ML Checked by: AN/IT

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 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
		FILL Silty sand (SM), some gravel, mixed with topsoil, brown, moist, (loose)	64	0	5		SS1	
		TILL Silty sand wih gravel (SM), bedrock debris, inferred occasional cobbles and boulders, grey, damp, (compact)	63.2	1	15		SS2	
		Borehole Terminated at Auger Refusal at 1.5 m Depth	62.5					

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa
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. Borehole Backfilled Upon Complesion
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00261406-A0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)
Complesion	Dry	1.2

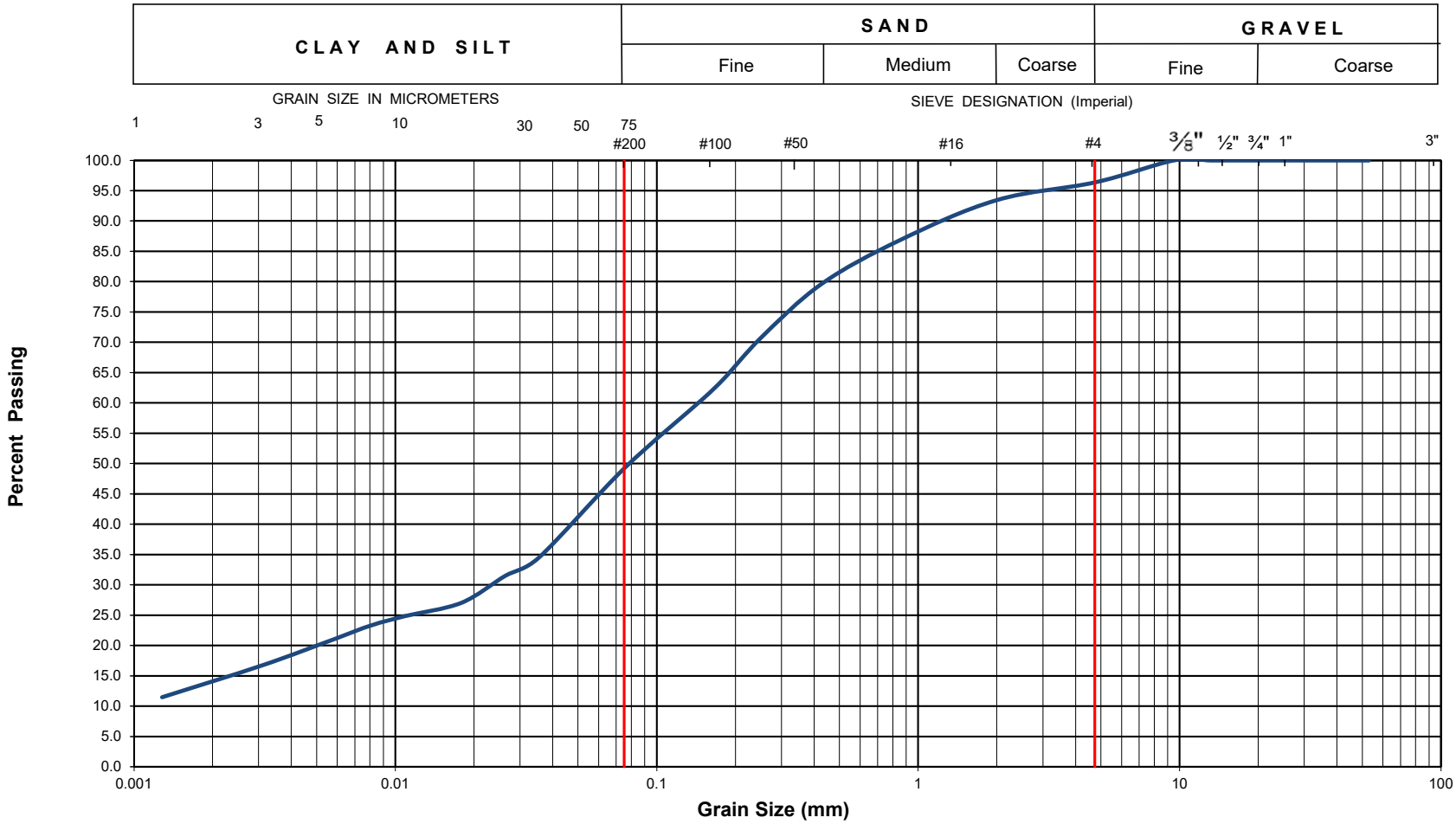
CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE LOGS OF BOREHOLES - 316-332 CLIFTON ROAD_REV0.GPJ TROW OTTAWA.GDT 9/14/20

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

Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422

Unified Soil Classification System

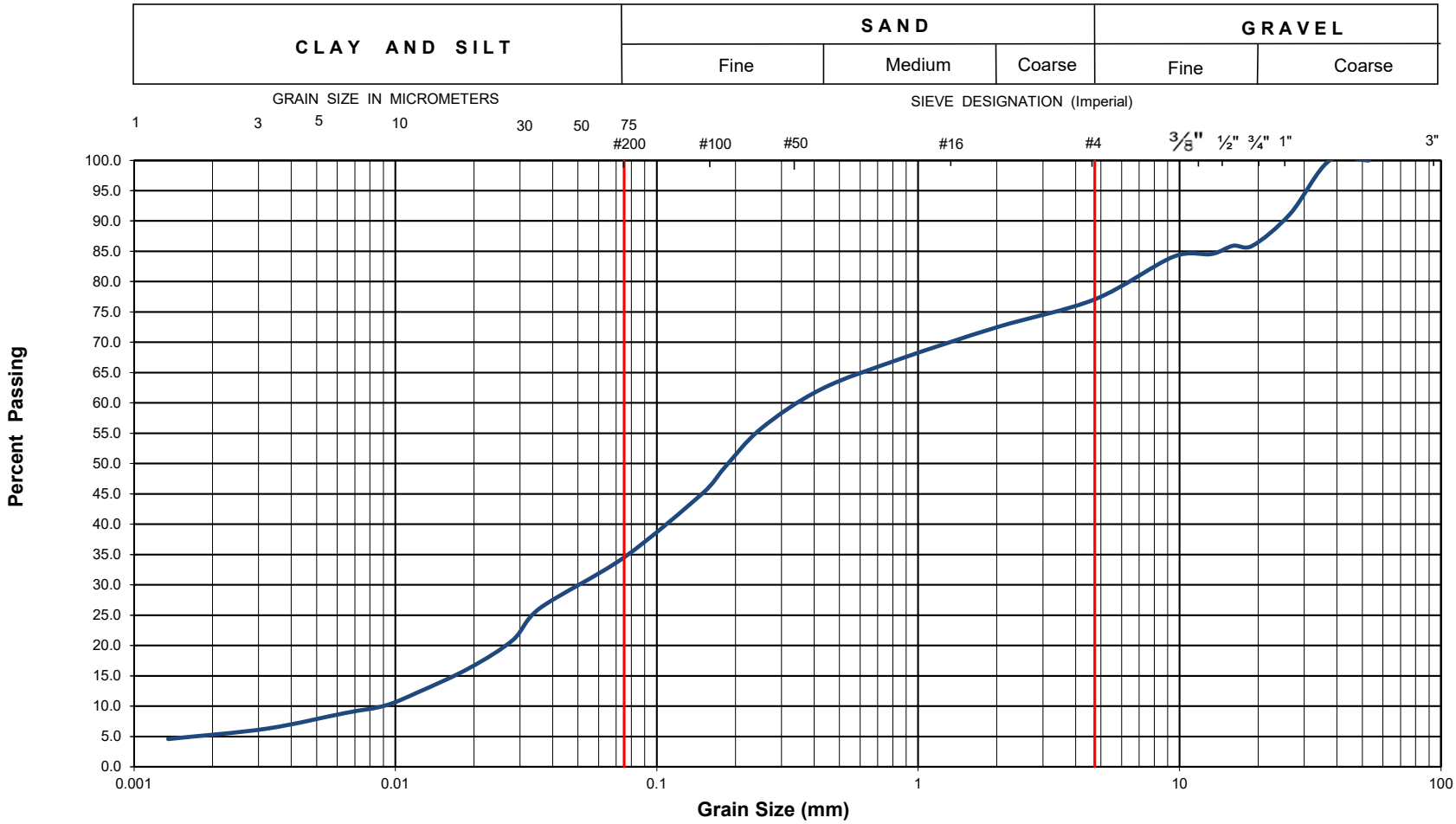


EXP Project No.:	**OTT-00261406-A0**	**Project Name :**	**Geotechnical Investigation - Proposed Residential Development**						
Client :	**Clifton Property Development Inc.**	**Project Location :**	**316-332 Clifton Road, Ottawa, ON**						
Date Sampled :	**September 3, 2020**	**Borehole No:**	**BH7**		**Sample No.:**	**SS1**		**Depth (m) :**	**0-0.6**
Sample Description :		**% Silt and Clay**	**49**	**% Sand**	**47**	**% Gravel**	**4**	**Figure :**	**10**
Sample Description :		**Silty SAND (SM)**							

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

Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422

Unified Soil Classification System



EXP Project No.:	**OTT-00261406-A0**	**Project Name :**	**Geotechnical Investigation - Proposed Residential Development**						
Client :	**Clifton Property Development Inc.**	**Project Location :**	**316-332 Clifton Road, Ottawa, ON**						
Date Sampled :	**September 3, 2020**	**Borehole No:**	**BH1**		**Sample No.:**	**SS2**		**Depth (m) :**	**0.8-1.4**
Sample Description :		**% Silt and Clay**	**35**	**% Sand**	**42**	**% Gravel**	**23**	**Figure :**	**11**
Sample Description :		**Silty SAND with Gravel (SM)**							

DRY BEDROCK CORES

WET BEDROCK CORES

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

• BUILDINGS • EARTH & ENVIRONMENT • ENERGY •
• INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

borehole no.	core runs	PROJECT	project no.
BH1	Run 1: 1.6 m - 1.8 m Run 2: 1.8 m - 2.2 m Run 3: 2.2 m - 3.1 m	PROPOSED RESIDENTIAL DEVELOPMENT 316-332 CLIFTON ROAD	OTT-00261406-A0
date cored Sep 03, 2020		ROCK CORE PHOTOGRAPHS	FIG 12

Appendix A:
Laboratory Certificates of Analysis

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: **Athir Nader**
PROJECT: **OTT-261406-AO**
AGAT WORK ORDER: **20Z647760**
SOIL ANALYSIS REVIEWED BY: **Nivine Basily, Inorganics Report Writer**
DATE REPORTED: **Sep 15, 2020**
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 following analysis, unless expressly agreed otherwise in writing. Please contact your Client Project Manager if you require additional sample storage time.*
- *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.*

AGAT Laboratories

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

Certificate of Analysis

AGAT WORK ORDER: 20Z647760

PROJECT: OTT-261406-AO

CLIENT NAME: EXP SERVICES INC

ATTENTION TO: Athir Nader

SAMPLING SITE:Clifton Road

SAMPLED BY:EXP

Inorganic Chemistry (Soil)

DATE RECEIVED: 2020-09-08 **DATE REPORTED: 2020-09-15**

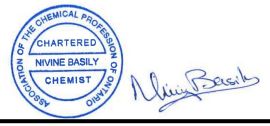
			SAMPLE DESCRIPTION:	BH4 SS2 2'6"-4'6"
			SAMPLE TYPE:	Soil
			DATE SAMPLED:	2020-09-03
Parameter	Unit	G / S	RDL	1426438
Chloride (2:1)	µg/g		2	3
Sulphate (2:1)	µg/g		2	7
pH (2:1)	pH Units		NA	7.8
Resistivity (2:1) (Calculated)	ohm.cm		1	6710

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

1426438 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:



AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
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: 20Z647760

PROJECT: OTT-261406-AO

ATTENTION TO: Athir Nader

SAMPLING SITE:Clifton Road

SAMPLED BY:EXP

Soil Analysis

RPT Date: Sep 15, 2020			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
Inorganic Chemistry (Soil)															
Chloride (2:1)	1426448		25	25	0.0%	< 2	99%	70%	130%	104%	80%	120%	106%	70%	130%
Sulphate (2:1)	1426448		55	55	0.0%	< 2	96%	70%	130%	102%	80%	120%	101%	70%	130%
pH (2:1)	1426448		8.42	8.47	0.6%	NA	97%	90%	110%						

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:

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Method Summary

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 20Z647760

PROJECT: OTT-261406-AO

ATTENTION TO: Athir Nader

SAMPLING SITE:Clifton Road

SAMPLED BY:EXP

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	MSA part 3 & SM 4500-H+ B	PH METER
Resistivity (2:1) (Calculated)	INOR-93-6036	McKeague 4.12, SM 2510 B,SSA #5 Part 3	CALCULATION

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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 #: 2076477 60

Cooler Quantity: one - no ice

Arrival Temperatures: 21.5 | 21.6 | 21.4
LT - 9.6 | 8 |

Custody Seal Intact: ☐Yes ☐No ☐N/A

Notes: (on ice)

Report Information:

Company: EXP
Contact: Attn: Nader
Address: 2650 Queensview Drive, Suite 100
Ottawa ON, K2B 8H6
Phone: 613-688-1899 Fax:
Reports to be sent to:
1. Email: Attn.Nader@exp.com
2. Email:

Regulatory Requirements:

☐ No Regulatory Requirement

(Please check all applicable boxes)

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

☐ Sewer Use
☐ Sanitary
☐ Storm
Region ____ *Indicate One*
☐ MISA

☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
____ *Indicate One*

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 CPM

Project Information:

Project: OTT-261406-A0
Site Location: Clifton Road
Sampled By: EXP
AGAT Quote #: PO:
Please note: If quotation number is not provided, client will be billed full price for analysis.

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

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

Invoice Information:

Bill To Same: Yes ☑ No ☐

Company:
Contact:
Address:
Email:

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI	O. Reg 153: Metals and Inorganics (☐ All Metals ☐ 153 Metals (excl. Hydrides) ☐ 153 Metals (Incl. Hydrides) ☐ Hydride Metals)	O. Reg 153: ORPs: ☐ B-HWS ☐ Cl ☐ CN ☐ Cr^{6+} ☐ EC ☐ FOC ☐ Hg ☐ pH ☐ SAR	Full Metals Scan	Regulation/Custom Metals	Nutrients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3+NO_2	Volatiles: ☐ VOC ☐ BTEX ☐ THM	PHCs F1 - F4	ABNs	PAHs	PCBs: ☐ Total ☐ Aroclors	Organochlorine Pesticides	TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Sewer Use	pH	Sulphide	Chloride	Electro Resistivity	Potentially Hazardous or High Concentration (Y/N)
						Y / N																	
BH4 SS2 2'6" - 4'6"	Sept 3/20																			✓	✓	✓	✓	

Samples Relinquished By (Print Name and Sign): Ryan DiGiovanni	Date: Sept 7/20	Time: 3:00pm	Samples Received By (Print Name and Sign): Berthelet	Date: 2020/09/08	Time: 8h00		
Samples Relinquished By (Print Name and Sign): FedEx	Date: 2020/09/08	Time: 16h00	Samples Received By (Print Name and Sign):	Date:	Time:	Page ____ of ____	
Samples Relinquished By (Print Name and Sign):	Date:	Time:	Samples Received By (Print Name and Sign): Shawn S	Date: Sept 9/2020	Time: 8:40am	N°: T 101275	