2597237 Ontario Ltd.

Geotechnical Investigation

Type of Document
Final

Project Name
Proposed Chapel Hill Housing
6102 Renaud Road
Ottawa, Ontario

Project Number
OTT-00246046-A0

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Date Submitted
February 25, 2020

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Executive Summary

EXP Services Inc. (EXP) is pleased to present the results of the geotechnical investigation completed for the proposed new residential development to be located at 6102 Renaud Road in the City of Ottawa, ON. The site location is shown on Figure 1. This work was authorized by Mr. Chris Lacroix of 2597237 Ontario Ltd.

The subject site is approximately 0.6 hectare (1.4 acres) in size and is currently occupied by buildings that will be demolished as part of the proposed development. Based on the latest site plan provided to EXP, the proposed development will comprise of four (4) townhouse blocks. Blocks 1 to 3 will consist of back-to-back townhouses with garages and basements whereas Block 4 will consist of stacked townhouses with basements and outdoor surface parking lot. The development will include a Stormtech chamber.

The fieldwork for the geotechnical investigation was undertaken from April 16 to 18, 2018 and consisted of five (5) boreholes (Borehole Nos. 1 to 5) at the locations shown on the Borehole Location Plan, Figure 2. The boreholes were advanced to termination depths from 8.1 m to 11.6 m and dynamic cone refusal depths of 26.1 m and 27.0 m below existing grade. The fieldwork was supervised on a full-time basis by a representative from EXP.

The geotechnical investigation revealed the subsurface soil conditions at the site to comprise of a surficial topsoil layer and pavement structure underlain by fill, silty sand and an extensive compressible marine clay deposit. Groundwater level measurements ranged from 0.4 m to 1.4 m depths (Elevation 76.4 m to 75.4 m).

The site is classified as **Class D** for seismic site response in accordance with Table 4.1.8.4.A of the 2012 Ontario Building Code. The subsurface soils are not considered to be liquefiable.

The site is underlain by a compressible marine clay prone to consolidation settlement if overstressed by loads imposed on it by site grade raise, foundations and groundwater lowering resulting in settlement of foundations. Based on a review of the site grading plan prepared by Stantec Consulting Ltd. (January 27, 2020), a design site grade raise of up to 1.2 m is proposed for the site. This site grade is considered to be acceptable from a geotechnical point of view when combined with footings designed as per the recommendation of the geotechnical report, i.e. a bearing pressures at serviceability limit state (SLS) of 60 kPa and 80 kPa and factored geotechnical resistance at ultimate limit state (ULS) of 90 kPa and 120 kPa. Settlements of the footings designed for the SLS value above and properly constructed are expected to be within the normally tolerated limits of 25 mm total and 19 mm differential movements.

Boreholes drilled to date revealed that limited data ae available within the areas of Block Nos. 2 and 4. Therefore, it is recommended that consideration should be given to drilling some additional boreholes within these blocks to confirm that the subsurface conditions assumed from the closet boreholes apply to these blocks.

The lowest floor slabs (basement slabs) of the buildings may be designed as slabs on grade. Perimeter and underfloor drains for the buildings will be required for the buildings.

Subsurface basement walls should be designed to resist static lateral earth pressure and dynamic lateral earth pressure during a seismic event.

The excavations at the site may be undertaken as open cut provided the excavations meet the requirements of the Ontario Occupational Health and Safety Act (OHSA). Seepage of water is expected in the excavations and may be handled by conventional sump-pump techniques. High capacity pumps may be required in zones of persistent seepage.

Based on the geotechnical investigation, the majority of material required for backfilling against subsurface walls, footings and service trenches would have to be imported and should conform to the Ontario Provincial Standard Specification (OPSS) requirements of Granular A, B Type II and Select Subgrade Material (SSM). On-site soils may be used as backfill in landscaped areas.

The pavement structure for light duty traffic areas may consist of 65 mm of asphaltic concrete underlain by 150 mm of OPSS 1010 Granular A base and 450 mm of OPSS 1010 Granular B Type II sub-base. The pavement structure for heavy duty traffic areas may consist of 90 mm of asphaltic concrete underlain by 150 mm of OPSS 1010 Granular A base and 600 mm of OPSS 1010 Granular B Type II sub-base.

Normal Portland cement may be used in the sub-surface concrete at this site. The subsurface soils are considered to be mildly corrosive to buried bare steel members/structures. Appropriate measures should be undertaken to protect buried steel elements from corrosion.

Tree planting restrictions and setbacks will require consultation with a landscape architect and should be in accordance with City of Ottawa guidelines and policy.

The above and other related considerations are discussed in greater detail in the main body of this report.

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1 Introduction

EXP Services Inc. (EXP) is pleased to present the results of the geotechnical investigation recently completed for the proposed new residential development to be located at 6102 Renaud Road in the City of Ottawa, Ontario. The site location is shown on Figure 1. This work was authorized by Mr. Chris Lacroix of 2597237 Ontario Ltd. on April 4, 2018.

The subject site is approximately 0.6 hectare (1.4 acres) in size and is currently occupied by buildings that will be demolished as part of the proposed development. Based on the latest site plan provided to EXP, the proposed development will comprise of four (4) townhouse blocks. Blocks 1 to 3 will consist of back-to-back townhouses with garages and basements whereas Block 4 will consist of stacked townhouses with basements and outdoor surface parking lot. The development will include a Stormtech chamber.

EXP completed a Phase One Environmental Site Assessment (ESA) of the site and the results are presented in our report dated September 18, 2017. EXP completed a Phase Two ESA of the site and the results are presented in our report dated October 30, 2017.

The geotechnical investigation was undertaken to:

a) Establish the subsurface soil and groundwater conditions at the five (5) boreholes located on site and a review of the subsurface soil and groundwater conditions of boreholes from the Phase Two ESA;

b) Assess the potential for liquefaction of the subsurface soils during a seismic event and classify the site for seismic site response in accordance with the requirements of the 2012 Ontario Building Code (OBC);

c) Comment on grade-raise restrictions;

d) Make recommendations regarding 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;

e) Discuss slab-on-grade construction and permanent drainage system requirements;

f) Provide lateral earth pressure parameters for subsurface basement wall design;

g) Comment on excavation conditions and de-watering requirements during construction;

h) Provide comments regarding pipe bedding requirements;

i) Discuss backfilling requirements and suitability of on-site soils for backfilling purposes;

j) Comment on subsurface concrete requirements for buried concrete structures/members and corrosion potential of subsurface soils to buried metal structures/members;

k) Recommend pavement structures for the parking lots and access roads; and

l) Provide recommendations for the planting of trees.

The comments and recommendations given in this report assume that the above-described design concept will proceed into construction. If changes are made either in the design phase or during construction, this

office must be retained to review these modifications. The result of this review may be a modification of our recommendations or it may require additional field or laboratory work to check whether the changes are acceptable from a geotechnical viewpoint.

2 Phase Two ESA Information

A Phase Two Environmental Site Assessment (ESA) of the site was undertaken by EXP and the results are presented in the report titled, “Phase Two Environmental Site Assessment, 6102 Renaud Road, Ottawa, Ontario” dated October 30, 2017 (EXP Project No. OTT-00246046-A0).

The Phase Two ESA consists of four (4) boreholes located inside and outside the existing buildings on site. The borehole information indicates that below interior concrete slabs, the subsurface soil conditions consist of fill to a 1.8 m depth underlain by native silty clay. The boreholes terminated within the silty clay at 3.7 m to 4.8 m depths. The groundwater levels measured in the monitoring wells installed in the four (4) boreholes ranges from 1.5 m to 1.7 m depths (Elevation 76.9 m to 75.5 m).

3 Site Description

The site is located on the south side of Renaud Road and east of Saddleridge Drive in Ottawa, Ontario. The site is approximately 0.6 hectare (1.4 acres) in size and is occupied by a residential building in the north part and a commercial building in the south part of the site. The surrounding properties consist of residential development. The site location is shown in Figure 1.

Based on the approximate ground surface elevations of the boreholes ranging from Elevation 79.1 m near the front of the property along Renaud Road and sloping down to Elevation 76.7 m at the rear of the property, the topography of the site is relatively flat.

4 Procedure

The fieldwork for the geotechnical investigation was undertaken from April 16 to 18, 2018 and consisted of five (5) boreholes (Borehole Nos. 1 to 5) at the locations shown on the Borehole Location Plan, Figure 2. The boreholes were advanced to termination depths from 8.1 m to 11.6 m and dynamic cone refusal depths of 26.1 m and 27.0 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 estimated from the spot elevations provided on the survey plan titled, “Part of Lot 6, Concession 4 (Ottawa Front) Geographic Township of Gloucester, City of Ottawa”, dated September 22, 2017 and prepared by Annis, O’Sullivan, Vollebekk Ltd. (AOV). Therefore, the ground surface elevations indicated on the borehole logs should be considered approximate. The borehole locations were cleared of private and public underground services, prior to the start of drilling operations.

The boreholes were drilled with a CME-55 truck-mounted drill rig equipped with continuous flight hollow-stem auger equipment. Standard penetration tests (ASTM 1586) were performed in all the boreholes at 0.75 m to 3.0 m depth intervals and soil samples retrieved by the split-barrel sampler. Relatively undisturbed thin-walled tube samples (Shelby tube samples) were retrieved at selected depth intervals within the clay. The undrained shear strength of the clay was measured by conducting penetrometer and in-situ vane tests at selected depth intervals. Borehole Nos. 1 and 4 were advanced by conducting dynamic cone penetration test (DCPT) from 10.1 m to cone refusal depth of 27.0 m in Borehole No. 1 and from 19.2 m to cone refusal depth of 26.1 m in Borehole No. 4.

Groundwater levels were measured in the open boreholes upon completion of drilling. In addition, 19 mm diameter slotted standpipes were installed in three boreholes for long-term monitoring of the groundwater levels. The standpipes were installed in accordance with EXP standard practice and their installation configuration is documented on the respective borehole log.

On completion of the fieldwork, all the soil samples were transported to the EXP laboratory located in the City of Ottawa. All the borehole samples were visually examined in the laboratory by a senior geotechnical engineer for textural classification. The engineer also assigned the geotechnical laboratory testing, which consisted of performing the following tests in accordance with the American Society for Testing and Materials (ASTM).

Natural Moisture Content	48 tests
Natural Unit Weight	10 tests
Grain-Size Analysis	2 tests
Atterberg Limits	4 tests
pH, Sulphate Chlorides and Resistivity Analyses	2 tests
Consolidation Tests	2 tests

5 Subsurface Soil and Groundwater Conditions

A detailed description of the subsurface soil and groundwater conditions determined from the boreholes are given on the attached borehole logs, Figure Nos. 3 to 7.

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.

It should be noted that the soil boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling. 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 soil stratigraphy with depth and groundwater level measurements.

5.1 Topsoil

A 50 mm thick surficial topsoil layer was contacted in Borehole Nos. 3 and 4.

5.2 Pavement Structure

Borehole No. 1 is located within the existing paved driveway. The pavement structure consists of 50 mm thick asphaltic concrete underlain by 150 mm thick crushed limestone gravel layer.

5.3 Fill

Fill was surficially encountered in Borehole Nos. 2 and 5 and below the topsoil in Borehole Nos. 3 and 4. The fill extends to depths of 0.7 m and 0.9 m (Elevation 76.8 m to 76.0 m). The fill consists of a mixture of gravel, silty sand with topsoil, roots, rootlets and wood debris (Borehole No. 5). Based on the N-values of 4 to 21 from the Standard Penetration Test (SPT), the fill is in a loose to compact state. The natural moisture content of the fill is 15 percent to 27 percent.

5.4 Silty Sand

The fill in Borehole No. 1 is underlain by silty sand to a 2.2 m depth (Elevation 76.9 m). Based on N-values of 8 and 13 from the SPT, the silty sand is in a loose to compact state. The natural moisture content of the silty sand ranges from 18 percent to 27 percent.

The results of the grain-size analysis of one (1) sample of the silty sand is summarized in Table I. The grain-size distribution curve is shown in Figure 8.

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

Borehole - Sample No.	Depth (Elevation) (m)	Grain Size Analysis (%)		
		Gravel	Sand	Fines (Silt and Clay)
BH 1 - SS3	1.5 – 2.1 (77.6 – 77.0)	0	80	20

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

5.5 Clay

Sensitive marine clay was contacted beneath the fill and silty sand at 0.7 m to 0.9 m depths (Elevation 76.8 m to 76.0 m) in the five (5) boreholes. The clay consists of an upper desiccated brown crust underlain by grey clay.

5.5.1 *Brown Clay (Desiccated Crust)*

The brown clay crust was contacted in Borehole Nos. 2 to 5 and was not present in Borehole No. 1. The upper crust extends to depths ranging from 2.1 to 3.0 m (Elevation 75.3 m to 74.2 m). The clay crust is approximately 1.4 m to 2.1 m thick. The undrained shear strength of the crust is 82 kPa to 192 kPa indicating a stiff to very stiff consistency. The sensitivity values of the clay are 4.9 and 7.2, indicating the sensitivity of the clay may be described as sensitive. The natural moisture content and unit weight of the crust are 23 percent to 60 percent and 16.9 kN/m^3 to 19.0 kN/m^3 respectively. Grain-size analysis and Atterberg limit determination of two (2) samples of the brown clay crust are summarized in Tables II and III. The grain-size distribution curve is shown in Figure 9.

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

Borehole No. - Sample No.	Depth (Elevation) (m)	Grain Size Analysis (%)		
		Gravel	Sand	Fines (Silt and Clay)
BH2 – SS2	0.8 – 1.4 (76.7 – 76.1)	0	2	98

Table III: Summary of Atterberg Limit Results – Brown Clay Sample					
Borehole No. - Sample No.	Depth (Elevation) (m)	Atterberg Limit Results (%)			
		w_n	LL	PL	PI
BH4 – SS2	0.8 – 1.4 (75.9 – 75.3)	45	72	29	43
W_n: Natural Moisture Content; **LL**: Liquid Limit; **PL:** Plastic Limit; **PI**: Plasticity Index (1): Refer to Casagrande Plasticity Chart (1932).					

Based on a review of the results from the grain-size analysis and the Atterberg limits, the soil may be classified as a high plastic clay (CH), in accordance with the Unified Soil Classification System (USCS).

5.5.2 *Grey Clay*

The silty sand in Borehole No. 1 and the brown clay crust in Borehole Nos. 2 to 5 are underlain by the grey clay contacted at 2.1 m to 3.0 m depths (Elevation 76.9 m to 74.2 m). The undrained shear strength of the clay ranges from 29 kPa to 86 kPa with one measurement of 115 kPa at 14.6 m (Elevation 62.1 m) in Borehole No. 4. The grey clay has a weaker zone in the upper 1.0 m in Borehole Nos. 2 and 3, as indicated by the lowest measured undrained shear strength values of 29 kPa and 34 kPa. Based on the undrained shear strength measurements, the clay has a firm to stiff consistency with a very stiff zone at 14.6 m depth (Elevation 62.1 m) in Borehole No. 4. The sensitivity values of 4.6 to 18 indicate the clay has a sensitivity that may be described a sensitive to quick. The silty clay has a moisture content of 35 percent to 88 percent and a natural unit weight measured from one sample of 17.9 kN/m^3.

Atterberg limit values of the clay are summarized in Table IV.

Table IV: Summary of Atterberg Limit Results – Grey Clay Samples					
Borehole No. - Sample No.	Depth (Elevation) (m)	Atterberg Limit Results (%)			
		w_n	LL	PL	PI
BH3 – SS6	3.8 – 4.4 (73.6 – 72.4)	82	59	27	32
BH4 – SS8	6.1 – 6.7 (70.6 – 70.0)	78	59	25	34
BH4 – SS11	10.7 – 11.3 (66.0 – 65.4)	76	60	30	30
W_n: Natural Moisture Content; **LL**: Liquid Limit; **PL:** Plastic Limit; **PI**: Plasticity Index (1): Refer to Casagrande Plasticity Chart (1932).					

Based on a review of the results from the Atterberg limits, the soil may be classified as a high plastic clay (CH), in accordance with the USCS.

One-dimensional oedometer (consolidation) test was conducted on two (2) thin walled tube samples of the grey clay and the results are summarized in Table V. The stress versus void ratio curves are shown in Figures 10 and 11.

Table V: One-Dimensional Oedometer (Consolidation) Test Results on Grey Clay Samples

Borehole - Sample No.	Depth (Elevation) (m)	σ'_{v0} (kPa)	w_c (%)	γ (kN/m^3)	σ'_p (kPa)	e_o	c_r	c_c	OCR	OC
BH 1-ST8	6.1-6.7 (73.0 – 72.4)	68	84	14.9	150	2.322	0.037	2.80	2.2	82
BH 5-ST6	3.8-4.4 (73.4 – 72.8)	47	81	15.1	110	2.229	0.034	2.66	2.3	63

σ'_{v0} = estimated effective overburden pressure (kPa); w_c: natural moisture content (%), γ: estimated natural unit weight (kN/m^3) σ'_p = pre-consolidation pressure (kPa), e_o = initial void ratio; c_r = re-compression index; c_c = compression index; OCR = Over consolidation ratio; OC= over-consolidation pressure (kPa);

(1)- estimated σ'_{v0} based on May 7, 2018 groundwater level measurements.

Based on a review of the consolidation test results, the over consolidation ratio is 2.2 and 2.3 indicating the clay is over consolidated.

5.6 Inferred Boulders and Bedrock

Boulders within glacial till and bedrock are inferred at cone refusal depths of 26.1 m and 27.0 m (Elevation 52.1 m and 50.6 m) in Borehole Nos. 1 and 4. Review of published geology maps indicate the bedrock is limestone of the Ottawa formation.

5.7 Groundwater Levels

The groundwater level measurements taken several days following the completion of drilling in the standpipes installed in selected boreholes are summarized in Table VI.

Table VI: Summary of Groundwater Levels in Boreholes

Borehole No.	Ground Surface Elevation (m)	Drill Date	Date of Groundwater Level Measurement (Number of Days After Drilling)	Depth of Groundwater Level Below Ground Surface (m)	Elevation of Groundwater Level (m)
3	76.81	April 17, 2018	May 7, 2018 (20 days)	0.4	76.4
4	76.67	April 17, 2018	May 7, 2018 (20 days)	1.3	75.4
5	77.18	April 18, 2018	May 7, 2018 (19 days)	1.4	75.8

A review of Table VI indicates that the groundwater level ranges from 0.4 m to 1.4 m depths (Elevation 76.4 m to 75.4 m).

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

6 Liquefaction Potential and Seismic Site Classification

6.1 Liquefaction Potential

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

6.2 Seismic Site Classification

The subsoil information at this site has been examined in relation to Section 4.1.8.4 of the 2012 Ontario Building Code (OBC). The average shear-wave velocity value of the clay inferred glacial till and bedrock to a 30-m depth was estimated.

The shear-wave velocity value of the clay deposit was correlated to the undrained shear strength values (Su) using the Dickenson, S.E. (1994)[1] formula:

$$Vs(m/s) = 23.Su^{0.475}$$

The shear-wave velocity value of the inferred glacial till was correlated to the standard penetration test values using Imai and Tonouchi[2] (1982) formula:

$$Vs(m/s) = 91.7\ N^{0.26}$$

The shear-wave velocity of the inferred bedrock was assumed as 360 m/s.

The average shear-wave velocity to 30 m depth was estimated at 230 m/s. On this basis, the site may be classified as Class D for seismic site response in accordance with Table 4.1.8.4 A of the 2012 OBC.

[1] Dickenson, S.E. (1994), "Dynamic Response of Soft and Deep Cohesive Soils during the Loma Prieta Earthquake".
2 Imai, T, and K Tonouchi (1982). Correlation of N value with S-wave velocity and shear modulus, Proc., 2nd European Symp. on Penetration Testing, Amsterdam, pp. 67–72.

7 Grade Raise Restrictions

The site is underlain by a sensitive marine clay deposit consisting of a reddish brown clay crust of limited thickness underlain by a grey clay which weakens with depth to a minimum value and thereafter increases with depth. The marine clay deposit is prone to consolidation settlement if overstressed by loads imposed on it by site grade raise, foundations, and by groundwater level lowering following construction. Overstressing of the clay stratum may result in its consolidation and subsequent settlement of foundations, which may exceed the tolerable limits of the structure resulting in cracking of the structure.

Based on a review of the grading plan prepared by Stantec dated January 27, 2020 (Drawing No. GP-1), the site grade raise for the four (4) blocks ranges from 0.42 m to 1.20 m. The site grade raise shown on the grading plan is considered acceptable provided the footings are designed at the underside of footing elevation shown on the grading plan and for the bearing pressure at serviceability limit state (SLS) and factored geotechnical resistance at ultimate limit state (ULS) indicated in Section 9 of this report.

A summary of the design grade raise at each block as shown on the grading plan is summarized in Table VII.

Table VII: Summary of Proposed Site Grade Raise

Block No.	Existing Grade (m)	Proposed Underside of Footings (m)	Proposed Final Site Grade Raise (m)	Maximum Site Grade Raise (m)
1	76.28-77.01	74.32	76.56-77.21	0.47
2	77.08-77.45	74.78	77.22-77.67	0.42
3	76.88-77.93	75.73	77.77-78.62	1.20
4	77.70-79.32	77.04	78.24-79.35	0.75

An allowance for groundwater lowering was not required as part of the review, since measures will be employed in new service trenches to minimize the permanent lowering of the groundwater level at the site (use of clay seals), as recommended in Section 12.

8 Site Grading Operations

As part of the site preparation, the site grading within the footprint of the proposed buildings and paved areas should consist of the excavation and removal of all topsoil, paved surfaces, fill and any organic stained soils from the site. Any soft/loose areas identified in the interior of the building footprint should be excavated and replaced with Ontario Provincial Standard Specification (OPSS 1010 as amended by SSP110S13) Granular B Type II compacted to 98 percent standard Proctor maximum dry density (SPMDD).

It may be possible to leave some of the existing fill and silty sand in-place in the parking lot/access road areas, pending further evaluation in the field during construction and acceptability from an environmental perspective. For budgeting purposes, the contractor should assume that all the existing fill material will be required to be removed and replaced with imported granular material from the area of the proposed building and parking lot/access road areas.

Following approval of the exposed subgrade, the grades beneath the floor slabs may be raised to the underside of the 300 mm thick clear stone layer, by the placement of engineered fill consisting of OPSS 1010 Granular B Type II placed in 300 mm thick lifts and each lift compacted to 98 percent of the SPMDD.

In areas where the existing buildings have been demolished and removed, all disturbed subsurface soils should be excavated, removed and replaced with engineered fill.

For the proposed parking and access road areas, the site grades may be raised to the design subgrade level by the placement of OPSS 1010 select subgrade material (SSM) compacted to 95 percent of the SPMDD.

In-place density tests should be performed on each lift of placed material to ensure that it has been compacted to the project specifications.

9 Foundation Considerations

The proposed buildings may be supported by conventional spread and strip footings founded at the design underside footing elevation on the native brown and grey clay.

A summary of the design founding elevation, anticipated founding material and bearing pressure at serviceability limit state (SLS) and factored geotechnical resistance at ultimate limit state (ULS) for a maximum 1.0 m wide strip footing and maximum 3 m by 3 m square pad footing at Blocks 1 to 4 is shown in Table VIII as per the latest grading plan prepared by Stantec Consulting Ltd.

Table VIII: Summary of Footing Information

Block No.	Borehole No.	Design Underside Footing Elevation (m)	Anticipated Founding Material	Bearing Pressure at SLS (kPa)	Factored Geotechnical Resistance at ULS (kPa)
1	3 and 4	74.32	Grey Clay	60	90
2	Closest Borehole - BH2	74.78	Grey Clay	60	90
3	5	75.73	Brown Clay	80	120
4	Closet Borehole - BH 1	77.04	Grey Clay	60	90

The factored ULS value includes a resistance factor of 0.5 in accordance with the 2006 Canadian Foundation Engineering Manual (CFEM). The above SLS value is considered valid, provided the design site grade raise indicated in the previous Table VII in each block is respected.

Settlements of the footings designed for the SLS value above and properly constructed are expected to be within the normally tolerated limits of 25 mm total and 19 mm differential movements.

All the footing beds should be examined by a geotechnical engineer to ensure that the founding surfaces are capable of supporting the design bearing pressure at SLS and that the footing beds have been properly prepared.

A minimum of 1.5 m of earth cover should be provided to the exterior foundations of heated structures to protect them from damage due to frost penetration. The frost cover should be increased to 2.1 m for unheated structures if snow will not be removed from their vicinity and to 2.4 m if snow will be removed from the vicinity of the structure. When earth cover is less than the minimum required, an equivalent combination of earth cover and rigid insulation (such as Styrofoam HI-40) or rigid insulation alone should be provided. EXP can provide additional comments in this regard, if required.

The footings should be reinforced, and nominal reinforcing steel should be provided in the basement walls to minimize cracking. For guidance, the reinforcement in the basement walls may consist of a minimum of two upper and two lower 15M-size reinforcing bar sizes. The required reinforcing detail for the footings and basement walls will need to be determined by the structural engineer.

It should be noted that the surface of the clay is susceptible to disturbance due to movement of workers and construction equipment especially if the excavations are undertaken during wet weather periods. It is therefore considered that depending on the weather conditions prevailing at the time of construction, footing beds may have to be covered with a 50 mm thick mud slab to prevent disturbance to the clay subgrade.

Boreholes drilled to date revealed that limited data is available within the areas of Block Nos. 2 and 4. Therefore, it is recommended that consideration should be given to drilling some additional boreholes within these blocks to confirm that the subsurface conditions assumed from the closet boreholes apply to these blocks.

9.1 General Comment

The recommended bearing pressure at SLS and factored geotechnical resistances at ULS 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 boreholes when foundation construction is underway. The interpretation between 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.

10 Floor Slab and Drainage Requirements

The floor slabs of the buildings may be constructed as slabs-on-grade provided they are set on a bed of well-packed 19 mm clear stone at least 300 mm thick placed on native soil or on well compacted engineered fill prepared as indicated in Section 8 of the report. The clear stone would prevent the capillary rise of moisture from the sub-soil to the floor slab. Adequate saw cuts should be provided in the floor slabs to control cracking.

It is recommended that perimeter as well as underfloor drains should be provided for the proposed buildings. The underfloor drainage system may consist of 100 mm diameter perforated pipe or equivalent placed in parallel rows at 5 m to 6 m centres and at least 300 mm below the underside of the floor slab. The drains should be set on 100 mm of pea-gravel and covered on top and sides with 150 mm of pea-gravel and 300 mm of CSA Fine Concrete Aggregate. The CSA Fine Concrete Aggregate may be replaced by an approved porous geotextile membrane, such as Terrafix 270R or equivalent. The perimeter drains may also consist of 100 mm diameter perforated pipe set on the footings and surrounded with 150 mm of pea-gravel and 300 mm of CSA Concrete Aggregate. The perimeter and underfloor drains should be connected to separate sumps so that at least one system would be operational should the other fail.

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

11 Subsurface Walls

The subsurface basement walls should be backfilled with free draining material, such as OPSS 1010 Granular B Type II and equipped with a perimeter drainage system to prevent the buildup of hydrostatic pressure behind the walls. The walls will be subjected to lateral static and dynamic (seismic) earth forces. The expressions below assume free draining backfill material, a perimeter drainage system, level backfill surface behind the wall and vertical face on the back side of the wall.

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

$$P = K_0\, h\, (\tfrac{1}{2}\, \gamma h + q)$$

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

K_0 = lateral earth pressure coefficient for 'at rest' condition for Granular B Type II backfill material = 0.50

γ = unit weight of free draining granular backfill; Granular B Type II = 22 kN/m^3

h = depth of point of interest below top of backfill, m

q = surcharge load, kPa

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

$$\Delta_{Pe} = \gamma H^2 \frac{a_h}{g} F_b$$

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

H = height of wall, m

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

$\frac{a_h}{g}$ = seismic coefficient = 0.309 (refer to 2015 National Building Code Seismic Hazard Calculation shown in Appendix A)

F_b = thrust factor = 1.0

The dynamic thrust does not take into account the surcharge load. The resultant force acts approximately at 0.63H above the base of the wall.

All subsurface basement walls should be properly waterproofed.

12 Pipe Bedding Requirements

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

Due to the presence of the sand and clay and high groundwater level, it is recommended the pipe bedding consist of 300 mm thick OPSS 1010 Granular B Type II sub-bedding material overlain by 150 mm thick OPSS 1010 Granular A bedding material. The bedding materials should be compacted to at least 95 percent SPMDD.

The bedding thickness may be further increased in areas where the sand and clay subgrade become disturbed. Trench base stabilization techniques, such as removal of loose/soft material, placement of crushed stone sub-bedding (OPSS Granular B Type II), completely wrapped in a non-woven geotextile, may also be used if trench base disturbance becomes a problem in wet or soft areas.

If the backfill for the service trenches will consist of granular fill, clay seals should be installed in the service trenches at select intervals as per City of Ottawa Drawing No. S8. The seals should be 1 m wide, extend over the entire trench width and from the bottom of the trench to the underside of the pavement structure. The clay should be compacted to 95 percent SPMDD. The purpose of the clay seals is to prevent the permanent lowering of the groundwater level.

13 Stormtech Chamber

The site servicing plan prepared by Stantec and dated January 27, 2020 indicates the stormtech chamber will be located in the northeast corner of the site near Borehole No. 1. The subsurface soils conditions consist of a pavement structure (asphalt and granular base) to 300 mm depth underlain by silty sand to 2.2 m depth overlying grey clay. The groundwater level is estimated to be at silty sand/clay interface at 2.2 m depth (Elevation 76.9 m). The site servicing plan indicates the bottom of the tank will be located at Elevation 77.05 m. Based on the borehole information, the bottom of the tank will be located within the silty sand and approximately 150 mm above the grey clay and the estimated groundwater level.

The estimated permeability of the silty sand and grey clay that may be used in the design of the stormtech are summarized in Table IX.

Table IX: Estimated Soil Permeability

Soil Type	Estimated Permeability (cm/s)
Silty Sand	$2.5\ 10^{-3}$
Grey Clay	1.0×10^{-8}

14 Excavations and De-Watering Requirements

14.1 Excavations

Excavations for the construction of the proposed structures and installation of the underground services assuming a site grade raise of up to 1.2 m are anticipated to extend to a 3.0 m to 3.5 m depth below existing grade as indicated in the grading and site servicing plans dated January 27, 2020 and prepared by Stantec Consulting Ltd. The excavations are expected to extend through the silty sand and into the clay. The excavations are anticipated to be below the groundwater level.

Upon completion of the demolition and removal of the existing buildings and their floor slabs, foundation walls and footings, the soils at the site may be excavated with conventional mechanical equipment capable of removing possible debris within the existing fill.

The excavations at the site may be undertaken as open cut provided they meet the requirements of the Ontario Occupational Health and Safety Act (OHSA). The overall soils are classified as Type 3 and must be cut back at 1H:1V from the bottom of the excavation. For excavations that extend below the groundwater level, the side slopes should be cut back at 2H:1V to 3H: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) or engineered support system.

The contractor must review the site plan and surrounding properties to determine if a shoring system for the excavation is required for the execution of the construction of the proposed buildings. The engineered support system should be designed and installed in accordance with the OHSA and the 2006 Canadian Foundation Engineering Manual (Fourth Edition).

Excavations up to a 3.5 m depth below existing grade are not expected to experience base-heave type failure.

The silty sand and clay stratum at the site are susceptible to disturbance due to the movement of construction equipment, and personnel on its surface. It is therefore recommended that the excavation at the site should be undertaken by equipment that does not travel on the excavated surface, such as a gradall or mechanical shovel. It is anticipated that temporary granular roads may be required to gain access to the site.

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.

14.2 De-Watering Requirements

Seepage of the surface and subsurface water into the excavations is anticipated. However, it should be possible to collect water entering the excavations at low points and to remove it by conventional pumping techniques. In areas of high infiltration or in areas where more permeable soil layers may exist (such as the silty sand) a higher seepage rate should be anticipated. Therefore, the need for high capacity pumps to keep the excavation dry should not be ignored.

It has been assumed that the maximum excavation depth at the site will be approximately 3.0 m to 3.5 m and would necessitate groundwater removal from the site. It is noteworthy to mention that new legislation came into force in Ontario on March 29, 2016 to regulate groundwater takings for construction dewatering purposes. Prior to March 29, 2016, a Category 2 Permit to Take Water (PTTW) was required from the Ontario Ministry of the Environment and Climate Change (MOECC) for groundwater takings related to construction dewatering, where taking volumes in excess of 50 m^3/day, but less than 400 m^3/day, and the taking duration was no more than 30 consecutive days. The new legislation replaces the Category 2 PTTW for construction dewatering with a new process under the Environmental Activity and Sector Registry (EASR). The EASR is an on-line registry, which allows persons engaged in prescribed activities, such as water takings, to register with the MOECC instead of applying for a PTTW.

To be eligible for the new EASR process, the construction dewatering taking must be less than 400 m^3/day under normal conditions. The water taking can be groundwater, storm water, or a combination of both. It should be noted that the 30-consecutive day limit on the water taking under the old Category 2 PTTW process has been removed in the new EASR process. Also, it should be noted that the EASR process requires two technical studies be prepared by a Qualified Person, prior to any water taking. These studies include a Water Taking Report, which provides assurance that the taking will not cause any unacceptable impacts, and a Discharge Plan, which provides assurance that the discharge will not result in any adverse impacts to the environment. A significant advantage of the new EASR process over the former Category 2 PTTW process, is that the groundwater taking may begin immediately after completing the on-line registration of the taking and paying the applicable fee, assuming the accompanying technical studies have been completed. The former PTTW process typically took more than 90 days, which had the potential to impact construction schedules. EXP can provide assistance during the EASR/PTTW process, if required.

Although this investigation has estimated the groundwater levels at the time of the fieldwork, and commented on dewatering and general construction problems, conditions may be present which are difficult to establish from standard boring and excavating techniques and which may affect the type and nature of dewatering procedures used by the contractor in practice. 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, 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 dewatering systems.

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

The on-site soils to be excavated are anticipated to consist of a granular fill, silty sand, brown clay (desiccated crust) and grey clay. Select portions of the granular fill, silty sand and brown clay (desiccated crust) from above the groundwater level may be used in service trenches outside the building area, subject to further examination and testing during the early stages of construction. These soils are moisture sensitive and should be protected from the effects of weather if stockpiled on site. The brown and grey clay below the groundwater level are considered too wet to achieve the required degree of compaction. Therefore, these soils may be used for general grading purposes in landscaped areas, provided the moisture content of these soils is lowered by air-drying in the sun.

It is anticipated that the majority of the material required for backfilling purposes or as subgrade fill for the project would have to be imported and should preferably conform to the following specification:

- Engineered fill under footings (also within demolished areas) - OPSS 1010 Granular B Type II placed in 300 mm thick lifts and each lift compacted to 100 percent of the SPMDD.
- Engineered fill under slabs-on-grade - OPSS 1010 Granular B Type II placed in 300 mm thick lifts and each lift compacted to 98 percent of the SPMDD.
- Backfill in services trenches inside buildings – OPSS 1010 Granular B Type II placed in 300 mm thick lifts and each lift compacted to 98 percent of the SPMDD.
- Trench backfill and subgrade fill in parking area and access roadways – OPSS 1010 Select Subgrade Material (SSM) placed in 300 mm thick lifts and each lift compacted to 95 percent of the SPMDD.

To minimize settlement of the pavement structure over services trenches, the trench backfill material within the frost zone should match the existing material along the trench walls to minimize differential frost heaving of the subgrade soil, provided this material is compactible. Otherwise, frost tapers may be required.

As previously indicated, if the backfill for the service trenches will consist of granular fill, clay seals should be installed in the service trenches at select intervals as per City of Ottawa Drawing No. S8. The seals should be 1 m wide, extend over the entire trench width and from the bottom of the trench to the underside of the pavement structure. The clay should be compacted to 95 percent SPMDD. The purpose of the clay seals is to minimize the permanent lowering of the groundwater level.

16 Pavement Structures

Pavement structures for the surface parking areas and access roads are given on Table X below for the anticipated engineered fill subgrade used to raise the site grades and for the native silty sand and clay subgrades. The pavement structures are based upon the assumption that the subgrade will be properly prepared and assumes a functional design life of 15 to 18 years. The proposed functional design life represents the number of years to the first rehabilitation, assuming regular maintenance is carried out.

Table X: Recommended Pavement Structure Thicknesses

Pavement Layer	Compaction Requirements	Computed Pavement Structure	
		Light Duty Traffic (Parking Lots - Cars Only)	Heavy Duty (Parking Lots and Access Roads)
Asphaltic Concrete (PG 58-34)	92-97% MRD	65 mm HL3/SP12.5 mm/ Cat.B	40 mm HL3/SP12.5 Cat. B 50 mm HL8/SP 19 Cat. B
OPSS 1010 Granular A Base (crushed limestone)	100% SPMDD	150 mm	150 mm
OPSS 1010 Granular B Type II Sub-base	100% SPMDD	450 mm	600 mm

Notes:

1. SPMDD denotes standard Proctor maximum dry density, ASTM, D-698-12e2.
2. MRD denotes Maximum Relative Density, ASTM D2041.

The upper 300 mm of the subgrade fill must be compacted to 98% SPMDD.

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

1. As part of the subgrade preparation, the proposed parking areas and access roads should be stripped of topsoil and other obviously unsuitable material. Fill required to raise the grades to design elevations should conform to requirement as per Section 8 and should be placed and compacted to 95 percent of the SPMDD. The subgrade should be properly shaped, crowned, then proofrolled with a heavy vibratory roller in the full-time presence of a representative of this office. Any soft or spongy subgrade areas detected should be sub excavated and properly replaced with suitable approved backfill compacted to 95 percent SPMDD (ASTM D698-12e2).
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. Subdrains should be installed on both sides of the access road(s). Subdrains must be installed in the proposed parking area at low points and should be continuous between catchbasins 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 subdrains required within the paved areas should be reviewed by this office in conjunction with the proposed site grading.

3. To minimize the problems of differential movement between the pavement and catchbasins/manhole due to frost action, the backfill around the structures should consist of free-draining granular preferably conforming to OPSS Granular B Type II material. Weep holes should be provided in the catchbasins/manholes to facilitate drainage of any water that may accumulate in the granular fill.
4. The most severe loading conditions on light-duty pavement areas and the subgrade may occur during construction. Consequently, special provisions such as restricted lanes, half-loads during paving, temporary construction roadways, etc., may be required, especially if construction is carried out during unfavorable weather.
5. 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.
6. Relatively weaker subgrade may develop over service trenches at subgrade level. These areas may require the use of thicker/coarser sub-base material and the use of a geotextile at the subgrade level. If this is the case, it is recommended that additional 150 mm of granular sub-base, OPSS Granular B Type II, should be provided in these areas, in addition to the use of a geotextile at the subgrade level.
7. 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 from 92 percent 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.

17 Corrosion Potential of Subsurface Soils

Chemical tests limited to pH, sulphate, chloride and resistivity tests were performed on two (2) selected soil samples. The results are shown on Table No. XI. The laboratory certificate of analysis is included in Appendix A.

Table XI: Results of pH, Sulphate, Chloride and Resistivity Tests on Soil Samples

Borehole No. - Sample No.	Depth (Elevation) (m)	Soil	pH	Sulphate (%)	Chloride Content (%)	Resistivity (ohm.cm)
			<5	>0.1 %	>0.04 %	
BH 1 – SS4	2.3 – 2.9 (76.8 – 76.2)	Grey Clay	7.54	0.0025	0.0051	6170
BH 4 – SS3	1.5 – 2.1 75.2 – 74.6)	Brown Clay	7.05	0.0122	0.0054	4270

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

The results of the resistivity tests indicate that the soil is mildly corrosive to buried bare steel elements as per the National Association of Corrosion Engineers (NACE). Appropriate measures should be undertaken to protect buried steel elements from corrosion.

18 Tree Planting Restrictions

The brown clay crust extends to depths ranging from 2.1 m to 3.0 m (Elevation 75.3 m to 74.2 m) in Borehole Nos. 2 to 5.

Based on the City of Ottawa document titled, “Tree Planting in Sensitive Marine Clay Soils – 2017 Guidelines,” the modified plasticity index of the brown clay was estimated at 43 percent indicating the brown clay crust has a high potential for soil volume change.

The grey clay was contacted beneath the silty sand in Borehole No. 1. The modified plasticity index of the grey clay is estimated at 32 percent indicating the grey clay has a medium potential for soil volume change.

In accordance with the above referenced 2017 guidelines, for high potential volume change soil types, the tree planting restrictions and setbacks from structures should follow the 2005 clay soil policy.

For medium potential volume change soil types, the tree planting restrictions and setbacks from structures should follow the above noted 2017 guidelines.

A landscape architect should be consulted to ensure the applicable tree planting restrictions and setbacks for the development of this site are in accordance with the applicable City of Ottawa guideline and policy.

19 Additional Study

Boreholes drilled to date revealed that limited data is available within the areas of Block Nos. 2 and 4. Therefore, it is recommended that consideration should be given to drilling some additional boreholes within these blocks to confirm that the subsurface conditions assumed from the closet boreholes apply to these blocks.

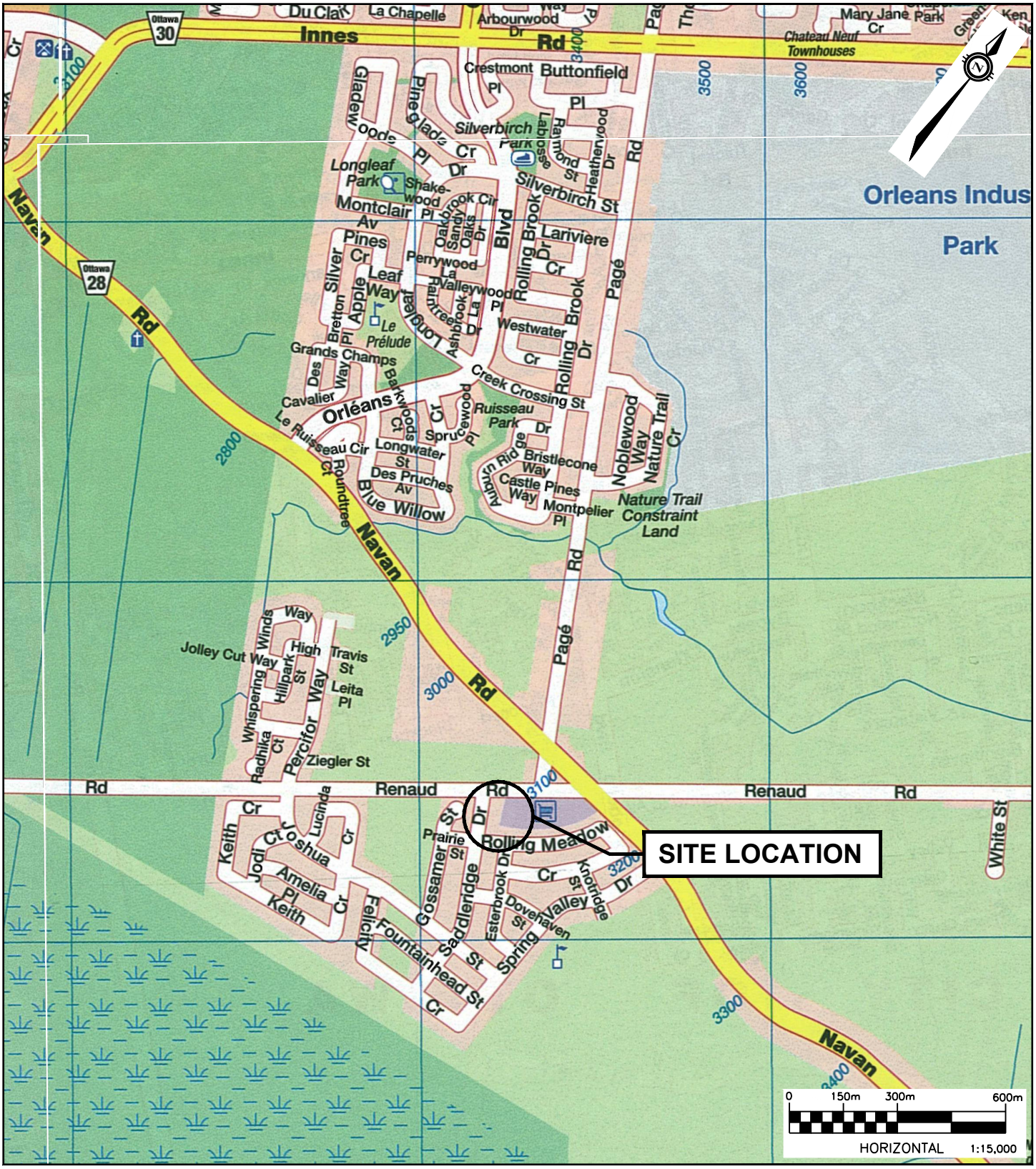
20 General Comments

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

The information contained in this report is not intended to reflect on environmental aspects of the soils. Reference is made to the Phase One and Two ESA reports regarding the environmental aspects of the soils.

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

Figures



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scale 1:15 000	PROJECT: 2597237 ONTARIO LTD. 6102 RENAUD ROAD, OTTAWA, ON	project no. OTT-00246046-A0
date MAY 2018		design S.P. / checked I.T.
drawn by J.R.	TITLE: SITE LOCATION PLAN	FIG 1

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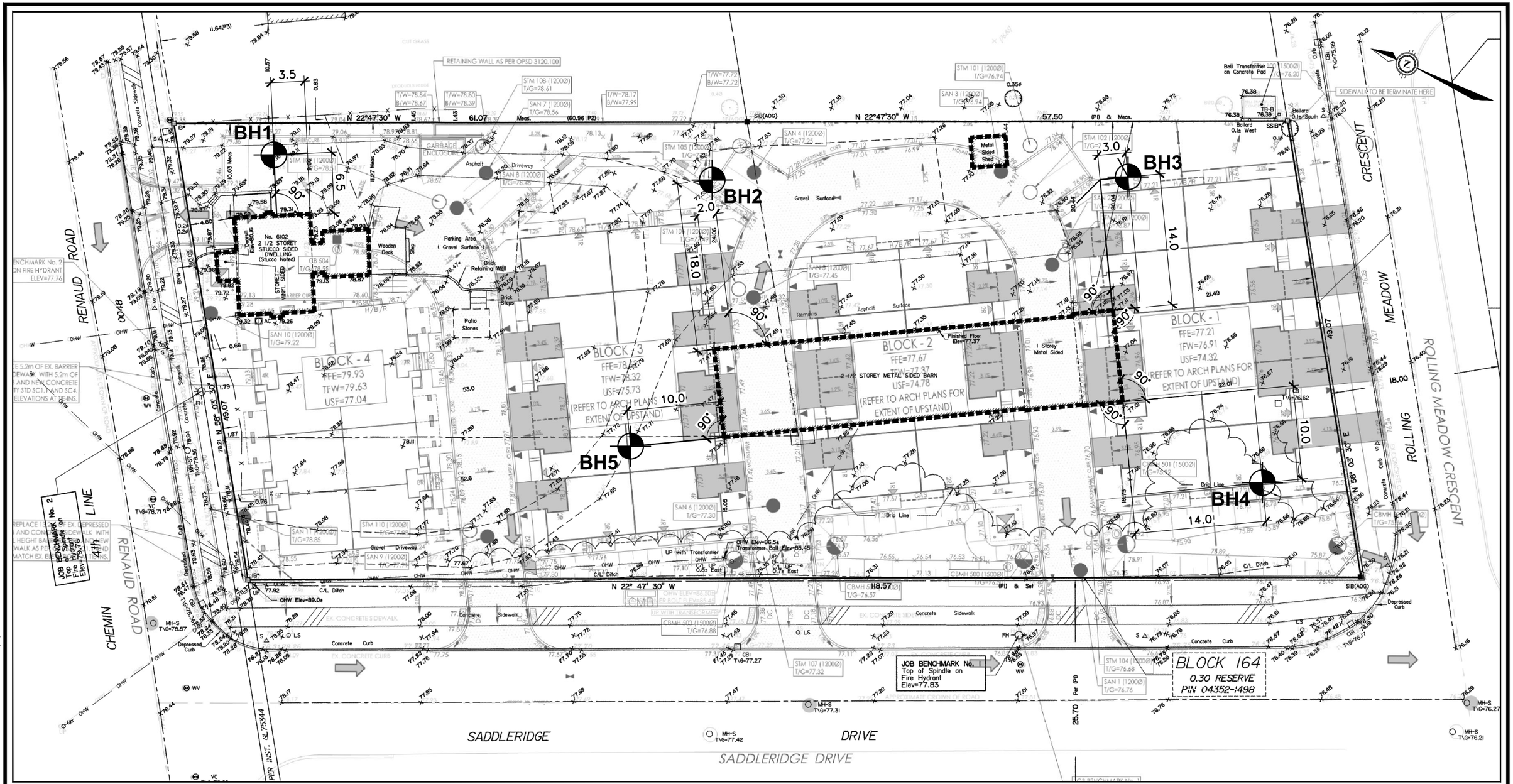

NOTES :

1. THE BOUNDARIES AND SOIL TYPES HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. BETWEEN BOREHOLES THEY ARE ASSUMED AND MAY BE SUBJECT TO CONSIDERABLE ERROR.
2. SOIL SAMPLES 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 THE 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. SURVEY PLAN PREPARED BY ANNIS, O'SULLIVAN, VOLLEBEKK LTD. JOB N°.18260-17 UTOPIA, DATED SEPTEMBER 1ST, 2017.

LEGEND :

BH1 PROPOSED BOREHOLE NUMBER & LOCATION

NOTE : ALL UNITS IN METRIC

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scale 1:400	PROJECT: 259727 ONTARIO LTD. PROPOSED RESIDENTIAL PROPERTY 6102 RENAUD ROAD, OTTAWA, ON	project no. OTT-00246046-A0
date FEB 2020		
drawn by S.K.	TITLE: BOREHOLE LOCATION PLAN	FIG 2

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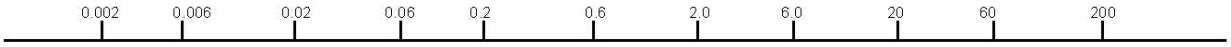
Notes On Sample Descriptions

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 1

Project No: OTT-00246046-A0

Project: Geotechnical Investigation - Proposed Residential Development

Location: 6102 Renaud Road, Ottawa, ON.

Figure No. 3

Page. 1 of 3

Date Drilled: 'April 18, 2018

Drill Type: CME-55 Truck Mount Drill Rig

Datum: Approximate Elevation

Logged by: ML Checked by: SMP

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	Approximate Elevation m	Depth
		ASPHALTIC CONCRETE ~50 mm	79.11	0
		FILL ~ 150 mm Crushed limestone, grey, moist	79.0 78.8	
		SILTY SAND Oxidized stains, brown, moist, (loose to compact)		1
			76.9	2
▼		**CLAY** Sensitive to extra-sensitive, grey, wet, (firm to stiff)		3
			74.91	4
				5
				6
				7
				8
				9
				10

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

9 ○
8 ○
13 ○
Hammer Weight
77 + s=9.1
Hammer Weight
38 + s=8.0
Hammer We
36 + s=10
Hammer We
36 + s=6.0
62 + s=6.9
Hammer Weight
67 + s=7.0
Hammer Weight
77 + s=4.6

82 ×

Continued Next Page

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00246046-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	4.2	8.2

CORE DRILLING RECORD

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

LOG OF BOREHOLE BH LOGS - 246046 - 6102 RENAUD ROAD.GPJ TROW OTTAWA.GDT 5/14/18

Log of Borehole BH 1

Project No: OTT-00246046-A0

Project: Geotechnical Investigation - Proposed Residential Development

Figure No. 3

GWL	SYMBOL	SOIL DESCRIPTION	Approximate 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
		Dynamic Cone Penetration Test (DCPT) conducted from 10.1 m to Cone Refusal Depth of 27.0 m.	69.11 69.0	10 11 12 13 14 15 16 17 18 19 20 21 22	20 40 60 80 Shear Strength kPa 50 100 150 200	250 500 750 Natural Moisture Content % Atterberg Limits (% Dry Weight) 20 40 60		

Continued Next Page

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00246046-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	4.2	8.2

CORE DRILLING RECORD

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

Log of Borehole BH 1

Project No: OTT-00246046-A0

Project: Geotechnical Investigation - Proposed Residential Development

Figure No. 3

Page. 3 of 3

GWL	SYMBOL	SOIL DESCRIPTION	Approximate 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
		Dynamic Cone Penetration Test (DCPT) conducted from 10.1 m to Cone Refusal Depth of 27.0 m. *(continued)*	57.11	22	20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60		
				23				
				24				
				25				
				26				
		Cone Refusal at 27.0 m Depth	52.1	27				

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00246046-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	4.2	8.2

CORE DRILLING RECORD

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

LOG OF BOREHOLE BH LOGS - 246046 - 6102 RENAUD ROAD.GPJ TROW OTTAWA.GDT 5/14/18

Log of Borehole BH 2

Project No: OTT-00246046-A0

Project: Geotechnical Investigation - Proposed Residential Development

Location: 6102 Renaud Road, Ottawa, ON.

Figure No. 4

Page. 1 of 1

Date Drilled: 'April 16, 2018

Drill Type: CME-55 Truck Mount Drill Rig

Datum: Approximate Elevation

Logged by: AN Checked by: SMP

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	Approximate Elevation m	Depth
			77.53	0
		FILL ~ 150 mm Crushed limestone, grey, moist	77.3	
		FILL Mixture of crushed limestone gravel and silty sand, grey and brown, wet	76.8	
		CLAY Sensitive, brown, moist, (stiff to very stiff)		1
				2
			75.3	
		CLAY Extra-sensitive, grey, wet, (firm to stiff)		3
				4
				5
				6
				7
			69.4	8
		Borehole Terminated at 8.1 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

4
192
17.6
2
17.1
82
s=4.9
1
34
s=14.0
Hammer Weight
83
43
s=9.0
Hammer Weight
58
s=12.0
Hammer Weight
68
s=13.0
Hammer Weight
67
s=9.3
Hammer Weight
82
67
s=14.0

LOG OF BOREHOLE BH LOGS - 246046 - 6102 RENAUD ROAD.GPJ TROW OTTAWA.GDT 5/14/18

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00246046-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion		

CORE DRILLING RECORD

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

Log of Borehole BH 3

Project No: OTT-00246046-A0

Project: Geotechnical Investigation - Proposed Residential Development

Location: 6102 Renaud Road, Ottawa, ON.

Figure No. 5

Page. 1 of 1

Date Drilled: 'April 17, 2018

Drill Type: CME-55 Truck Mount Drill Rig

Datum: Approximate Elevation

Logged by: AN Checked by: SMP

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	Approximate Elevation m	Depth
		TOPSOIL ~ 50 mm	76.81	0
		FILL Mixture of gravel, silty sand, topsoil and roots, brown and black, wet, (loose)	76.7	
		CLAY Brown, moist, (very stiff)	76.41	
			76.1	1
				2
			74.7	
		CLAY High plasticity, sensitive to extra-sensitive, grey, wet, (firm to stiff)		
				5
				6
				7
				8
			68.3	
		Borehole Terminated at 8.5 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

4
5 192
2 144
58 s=12.0
Hammer Weight
29 s=12.0
Hammer Weight
38 s=16.0
Hammer Weight
43 s=9.0
53 s=8.8
Hammer Weight
67 s=8.7
Hammer Weight
67 s=5.6

16.9
88
82
15.8

LOG OF BOREHOLE BH LOGS - 246046 - 6102 RENAUD ROAD.GPJ TROW OTTAWA.GDT 5/14/18

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter standpipe piezometer 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-00246046-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	5.2	7.3
20 days	0.4	

CORE DRILLING RECORD

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

Log of Borehole BH 4

Project No: OTT-00246046-A0

Project: Geotechnical Investigation - Proposed Residential Development

Location: 6102 Renaud Road, Ottawa, ON.

Figure No. 6

Page. 1 of 3

Date Drilled: 'April 17, 2018

Drill Type: CME-55 Truck Mount Drill Rig

Datum: Approximate Elevation

Logged by: AN Checked by: SMP

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	Approximate 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
		TOPSOIL ~ 50 mm	76.67	0	18			
		FILL Mixture of crushed limestone gravel, silty sand, topsoil and rootlets, black, moist, (compact)	76.6					
		CLAY High plasticity, brown, moist, (very stiff)	76.0	1	7, 168			18.3
			75.37	2	4, 120, 67			19.0
		CLAY High plasticity, sensitive to quick, grey, wet, (firm to very stiff)	74.6		Hammer Weight, s=7.0			
				3	38, s=8.0, Hammer Weight	82		
					43, s=6.0, Hammer Weight			
				5	43, s=18.0			
				6	48, s=10.0, Hammer Weight			
				7	58, s=12.0, Hammer Weight			
				8	62, s=8.7			
				9				
				10	67, s=9.3			

Continued Next Page

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter standpipe piezometer 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-00246046-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	2.3	
20 days	1.3	

CORE DRILLING RECORD

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

LOG OF BOREHOLE BH LOGS - 246046 - 6102 RENAUD ROAD.GPJ TROW OTTAWA.GDT 5/14/18

Log of Borehole BH 4

Project No: OTT-00246046-A0

Project: Geotechnical Investigation - Proposed Residential Development

Figure No. 6

GWL	SYMBOL	SOIL DESCRIPTION	Approximate 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
		CLAY High plasticity, sensitive to quick, grey, wet, (firm to very stiff) *(continued)*	66.67	10	Shear Strength 20 40 60 80 kPa; 50 100 150 200	250 500 750; 20 40 60		
				11	Hammer Weight			
				12	82 s=6.8			
				13	86 s=7.2			
				14	Hammer Weight			
				15	115 s=9.6			
				16	Hammer Weight			
				18	86 s=7.2			
				19	Hammer Weight			
		Dynamic Cone Penetration Test (DCPT) conducted from 19.2 m to Cone Refusal Depth of 26.1 m.	57.5	20	77 s=5.3			
				21	Hammer Weight			
				22	86 s=9.0			

Continued Next Page

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter standpipe piezometer 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-00246046-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	2.3	
20 days	1.3	

CORE DRILLING RECORD

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

Log of Borehole BH 4

Project No: OTT-00246046-A0

Project: Geotechnical Investigation - Proposed Residential Development

Figure No. 6

GWL	SYMBOL	SOIL DESCRIPTION	Approximate 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
		Dynamic Cone Penetration Test (DCPT) conducted from 19.2 m to Cone Refusal Depth of 26.1 m. *(continued)*	54.67	22	20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60		
				23				
				24				
				25				
			50.6	26				
		Cone Refusal at 26.1 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter standpipe piezometer 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-00246046-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	2.3	
20 days	1.3	

CORE DRILLING RECORD

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

LOG OF BOREHOLE BH LOGS - 246046 - 6102 RENAUD ROAD.GPJ TROW OTTAWA.GDT 5/14/18

Log of Borehole BH 5

Project No: OTT-00246046-A0

Project: Geotechnical Investigation - Proposed Residential Development

Location: 6102 Renaud Road, Ottawa, ON.

Figure No. 7

Page. 1 of 2

Date Drilled: 'April 18, 2018

Drill Type: CME-55 Truck Mount Drill Rig

Datum: Approximate Elevation

Logged by: ML Checked by: SMP

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	Approximate 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
		FILL ~ 150 mm Crushed limestone, grey, wet	77.18 / 77.0	0	21			
		FILL Mixture of gravel, silty sand, clay, topsoil and wood debris, brown and black, moist, (loose to compact)	76.3	1	5; >120			
▽		**CLAY** Sensitive, brown, moist, (stiff to very stiff)	75.78	2	6; 86 s=7.2; 2			17.8
		CLAY Sensitive to extra-senstive, grey, wet, (firm to stiff)	74.2	3	53 s=14.7			
				4	43 s=9.0; 38 s=8.0			
				5	Hammer Weight; 36 s=6.0		87	
				6	Hammer Weight		84	
				7	53 s=8.8			
				8	Hammer Weight; 62 s=8.7			
				9	Hammer Weight			
				10	67 s=7.0			

Continued Next Page

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter standpipe piezometer 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-00246046-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	3.6	10.1
19 days	1.4	

CORE DRILLING RECORD

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

LOG OF BOREHOLE BH LOGS - 246046 - 6102 RENAUD ROAD.GPJ TROW OTTAWA.GDT 5/14/18

Log of Borehole BH 5

Project No: OTT-00246046-A0

Project: Geotechnical Investigation - Proposed Residential Development

Figure No. 7

GWL	SYMBOL	SOIL DESCRIPTION	Approximate 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
		CLAY Sensitive to extra-senstive, grey, wet, (firm to stiff) *(continued)*	67.18	10	20 40 60 80 50 100 150 200	250 500 750 20 40 60		
					Hammer Weight			
				11	67 s=5.6			
			65.6					
		Borehole Terminated at 11.6 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter standpipe piezometer 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-00246046-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	3.6	10.1
19 days	1.4	

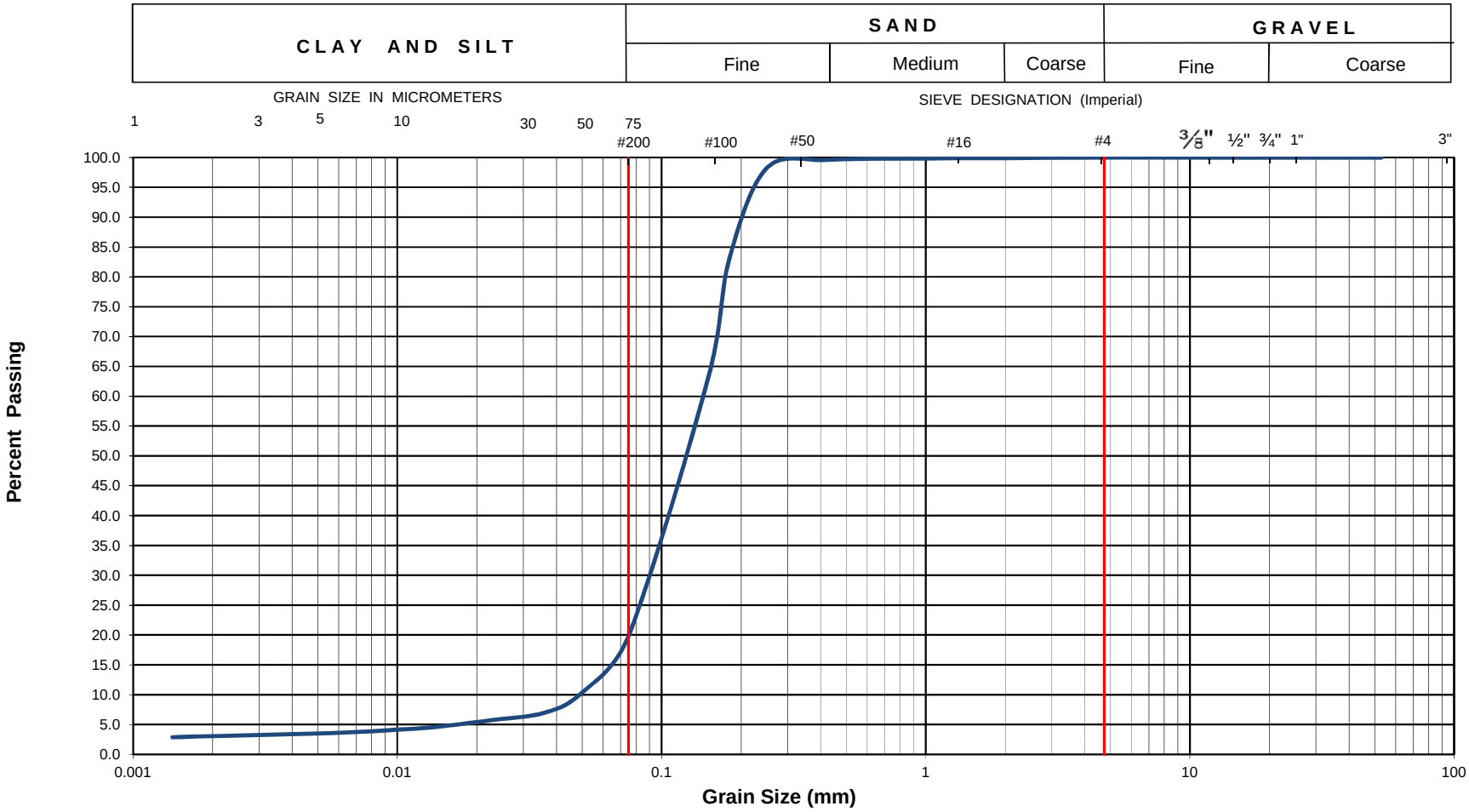
CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

LOG OF BOREHOLE BH LOGS - 246046 - 6102 RENAUD ROAD.GPJ TROW OTTAWA.GDT 5/14/18

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

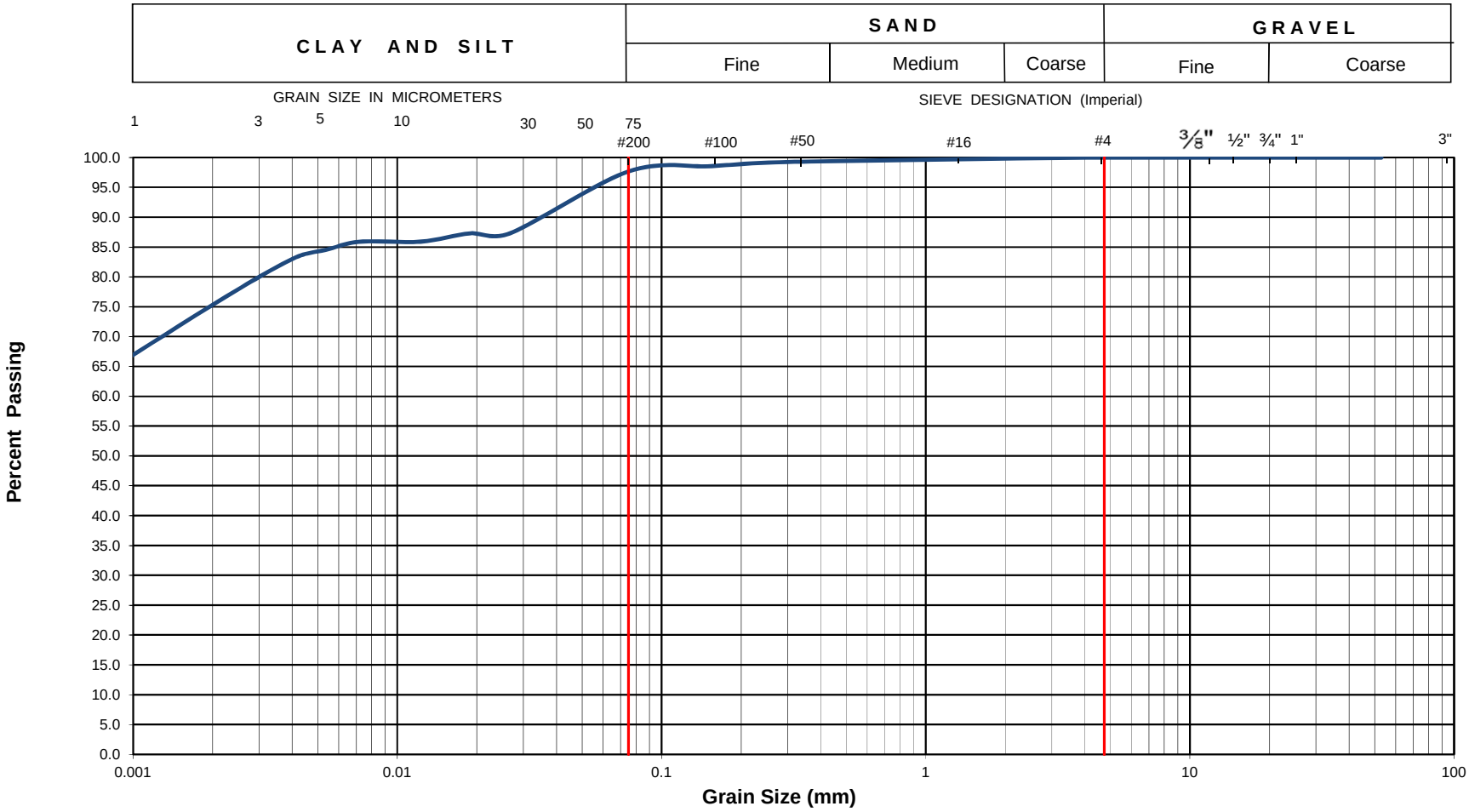


EXP Project No.:	**OTT-00246046 - A0**	**Project Name :**	**Geotechnical Investigation - Proposed Residential Development**						
Client :	**2597237 Ontario Ltd.**	**Project Location :**	**6102 Renaud Road, Ottawa, ON.**						
Date Sampled :	**April 18, 2018**	**Borehole No:**	**BH1**		**Sample No.:**	**SS3**		**Depth (m) :**	**1.5-2.1**
Sample Description :		**% Silt and Clay**	**20**	**% Sand**	**80**	**% Gravel**	**0**	**Figure :**	**8**
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-00246046 - A0**	**Project Name :**	**Geotechnical Investigation - Proposed Residential Development**						
Client :	**2597237 Ontario Ltd.**	**Project Location :**	**6102 Renaud Road, Ottawa, ON.**						
Date Sampled :	**April 16, 2018**	**Borehole No:**	**BH2**	**Sample No.:**	**SS2**	**Depth (m) :**	**0.8-1.4**		
Sample Description :		**% Silt and Clay**	**98**	**% Sand**	**2**	**% Gravel**	**0**	**Figure :**	**9**
Sample Description :	**Clay (CH)**								

Appendix A: Laboratory Certificate 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: Susan Potyondy

PROJECT: OTT-246046

AGAT WORK ORDER: 18Z331542

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Coordinator

DATE REPORTED: Apr 27, 2018

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

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

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: 18Z331542

PROJECT: OTT-246046

CLIENT NAME: EXP SERVICES INC

ATTENTION TO: Susan Potyondy

SAMPLING SITE:6102 Renaud Road

SAMPLED BY:exp

Inorganic Chemistry (Soil)

DATE RECEIVED: 2018-04-23

DATE REPORTED: 2018-04-26

				SAMPLE DESCRIPTION:	BH1 SS4 7. 5'-9.5'	BH4 SS3 5'-7'
				SAMPLE TYPE:	Soil	Soil
				DATE SAMPLED:	2018-04-18	2018-04-18
Parameter	Unit	G / S	RDL		9195398	9195399
pH, 2:1 CaCl2 Extraction	pH Units				7.54	7.05
Chloride (2:1)	µg/g		2		51	54
Sulphate (2:1)	µg/g		2		25	122
Resistivity (2:1)	ohm.cm		1		6170	4270

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

9195398-9195399 EC/Resistivity, Chloride and Sulphate were determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio.

Certified By: Amanjot Bhela

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: 18Z331542

PROJECT: OTT-246046

ATTENTION TO: Susan Potyondy

SAMPLING SITE:6102 Renaud Road

SAMPLED BY:exp

Soil Analysis

RPT Date:			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)															
pH, 2:1 CaCl2 Extraction	9195564		7.58	7.54	0.5%	NA	99%	80%	120%						
Chloride (2:1)	9194146		623	584	6.5%	< 2	107%	70%	130%	103%	70%	130%	101%	70%	130%
Sulphate (2:1)	9194146		34	33	3.0%	< 2	97%	70%	130%	102%	70%	130%	100%	70%	130%

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By: Amanjot Bhela

AGAT Laboratories

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

Method Summary

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 18Z331542

PROJECT: OTT-246046

ATTENTION TO: Susan Potyondy

SAMPLING SITE:6102 Renaud Road

SAMPLED BY:exp

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
pH, 2:1 CaCl2 Extraction	INOR-93-6031	MSA part 3 & SM 4500-H+ B	PH METER
Chloride (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
Resistivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B,SSA #5 Part 3	EC METER

AGAT Laboratories

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 #: 18273154 2
Cooler Quantity: one - no ice.
Arrival Temperatures: 12.5 | 12.2 | 12.1
Custody Seal Intact: ☐Yes ☐No ☐N/A
Notes:

Report Information:
Company: Exp Services
Contact: Susan Potyondy
Address: 100-2650 Queensview Drive
Ottawa ON, K2B 8H6
Phone: 613-688-1899 Fax:
Reports to be sent to:
1. Email: susan.potyondy@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)

Is this submission for a **Record of Site Condition?** ☐ 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 CPM

Project Information:
Project: OTT-246046
Site Location: 6102 Renaud Road
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:

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 (Y/N)	O. Reg 153: Metals and Inorganics (All Metals ☐ 153 Metals (excl. Hydrides); Hydride Metals ☐ 153 Metals (incl. Hydrides))	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	Sulphates	Chlorides	Electro Resistivity
BH 1 SS4 7.5'-9.5'	Apr 18/18																		✓	✓	✓	✓
BH 4 SS3 5'-7'	Apr 17/18																		✓	✓	✓	✓

Samples Relinquished By (Print Name and Sign): Ryan DiBiase Ryan DiBiase	Date: Apr 23/18	Time: 11:30	Samples Received By (Print Name and Sign): [illegible]	Date: 23-Apr-18	Time: 11h39
Samples Relinquished By (Print Name and Sign): FedEx	Date: 23-Apr-18	Time: 16h00	Samples Received By (Print Name and Sign):	Date:	Time:
Samples Relinquished By (Print Name and Sign):	Date:	Time:	Samples Received By (Print Name and Sign):	Date:	Time:

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