- **2705460 Ontario Inc.**

Preliminary Geotechnical Investigation

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Executive Summary

EXP Services Inc. was retained by 2705460 Ontario Inc. to update the preliminary geotechnical investigation report completed at the site situated at 112 Montreal Road, Ottawa, Ontario in 2013. The purpose of the update is to reflect the proposed new development plan which calls for the construction of two 19 storey buildings (Tower A and B) and one sixteen (16) storey building (Tower C) with a two (2) level underground parking garage covering the entire property. Tower A and B will be linked by an eight (8) storey podium. Underground services, surface parking facility and hard and soft landscaped areas also form part of the proposed facility. This work was authorized by Mr. Anand Aggarwal by a signed EXP work authorization form.

The ground floor level of the proposed buildings will be at Elevation 56.9 m. The founding level of each tower was not available at the time of the preparation of this report. However, for the purpose of this preliminary report, it has been assumed that the founding level of the underground parking garage will be set at approximately 9 m below the ground floor, i.e. Elevation 47.9 m.

The preliminary geotechnical investigation comprised of drilling ten (10) boreholes to refusal/termination depths ranging between 2.8 m and 8.1 m. The investigation revealed that the surficial soil at the site is heterogeneous fill, which extends to depths ranging from 0.2 m to 2.7 m below existing grade. The fill is underlain by compact to very dense silty sand till to 2.1 m to 3.3 m depths. Limestone bedrock underlies the till in all the boreholes except in Borehole Nos 1A and 3 and extends to the entire depth investigated; i.e. to 5.6 m to 8.1 m depths. The groundwater table at the site was established at 2.4 m to 4.2 m depth. It is noted that updated groundwater levels would have to be established as part of the additional detailed investigation.

Since compressible soils were not encountered, a grade raise of up to 2 m is considered acceptable from a geotechnical point of view.

The design of the proposed structures would depend on if the site can be dewatered without adversely impacting the existing structures and services in the neighborhood. If the additional detailed investigation reveals that dewatering of the site will not have an adverse impact on neighboring structures and services, the basement walls of the proposed structures may be designed to resist lateral earth pressures for static as well seismic conditions along with perimeter and underfloor drainage systems provided to maintain the groundwater table below the founding level(s). If this is the case, the lowest floor slabs of the proposed structures may be designed as slab on grades. If the additional detailed investigation reveals that dewatering of the site will adversely impact existing structures and services in the neighborhood, the basements below the groundwater table would have to be designed as water-tight structures capable of resisting lateral earth as well as hydrostatic pressures.

The site can be classified as **Class C** for seismic site response in accordance with Section 4.1.8.4 of the 2012 Ontario Building Code. The site classification will likely be higher since the footings will be founded on the bedrock. This would have to be confirmed by shear wave velocity measurements (Multi-channel

Analysis of Surface Waves (MASW) survey) at the site as part of the additional detailed geotechnical investigation.

Based on the geotechnical conditions encountered at the site, it is considered feasible to found the proposed high rise structures on spread and strip footings set on limestone bedrock. Since the footings will be set on bedrock, the factored geotechnical resistance at Ultimate Limit State (ULS) will govern the design. The factored geotechnical resistance at ULS may be taken as 3.0 MPa for preliminary design purposes. Settlements of footings founded on bedrock and properly constructed are expected to be less than 10 mm. A higher ULS bearing pressure of the bedrock may be available, depending on the results of the additional detailed geotechnical investigation.

Excavations at the site in the overburden may be undertaken as open-cut provided that they are cut back at 1H:1V. If space restrictions prevent open-cut excavations, the excavations would have to be shored. Excavation of the overburden soil may be undertaken with conventional mechanical equipment. The bedrock may be excavated with near vertical sides. Excavation of the bedrock would require line drilling and blasting and must be undertaken by a specialized blasting contractor working under the supervision of a specialized blasting engineer. Vibrations should be monitored during construction to prevent damage to adjacent structures and services. A condition survey of all the structures and services located within the zone of influence of the construction will be required prior to commencement of construction. Seepage of surface and sub-surface water into the excavations should be anticipated. It should be possible to collect the water entering the excavation in perimeter ditches and to remove it by pumping from sumps. Appropriate permits to take water will have to be obtained from the Ministry of Environment and Climate Change.

It is anticipated that the majority of fill required for construction will have to be imported to the site and should conform to the Ontario Provincial Standard Specification (OPSS) requirements for Granular A, B Type II and Select Subgrade Material (SSM).

The pavement structure thicknesses for light duty and heavy duty traffic areas should be as per recommendations of the report.

This report is prepared using widely spaced boreholes which were of limited depth. An additional and more detailed geotechnical investigation will be required once the design grades have been finalized. The detailed investigation will include the drilling of deeper boreholes within the envelopes of the proposed structures as well as the completion of a Multi-channel Analysis of Surface Waves (MASW) survey at the site.

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1 Introduction

EXP Services Inc. was retained by 2705460 Ontario Inc. to update the preliminary geotechnical investigation report which was provided for the site situated at 112 Montreal Road, Ottawa, Ontario in 2013 under EXP Project No. OTT-00214936-B0. The location of the site is shown in Figure 1.

It is noted that since the preparation of the 2013 preliminary report, the property has changed hands to the current owner 2705460 Ontario Inc. It is now proposed to develop the property with three residential towers with two levels of underground parking garage. Therefore, this update was required to reflect the proposed new development plan. This work was authorized by Mr. Anand Aggarwal via EXP signed work authorization form.

Current development plans call for the following construction at the site as presented in the borehole location plan, Figure 2:

- Tower A- nineteen storey (19) building - Total 213 units.
- Tower B – nineteen storey (19) building – Total 219 units.
- Tower C – sixteen (16) storey building - Total 159 units.
- Tower A and B will be linked by an eight (8) storey podium
- Two (2) level underground parking garage covering the entire site.
- A drop-off roundabout is also proposed at the center of the site between the three (3) buildings.
- Underground services, surface parking facility and hard and soft landscaped areas also form part of the proposed development.

The ground floor level of the proposed buildings will be at Elevation 56.9 m. The founding level of each tower was not available at the time of the preparation of this report. However, for the purpose of this preliminary report, it has been assumed that the founding level of the underground parking garage will be set at approximately 9 m below the ground floor of the proposed buildings, i.e. at Elevation 47.9 m.

The investigation was undertaken to:

1.) Establish the geotechnical and groundwater conditions at the site at the borehole locations;

2.) Classify the site for seismic site response in accordance with the requirements of the 2012 Ontario Building Code (OBC) and assess the potential for liquefaction of the subsurface soils during a seismic event;

3.) Comment on grade-raise restrictions;

4.) 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;

5.) Discuss the feasibility of constructing the lowest floor slab as a slab on grade and provide comments regarding perimeter and underfloor drainage systems;

6.) Provide lateral earth pressure parameters (for static and seismic conditions) for the subsurface foundation walls of the proposed building;

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

8.) Comment on backfilling requirements and suitability of on-site soils for backfilling purposes;

9.) Discuss pavement structure thickness for access roads and parking areas; and

10.) Comment on subsurface concrete requirements.

The above considerations have been updated, where applicable, based on current plans for the proposed development. The comments and recommendations given in this report are preliminary in nature and subject to review once the design parameters have been finalized and an additional detailed geotechnical investigation has been completed. The additional detailed geotechnical investigation will include drilling deeper boreholes within the envelope of the proposed towers and completion of an MASW seismic survey at the site.

2 Procedure

The fieldwork for the investigations was undertaken with truck-mounted drill rigs equipped with continuous-flight hollow-stem augers and rock core drilling capabilities and was supervised on a full-time basis by a representative of EXP Services Inc. The fieldwork for the geotechnical investigation was undertaken on October 23, 24 and November 7, 2013 and consisted of drilling ten (10) boreholes to 3.6 m to 8.1 m depths below existing grade (Borehole Nos. 1A, 1B, and 2 to 9 inclusive).

The locations of the boreholes were established by a representative of EXP as shown on the updated Borehole Plan, Figure 2. Their geodetic elevations were estimated from spot elevations shown on the topographical survey prepared by Fairhall Moffat and Woodland for this project on October 4, 2019 and provided to EXP. Therefore, these elevations should be considered as approximate. It should be noted that recent demolition activities at the site may have altered the ground surface elevations throughout the site.

Standard penetration tests were performed in the overburden soil in all the boreholes at 0.75 m to 1.5 m depth intervals and soil samples retrieved by split barrel sampler. The bedrock was core drilled in all the boreholes except Borehole Nos. 1A and 3 using NX size core barrel. During bedrock coring, a careful record of any sudden drops of the drill rods, colour of wash water and wash water return was kept.

Groundwater levels were measured in the open boreholes on completion of drilling. In addition, groundwater-monitoring wells with 51 mm diameter casing or standpipes consisting of 13 mm diameter PVC (polyvinyl chloride) pipes were installed in all the boreholes. The installation configuration is documented on the respective borehole log. All boreholes were backfilled upon completion of the fieldwork. 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 samples and rock cores were transported to the EXP laboratory in the City of Ottawa, Ontario.

All the soil samples and rock cores were visually examined in the laboratory by a geotechnical engineer and borehole logs prepared. The engineer also assigned the laboratory testing which consisted of performing the following laboratory testing on selected soil samples and rock core sections:

Soil Samples:

- Natural Moisture Contents ---------- 40 tests
- Unit Weights ---------- 6 tests
- Grain size analysis ---------- 3 tests
- pH and Sulphate Determinations ---------- 3 tests

Rock Core Sections:

- Unit Weight Determination and Unconfined Compressive Strength Tests --- 4 tests

3 Site Description and Subsurface Conditions

3.1 Site Description

The site under consideration is located at 112 Montreal Road between Palace Street and Vanier Parkway in the City of Ottawa, Ontario (Figure 1). The site is irregular in shape. The site was occupied by several one- and two-storey structures which have been recently demolished. The site is flat lying with ground surface elevations at the location of the boreholes varying from Elevation 56.87 m to 56.02 m. As indicated previously, recent demolition activities at the site may have altered the ground surface elevations.

3.2 Subsurface Conditions

A detailed description of the geotechnical conditions encountered in the ten (10) boreholes is given on Borehole Logs, Figures 3 to 12 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 location 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. A review of Figures 3 to 12 inclusive indicates the following subsurface soil stratigraphy with depth and groundwater levels.

3.2.1 Asphaltic Concrete

The site is covered with a surficial layer of asphaltic concrete 19 mm to 100 mm thick. It is noted that current demolition activities carried out at the subject site may have affected this layer; i.e. partially removed, etc.

3.2.2 Fill

The asphaltic concrete in the boreholes is underlain by fill, which extends to 0.2 m to 2.7 m depths (approximately at Elevation 56.1 m to 53.8 m). The fill consists of a mixture of silt, sand and gravel with some clay, occasional cobbles, red brick pieces, plaster, etc. The fill is generally loose to compact with its standard penetration resistance varying from 4 to 65 blows for 300 mm penetration of the split-barrel sampler. The natural moisture content of the fill varies from 3 percent to 35 percent. The unit weight of the fill is 16.9 kN/m^3 to 21.1 kN/m^3. A grain-size analysis performed on a sample of the fill revealed that the fill comprises of 14 percent clay, 31 percent silt, 30 percent sand and 25 percent gravel (Figure 13).

3.2.3 Sandy Gravel Till

The fill in all the boreholes is underlain by sandy gravel till, which extends to 2.1 m to 3.6 m depth (approximately Elevation 54.5 m to 52.9 m). The till is slightly cohesive and contains some silt and occasional cobbles and boulders. It is loose to very dense ('N' values of 7 to 50 for 25 mm penetration of

sample). The natural moisture content of the till varies from 3 percent to 35 percent. It has a unit weight of 19.3 kN/m^3 to 23.2 kN/m^3.

Grain-size analysis performed on two samples of the till are given on Figures 14 and 15 and indicate that the till comprises of 19 to 22 percent silt, 16 to 33 percent sand and 45 to 65 percent gravel.

3.2.4 Limestone Bedrock

The till in all the boreholes except Borehole Nos. 1A and 3 is underlain by limestone bedrock extending to the entire depth investigated, i.e. 5.6 m to 8.1 m (approximately at Elevation 50.5 m to 48.2 m). The limestone bedrock contains shaley partings along bedding planes. Its stratification is horizontal to slightly dipping. The principal joints are near vertical and moderately to widely spaced. A summary of bedrock depths and elevations at the locations of the boreholes are summarized in Table I.

Table I: Summary of Auger Refusal and Bedrock Depths/Elevations at the Borehole Locations

Borehole No.	Estimated Ground Surface Elevation (m)	Bedrock Depth and Elevation (m)		Bedrock Confirmed by Rock Coring Method
		Depth (m)	Elevation (m)	
1B	56.5	3.0	53.5	Yes to 8.1 m depth
2	56.1	2.8	53.3	Yes to 5.6 m depth
3	56.1	2.8	53.3	No – Inferred
4	56.2	2.7	53.5	Yes to 5.7 m depth
5	56.9	2.4	54.5	Yes to 7.2 m depth
6	56.2	2.6	53.6	Yes to 6.9 m depth
7	56.2	2.6	53.6	Yes to 7.3 m depth
8	56.4	2.1	54.3	Yes to 7.0 m depth
9	56.0	3.3	52.7	Yes to 7.8 m depth

A review of the above table indicates that the depth to the bedrock surface ranges from 2.1 m to 3.3 m below existing grade (approximately at Elevation 54.5 m to 52.7 m).

The Total Core Recovery (TCR) of the bedrock was 59 to 100 percent. The Rock Quality Designation (RQD) ranged from 25 percent to 100 percent indicating the bedrock is of a fair to excellent quality. Unit weight determination and unconfined compressive strength tests were conducted on four (4) rock core sections and the results are summarized in Table II.

Table No. II: Results of Compressive Strength Tests on Rock Cores			
Borehole #	**Depth (m)**	**Unit Weight (kg/m^3)**	**Unconfined Compressive Strength (MPa)**
1B	3.7 – 3.84	2595	75.6
1B	7.3 – 7.4	2692	89.9
6	4.4 – 4.5	2616	63.9
9	7.1 – 7.25	2630	90.0

A review of the above table indicates that the unit weight of the bedrock varies from 2595 kg/m^3 to 2692 kg/m^3. Its unconfined compressive strength varies from 63.9 MPa to 90 MPa indicating that the rock may be classified as strong in accordance with the Canadian Foundation Engineering Manual (CFEM), Fourth Edition, 2006.

A review of the available geological maps indicates that the bedrock underlying the site is limestone of the Eastview formation.

3.2.5 Groundwater Levels

Water level observations were made during drilling and in monitoring wells and standpipes installed in the boreholes subsequent to drilling in 2013. The observations indicate that the groundwater table at the site was present at 2.4 m to 4.2 m depths (approximately at Elevation 54.1 m to 52.1 m). Generally, the stabilized groundwater table is below the bedrock surface except in the case of Borehole Nos. 1A and 3. The groundwater table is subject to seasonal fluctuations and may be at a higher level during wet weather periods. As indicated previously, these readings were taken in 2013 and more updated groundwater measurements should be collected as part of the detailed geotechnical investigation which will be completed at the site.

Water levels were made in the exploratory boreholes at the times and under the conditions stated in the scope of services. These data were reviewed and EXP's interpretation of them discussed in the text of the report. Note that fluctuations in the level of the groundwater may occur due to 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.

4 Design Considerations

The recommendations made in this report are based on the assumption that the site can be permanently dewatered without impacting the neighboring structures and services. This aspect would need to be investigated during the additional detailed geotechnical investigation. If the additional detailed geotechnical investigation indicates that site dewatering is not feasible, the basements of the proposed structures below the groundwater table may have to be designed as water-tight structures capable of withstanding lateral static as well as seismic earth pressures inclusive of hydrostatic pressure.

5 Grade Raise Restrictions

Since the subsurface soils consist of cohesionless sandy soils that are not susceptible to consolidation settlement, there is no restriction to raising the grades at the site from a settlement perspective.

Based on the existing grades of the site and surrounding roadways and properties, the design site grade raise is anticipated to be less than 1 m for this development. However, for design purposes, a grade raise of up to 2 m is considered acceptable at the site.

6 Seismic Site Classification and Liquefaction Potential of Subsurface Soils

The subsoil and groundwater information at the site has been examined in relation to Section 4.1.8.4 of the 2012 Ontario Building Code (OBC) . The subsoil at the site comprises of surficial fill underlain by silty sand till, which extends to 2.1 m to 3.3 m depth. The silty sand till is underlain by limestone bedrock.

The proposed towers with two (2) levels of underground parking are expected to be supported by footings founded on limestone bedrock. Therefore, the site can be classified as **Class C** for seismic site response in accordance with Section 4.1.8.4 of the 2012 Ontario Building Code. The site classification will likely be higher, since the footings will be founded in the bedrock. However, this would have to be confirmed by the completion of shear wave velocity measurements (Multi-channel Analysis of Surface Waves (MASW) survey) at the site, as part of the additional detailed geotechnical investigation.

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

7 Foundation Considerations

Current plans call for the development of the site with three (3) high rise residential towers with a two (2) level underground parking garage. Available information revealed that the ground floor level of the proposed buildings will be at Elevation 56.9 m. The founding level of each tower was not available at the time of the preparation of this report. However, for the purpose of this preliminary report, it has been assumed that the founding level of the underground parking garage will be set at approximately 9 m below the ground floor of the proposed buildings, i.e. at Elevation 47.9 m.

The investigation has revealed that the geotechnical conditions at the site are well suited for the construction of the proposed high rise residential towers with two underground levels on spread and strip footing founded in the bedrock contacted at the site at shallow depths of 2.1 m to 3.3 m (approximately at Elevation 54.5 m to 52.7 m). Since the structures will be founded on bedrock, factored geotechnical resistance at Ultimate Limit State (ULS) will govern the design. The factored geotechnical resistance at ULS is a function of the bedrock quality and generally increases with depth below the ground surface. For preliminary design, footings designed to bear in the limestone bedrock at a minimum depth of 9.0 m below the existing ground surface may be designed for a preliminary factored geotechnical resistance of 3.0 MPa at ULS. A higher bearing capacity at ULS is likely available and can be confirmed as part of the additional detailed investigation which will be completed at the site.

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

All the footing beds should be reviewed by a geotechnical engineer to ensure that the bedrock can support the design ULS value. Where fractured rock is encountered, sub-excavation may be required to the underlying more competent bedrock. Alternatively, the footings may be redesigned to a reduced factored geotechnical resistance at ULS. Any sub-excavation which extends below the underside of the design footing levels would have to be backfilled using 15 MPa lean mix concrete. Also, the lean concrete may be used to level the bedrock surface.

The resistance to sliding of the building footings will be provided by friction between the footing concrete and the sound sandstone bedrock. The unfactored ULS coefficient of friction is 0.70.

A minimum of 1.5 m of earth cover should be provided to exterior footings 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 the vicinity of the footing and 2.4 m of earth cover if snow will be removed from the vicinity of the footing. In areas where earth cover will be less than the required, rigid insulation may be used to protect the footings. Alternatively, a combination of earth cover and rigid insulation may also be used to protect the footings. For this project it is anticipated that the required earth cover for the footings of the proposed buildings will be satisfied, since the footings are anticipated to be at depths greater than 1.5 m below the final grade.

The recommended 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.

8 Floor Slab and Drainage Requirements

If dewatering of the site will not have any impact on the neighbouring properties, the lowest level floors of the proposed buildings with basements may be constructed as slabs-on-grade provided they are set on beds of well compacted 19 mm clear stone at least 300 mm thick placed on well compacted engineered fill comprised of OPSS 1010 Granular B Type II or on bedrock. The clear stone would prevent the capillary rise of moisture to the floor slab. Adequate saw cuts should be provided in the floor slab to control cracking.

It is anticipated that perimeter as well as underfloor drains would be required for the proposed buildings with two (2) levels of underground parking. 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 drain 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 perimeter drains may 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 subsurface walls should be adequately damp proofed.

If dewatering of the site will have an impact on the neighbouring structures ad services, the basement of the structures below the groundwater table would have to be constructed as a water-tight structures capable of supporting hydrostatic pressures in addition to the lateral static and seismic lateral earth pressures.

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

9 Lateral Earth Pressure against Subsurface Walls

If dewatering of the site will not have any impact on neighbouring structures and the space between the subsurface walls and the rock face is backfilled with OPSS 1010 Granular B Type II, the subsurface walls will be subjected to lateral static earth pressure as well as lateral dynamic earth pressure during a seismic event. The lateral static earth thrust that the subsurface walls would be subjected to may be computed from equation (i) and the lateral dynamic earth thrust from equation (ii) given below.

The equations given below assume that the backfill against the subsurface walls will be free-draining granular material and that subsurface drains will be provided to prevent build-up of hydrostatic pressure.

For design purposes, the lateral static earth thrust against the subsurface walls may be computed from the following equation (i) given below:

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

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 stress, kPa

The lateral seismic thrust may be computed from equation (ii) given below:

$$\Delta_{Pe} = \gamma H^2 \frac{a_h}{g} F_b \text{----------(ii)}$$

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 = 0.32

F_b = thrust factor = 1.0

The resultant force acts approximately at 0.63H above the base of the wall.

All subsurface walls should be properly waterproofed.

10 Excavations and De-watering Requirements

10.1 Excavations

The geotechnical conditions at the site comprise of 2.1 m to 3.3 m thick overburden soil, which is underlain by limestone bedrock. The groundwater table at the site is at a depth of 2.4 m to 4.2 m below the existing ground surface.

Excavations at the site for the construction of the proposed residential towers with two (2) level of underground parking levels will likely extend to a depth of 9 m to 10 m below the existing ground surface. These excavations will extend below the prevailing groundwater table. If lowering of the groundwater table at the site will not adversely affect the neighbouring structures, the excavation may be undertaken as described below.

Excavations at the site must comply with the latest version of the Ontario Occupational Health and Safety Act, 1991. Excavations in the overburden soil above the groundwater table are expected to be stable when cut back at 1H:1V. Below the groundwater, the excavation side slopes are expected to slough and may eventually stabilize at a slope of 2H:1V. If space restrictions at the site do not permit open-cut excavations, the excavations would have to be shored.

The need for a shoring system, the most appropriate shoring system and the design and installation of the shoring system should be determined by the contractors bidding on this project. The design of the shoring system should be undertaken by a professional engineer experienced in shoring design and the installation of the shoring system undertaken by a contractor experienced in the installation of shoring systems. The shoring system should be designed and installed in accordance with the latest edition of the Ontario Regulation 213/91 under the OHSA and the 2006 CFEM (Canadian Foundation Engineering Manual (Fourth Edition).

Excavation of the bedrock may be undertaken with near vertical sides and would require the use of line drilling and blasting, completed by a specialized blasting contractor working under the supervision of a specialized blasting engineer. To prevent any damage to the surrounding structures and services, the blasting operations would have to be carefully planned and closely monitored. It is recommended that the blasting contractor should retain the services of a blast specialist to provide a blasting plan. The contractor should always have a licensed blaster on site during the blasting and a vibration engineer on retainer. A condition survey of all the structures in the vicinity of the site should be undertaken prior to commencement of the excavation work.

10.1.1 Rock Support

Excavations within the bedrock may be undertaken with near vertical sides subject to review by a geotechnical engineer. The upper weathered and fractured rock face may require support in the form of rock bolts to maintain the integrity of the rock face in conjunction with a wire mesh system and shotcrete.

10.1.2 Vibration Control

The vibration limits for blasting should be in accordance with City of Ottawa Special Provisions (SP No. 1201).

It is recommended that vibration monitoring of the nearby structures and services should be undertaken during excavation, blasting and construction operations. Prior to the commencement of blasting, a detailed blast methodology should be submitted by the Contractor.

10.2 De-Watering Requirements

Excavations at the site may be dewatered by conventional sump pumping techniques if dewatering of the site will not have any adverse impact on existing nearby structures and services.

It has been assumed that the excavation depth for the proposed buildings will be approximately 10.0 m deep 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. EXP has qualified persons who can prepare these types of reports, if required. 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.

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.

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

Conventional backfill against the subsurface walls and backfill in footing and service trenches inside the building should consist of free draining granular material preferably conforming to the Ontario Provincial Standard Specification (OPSS) for Granular B Type II. It should be placed in layers not exceeding 150 mm in thickness and compacted to 95 percent of standard Proctor maximum dry density (SPMDD).

The backfill in footing trenches and service trenches outside the building, should consist of compactible material; i.e. free of organics and debris; with a natural moisture content within two (2) percent of the optimum value. It should also be placed in thin lifts and compacted to 98 percent SPMDD.

The majority of the fill required to backfill footing trenches, service trenches and against the subsurface walls would have to be imported and should preferably conform to the OPSS 1010 requirements for Granular B Type II.

12 Subsurface Concrete Requirements

Chemical tests limited to pH and sulphate content were performed on selected soil samples retrieved from the boreholes. The test results are given on Table No. III.

Table No. III: Results of Chemical Tests on Soil Samples

Borehole No.	Depth (m)	pH	Sulphate Content (%)
BH 1	0.6 – 1.2	7.7	0.1460
BH 6	1.2 – 1.8	7.7	0.0190
BH 9	2.4 – 3.0	7.9	0.0145

A review of Table No. III indicates that the concentration of water soluble sulphates in the soil varies from 0.0145 percent to 0.146 percent. This concentration of sulphates is considered to have a moderate potential of sulphate attack on sub-surface concrete. The subsurface concrete for use at the site should be designed in accordance with the requirements of National Standards of Canada, CSA A23.1-09.

13 Access Roads and Parking Areas

The site contains surficial fill, which is underlain by silty sand till over the majority of the site. For the purpose of computing the pavement structure thicknesses, it has been assumed the subgrade will comprise of backfill material conforming to OPSS 1010 Select Subgrade Material as all the existing overburden soil is expected to be excavated as part of the proposed development.

The following pavement structure thicknesses are suggested for preliminary design considerations:

Pavement Structure Thicknesses for Light Duty Traffic Areas:

75 mm Asphaltic Concrete (HL3 or SP12.5 mm)
150 mm of OPSS 1010 Granular A Base
300 mm OPSS 1010 Granular B Type II Sub-base

Pavement Structure Thicknesses for Heavy Duty Traffic Areas:

90 mm Asphaltic Concrete (40 mm HL3/SP12.5 OVER 50 mm HL8/SP19mm)
150 mm Granular A Base
450 mm Granular B Sub-base

The granular materials used for pavement construction should conform to Ontario Provincial Standard Specifications (OPSS) for Granular A and Granular B Type II and should be compacted to 100 percent SPMDD. The asphaltic concrete used in the pavement structures and its placement should meet OPSS 1151 requirements. It should be placed and compacted in accordance with OPSS 311 and 313. Further, PG 58-34 is recommended to be used in the asphaltic concrete.

In addition, it is anticipated that sub-surface drains will be required for the roadways and parking areas at the site.

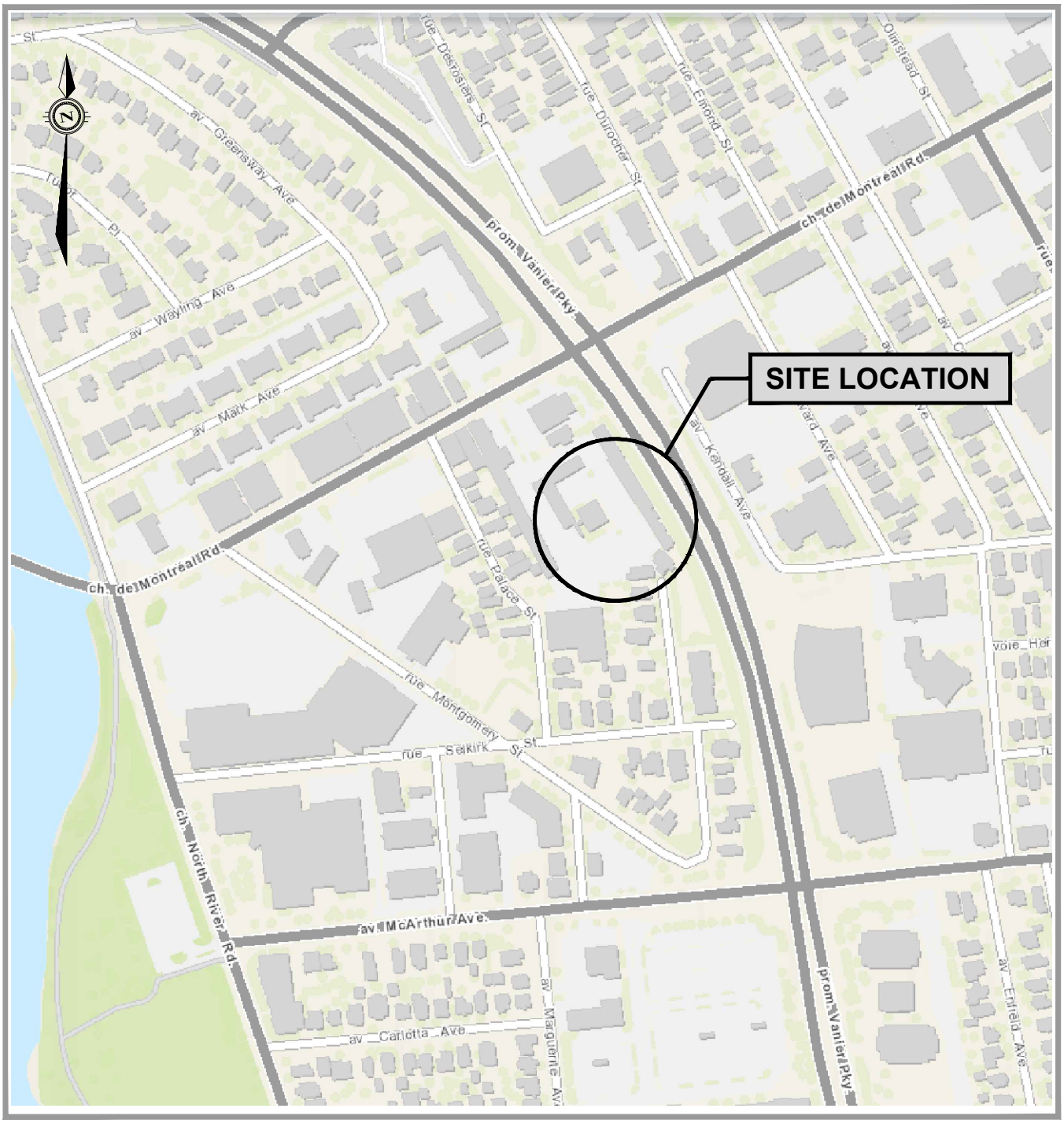
14 General Comments

The recommendations in this report are based on widely spaced boreholes of limited depths and therefore, are preliminary in nature. Once the design grades have been finalized for this project, the recommendations in this report must be verified by conducting an additional detailed geotechnical investigation at the site. The additional detailed investigation will include the drilling of deeper boreholes within the envelopes of the proposed structures as well as the completion of a Multi-channel Analysis of Surface Waves (MASW) survey at the site.

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

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

Figures



BACKGROUND MAP DATA FROM CITY OF OTTAWA © 2019, TERANET ENTERPRISES

0 40m 80m 160m

HORIZONTAL 1:4000

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scale: AS SHOWN	CLIENT: 2705460 ONTARIO INC.	project no.: OTT-00257739-A0
date: FEB. 2020	PROPOSED RESIDENTIAL DEVELOPMENT 112 MONTREAL ROAD, OTTAWA, ONTARIO	
drawn by: G.C.	TITLE: SITE LOCATION PLAN	FIG 1

Filename: e:\ott\ott-00257739-a0\60 execution\65 drawings_geot\fig-2 bh location plan (112 montreal).dwg
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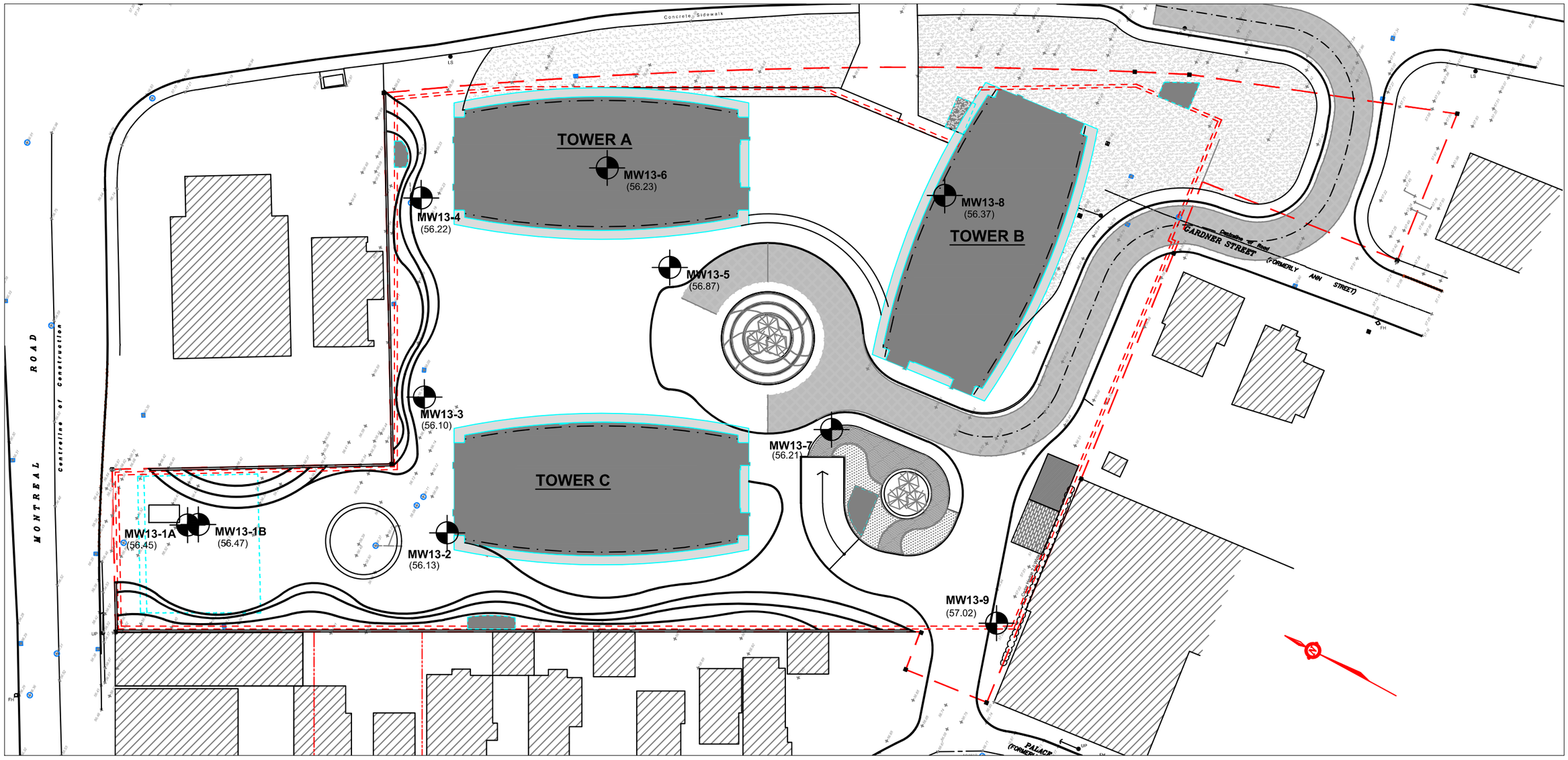

NOTES:

1. THE BOUNDARIES, SOIL AND ROCK TYPES HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. BETWEEN BOREHOLES THEY ARE ASSUMED AND MAY BE SUBJECT TO CONSIDERABLE ERROR.
2. SOIL SAMPLES AND ROCK CORES WILL BE RETAINED IN STORAGE FOR THREE MONTHS AND THEN DESTROYED UNLESS THE CLIENT ADVISES THAT AN EXTENDED TIME PERIOD IS REQUIRED.
3. BOREHOLE ELEVATIONS SHOULD NOT BE USED TO DESIGN BUILDING(S) OR FLOOR SLABS OR PARKING LOT(S) GRADES.
4. THIS DRAWING FORMS PART OF THE REPORT PROJECT NUMBER AS REFERENCED AND SHOULD BE USED ONLY IN CONJUNCTION WITH THIS REPORT.
5. BASE PLAN OBTAINED FROM WOODMAN ARCHITECTS & ASSOCIATES LTD., PROJECT 1953, DRAWING "SITE PLAN", DATED NOVEMBER 01, 2019.

LEGEND

MW13-1A
(56.45)

BOREHOLE NUMBER, LOCATION AND ELEVATION IN METERS

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scale: AS SHOWN	CLIENT: 2705460 ONTARIO INC.	project no.: OTT-00257739-A0
date: FEB. 2020	PROPOSED RESIDENTIAL DEVELOPMENT 112 MONTREAL ROAD, OTTAWA, ONTARIO	
drawn by: G.C.	TITLE: BOREHOLE LOCATION PLAN	FIG 2

Filename: e:\ott\ott-00257739-a0\60 execution\65 drawings_geot\fig-2 bh location plan (112 montreal).dwg
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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		

0.002 0.006 0.02 0.06 0.2 0.6 2.0 6.0 20 60 200

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 1-A

Project No: OTT-00257739-A0

Project: Preliminary Geotechnical Investigation. Proposed three high Ride Residential Towers

Location: 112 Montreal Road, Ottawa, Ontario

Figure No. 3

Page. 1 of 1

Date Drilled: 'October 23, 2013 / November 7, 2013

Drill Type: CME-75 (Truck Mount)

Datum: Estimated Geodetic

Logged by: MAD Checked by: MGM/SA

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	Estimated 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
		ASPHALT ~ 50 mm	56.45 / 56.4	0	43	×		
		FILL Crushed limestone, sand and gravel, grey, moist, (dense)	55.7	1	9	×		
		FILL Sand, silt and gravel with some brick debris, some boulders and cobbles, dark grey with black and lighter patches, moist (loose to very loose)		1	5	×		
				2	4	×		
			54.15					
		GLACIAL TILL Some silt with cobbles, trace clay, brown, wet (compact to very dense)	53.8	2	13	×		19.2
				3	69	×		21.6
			52.9					
		Borehole Terminated at 3.6 m Depth						

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. A Monitoring Well with a 51mm diameter casing was installed in the borehole upon completion.
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00257739-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	Dry	
7 Days	2.4	

CORE DRILLING RECORD

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

LOG OF BOREHOLE LOGS OF BOREHOLES_GEO.GPJ TROW OTTAWA.GDT 3/6/20

Log of Borehole 1-B

Project No: OTT-00257739-A0

Project: Preliminary Geotechnical Investigation. Proposed three high Ride Residential Towers

Location: 112 Montreal Road, Ottawa, Ontario

Figure No. 4

Page. 1 of 1

Date Drilled: 'October 23, 2013 / November 7, 2013

Drill Type: CME-75 (Truck Mount)

Datum: Estimated Geodetic

Logged by: MAD Checked by: MGM/SA

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	Estimated Geodetic m	Depth
		ASPHALT ~ 50 mm	56.47 / 56.4	0
		FILL Crushed limestone, sand and gravel, grey, moist, (dense)	55.7	
		FILL Sand, silt and gravel with some brick debris, some boulders and cobbles, dark grey with black and lighter patches, moist (loose to very loose)		1
				2
			53.9	
		SAND AND GRAVEL TILL Some silt, cobbles, trace clay, brown, wet (compact to very dense)	53.5	3
		LIMESTONE BEDROCK Shaley partings along bedding planes, stratification flat to gently dipping, principal joints near vertical and moderately to widely spread, (poor to excellent quality)	52.57	4
				5
				6
				7
			48.4	8
		Borehole Terminated at 8.1 m		

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

SAMPLES: Run 1, Run 2, Run 3, Run 4, Run 5

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. A Monitoring Well with a 51mm diameter casing was installed in the borehole upon completion.
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00257739-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
12 Days	3.9	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	3 - 3.41	100	38
2	3.41 - 4.45	88	85
3	4.45 - 5.98	100	77
4	5.98 - 7.5	92	87
5	7.5 - 8.06	100	100

LOG OF BOREHOLE LOGS OF BOREHOLES_GEO.GPJ TROW OTTAWA.GDT 3/6/20

Log of Borehole 2

Project No: OTT-00257739-A0

Project: Preliminary Geotechnical Investigation. Proposed three high Ride Residential Towers

Location: 112 Montreal Road, Ottawa, Ontario

Figure No. 5

Page. 1 of 1

Date Drilled: 'October 24, 2013

Drill Type: CME-75 (Truck Mount)

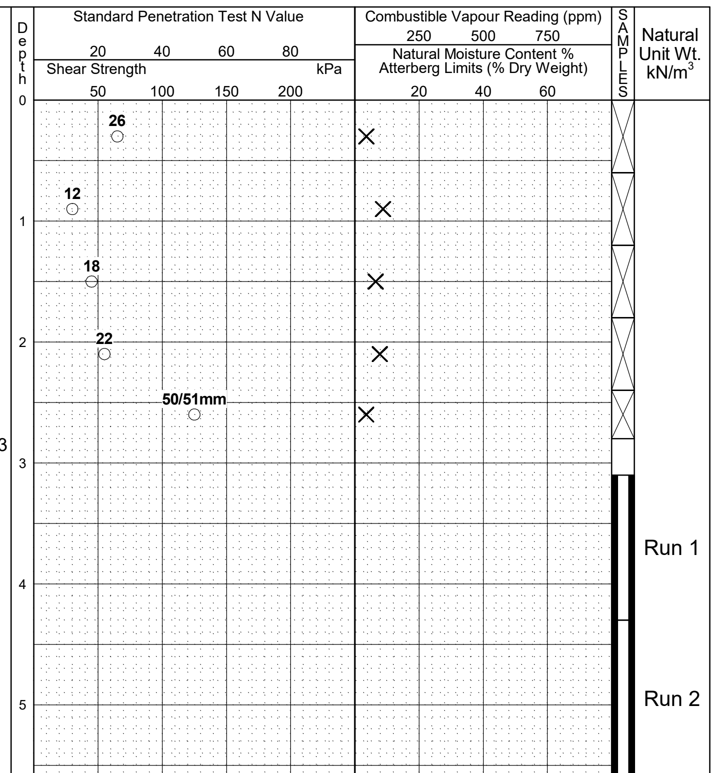
Datum: Estimated Geodetic

Logged by: MAD Checked by: MGM/SA

Legend		Legend	
Split Spoon Sample	⊠	Combustible Vapour Reading	□
Auger Sample	◧	Natural Moisture Content	×
SPT (N) Value	○	Atterberg Limits	├──○
Dynamic Cone Test	──	Undrained Triaxial at % Strain at Failure	⊕
Shelby Tube	■	Shear Strength by Penetrometer Test	▲
Shear Strength by Vane Test	+ S		

Soil Description	Estimated Geodetic (m)
	56.13
ASPHALT ~ 50 mm	56.0
FILL Sand and gravel, grey, moist, (compact)	55.2
SANDY GRAVELLY TILL Some silt, shale fragments present, brown/grey to dark grey, moist (compact) - Boulders and cobbles at 2.3 m depth	53.3
LIMESTONE BEDROCK Grey aphanitic to medium grained shaley partings along bedding planes, stratification flat to gently dipping, mainly medium bedding, principal joints near vertical and moderately to widely spread, (excellent quality)	53.23 50.5

Borehole Terminated at 5.6 m Depth



NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A Monitoring Well with a 51mm diameter casing was installed in the borehole upon completion.
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00257739-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
26 days	2.9	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	3.05 - 4.32	100	100
2	4.32 - 5.64	100	100

Log of Borehole 3

Project No: OTT-00257739-A0

Project: Preliminary Geotechnical Investigation. Proposed three high Ride Residential Towers

Location: 112 Montreal Road, Ottawa, Ontario

Figure No. 6

Page. 1 of 1

Date Drilled: 'October 23, 2013

Drill Type: CME-75 (Truck Mount)

Datum: Estimated Geodetic

Logged by: MAD Checked by: MGM/SA

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	Estimated 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
		ASPHALT ~ 100 mm	56.1	0				
		FILL	56.0					
		Sand, silt and gravel with some brick debris, brown grey and orange, moist (compact)	55.5		10			
		SANDY GRAVELLY TILL		1	6			
		Some silt, shale fragments, brown/grey to dark grey, moist to wet, (loose to very dense)			9			
		- Boulders and cobbles at 1.8 m depth		2	60			
			53.7		50/25mm			
		Auger Refusal at 2.8 m Depth, Borehole Terminated	53.3					

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A Monitoring Well with a 51mm diameter casing was installed in the borehole upon completion.
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00257739-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	Dry	
1 Day	Dry	
27	2.4	

CORE DRILLING RECORD

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

LOG OF BOREHOLE LOGS OF BOREHOLES_GEO.GPJ TROW OTTAWA.GDT 3/6/20

Log of Borehole 4

Project No: OTT-00257739-A0

Project: Preliminary Geotechnical Investigation. Proposed three high Ride Residential Towers

Location: 112 Montreal Road, Ottawa, Ontario

Figure No. 7

Page. 1 of 1

Date Drilled: 'October 24, 2013

Drill Type: CME-75 (Truck Mount)

Datum: Estimated Geodetic

Logged by: MAD Checked by: MGM/SA

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	Estimated Geodetic m	Depth
		ASPHALT ~ 19 mm	56.22	0
		FILL Sand, silt and gravel with trace organics, clay and wood debris, dark brownish grey and white, moist, (compact to loose)	56.1	
		SANDY GRAVELLY TILL Some silt, shale fragments, brown/grey to dark grey, moist (compact) - Boulders and cobbles at 2.2 m depth	54.7	1
		LIMESTONE BEDROCK Shaley partings along bedding planes, stratification flat to gently dipping, principal joints near vertical and moderately to widely spread, (excellent quality)	53.5	2
			53.12	3
				4
			50.5	5
		Auger Refusal at 2.7 m Depth, Borehole Terminated at 5.7 m		

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

SAMPLES | Natural Unit Wt. kN/m³

31 | 5 | 12 | 50/50mm

Run 1

Run 2

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A Monitoring Well with a 51mm diameter casing was installed in the borehole upon completion.
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00257739-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
26 Days	3.1	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	2.69 - 4.35	95	95
2	4.35 - 5.74	98	96

LOG OF BOREHOLE LOGS OF BOREHOLES_GEO.GPJ TROW OTTAWA.GDT 3/6/20

Log of Borehole 5

Project No: OTT-00257739-A0

Project: Preliminary Geotechnical Investigation. Proposed three high Ride Residential Towers

Location: 112 Montreal Road, Ottawa, Ontario

Figure No. 8

Page. 1 of 1

Date Drilled: 'November 7, 2013

Drill Type: CME-75 (Truck Mount)

Datum: Estimated Geodetic

Logged by: MAD Checked by: MGM/SA

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	Estimated Geodetic m	Depth
		ASPHALT ~ 50 mm	56.87	0
		FILL Sand and gravel, dark brown, moist, (loose)	56.8	
		SANDY GRAVELLY TILL Some silt, shale fragments, brown/grey to dark grey, moist (compact)	56.1	1
		- Boulders and cobbles at 2.3 m depth		2
		LIMESTONE BEDROCK Shaley partings along bedding planes, stratification flat to gently dipping, principal joints near vertical and moderately to widely spread, (fair to excellent quality)	54.5	3
			53.37	4
				5
				6
			49.7	7
		Auger Refusal at 2.4 m Depth, Borehole Terminated at 7.2 m		

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

5 ○ — 16.9

34 ○ — ×

41 ○ — ×

× — Run 1

Run 2

Run 3

Run 4

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A Piezometer with a 13mm diameter casing was installed in the borehole upon completion.
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00257739-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
7 Days	3.5	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	2.42 - 2.78	85	64
2	2.78 - 4.3	100	100
3	4.3 - 5.74	93	93
4	5.74 - 7.24	100	98

LOG OF BOREHOLE LOGS OF BOREHOLES_GEO.GPJ TROW OTTAWA.GDT 3/6/20

Log of Borehole 6

Project No: OTT-00257739-A0

Project: Preliminary Geotechnical Investigation. Proposed three high Ride Residential Towers

Location: 112 Montreal Road, Ottawa, Ontario

Figure No. 9

Page. 1 of 1

Date Drilled: 'October 24, 2013

Drill Type: CME-75 (Truck Mount)

Datum: Estimated Geodetic

Logged by: MAD Checked by: MGM/SA

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	Estimated Geodetic m	Depth
		ASPHALT ~ 50 mm	56.23	0
		FILL Crushed limestone, sand and gravel, grey, moist, (loose)	56.1 / 56.0	
		SANDY GRAVELLY TILL Some silt, cobbles, dark brown grey, moist, (compact to dense)		1
				2
			53.6	
		LIMESTONE BEDROCK Shaley partings along bedding planes, stratification flat to gently dipping, principal joints near vertical and moderately to widely spread, (excellent quality)		3
			52.13	4
				5
				6
			49.3	
		Auger Refusal at 2.6 m Depth, Borehole Terminated at 6.9 m		

Standard Penetration Test N Value: 20 40 60 80
Shear Strength: 50 100 150 200 kPa

6
15
12
50/130mm

Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SAMPLES: Run 1, Run 2, Run 3

Natural Unit Wt. kN/m³

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A Monitoring Well with a 51mm diameter casing was installed in the borehole upon completion.
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00257739-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
26 days	4.1	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	2.64 - 3.86	100	100
2	3.86 - 5.49	100	97
3	5.49 - 6.91	100	98

LOG OF BOREHOLE LOGS OF BOREHOLES_GEO.GPJ TROW OTTAWA.GDT 3/6/20

Log of Borehole 7

Project No: OTT-00257739-A0

Project: Preliminary Geotechnical Investigation. Proposed three high Ride Residential Towers

Location: 112 Montreal Road, Ottawa, Ontario

Figure No. 10

Page. 1 of 1

Date Drilled: 'November 7, 2013

Drill Type: CME-75 (Truck Mount)

Datum: Estimated Geodetic

Logged by: MAD Checked by: MGM/SA

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	Estimated Geodetic m	Depth
		ASPHALT ~ 50 mm	56.21	0
		FILL Crushed limestone, sand and gravel, grey, moist, (loose)	56.1 / 56.0	
		SANDY GRAVELLY TILL Some silt, brown and black, moist, (loose to very dense)		1
		- Boulders and cobbles at 1.5 m depth		2
			53.6	
		LIMESTONE BEDROCK Shaley partings along bedding planes, stratification flat to gently dipping, principal joints near vertical and moderately to widely spread, (excellent quality)	53.51	3
				4
				5
				6
			48.9	7
		Auger Refusal at 2.6 m Depth, Borehole Terminated at 7.3 m		

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

5 — 21.1

7 — 19.3

50/130mm

50/25mm

Run 1

Run 2

Run 3

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A Piezometer with a 13mm diameter casing was installed in the borehole upon completion.
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00257739-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
12 Days	2.7	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	2.64 - 4.22	98	98
2	4.22 - 5.74	93	93
3	5.74 - 7.27	100	100

LOG OF BOREHOLE LOGS OF BOREHOLES_GEO.GPJ TROW OTTAWA.GDT 3/6/20

Log of Borehole 8

Project No: OTT-00257739-A0

Project: Preliminary Geotechnical Investigation. Proposed three high Ride Residential Towers

Location: 112 Montreal Road, Ottawa, Ontario

Figure No. 11

Page. 1 of 1

Date Drilled: 'November 7, 2013

Drill Type: CME-75 (Truck Mount)

Datum: Estimated Geodetic

Logged by: MAD Checked by: MGM/SA

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	Estimated Geodetic m	Depth
		ASPHALT ~ 50 mm	56.37	0
		FILL crushed limestone, sand and gravel, grey, moist, (loose)	56.3	
		FILL Sand and gravel with silt, dark brown, moist (loose to very dense)	56.2	
		SANDY GRAVELLY TILL Some silt gravel with boulders and cobbles, trace clay, dark brown/grey, moist, (dense)	55.0	1
		LIMESTONE BEDROCK Shaley partings along bedding planes, stratification flat to gently dipping, principal joints near vertical and moderately to widely spread, (excellent quality)	54.3	2
			52.17	3
				4
				5
				6
			49.4	7
		Auger Refusal at 2.1 m Depth, Borehole Terminated at 7.0 m		

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 ○ | 65 ○ | 34 ○ | × | 23.2

Run 1 | Run 2 | Run 3 | Run 4

LOG OF BOREHOLE LOGS OF BOREHOLES_GEO.GPJ TROW OTTAWA.GDT 3/6/20

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A Piezometer with a 13mm diameter casing was installed in the borehole upon completion.
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00257739-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
12 Days	4.2	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	2.24 - 2.75	89	89
2	2.75 - 4.25	100	100
3	4.25 - 5.77	100	100
4	5.77 - 7.02	100	100

Log of Borehole 9

Project No: OTT-00257739-A0

Project: Preliminary Geotechnical Investigation. Proposed three high Ride Residential Towers

Location: 112 Montreal Road, Ottawa, Ontario

Figure No. 12

Page. 1 of 1

Date Drilled: 'October 23, 2013

Drill Type: CME-75 (Truck Mount)

Datum: Estimated Geodetic

Logged by: MAD Checked by: MGM/SA

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	Estimated Geodetic m	Depth
		ASPHALT ~ 50 mm	56.02	0
		FILL Crushed limestone, sand and gravel, grey, moist, (compact)	55.9 55.8	
		FILL Sand and gravel with silt, brick debris, dark grey with black and white, moist (loose compact)	55.1	1
		SANDY GRAVELLY TILL Some silt, shale fragments throughout, dark brown/grey, moist, (compact to dense)		2
			52.7 52.62	3
		LIMESTONE BEDROCK Shaley partings along bedding planes, stratification flat to gently dipping, principal joints near vertical and moderately to widely spread, (fair to excellent quality)		4
				5
				6
				7
			48.2	
		Auger Refusal at 3.3 m Depth, Borehole Terminated at 7.8 m		

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

SAMPLES: Run 1 | Run 2 | Run 3

Natural Unit Wt. kN/m³

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A Monitoring Well with a 51mm diameter casing was installed in the borehole upon completion.
3. Field work was supervised by an exp representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00257739-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	3.2	
1 Day	3.4	
27 Days	3.4	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	3.28 - 4.71	73	61
2	4.71 - 6.23	59	53
3	6.23 - 7.78	100	100

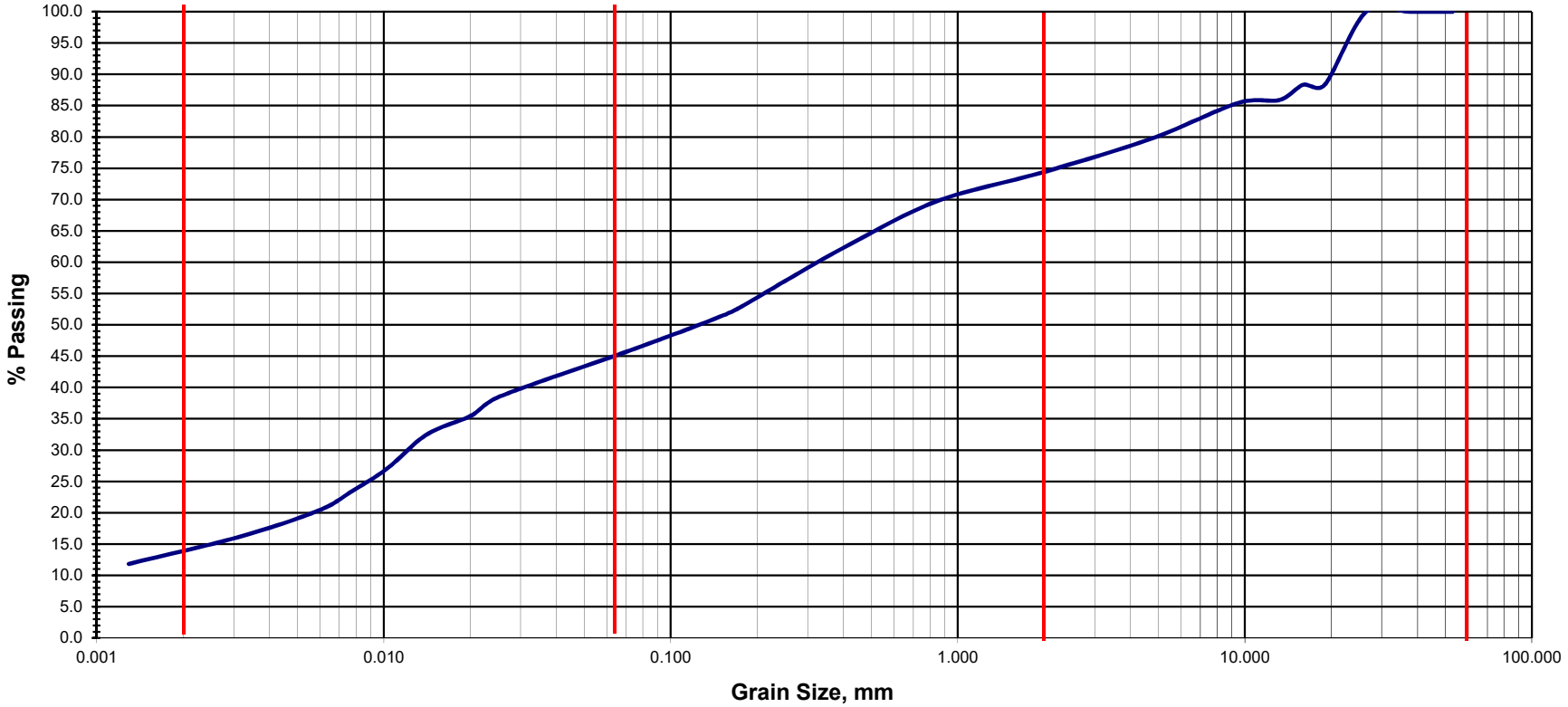
LOG OF BOREHOLE LOGS OF BOREHOLES_GEO.GPJ TROW OTTAWA.GDT 3/6/20

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

Method of Test for Particle Size Analysis of Soil

ASTM D-422

Grain Size Distribution Curve



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
	SILT			SAND			GRAVEL			
Modified M.I.T. Classification										

Exp Project No.:	**OTT-00257739-A0**	**Project Name :**	**Preliminary Geotechnical Inv. Proposed High Rise Residential Towers**		
Client :	**2705460 ONT Inc.**	**Project Location :**	**112 Montreal Road, City of Ottawa, ON**		
Date Sampled :	**October 23, 2013**	**Borehole No.**	**1**	**Sample No.:**	**SS3**
Sample Description :	**Silt, Sand and Gravel, Some Clay**			**Depth (m) :**	**1.2-1.8**
				Figure :	**13**

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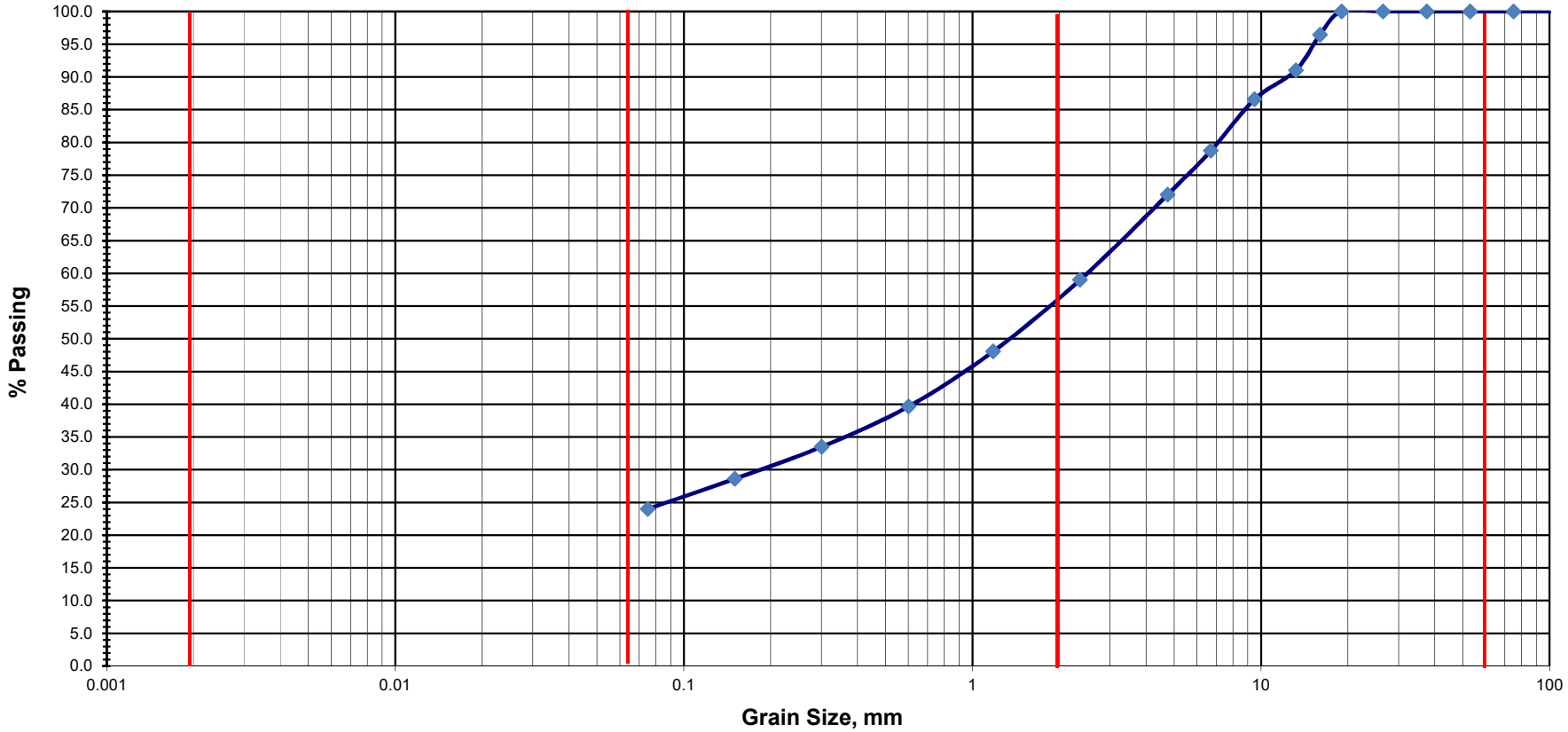
Ottawa, ON K2B 8H6

Method of Test for Sieve Analysis of Aggregate

ASTM C-136 (LS-602)

Grain Size Distribution Curve



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
	SILT			SAND			GRAVEL			
Modified M.I.T. Classification										

Exp Project No.:	OTT-00257739-A0	Project Name :	Preliminary Geotechnical Inv. Proposed high Rise Residential Towers		
Client :	2705460 ONT Inc.	Project Location :	112 Montreal Road, City of Ottawa, ON		
Date Sampled :	October 24, 2013	Borehole No.	6	SAMPLE SS2	Depth (m) : 0.6-1.2
Sample Description :	Silty Sandy Gravel				Figure : 14

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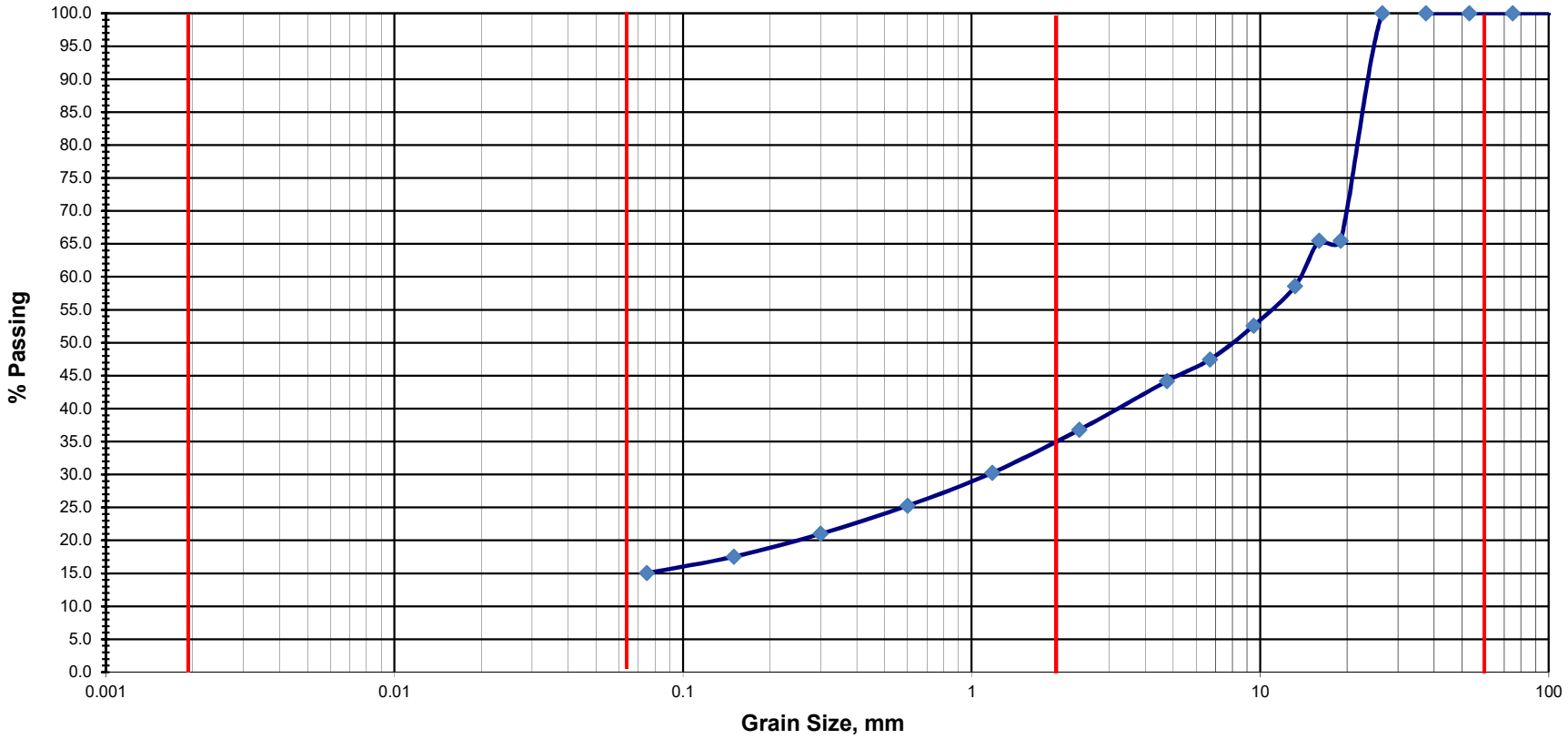
Method of Test for Sieve Analysis of Aggregate

ASTM C-136 (LS-602)

Grain Size Distribution Curve



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
	SILT			SAND			GRAVEL			
Modified M.I.T. Classification										

Exp Project No.:	**OTT-0057739-A0**	**Project Name :**	**Preliminary Geotechnical Inv. Propsoed High Rise Residential Towers**		
Client :	**2705460 ONT Inc.**	**Project Location :**	**112 Montreal Road, City of Ottawa, ON**		
Date Sampled :	**October 24, 2013**	**Borehole No.**	**9**	**SAMPLE**	**SS5**
Sample Description :	**Gravel, Some Silt and Sand**			**Depth (m) :**	**1.8-2.4**
				Figure :	**15**

List of Distribution

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