National Capital Commission

Preliminary Geotechnical Investigation

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Updated Final (supersedes April 29, 2019 final report)

Project Name
Burnside OPA & ZBLA Supporting Studies
Burnside Avenue, City of Ottawa, Ontario

Project Number
OTT-00245595-A0

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Date Submitted
November 26, 2019

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Executive Summary

EXP Services Inc. (EXP) is pleased to present the results of the preliminary geotechnical investigation recently completed for the proposed development of the site located between the Sir John A. MacDonald Parkway and Burnside Avenue, and Forward Avenue and Slidell Street in the City of Ottawa, Ontario (Figure 1). Written authorization for EXP to conduct the civil engineering services (preliminary geotechnical investigation, adequacy of public services and tree conservation) is provided under Purchase Agreement No. 589765 and the Purchase Order No. 004730-2 dated March 9, 2018. The assessment of civil engineering services and tree conservation are undertaken concurrently with this investigation and will be presented under separate cover.

It is our understanding that conceptual plans call for the site to be divided into four (4) separate buildable lots (identified as Lot Nos. 1 to 4) and an open green space. Design details regarding the proposed development on each lot were not known at the time of this preliminary geotechnical investigation.

Based on a review of available background information, the east portion of Lot No. 3, the northerly two-thirds of Lot No. 4 and the westerly portion of the open space are historical filled-in areas of the Ottawa River's Lazy Bay. Published geology maps indicate that the Gloucester fault runs approximately through Lot No. 4.

Available information indicates that major deep municipal services run through the site. These existing services include two storm trunk sewers (West Transit Storm Sewer and the Central North Hintonburg Storm Sewer), a 1981 mm diameter watermain, 200 mm and 300 mm diameter sanitary services. Some of these services run along Hinchey Avenue, between Lot Nos. 2 and 3 and through the green space site.

The preliminary geotechnical investigation comprised of drilling four (4) boreholes to depths ranging from 2.9 m to 24.1 m and the excavation of thirteen (13) test pits to depths of 0.3 m to 3.2 m below existing grade. The boreholes and test pits were located on Lot Nos. 1 to 4. Test holes could not be undertaken at the green space parcel of land due to potential conflict with an underground service that could not be located by the public utilities.

The borehole and test pit information revealed that the subsurface soil conditions consist of heterogeneous fill underlain by glacial till and shallow limestone bedrock at 1.0 m to 1.9 m depths (Elevation 62.0 m to 58.0 m). The fill at Lot No. 4 and within the historical filled-in area of Lazy Bay extends to 7.4 m depth (Elevation 49.8 m), and the glacial till was contacted beneath the fill at 7.4 m depth (Elevation 49.8 m). The glacial till at Lot No. 4 is deep compared to other lots and is likely due to the presence of the Gloucester fault located within the property. The groundwater level was measured at 1.6 m to 2.3 m depths (Elevation 61.2 m to 57.6 m).

Based on an overall review of the borehole and test pit information, it is considered that building development of Lot Nos. 1 to 3 is considered feasible and should be relatively straightforward for building lots having shallow bedrock conditions. Lot No. 4 is considered to be more problematic and challenging for building development due to the presence of the deep fill from the historical in-filling operations of

Lazy Bay, potential for high groundwater level within the in-filled area of the lot, and deep glacial till likely resulting from the presence of the Gloucester fault.

The geotechnical engineering comments and recommendations provided below and in this report are for preliminary guidance for the proposed building development of each lot. Once design details are available, it is recommended that additional detailed geotechnical investigations be undertaken at each lot to define the depth to bedrock and engineering properties of the bedrock, provide additional groundwater level measurements and update the geotechnical engineering comments and recommendations provided in this preliminary report. The additional investigation for Lot No. 3 should extend into the in-filled Lazy Bay area as the fill thickness may be greater than elsewhere on the lot, which may impact the proposed development.

For Lot No. 4, it is recommended that the additional detailed geotechnical investigation delineate the limits of the in-filled area and the Gloucester fault and provide detailed geotechnical engineering comments and recommendations regarding the management and treatment of the fault and in-filled area for the proposed building development.

A geotechnical investigation should be conducted at the parcel of land identified as the green space since test holes could not be undertaken as part of this preliminary geotechnical investigation due to the potential conflict with an existing underground service that could not be located by the public utilities.

Site class has been classified as Class C for seismic site response in accordance with Section 4.1.8.4 of the 2012 Ontario Building Code for Lots 1 to 3. The site classification may be increased by conducting shear-wave velocity measurements at the lots. Liquefaction potential of subsurface soils is not considered an issue for Lot Nos. 1 to 3. As part of the detailed geotechnical investigation for Lot No. 4, shear-wave velocity measurements should be undertaken to assess the impact the presence of the deep fill and glacial till and the fault line may have on the site classification for seismic site response and the liquefaction potential of the subsurface soils. Depending on the results from the geotechnical investigation, shear-wave velocity measurements may be required for the green space.

There is no grade restriction for Lot Nos. 1 to 4. The grade-raise restriction for the green space will have to be assessed during the geotechnical investigation of the property.

For Lot Nos. 1 to 3, proposed buildings may be supported by strip and spread footings set on sound limestone bedrock below any weathered and detached zones of the bedrock and may be designed for a factored geotechnical resistance at Ultimate Limit State (ULS) of 1 MPa. Settlements of the footings designed to the factored geotechnical resistance at ULS and properly constructed are expected to be within the normally tolerated limits of 25 mm total and 19 mm differential movements. For Lot No. 4 and the green space, the additional detailed investigation should establish the depth of fill, glacial till and bedrock and provide feasible foundation options such as deep foundations and/or soil densification and an assessment of the feasibility of slab-on-grade design.

In areas where existing deep municipal services exist, it is recommended that the location and depth of these services be confirmed and compared with the proposed building locations to determine the impact these services may have on the proposed building location and design. For example, buildings may need to be located away from the services and/or deep foundation options such as piles or caissons may need to be taken into consideration for foundation design. Once the information regarding the existing municipal services becomes available and is confirmed, this office should be contacted for review and additional recommendations if required.

The lowest floor slabs of the proposed structures at Lot Nos. 1 to 3 may be constructed as slabs on grade. Perimeter and underfloor drains may be required for the proposed structures.

Subsurface walls should be designed to resist lateral earth pressure for static loading conditions as well as for seismic (dynamic) loading conditions.

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

All fill required to backfill footing trenches, service trenches, beneath slabs on grade and against the subsurface walls would have to be imported and should preferably conform to the requirements of the Ontario Provincial Standard Specifications (OPSS). The on-site fill is not considered suitable for re-use as backfill under structural elements and should be managed as per the comments and recommendations provided in the referenced environmental reports. The on-site fill may used as fill in landscaped areas, if acceptable to remain on-site from an environmental perspective.

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

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1 Introduction

EXP Services Inc. (EXP) is pleased to present the results of the preliminary geotechnical investigation recently completed for the proposed development of the property located between the Sir John A. MacDonald Parkway and Burnside Avenue, and Forward Avenue and Slidell Street in the City of Ottawa, Ontario (Figure 1).

The preliminary geotechnical investigation forms part of the engineering and landscaping services required to support the National Capital Commission (NCC) application to change the land use of the subject property for future development as diplomatic mission sites. The preliminary geotechnical investigation is defined under the civil engineering services assignment awarded to EXP, which also includes assessing the adequacy of public services and providing a tree conservation report. Written authorization for EXP to conduct the civil engineering services (preliminary geotechnical investigation, adequacy of public services and tree conservation) is provided under Purchase Agreement No. 589765 and the Purchase Order No. 004730-02 dated March 9, 2018. The assessment of civil engineering services and tree conservation are undertaken concurrently with this investigation and will be presented under separate cover.

It is our understanding that conceptual plans call for the site to be divided into four (4) separate buildable lots (identified as Lot Nos. 1 to 4) and an open green space. The area of the four (4) lots range from 5,005 m^2 to 6,843 m^2 and the area of the open space will be 5,131 m^2. Design details regarding the proposed development on each lot were not known at the time of this preliminary geotechnical investigation.

Available information indicates that major existing deep municipal services run through the site. These services include two storm trunk sewers (West Transit Storm Sewer and the Central North Hintonburg Storm Sewer), a 1981 mm diameter watermain, 200 mm and 300 mm diameter sanitary services. Some of these services run along Hinchey Avenue, between Lot Nos. 2 and 3 and through the green space site.

The preliminary geotechnical investigation was undertaken to:

a) Establish the subsurface soil, bedrock and groundwater conditions at the borehole and test pit locations shown in Figure 2;

b) 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;

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

f) Provide lateral earth pressure for basement walls;

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

h) Discuss backfilling requirements and suitability of on-site soils for backfilling purposes.

The comments and recommendations given in this report are preliminary in nature. Additional detailed geotechnical investigations are recommended for each lot, once design details of the proposed development are made available.

2 Background Information

The following previous environmental reports were completed by Trow Associates Inc. (now EXP Services Inc.) for the National Capital Commission (NCC) regarding the subject property (site) and were used as reference in the preparation of this preliminary geotechnical report:

- *Surface Soil and Groundwater Monitoring Program, Burnside Site, Ottawa, ON. (Property Asset #95979)* dated January 2010 (Trow Project No. OTEN00020038S); and
- *Enhanced Phase I Environmental Site Assessment (ESA), Ottawa River Parkway, Ottawa, Ontario, Property Asset # 95979*, (Section E) dated December 2008 (Trow Project No. OTEN00019406I)

The above-noted reports provide comments and recommendations regarding the environmental condition and management of the subsurface soil and groundwater at the site.

Based on a review of the above reports, relevant information used to prepare this preliminary geotechnical investigation includes the following:

- Based on the findings from the Phase I ESA, the east portion of Lot No. 3, the northerly two-thirds of Lot No. 4 and the westerly portion of the open space are historical filled in areas of the Ottawa River's Lazy Bay. Aerial photographs indicate that Lazy Bay originally extended south, almost to Burnside Avenue as shown in the 1928 background photograph, Figure 3. The south portion of the bay was filled in from 1951 to 1966 and the Sir John A. MacDonald Parkway was constructed over the filled in area.
- Two (2) waste disposal sites were located at Burnside Avenue and Slidell Street and nearby Bayview Road and Slidell Street.

Reference is made to the above noted reports regarding the environmental condition of the subsurface soil and groundwater at the site.

3 Geology of the Site

3.1 Surficial Geology

Review of published geology maps indicates the site is covered by a thin veneer of glacial till comprising of silty sand to sandy silt with gravel. Generally, the depth of the glacial till is expected to be less than 5 m. The Lazy Bay in-filled areas of the lots and open space are anticipated to consist of fill that may extend to depths greater than 5 m.

3.2 Bedrock Geology

Review of published geology maps indicates the site is underlain by shallow limestone bedrock of the Lindsay formation. The limestone bedrock may contain interbeds of calcarenite and shale. The Gloucester fault is located approximately in the western portion of Lot No. 4 as shown in Figures 2 and 3. The fault may have a bearing on the development construction at Lot No. 4.

4 Site Description

The subject site is a vacant parcel of land located on the south side of Sir John A. MacDonald Parkway, north side of Burnside Avenue, east of Hinchey Avenue and Forward Avenue and west of Slidell Street in the Mechanicsville sector of the City of Ottawa. The site is located approximately 200 m south of Ottawa River's Lazy Bay and the Sir John A. MacDonald Parkway. The site is currently divided into four (4) buildable lots and one (1) open space area as shown in Figure 2.

The ground surface of the site is generally at two elevations; a higher plateau on the western side, which includes Lot Nos. 1 and 2 (Elevation 59.17 m to 63.49 m) and a lower plateau on the eastern side, which includes Lot No. 4 and the open space (Elevation 56.79 m to 57.36 m). The topography of Lot No. 3 slopes down towards the east from Elevation 60.27 m and 62.37 m to Elevation 59.78 m. The ground surface of Lot No. 1 gently slopes down in the northwest direction from Elevation 62.18 m to 59.17 m.

The site is primarily grass covered with groups of trees across the site. Cobbles and boulders are scattered on the ground surface of the site. A small gravel parking lot exists at the entrance to the site located north of the Carruthers Avenue and Burnside Avenue intersection.

5 Procedure

The fieldwork for the preliminary geotechnical investigation was undertaken between March 29, 2018 and April 5, 2018 and consisted of drilling four boreholes (Borehole Nos. 1 to 4) and excavating 13 test pits (Test Pit Nos. 1 to 13) at the locations shown on the Test Hole Location Plan, Figure 2. A summary of the test hole locations is shown in Table I.

Table I: Summary of Borehole and Test Pit Locations

Lot No.	Test Pit Number	Borehole Number
1	1 - 3	1
2	4 - 7	2
3	8 - 10	3
4	11 - 13	4

Borehole Nos. 1 to 3 were advanced to termination depths of 2.9 m and 4.3 m depths. Borehole No. 4 was advanced to a dynamic cone refusal depth of 24.1 m below existing grade. The test pits were excavated to bucket refusal and termination depths from 0.3 m to 3.2 m below existing grade. The fieldwork was supervised on a full-time basis by a representative from EXP.

The locations and geodetic elevations of the boreholes and test pits were established on site by EXP and are shown on the Test Hole Location Plan, Figure No. 2. Prior to commencement of the fieldwork, the test hole locations were cleared of any underground services by a local cable locating company. The test hole originally located in the open space area cold not be undertaken due to the potential conflict with an underground service that could not be located by the public utilities.

The boreholes were drilled using a CME-75 track-mounted drill rig owned and operated by a local drilling contractor. The boreholes were advanced through the soil to auger refusal depths of 1.0 m to 1.9 m by power augering techniques. The boreholes were advanced further by core drilling the fill, glacial till and bedrock using NQ-size core barrel. Careful records were kept of the wash water return, the colour of wash water, and any sudden drops of the drill rods during coring operations. Within the glacial till of Borehole No. 4, a standard penetration test (ASTM 1586) was undertaken at 11.8 m depth and the soil sample retrieved by the split-barrel sampler. Dynamic cone penetration test (DCPT) was conducted from 24.0 m to cone refusal depth of 24.1 m in Borehole No. 4.

Standpipes consisting of 19 mm diameter slotted PVC pipe were installed in Borehole Nos. 1 to 3 for long-term monitoring of groundwater levels. The standpipes were installed in accordance with EXP standard practice and their installation configuration is documented on the respective borehole log.

The test pits were excavated with a Case rubber-tired backhoe. Grab samples of the soils encountered were collected from selected depths within some of the test pits. Groundwater level observations were made in each test pit during and upon completion of excavating operations. Upon completion of

excavating operations, the test pits were backfilled, and the backfill was nominally packed in place using the backhoe bucket.

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

Natural Moisture Content.....11 tests

Grain-Size Analysis .....6 tests

Unit Weight and Unconfined Compressive Strength Tests on Rock Cores .....6 tests

6 Subsurface Conditions and Groundwater Levels

A detailed description of the subsurface soil, bedrock and groundwater conditions determined from the boreholes and test pits are given on the attached Borehole and Test Pit Logs, Figure Nos. 4 to 20 inclusive. The borehole and test pit 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 and test pits were excavated 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 and test pit logs are inferred from non-continuous sampling and observations during drilling and excavating operations. These boundaries are intended to reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. The “Note on Sample Descriptions” preceding the borehole and test pit logs form an integral part of this report and should be read in conjunction with this report.

A review of the borehole and test pit logs indicate the following subsurface soil conditions with depth and groundwater level measurements.

6.1 Topsoil

A 50 mm to 150 mm thick surficial layer of topsoil was encountered in Test Pit Nos. 1 to 3, 7 to 9 and 11 to 13.

6.2 Fill

Fill was contacted at ground surface and beneath the topsoil layer in all the test pits and in Borehole No. 4. The fill extends to depths ranging from 0.2 m to 1.7 m depths (Elevation 62.0 m to 55.7 m). The fill in Borehole No. 4 located within Lot No. 4 and within the filled-in area of Lazy Bay extends to a 7.4 m depth (Elevation 49.8 m). The fill is a heterogenous mixture of silty clay, silty sand, gravel, cobbles, boulders, angular blast rock pieces and roots with debris consisting of asphalt, brick, concrete, glass, metal and wood pieces. The natural moisture content of the fill is 5 percent to 31 percent.

The results from the grain-size analysis conducted on selected samples of the fill are summarized in Table II. The grain-size distribution curves are shown in Figures 21 to 24.

Table II: Summary of Grain-Size Analysis – Fill Samples					
Test Pit No.	**Sample No.**	**Depth (m)**	**Gravel (%)**	**Sand (%)**	**Fines (%)**
TP-5	GS1	0.5 – 1.0	50	22	28
TP-9	GS1	0.5 – 1.0	61	27	12
TP-11	GS1	0.6 – 1.2	47	32	21
TP-13	GS2	2.0 – 2.5	39	49	12

Based on a review of the results of the grain-size analyses, the soil matrix of the fill may be classified in accordance with the Unified Soil Classification System (USCS) as a silty clayey gravel with sand (GC-GM) to a gravel with silty clay and sand (GW-GC) to a sand with silt and gravel (SW-SM).

6.3 Glacial Till

Glacial till was contacted beneath the fill in Borehole No. 4 at 7.4 m depth (Elevation 49.8 m) and in Test Pit Nos. 2, 3, 8 and 12 at 0.2 m to 1.7 m depths (Elevation 62.0 m to 55.7 m). The glacial till in Borehole No. 4 is deep compared with the test pits and is likely due to the close proximity of the borehole to the Gloucester fault. The glacial till contains cobbles and boulders. The natural moisture content of the glacial till is 8 percent, based on one (1) sample from Test Pit No. 2.

The results from the grain-size analysis conducted on selected samples of the glacial till are summarized in Table III. The grain-size distribution curves are shown in Figures 25 and 26.

Table III: Summary of Grain-Size Analysis – Glacial Till Samples					
Borehole No.	**Sample/Rock Core No.**	**Depth (m)**	**Gravel (%)**	**Sand (%)**	**Fines (%)**
BH-4	SS1	11.8-12.4	16	61	23
BH-4	Run 12	18.3-18.6	18	43	39

Based on a review of the results of the grain-size analysis, the glacial till may be classified in accordance with the USCS as a silty clayey sand with gravel (SC-SM).

6.4 Refusal Depths

Auger refusal was met at 1.0 m to 1.9 m depths (Elevation 61.6 m to 58.0 m) in Borehole Nos. 1 to 3 and cone refusal (from the dynamic cone penetration test) was met at 24.1 m depth (Elevation 33.1 m) in Borehole No. 4. Bucket refusal was met in Test Pit Nos. 1 to 10 and 12 at 0.3 m to 2.6 m depths (Elevation 61.9 m to 55.4 m). The refusal depths occurred on inferred boulders or bedrock.

6.5 Limestone Bedrock

The presence of the bedrock was confirmed at 1.0 m to 1.9 m depths (Elevation 61.6 m to 58.0 m) in Borehole Nos. 1 to 3 by coring the bedrock to depths ranging from 2.9 m and 4.3 m (Elevation 59.2 m to 54.9 m). Bedrock was contacted in Test Pit No. 7 at 1.5 m depth (Elevation 62.0 m) and it was possible to excavate 200 mm into the bedrock to 1.7 m depth (Elevation 61.8 m).

The Total Core Recovery (TCR) and Rock Quality Designation (RQD) of the cored bedrock is 100 percent and 0 to 100 percent respectively indicating the rock has a very poor to excellent quality. Rock core photographs are shown in **Appendix A**.

Unconfined compressive strength tests and unit weight determination were performed on six (6) selected rock cores and the results are presented in Table IV.

Table IV: Unconfined Compressive Strength Test Results - Bedrock Cores

Borehole No.	Rock Core Depth (m)	Unconfined Compressive Strength (MPa)	Unit Weight (kg/m^3)
1	1.3 – 1.5	65.9	2645
1	3.1 – 3.4	106.3	2655
2	2.4 – 2.6	158.1	2744
2	3.7 – 3.9	52.0	2723
3	1.8 – 2.0	108.1	2736
3	2.6 – 2.8	68.5	2730

Based on a review of the unconfined compressive strength test results, the rock may be classified with respect to strength as a strong to very strong rock in accordance with the 2006 Fourth Edition of the Canadian Foundation Engineering Manual.

6.6 Groundwater Levels

Groundwater level observations were made in the test pits during and upon completion of excavating operations and in standpipes installed in boreholes subsequent to the completion of drilling operations. The test pits remained dry during and upon completion of excavating operations. The groundwater level observations made in the borehole standpipes are summarized in Table V.

Table V: 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 (m)**	**Elevation of Groundwater Level (m)**
BH 1	59.17	April 5, 2018	May 7, 2018 (32 days)	1.6	57.6
BH 2	63.49	April 4, 2018	May 7, 2018 (33 days)	2.3	61.2
BH 3	60.27	April 4, 2018	May 7, 2018 (33 days)	2.0	58.3

Water levels were determined in the boreholes and test pits 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.

7 Design Considerations

Based on an overall review of the borehole and test pit information, it is considered that building development of Lot Nos. 1 to 3 is considered feasible and should be relatively straightforward for building lots having shallow bedrock conditions. Lot No. 4 is considered to be more problematic and challenging for building development due to the presence of the deep fill from the historical in-filling operations of Lazy Bay, potential for high groundwater level from within the in-filled area of the lot, and deep glacial till likely resulting from the presence of the Gloucester fault.

The geotechnical engineering comments and recommendations provided in the remaining sections of this report are preliminary guidance for the proposed building development of each lot. Once design details are available, it is recommended that additional detailed geotechnical investigations be undertaken at each lot to define in detail the depth to bedrock and engineering properties of the bedrock, provide additional groundwater level measurements, and update the geotechnical engineering comments and recommendations provided in this preliminary report. The additional investigation for Lot No. 3 should extend into the in-filled Lazy Bay area as the fill thickness may be greater than elsewhere on the lot, which may impact the proposed development.

For Lot No. 4, it is recommended that an additional detailed geotechnical investigation also be conducted to delineate the limits of the in-filled area and the Gloucester fault from which detailed geotechnical engineering comments and recommendations can be provided regarding the management and treatment of the fault and in-filled area for the proposed building development.

A geotechnical investigation should also be conducted at the lot identified as green space since test holes could not be undertaken as part of this preliminary geotechnical investigation due to the potential conflict with an existing underground service.

In view of the borehole and test pit data from Lot No. 4, and depending on the findings from the geotechnical investigation conducted for the green space, if the subsurface conditions are considered to be more favorable for building development at the green space property compared with conditions at Lot No. 4, consideration may be given to developing Lot No. 4 as a green space and converting the current green space to a buildable lot.

Available information indicates that major existing deep municipal services run through the site. These existing services include two storm trunk sewers (West Transit Storm Sewer and the Central North Hintonburg Storm Sewer), a 1981 mm diameter watermain, 200 mm and 300 mm diameter sanitary services. Some of these services run along Hinchey Avenue, between Lot Nos. 2 and 3 and through the green space site. The locations of the municipal services are shown in Figure 2A. It is recommended that the location and depth of the municipal services running through the site be confirmed and compared with the proposed building locations to determine the impact these services may have on the proposed building location and design. For example, buildings may need to be located away from the services and/or deep foundation options such as piles or caissons may need to be taken into consideration for

foundation design. Once the information regarding the existing municipal services becomes available and is confirmed, this office should be contacted for review and additional recommendations if required.

The management of the environmental condition of the subsurface soils and groundwater during construction will also have to be taken into consideration in the development of the four (4) lots and green space.

8 Site Classification for Seismic Site Response and Liquefaction Potential of Soils

The subsurface soil 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 subsurface soil conditions at Lot Nos. 1 to 3 comprise of surficial fill underlain by silty clayey sand till with gravel, cobbles and boulders, which extends to depths ranging from 1.0 m to 1.9 m depths (Elevation 62.0 m to 58.0 m). The silty clayey sand till is underlain by limestone bedrock. Therefore, in view of the shallow bedrock, the proposed buildings at each lot with or without basements are anticipated to be founded on the limestone bedrock.

Based on the assumption that the proposed buildings will be founded on the limestone bedrock, the current site classification for seismic response would be Site Class C. The OBC does not allow a site to be classified as Class A or B unless shear-wave velocity measurements are conducted at each lot. Therefore, the site class at Lot Nos. 1 to 3 may possibly be raised to Site Class B or A subject to the completion of shear-wave velocity measurements.

Based on the assumption that the proposed buildings will be supported by foundations set on the limestone bedrock and that the lowest floor slabs will be designed as slabs-on-grade constructed on an engineered fill pad set on the limestone bedrock, liquefaction is not considered to be an issue for Lot Nos. 1 to 3.

As part of the detailed geotechnical investigation for Lot No. 4, shear-wave velocity measurements should be undertaken to assess the impact the presence of the deep fill and glacial till and the fault line have on the site classification for seismic site response and the liquefaction potential of the subsurface soils. Depending on the results from the geotechnical investigation, shear-wave velocity measurements may be required for the green space property.

9 Grade Raise Restrictions

The geotechnical investigation revealed that Lot Nos. 1 to 4 are underlain by native cohesionless soil consisting of silty clayey sand with gravel till. Cohesive, compressible clayey soils were not encountered in the boreholes and test pits. Therefore, based on a review of the findings from the boreholes and test pits, it is considered that there are no grade-raise restrictions for Lot Nos. 1 to 4.

Grade-raise restrictions will have to be assessed in the geotechnical investigation for the green space property.

10 Foundation Considerations

The investigation has revealed that the geotechnical conditions at Lot Nos. 1 to 3 are well suited to supporting the proposed buildings, with or without basements, by strip and spread footings set on the shallow limestone bedrock contacted in Borehole Nos. 1 to 3 and Test Pit No. 7 at 1.0 m to 1.9 m depths below existing grade (Elevation 62.0 m to 58.0 m).

Strip and spread footings set on sound limestone bedrock below any weathered and detached zones of the bedrock may be designed for a factored geotechnical resistance at ULS of 1 MPa. The factored geotechnical resistance value at ULS includes a resistance factor of 0.5. Since the structures will be founded on bedrock, factored geotechnical resistance at ULS will govern the design.

Settlements of the footings designed to the factored geotechnical resistance value at ULS 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 ULS value and that the footing beds have been properly prepared.

A minimum of 1.0 m of earth cover should be provided to the footings founded on sound bedrock to protect them from damage due to frost penetration. The frost cover should be increased to 1.2 m for unheated structures if snow will not be removed from their vicinity. If snow will be removed from the vicinity of the unheated structures, the frost cover should be increased to 1.5 m. Equivalent rigid insulation may be used instead of the required soil cover or a combination of rigid insulation and soil cover may be used to achieve the required frost protection.

As previously mentioned, in the areas of existing deep municipal services, it is recommended that the location and depth of the existing municipal services running through the site be confirmed and compared with the proposed building locations to determine the impact these services may have on the proposed building location and design. For example, buildings may need to be located away from the services and/or deep foundation options such as piles or caissons may need to be taken into consideration for foundation design. Once the information regarding the existing municipal services becomes available and is confirmed, this office should be contacted for review and additional recommendations if required.

For Lot No. 4 and the green space property, the additional detailed geotechnical investigations should determine the depth of fill, glacial till and bedrock and feasible foundation options such as deep foundations and/or soil densification and the feasibility of slab-on-grade design.

11 Floor Slab and Drainage Requirements

The lowest level floor of the proposed buildings may be constructed as a slab-on-grade provided they are set on a bed of well compacted 19 mm clear stone at least 300 mm thick placed on natural undisturbed soil or on well compacted engineered fill. The clear stone would prevent the capillary rise of moisture to the floor slab. Adequate saw cuts should be provided in the floor slab to control cracking.

Perimeter drains will not be required if the slab-on-grade is set a minimum 150 mm above the final exterior grade and the final grade surrounding the building is sloped away from the structure. For buildings with a basement, perimeter drains will be required, as referenced in Section 12 of this report.

The need for underfloor drains will have to be assessed during detailed design by comparing the slab-on-grade design elevation with the elevation of the prevailing groundwater level. If required, 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.

If required, 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 preferably be connected to separate sumps so that at least one system would be operational should the other fail.

12 Lateral Earth Pressure Against Subsurface Walls

The subsurface walls should be backfilled with free draining material, such as Ontario Provincial Standard Specification (OPSS) Granular B Type II and equipped with a permanent drainage system to prevent the buildup of hydrostatic pressure behind the wall. The subsurface walls should be adequately damp proofed.

The walls will be subjected to lateral static and dynamic (seismic) earth forces.

For preliminary 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 pressure acting on the subsurface wall; kN/m

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

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

h = depth of interest below final grade behind wall, m

q = surcharge load, kPa

In addition to the lateral static earth thrust, the subsurface walls would be subjected to dynamic thrust from the soil during a seismic event. The soil dynamic thrust (Δ_{Pe}) 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 subsurface wall, m

γ = unit weight of soil = 22 kN/m^3

$\frac{a_h}{g}$ = earth pressure coefficient = 0.278 (refer to 2015 National Building Code Seismic Hazard Calculation shown in **Appendix B**)

F_b = thrust factor = 1.0

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

13 Excavations and De-Watering Requirements

Details regarding the lateral extent of excavations at Lot Nos. 1 to 3 and depth of the excavations are not available at this stage. The geotechnical conditions at the site comprise of 1.0 m to 1.9 m thick overburden soil underlain by limestone bedrock. The groundwater table at the site is at a depth of 1.6 m to 2.3 m below the existing ground surface. Excavation and de-watering requirements for Lot No. 4 and the green space property will have to be assessed during the additional detailed geotechnical investigations.

13.1 Excavations

The soils at the site may be excavated with conventional mechanical equipment capable of removing construction debris within the fill as well as cobbles and boulders within the fill and glacial till. Excavations into the limestone bedrock would require the use of line drilling and blasting techniques. The blasting should be carried out by an experienced contractor under the supervision of a blasting specialist to ensure that the integrity of any existing structures and underground services are not adversely affected. A condition survey of the existing structures, groundwater wells and services in the vicinity of the work area should be undertaken prior to commencement of construction. Vibrations generated by blasting operations should be monitored and should conform to City of Ottawa requirements.

The excavations at the site may be undertaken as open-cut provided they meet the requirements of the Ontario Occupational Health and Safety Act. The soils are classified as Type 3 and must be cut back at 1H:1V from the bottom of the excavation. For excavations below the groundwater level, the side slopes should be flattened to a gradient ranging from 2 to 3H:1V from the bottom of the excavation. If space restrictions prevent open-cut excavation, the excavations will have to be undertaken within the confines of an engineered support system designed and constructed in accordance with the above regulation.

Underground services at the site may be installed within the confines of a pre-fabricated support system (such as a trench box) designed and installed in accordance with the above regulation.

The bedrock may be excavated with near vertical sides, subject to examination by a geotechnical engineer. Some scaling back of the bedrock face, such as to 1H:1V, may be required in areas of weathered bedrock.

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.

13.2 De-watering Requirements

Seepage of the surface and subsurface water into the excavations is anticipated. However, it should be possible to collect any water entering the excavations in perimeter ditches and to remove it by pumping from sumps.

It is noteworthy to mention that new legislation came into force in Ontario on March 29, 2016 to regulate groundwater takings for construction de-watering 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 de-watering, 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 de-watering 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 de-watering 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. 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 field work and commented on de-watering and general construction problems, conditions may be present that are difficult to establish from standard boring and test pit excavating techniques and which may affect the type and nature of de-watering 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 de-watering systems.

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

Conventional backfill against the subsurface walls and backfill beneath slabs-on-grade, in footing and service trenches inside the building should be free draining granular material preferably conforming to the Ontario Provincial Standard Specifications (OPSS) for Granulars A and B Type II. It should be placed in layers not exceeding 150 mm in thickness and compacted to a minimum of 95 percent of standard Proctor maximum dry density (SPMDD) outside the building and to 98 percent SPMDD inside the building.

The backfill in footing trenches, service trenches outside the building, should be compactible, i.e. free of organics and debris, and with natural moisture content, which is within two percent of the optimum value. It should also be placed in thin lifts and compacted to 95 percent SPMDD.

It is anticipated that the majority of the fill required to backfill footing trenches, service trenches, beneath slabs-on-grade and against the subsurface walls would have to be imported and should preferably conform to the OPSS 1010 requirements for Granulars A and B Type II.

The on-site fill is not considered suitable for re-use as backfill under structural elements and should be managed as per the comments and recommendations provided in the previously referenced environmental reports. The on-site fill may used as fill in landscaped areas, if acceptable to remain on-site from an environmental perspective.

15 General Comments

The proposed prospect development details for the site (i.e. number of basements, building height, design loads, etc.) were not available at the time of the preparation of this report. Therefore, the comments and recommendations made in this report are preliminary in nature and must be verified by more detailed geotechnical investigations at the site once the lateral extent of construction, design grades, contemplated design loads, etc. are known.

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

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

Figures

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scale: 1:20 000	PROJECT: PRELIMINARY GEOTECHNICAL INVESTIGATION BURNSIDE OPA AND ZBLA SUPPORTING STUDIES BURNSIDE AVENUE, OTTAWA, ON	project no.: OTT-00245595-A0
date: MAY 2018		design: S.P. / checked: I.T.
drawn by: J.R.	TITLE: SITE LOCATION PLAN	FIG 1

Filename: r:\240000\245000\245595-a0 ncc - burnside (ch2-241631)\245595-ge-bh-f2.dwg
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Last Plotted: 5/9/2018 8:37:13 AM
Plotted by: RevellJ
Pen Table:: exp.ctb

NOTES :

1. THE BOUNDARIES AND SOIL TYPES HAVE BEEN ESTABLISHED ONLY AT BOREHOLE LOCATIONS. BETWEEN TEST HOLES THEY ARE ASSUMED AND MAY BE SUBJECT TO CONSIDERABLE ERROR.
2. SOIL AND ROCK SAMPLES AND ROCK WILL BE RETAINED IN STORAGE FOR THREE MONTHS AND THEN DESTROYED UNLESS THE CLIENT ADVISES THAT AN EXTENDED TIME PERIOD IS REQUIRED.
3. TEST HOLE 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.

LEGEND:

- PROPERTY LIMIT
- BUILDABLE AREA
- APPROXIMATE LOCATION OF FAULT
- TP8 — TEST PIT LOCATION & NUMBER
- BH3 — BOREHOLE LOCATION & NUMBER

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scale: 1:1500	CLIENT: PRELIMINARY GEOTECHNICAL INVESTIGATION BURNSIDE OPA AND ZBLA SUPPORTING STUDIES BURNSIDE AVENUE, OTTAWA, ON	project no.: OTT-00245595-A0
date: MAY 2018		
drawn by: J.R.	TITLE: TEST HOLE LOCATION PLAN INTERPRETED FAULT-LINE LOCATION	FIG 2

Filename: r:\2400000245000\245595-a0 ncc - burnside (ch2-2416311)\245595-ge-bh-f2.dwg
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Last Plotted:5/14/2018 1:46:17 PM

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Last Saved: 11/26/2019 9:50:51 AM Last Plotted:11/26/2019 10:31:03 AMPlotted by: CuningB
Pen Table:: exp-64.ctb
References: xref-Keyplan.dwg; xref-CITY-TOPO-II.dwg; xref-Concept.dwg; 2019-11-15-BH-srvy.dwg

CAUTION
THE POSITION OF ALL POLE LINES, CONDUITS, WATERMAINS, SEWERS AND OTHER UNDERGROUND AND OVERGROUND UTILITIES AND STRUCTURES IS NOT NECESSARILY SHOWN ON THE CONTRACT DRAWINGS, AND WHERE SHOWN, THE ACCURACY OF THE POSITION OF SUCH UTILITIES AND STRUCTURES IS NOT GUARANTEED. BEFORE STARTING WORK, DETERMINE THE EXACT LOCATION OF ALL SUCH UTILITIES AND STRUCTURES AND ASSUME ALL LIABILITY FOR DAMAGE TO THEM.

PRELIMINARY
NOT FOR CONSTRUCTION

REV	REVISION DESCRIPTION	DATE	BY	APPD	REV	REVISION DESCRIPTION	DATE	BY	APPD
					1	OPA AND ZBLA	26/11/19	BC	LPD

SCALE: NTS

DESIGNED BY

REVIEWED BY

NORTH

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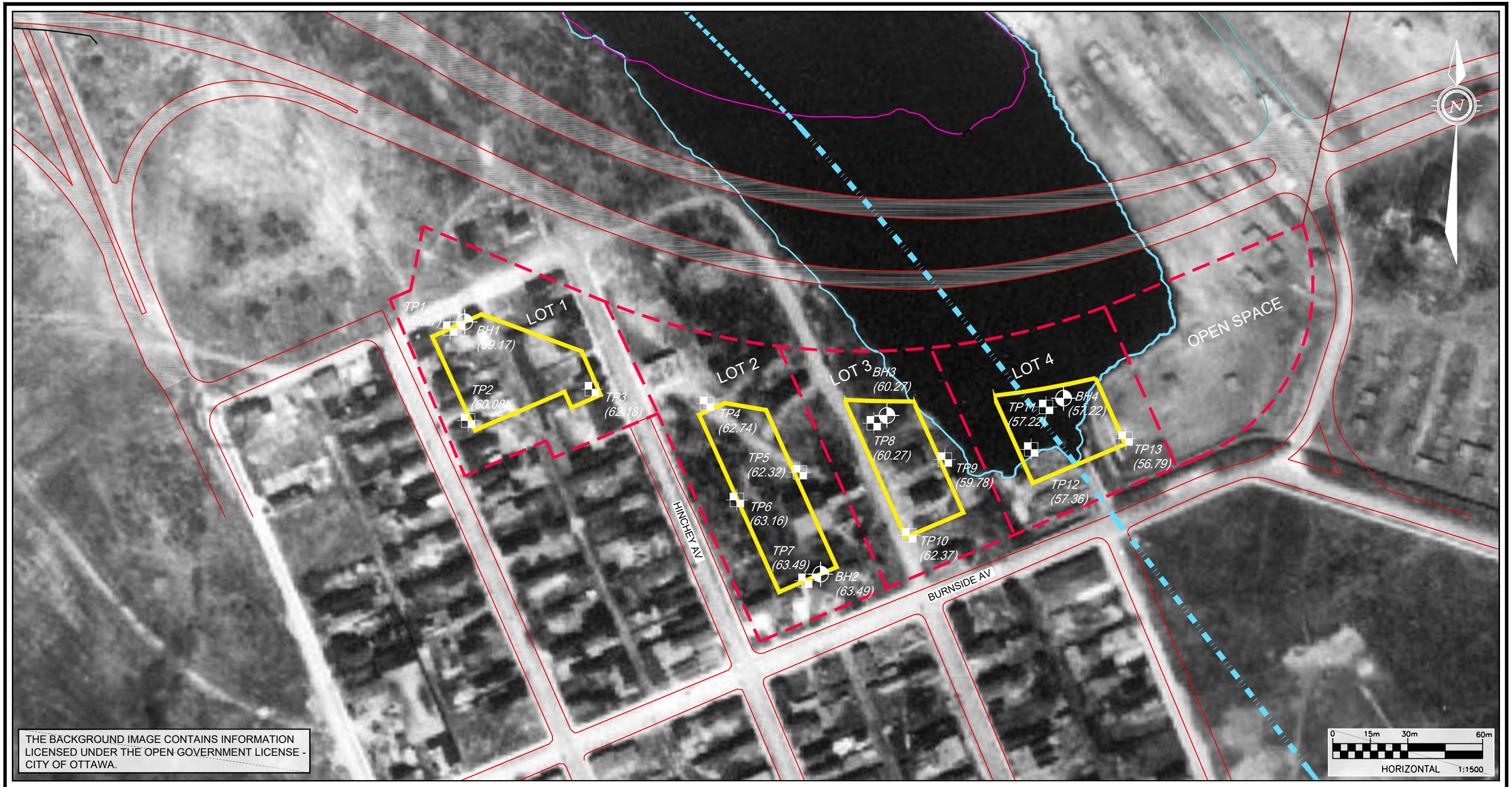
BASEPLAN	SAB
DESIGN	LPD
CHECKED	LPD
CAD	BC
PROJECT MANAGER	LPD
APPROVED	LPD

PROJECT
PRELIMINARY GEOTECHNICAL INVESTIGATION
BURNSIDE OPA AND ZBLA SUPPORTING STUDIES, BURNSIDE AVE. OTTAWA, ONTARIO.

TITLE
LOCATION OF MUNICIPAL SERVICES

PROJECT No.	OTT-00245595-AO
SURVEY	CITY TOPO
DATE	15/11/2019
DRAWING No.	2A



THE BACKGROUND IMAGE CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENSE - CITY OF OTTAWA.

LEGEND:

- APPROXIMATE 1928 SHORELINE
- CURRENT SHORELINE (2015)
- SIR JOHN A. MCDONALD PARKWAY (NCC)
- PROPERTY LIMIT
- BUILDABLE AREA
- TP8 — TEST PIT LOCATION & NUMBER
- BH3 — BOREHOLE LOCATION & NUMBER
- APPROXIMATE LOCATION OF FAULT

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scale	1:1500
date	MAY 2018
drawn by	J.R.
PROJECT:	PRELIMINARY GEOTECHNICAL INVESTIGATION BURNSIDE OPA AND ZBLA SUPPORTING STUDIES BURNSIDE AVENUE, OTTAWA, ON
TITLE:	TEST HOLE LOCATION PLAN SUPERIMPOSED ON 1928 AERIAL PHOTOGRAPH
project no.	OTT-00245595-A0
	FIG 3

Filename: r:\24000\00245000\245595-a0 ncc - burnside (ch2-2416311)\245595-ge-bh-f3.dwg
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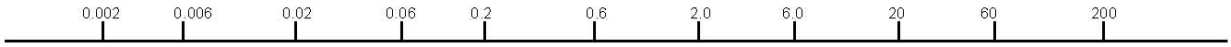
Notes On Sample Descriptions

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		



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-00245595-A0

Project: Preliminary Geotechnical Investigation - Burnside OPA and ZBLA Supporting Studies

Location: Burnside Avenue, Ottawa, ON.

Date Drilled: 'April 5, 2018

Drill Type: CME-75 Track Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N. Checked by: S.P.

Figure No. 4

Page. 1 of 1

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		Power augered to 1.2 m auger refusal depth.	59.17	0
			58.0	1
		LIMESTONE BEDROCK Aphanitic to fine grained, medium to thickly bedded, grey, (good and excellent quality)	57.57	2
				3
			54.9	4
		Borehole Terminated at 4.3 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

SAMPLES: Run 1, Run 2

Natural Unit Wt. kN/m³

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. 19 mm diameter standpipe 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-00245595-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On Completion	N/A	
32 days	1.6	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	1.2 - 2.7	100	88
2	2.7 - 4.3	100	100

LOG OF BOREHOLE BOREHOLE LOGS - 245595 - BURNSIDE AVE.GPJ TROW OTTAWA.GDT 4/29/19

Log of Borehole BH 2

Project No: OTT-00245595-A0

Project: Preliminary Geotechnical Investigation - Burnside OPA and ZBLA Supporting Studies

Location: Burnside Avenue, Ottawa, ON.

Date Drilled: 'April 4, 2018

Drill Type: CME-75 Track Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N. Checked by: S.P.

Figure No. 5

Page. 1 of 1

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		Power augered to 1.9 m auger refusal depth.	63.49	0
				1
			61.6	
		LIMESTONE BEDROCK Aphanitic to fine grained, medium to thickly bedded, grey, (poor and excellent quality)	61.19	2
				3
			59.2	4
		Borehole Terminated at 4.3 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

SAMPLES: Run 1, Run 2

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. 19 mm diameter standpipe 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-00245595-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On Completion	N/A	
33 days	2.3	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	1.9 - 2.7	100	30
2	2.7 - 4.3	100	95

LOG OF BOREHOLE BOREHOLE LOGS - 245595 - BURNSIDE AVE.GPJ TROW OTTAWA.GDT 4/29/19

Log of Borehole BH 3

Project No: OTT-00245595-A0

Project: Preliminary Geotechnical Investigation - Burnside OPA and ZBLA Supporting Studies

Location: Burnside Avenue, Ottawa, ON.

Figure No. 6

Page. 1 of 1

Date Drilled: 'April 4, 2018

Drill Type: CME-75 Track Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N. Checked by: S.P.

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		Power augered to 1.0 m auger refusal depth.	60.27	0	20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60		
			59.3	1			Run 1	
		LIMESTONE BEDROCK Aphanitic to fine grained, medium to thickly bedded, grey, (very poor and excellent quality)	58.27	2			Run 2	
			57.4					
		Borehole Terminated at 2.9 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. 19 mm diameter standpipe 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-00245595-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On Completion	N/A	
33 days	2.0	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	1 - 1.3	100	0
2	1.3 - 2.9	100	100

LOG OF BOREHOLE BOREHOLE LOGS - 245595 - BURNSIDE AVE.GPJ TROW OTTAWA.GDT 4/29/19

Log of Borehole BH 4

Project No: OTT-00245595-A0

Project: Preliminary Geotechnical Investigation - Burnside OPA and ZBLA Supporting Studies

Location: Burnside Avenue, Ottawa, ON.

Date Drilled: 'April 4 and 5, 2018

Drill Type: CME-75 Track Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: A.N. Checked by: S.P.

Figure No. 7

Page. 1 of 3

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		Power augered to 1.3 m auger refusal depth.	57.22	0	20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60		
		FILL Silty sand with gravel, cobbles, boulders, concrete, glass and wood debris, grey Borehole advanced from 1.3 m to 7.4 m depths by coring technique.	55.9	1			Run 1	
				2				
				3			Run 2	
				4				
				5			Run 3	
				6				
				7			Run 4	
		GLACIAL TILL Silty clayey sand with gravel, cobbles, boulders, grey, (very dense) Borehole advanced from 7.4 m to 24.0 m depths by coring techniques.	49.8	8			Run 5	
				9				
				10			Run 6	

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-00245595-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On Completion	N/A	

CORE DRILLING RECORD

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

LOG OF BOREHOLE BOREHOLE LOGS - 245595 - BURNSIDE AVE.GPJ TROW OTTAWA.GDT 4/29/19

Log of Borehole BH 4

Project No: OTT-00245595-A0

Project: Preliminary Geotechnical Investigation - Burnside OPA and ZBLA Supporting Studies

Figure No. 7

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		GLACIAL TILL Silty clayey sand with gravel, cobbles, boulders, grey, (very dense) Borehole advanced from 7.4 m to 24.0 m depths by coring techniques. *(continued)*	47.22	10 11 12 13 14 15 16 17 18 19 20 21 22	20 40 60 80 Shear Strength kPa 50 100 150 200 55	250 500 750 Natural Moisture Content % Atterberg Limits (% Dry Weight) 20 40 60	Run 7 Run 8 Run 9 Run 10 Run 11 Run 12 Run 13 Run 14	

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-00245595-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
On Completion	N/A	

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

LOG OF BOREHOLE BOREHOLE LOGS - 245595 - BURNSIDE AVE.GPJ TROW OTTAWA.GDT 4/29/19

Log of Borehole BH 4

Project No: OTT-00245595-A0

Project: Preliminary Geotechnical Investigation - Burnside OPA and ZBLA Supporting Studies

Figure No. 7

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		GLACIAL TILL Silty clayey sand with gravel, cobbles, boulders, grey, (very dense) Borehole advanced from 7.4 m to 24.0 m depths by coring techniques. *(continued)*	35.22	22 23	20 40 60 80 50 100 150 200	250 500 750 20 40 60	Run 15	
		Dynamic Cone Penetration Test (DCPT) conducted from 24.0 m to cone refusal depth at 24.1 m. **Cone Refusal at 24.1 m Depth**	33.2 33.1	24				

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-00245595-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On Completion	N/A	

CORE DRILLING RECORD

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

LOG OF BOREHOLE BOREHOLE LOGS - 245595 - BURNSIDE AVE.GPJ TROW OTTAWA.GDT 4/29/19

Log of Test Pit TP 1

Project No: OTT-00245595-A0

Project: Preliminary Geotechnical Investigation - Burnside OPA and ZBLA Supporting Studies

Location: Burnside Avenue, Ottawa, ON.

Figure No. 8

Page. 1 of 1

Date Drilled: 'March 29, 2018

Drill Type: Rubber Tired Backhoe

Datum: Geodetic Elevation

Logged by: M.L. Checked by: S.P.

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		TOPSOIL ~100 mm	59.17	0	20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60		
		FILL Mixture of silty sand and silty clay, gravel, cobbles, boulders, angular blast-rock pieces, brick and glass debris, brown and grey, moist	59.1					
			58.0	1				
		Bucket Refusal at 1.2 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Test Pit backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00245595-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On Completion	Dry	1.1

CORE DRILLING RECORD

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

LOG OF BOREHOLE TP LOGS - 245595 - BURNSIDE AVE.GPJ TROW OTTAWA.GDT 5/9/18

Log of Test Pit TP 2

Project No: OTT-00245595-A0

Project: Preliminary Geotechnical Investigation - Burnside OPA and ZBLA Supporting Studies

Location: Burnside Avenue, Ottawa, ON.

Figure No. 9

Page. 1 of 1

Date Drilled: 'March 29, 2018

Drill Type: Rubber Tired Backhoe

Datum: Geodetic Elevation

Logged by: M.L. Checked by: S.P.

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		TOPSOIL ~ 50 mm	60.08 60.0	0
		FILL Gravelly silty sand, cobbles, asphalt debris, brown, moist	59.7	
		GLACIAL TILL Silty clayey sand with gravel, brown, moist	59.6	
		Bucket Refusal at 0.5 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

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. Test Pit backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00245595-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On Completion	Dry	0.5

CORE DRILLING RECORD

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

LOG OF BOREHOLE TP LOGS - 245595 - BURNSIDE AVE.GPJ TROW OTTAWA.GDT 5/9/18

Log of Test Pit TP 3

Project No: OTT-00245595-A0

Project: Preliminary Geotechnical Investigation - Burnside OPA and ZBLA Supporting Studies

Location: Burnside Avenue, Ottawa, ON.

Figure No. 10

Page. 1 of 1

Date Drilled: 'March 29, 2018

Drill Type: Rubber Tired Backhoe

Datum: Geodetic Elevation

Logged by: M.L. Checked by: S.P.

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		TOPSOIL ~50 mm	62.18	0
		FILL	62.1	
		Gravelly silty sand, cobbles, asphalt debris, brown, moist	62.0	
		GLACIAL TILL	61.9	
		Silty clayey sand with gravel, brown, moist		
		Bucket Refusal at 0.3 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
SAMPLES
Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. Test Pit backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00245595-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On Completion	Dry	0.3

CORE DRILLING RECORD

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

LOG OF BOREHOLE TP LOGS - 245595 - BURNSIDE AVE.GPJ TROW OTTAWA.GDT 5/9/18

Log of Test Pit TP 4

Project No: OTT-00245595-A0

Project: Preliminary Geotechnical Investigation - Burnside OPA and ZBLA Supporting Studies

Location: Burnside Avenue, Ottawa, ON.

Figure No. 11

Page. 1 of 1

Date Drilled: 'March 29, 2018

Drill Type: Rubber Tired Backhoe

Datum: Geodetic Elevation

Logged by: M.L. Checked by: S.P.

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		FILL Mixture of silty sand and silty clay, gravel, cobbles, angular blast-rock pieces, roots, dark brown and grey, moist to wet	62.74	0
			61.9	
		Bucket Refusal at 0.8 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

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. Test Pit backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00245595-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On Completion	Dry	0.8

CORE DRILLING RECORD

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

LOG OF BOREHOLE TP LOGS - 245595 - BURNSIDE AVE.GPJ TROW OTTAWA.GDT 5/9/18

Log of Test Pit TP 5

Project No: OTT-00245595-A0

Project: Preliminary Geotechnical Investigation - Burnside OPA and ZBLA Supporting Studies

Location: Burnside Avenue, Ottawa, ON.

Figure No. 12

Page. 1 of 1

Date Drilled: 'March 29, 2018

Drill Type: Rubber Tired Backhoe

Datum: Geodetic Elevation

Logged by: M.L. Checked by: S.P.

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		FILL Silty clayey gravel with sand, cobbles and angular blast-rock pieces, brick debris, brown to reddish brown and grey, moist to wet	62.32	0
			61.1	1
		Bucket Refusal at 1.2 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
SAMPLES
Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. Test Pit backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00245595-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On Completion	Dry	1.2

CORE DRILLING RECORD

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

LOG OF BOREHOLE TP LOGS - 245595 - BURNSIDE AVE.GPJ TROW OTTAWA.GDT 5/9/18

Log of Test Pit TP 6

Project No: OTT-00245595-A0

Project: Preliminary Geotechnical Investigation - Burnside OPA and ZBLA Supporting Studies

Location: Burnside Avenue, Ottawa, ON.

Figure No. 13

Page. 1 of 1

Date Drilled: 'March 29, 2018

Drill Type: Rubber Tired Backhoe

Datum: Geodetic Elevation

Logged by: M.L. Checked by: S.P.

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		FILL Mixture of silty sand and silty clay, gravel, cobbles, boulders, angular blast-rock pieces, brick debris, brown and grey, moist to wet	63.16	0	20 40 60 80 50 100 150 200 kPa	250 500 750 20 40 60		
			61.6	1				
		Bucket Refusal at 1.6 m Depth						

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. Test Pit backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00245595-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On Completion	Dry	1.6

CORE DRILLING RECORD

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

LOG OF BOREHOLE TP LOGS - 245595 - BURNSIDE AVE.GPJ TROW OTTAWA.GDT 5/9/18

Log of Test Pit TP 7

Project No: OTT-00245595-A0

Project: Preliminary Geotechnical Investigation - Burnside OPA and ZBLA Supporting Studies

Location: Burnside Avenue, Ottawa, ON.

Figure No. 14

Page. 1 of 1

Date Drilled: 'March 29, 2018

Drill Type: Rubber Tired Backhoe

Datum: Geodetic Elevation

Logged by: M.L. Checked by: S.P.

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		TOPSOIL ~50 mm	63.49	0
		FILL Mixture of silty sand and silty clay, gravel, cobbles, boulders, angular blast-rock pieces, brick and metal debris, brown and grey, moist	63.4	
				1
			62.0	
		LIMESTONE BEDROCK Weathered, grey	61.8	
		Bucket Refusal at 1.7 m Depth		

Standard Penetration Test N Value: 20 40 60 80
Shear Strength kPa: 50 100 150 200
Combustible Vapour Reading (ppm): 250 500 750
Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60
SAMPLES
Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. Test Pit backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00245595-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On Completion	Dry	1.4

CORE DRILLING RECORD

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

LOG OF BOREHOLE TP LOGS - 245595 - BURNSIDE AVE.GPJ TROW OTTAWA.GDT 5/9/18

Log of Test Pit TP 8

Project No: OTT-00245595-A0

Project: Preliminary Geotechnical Investigation - Burnside OPA and ZBLA Supporting Studies

Location: Burnside Avenue, Ottawa, ON.

Figure No. 15

Page. 1 of 1

Date Drilled: 'March 29, 2018

Drill Type: Rubber Tired Backhoe

Datum: Geodetic Elevation

Logged by: M.L. Checked by: S.P.

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		TOPSOIL ~150 mm	60.27	0
		FILL Mixture of silty sand and silty clay, gravel, cobbles, boulders, brick and wood debris, brown and grey, moist to wet	60.1	
		GLACIAL TILL Silty clayey sand with gravel, brown, moist to wet	59.6	
		Bucket Refusal at 0.8 m Depth	59.5	

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

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

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. Test Pit backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00245595-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On Completion	Dry	0.8

CORE DRILLING RECORD

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

LOG OF BOREHOLE TP LOGS - 245595 - BURNSIDE AVE.GPJ TROW OTTAWA.GDT 5/9/18

Log of Test Pit TP 9

Project No: OTT-00245595-A0

Project: Preliminary Geotechnical Investigation - Burnside OPA and ZBLA Supporting Studies

Location: Burnside Avenue, Ottawa, ON.

Figure No. 16

Page. 1 of 1

Date Drilled: 'March 29, 2018

Drill Type: Rubber Tired Backhoe

Datum: Geodetic Elevation

Logged by: M.L. Checked by: S.P.

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		TOPSOIL ~100 mm	59.78	0
		FILL Gravel with silty clay and sand, cobbles, boulders, angular blast-rock pieces, roots, asphalt, brick, glass, metal debris, dark brown to brown, moist to wet	59.7	
				1
				2
			57.2	
		Bucket Refusal at 2.6 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

SAMPLES

Natural Unit Wt. kN/m³

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Test Pit backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00245595-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On Completion	Dry	2.3

CORE DRILLING RECORD

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

LOG OF BOREHOLE TP LOGS - 245595 - BURNSIDE AVE.GPJ TROW OTTAWA.GDT 5/9/18

Log of Test Pit TP 10

Project No: OTT-00245595-A0

Project: Preliminary Geotechnical Investigation - Burnside OPA and ZBLA Supporting Studies

Location: Burnside Avenue, Ottawa, ON.

Figure No. 17

Page. 1 of 1

Date Drilled: 'March 29, 2018

Drill Type: Rubber Tired Backhoe

Datum: Geodetic Elevation

Logged by: M.L. Checked by: S.P.

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		FILL Mixture of silty sand and silty clay, gravel, cobbles, boulders and angular blast-rock pieces, reddish brown and grey, moist to wet	62.37	0	20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60		
		Bucket Refusal at 0.9 m Depth	61.5					

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. Test Pit backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00245595-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On Completion	Dry	0.9

CORE DRILLING RECORD

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

LOG OF BOREHOLE TP LOGS - 245595 - BURNSIDE AVE.GPJ TROW OTTAWA.GDT 5/9/18

Log of Test Pit TP 11

Project No: OTT-00245595-A0

Project: Preliminary Geotechnical Investigation - Burnside OPA and ZBLA Supporting Studies

Location: Burnside Avenue, Ottawa, ON.

Figure No. 18

Page. 1 of 1

Date Drilled: 'March 29, 2018

Drill Type: Rubber Tired Backhoe

Datum: Geodetic Elevation

Logged by: M.L. Checked by: S.P.

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		TOPSOIL ~ 100 mm	57.22	0	20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60		
		57.1						
		FILL Silty clayey gravel with sand, cobbles, angular blast-rock pieces, asphalt, brick and wood debris, brown and grey, moist		1		×		
				2				
				3				
			54.0					
		Test Pit Terminated at 3.2 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Test Pit backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00245595-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On Completion	Dry	2.6

CORE DRILLING RECORD

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

LOG OF BOREHOLE TP LOGS - 245595 - BURNSIDE AVE.GPJ TROW OTTAWA.GDT 5/9/18

Log of Test Pit TP 12

Project No: OTT-00245595-A0

Project: Preliminary Geotechnical Investigation - Burnside OPA and ZBLA Supporting Studies

Location: Burnside Avenue, Ottawa, ON.

Figure No. 19

Page. 1 of 1

Date Drilled: 'March 29, 2018

Drill Type: Rubber Tired Backhoe

Datum: Geodetic Elevation

Logged by: M.L. Checked by: S.P.

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		TOPSOIL ~100 mm	57.36	0
		FILL Mixture of silty sand and silty clay, gravel, cobbles, boulders, angular blast-rock pieces, roots, asphalt, brick and concrete pieces, brown to dark brown, moist to wet	57.3	
			55.7	1
		GLACIAL TILL Silty sand with clay, gravel, cobbles, brown and grey, moist	55.4	
		Bucket Refusal at 2.0 m Depth		2

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

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. Test Pit backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00245595-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On Completion	Dry	1.9

CORE DRILLING RECORD

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

LOG OF BOREHOLE TP LOGS - 245595 - BURNSIDE AVE.GPJ TROW OTTAWA.GDT 5/9/18

Log of Test Pit TP 13

Project No: OTT-00245595-A0

Project: Preliminary Geotechnical Investigation - Burnside OPA and ZBLA Supporting Studies

Location: Burnside Avenue, Ottawa, ON.

Figure No. 20

Page. 1 of 1

Date Drilled: 'March 29, 2018

Drill Type: Rubber Tired Backhoe

Datum: Geodetic Elevation

Logged by: M.L. Checked by: S.P.

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		TOPSOIL ~100 mm	56.79	0
		56.7		
		FILL Sand with silt and gravel, cobbles, boulders, angular blast-rock pieces, roots, brick debris, brown and grey, moist to wet		1
				2
		53.8		3
		Test Pit Terminated at 3.0 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

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. Test Pit backfilled upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00245595-A0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
On Completion	Dry	2.6

CORE DRILLING RECORD

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

LOG OF BOREHOLE TP LOGS - 245595 - BURNSIDE AVE.GPJ TROW OTTAWA.GDT 5/9/18

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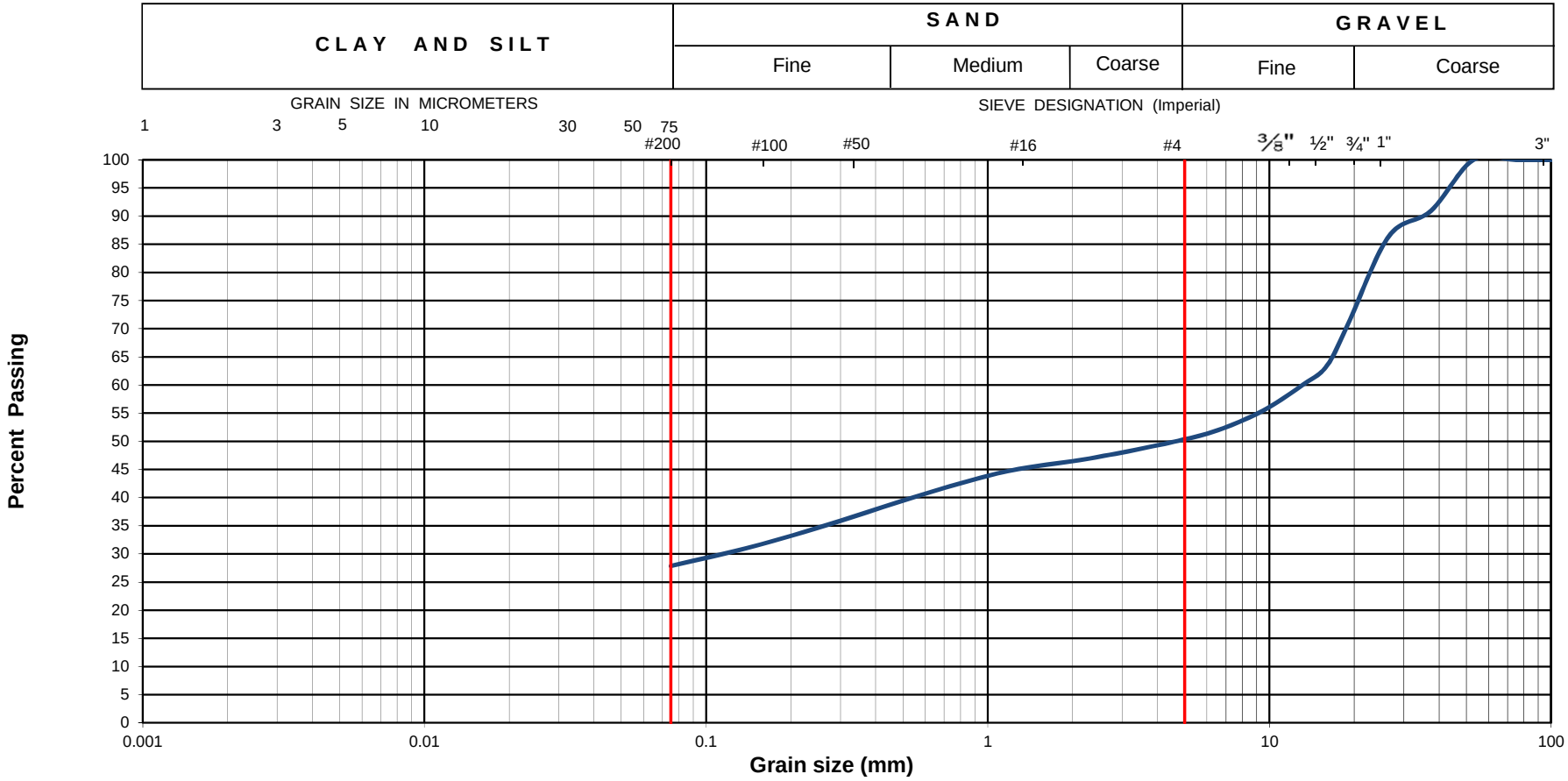
Grain-Size Distribution Curve
Method of Test For Sieve Analysis of Aggregate
ASTM C-136

Unified Soil Classification System



EXP Project No.:	**OTT-00245595-A0**	**Project Name :**	**Geotechnical Investigation - Burnside OPA and ZBLA Supporting Studies**						
Client :	**National Capital Commission (NCC)**	**Project Location :**	**Burnside Avenue, Ottawa, ON.**						
Date Sampled :	**March 29, 2018**	**Test Pit No:**	**TP 5**	**Sample:**	**S1**	**Depth (m) :**	**0.5-1.0**		
Sample Composition :		**Gravel (%)**	**50**	**Sand (%)**	**22**	**Silt & Clay (%)**	**28**	**Figure :**	**21**
Sample Description :	**Fill - Silty Clayey Gravel with Sand (GC-GM)**								

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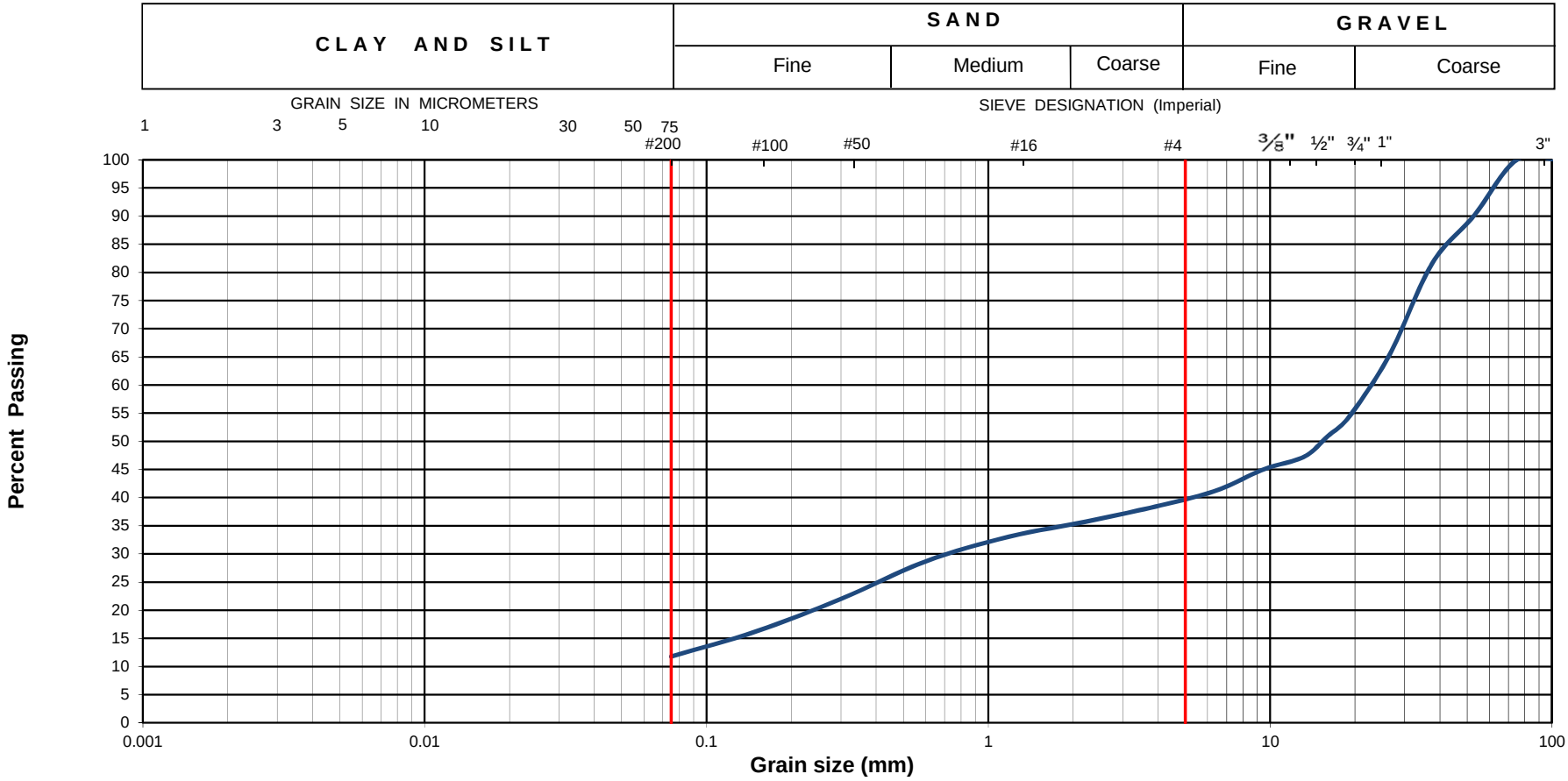

EXP Project No.:	**OTT-00245595-A0**		**Project Name :**	**Geotechnical Investigation - Burnside OPA and ZBLA Supporting Studies**					
Client :	**National Capital Commission (NCC)**		**Project Location :**	**Burnside Avenue, Ottawa, ON.**					
Date Sampled :	**March 29, 2018**		**Test Pit No:**	**TP 9**		**Sample:**	**S1**	**Depth (m) :**	**0.5-1.0**
Sample Composition :			**Gravel (%)**	**61**	**Sand (%)**	**27**	**Silt & Clay (%)**	**12**	**Figure :** **22**
Sample Description :	**Fill - Gravel with Silty Clay and Sand (GW-GC)**								

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

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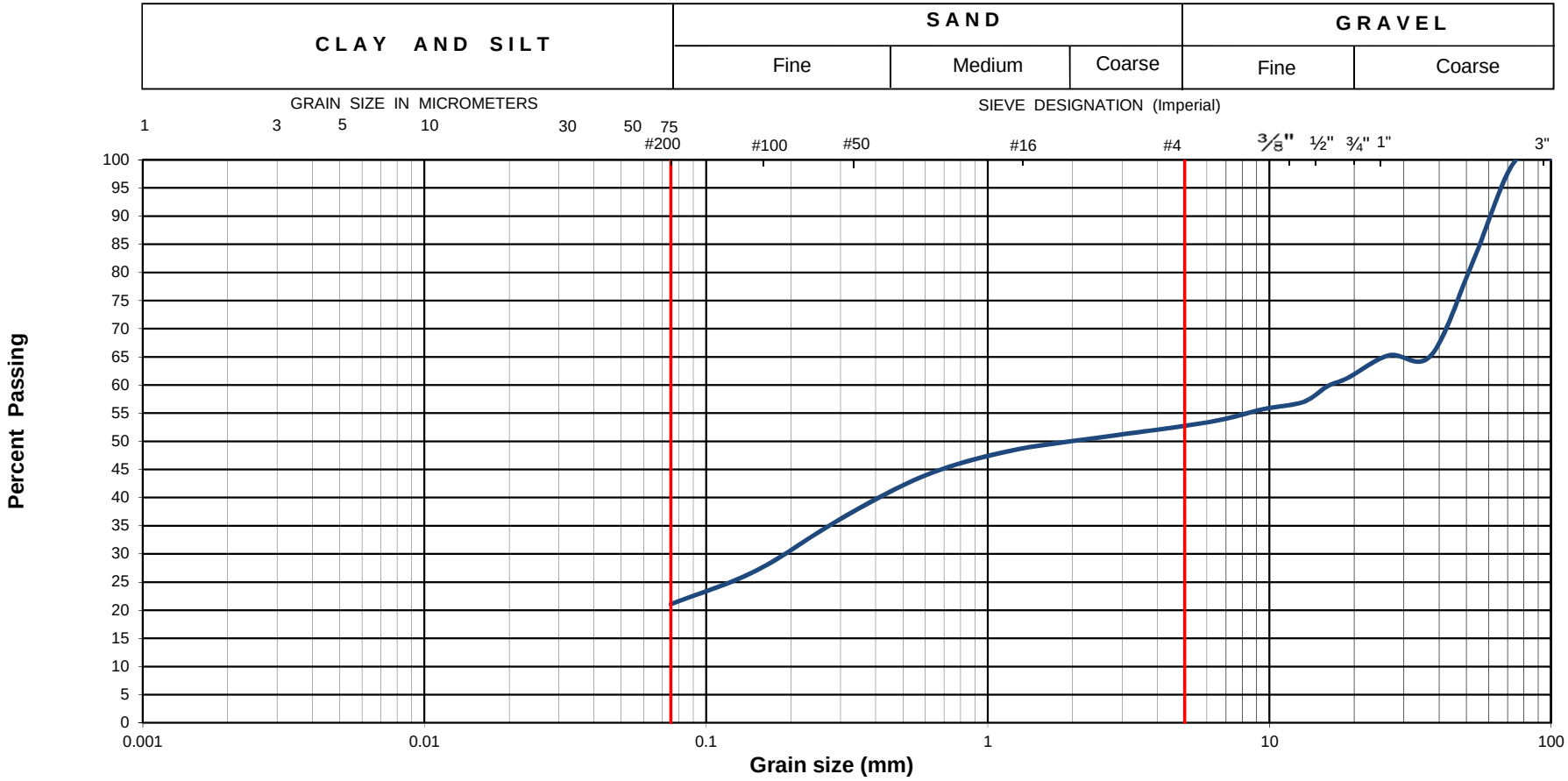

EXP Project No.:	**OTT-00245595-A0**		**Project Name :**	**Geotechnical Investigation - Burnside OPA and ZBLA Supporting Documents**					
Client :	**National Capital Commission (NCC)**		**Project Location :**	**Burnside Avenue, Ottawa, ON.**					
Date Sampled :	**March 29, 2018**		**Test Pit No:**	**TP 11**		**Sample:**	**S1**	**Depth (m) :**	**0.6-1.2**
Sample Composition :			**Gravel (%)**	**47**	**Sand (%)**	**32**	**Silt & Clay (%)**	**21**	**Figure :** **23**
Sample Description :	**Fill - Silty Clayey Gravel with Sand (GC-GM)**								

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

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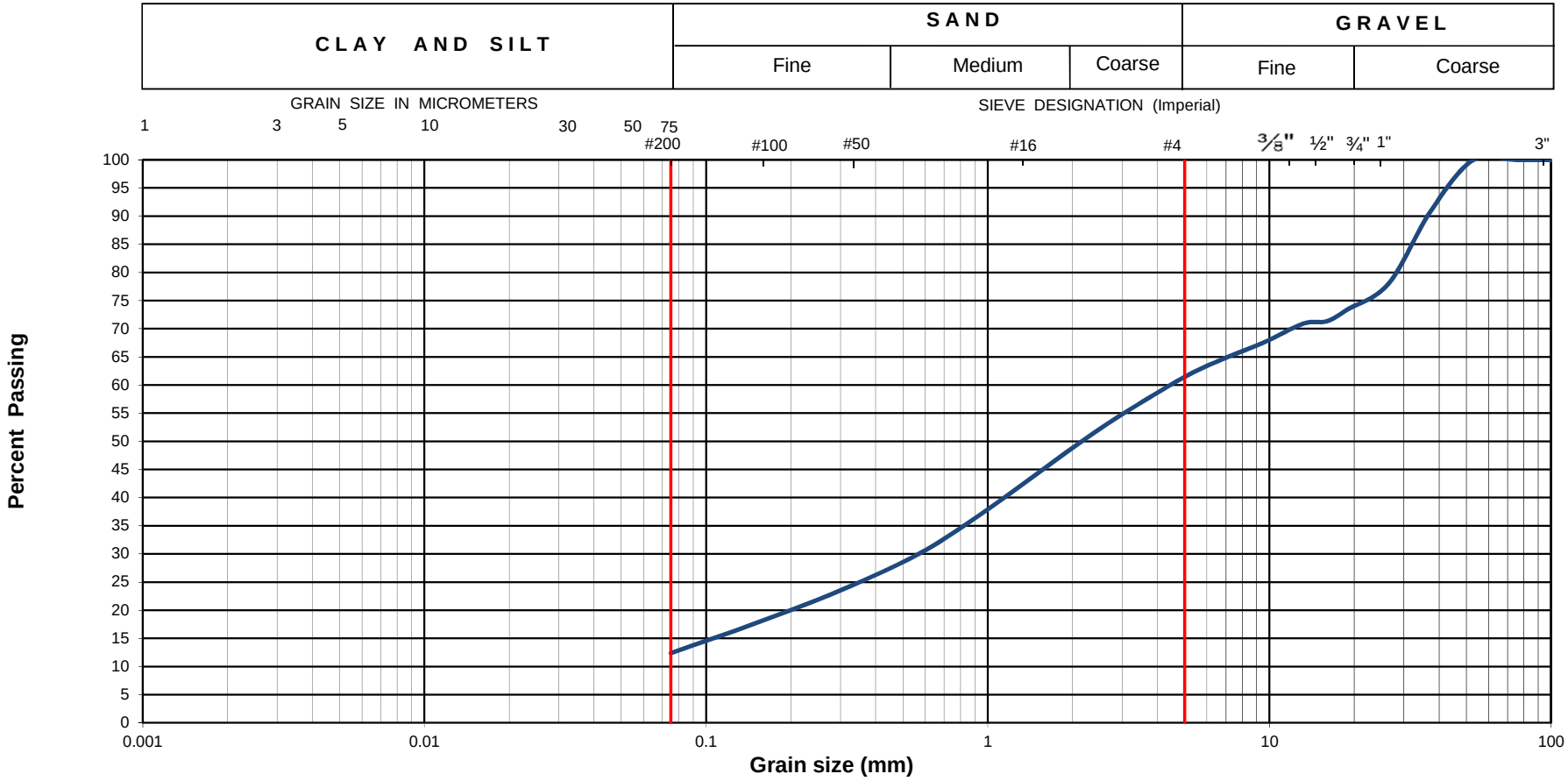

EXP Project No.:	**OTT-00245595-A0**	**Project Name :**	**Geotechnical Investigation - Burnside OPA and ZBLA Supporting Studies**						
Client :	**National Capital Commission (NCC)**	**Project Location :**	**Burnside Avenue, Ottawa, ON.**						
Date Sampled :	**March 29, 2018**	**Test Pit No:**	**TP 13**	**Sample:**	**S2**	**Depth (m) :**	**2.0-2.5**		
Sample Composition :		**Gravel (%)**	**39**	**Sand (%)**	**49**	**Silt & Clay (%)**	**12**	**Figure :**	**24**
Sample Description :	**Fill - Sand with Silt and Gravel (SW-SM)**								

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

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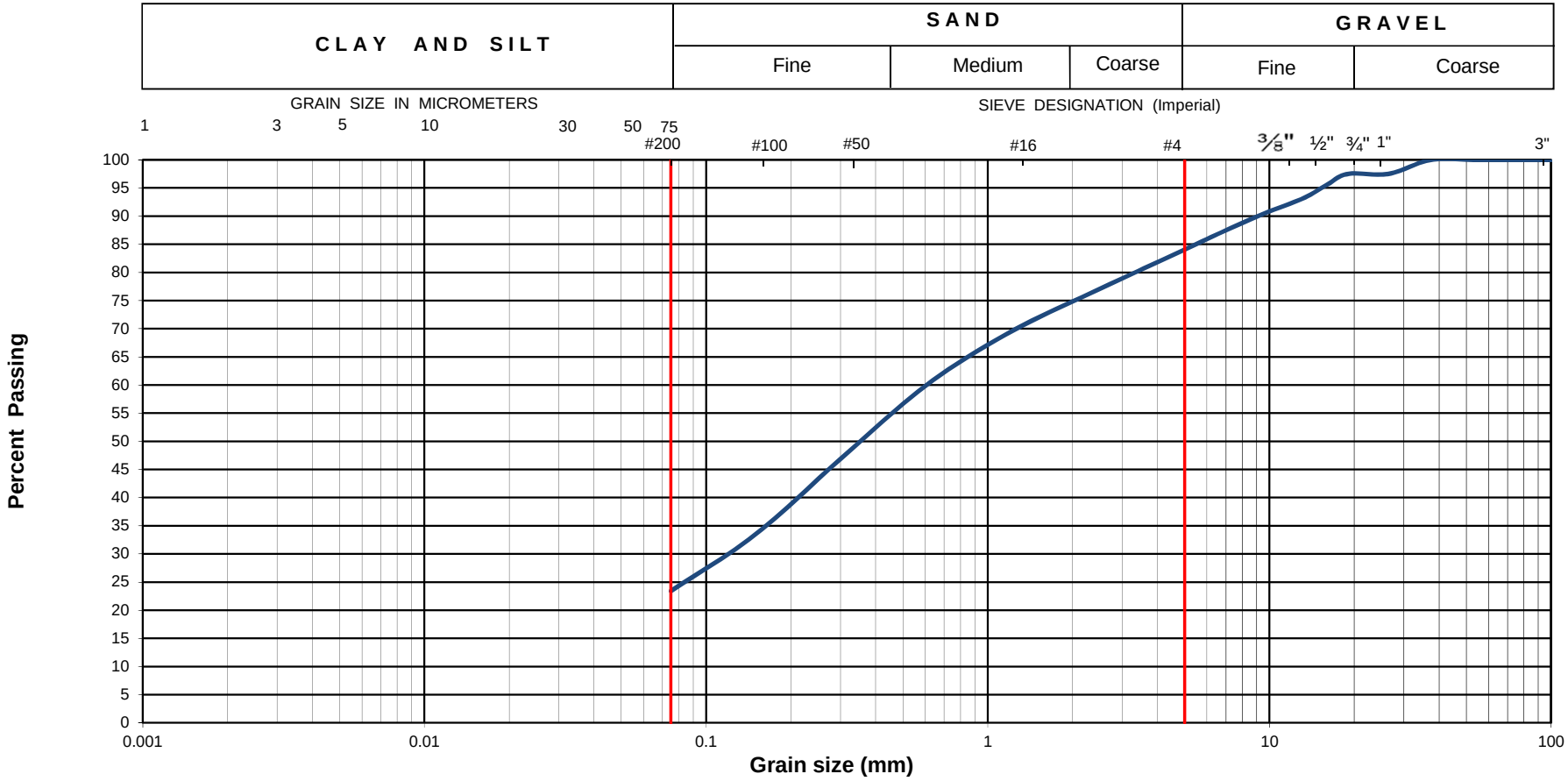

EXP Project No.:	**OTT-00245595-A0**		**Project Name :**	**Geotechnical Investigation - Burnside OPA and ZBLA Supporting Studies**					
Client :	**National Capital Commission (NCC)**		**Project Location :**	**Burnside Avenue, Ottawa, ON.**					
Date Sampled :	**April 5, 2018**		**Borehole No.**	**BH 4**	**Sample:**	**SS1**	**Depth (m) :**	**11.8-12.4**	
Sample Composition :			**Gravel (%)**	**16**	**Sand (%)**	**61**	**Silt & Clay (%)**	**23**	**Figure : 25**
Sample Description :	**Glacial Till - Silty Clayey Sand with Gravel (SC-SM)**								

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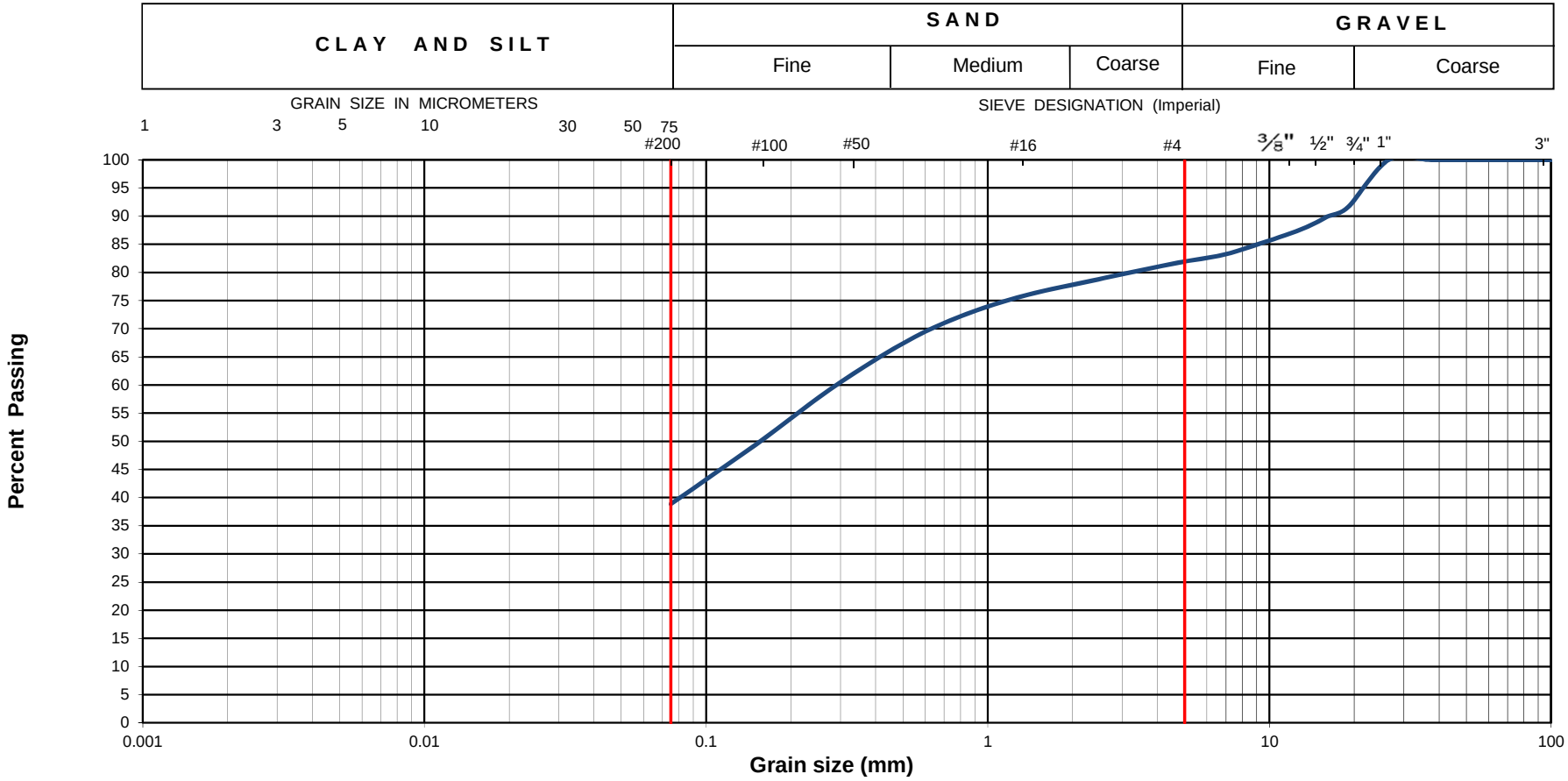
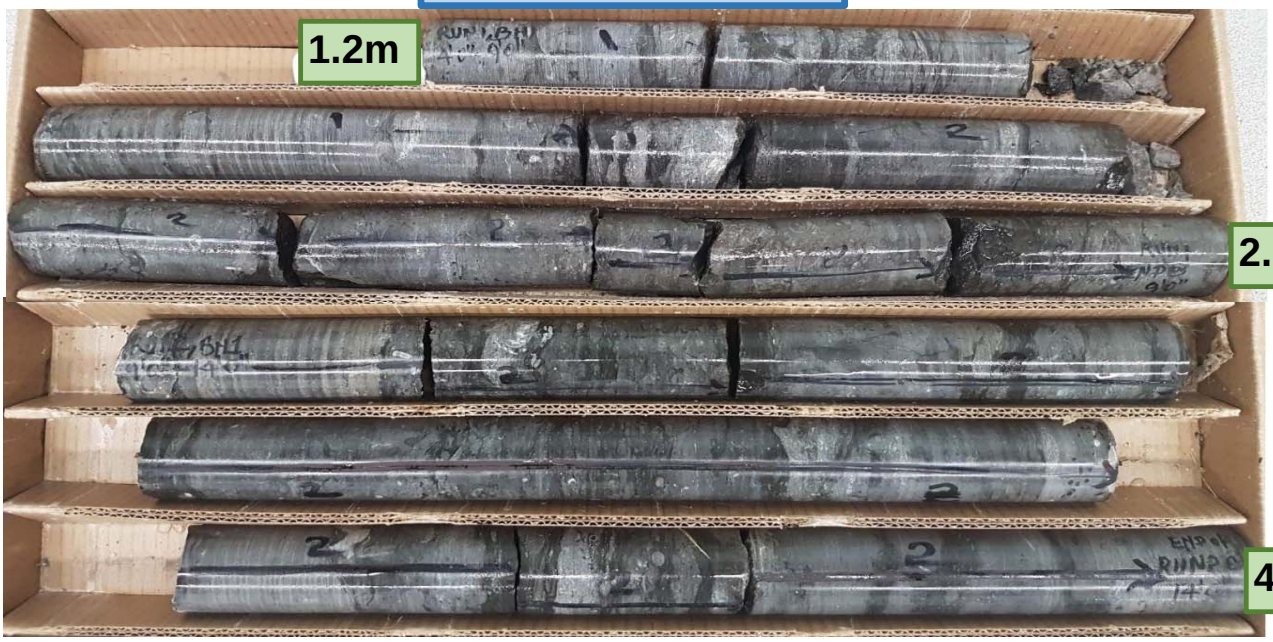


EXP Project No.:	**OTT-00245595-A0**	**Project Name :**	**Geotechnical Investigation - Burnside OPA and ZBLA Supporting Studies**				
Client :	**National Capital Commission (NCC)**	**Project Location :**	**Burnside Avenue, Ottawa, ON.**				
Date Sampled :	**April 5, 2018**	**Borehole No:**	**BH 4**	**Sample:**	**Run 12**	**Depth (m) :**	**18.3-18.6**
Sample Composition :		**Gravel (%)**	**18**	**Sand (%)**	**43**	**Silt & Clay (%)**	**39**
Sample Description :	**Glacial Till - Silty Clayey Sand with Gravel (SC-SM)**					**Figure :**	**26**

Appendix A: Rock Core Photographs

DRY BEDROCK CORES

WET BEDROCK CORES



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borehole no.	core runs	PROJECT	project no.
BH-1	Run 1: 1.2m-2.7m Run 2: 2.7m-4.3m	BURNSIDE OPA & ZBLA SUPPORTING STUDIES	OTT-00245595-A0
date cored Apr 05, 2018		ROCK CORE PHOTOGRAPHS	FIG A-1

DRY BEDROCK CORES

WET BEDROCK CORES

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borehole no.	core runs	PROJECT	project no.
BH-2	Run 1: 1.9m-2.7m Run 2: 2.7m-4.3m	BURNSIDE OPA & ZBLA SUPPORTING STUDIES	OTT-00245595-A0
date cored Apr 05, 2018		ROCK CORE PHOTOGRAPHS	FIG A-2

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borehole no.	core runs	PROJECT	project no.
BH-3	Run 1: 1.0m-1.3m Run 2: 1.3m-2.9m	BURNSIDE OPA & ZBLA SUPPORTING STUDIES	OTT-00245595-A0
date cored Apr 05, 2018		ROCK CORE PHOTOGRAPHS	FIG A-3

EXP Services Inc.

Client: National Capital Commission
Project Name: Preliminary Geotechnical Investigation, Burnside OPA & ZBLA Supporting Studies
Location: Burnside Avenue, Ottawa, Ontario
Project Number: OTT-00245595-A0
Date: November 26, 2019

Appendix B: 2015 National Building Code Seismic Hazard Calculation

2015 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

May 09, 2018

Site: 45.4095 N, 75.7307 W User File Reference: Burnside Avenue, Ottawa, ON.

Requested by: , EXP Services Inc.

National Building Code ground motions: 2% probability of exceedance in 50 years (0.000404 per annum)

Sa(0.05)	Sa(0.1)	**Sa(0.2)**	Sa(0.3)	**Sa(0.5)**	**Sa(1.0)**	**Sa(2.0)**	**Sa(5.0)**	**Sa(10.0)**	**PGA (g)**	**PGV (m/s)**
0.442	0.518	**0.434**	0.330	**0.234**	**0.117**	**0.056**	**0.015**	**0.0054**	**0.278**	**0.195**

Notes. Spectral (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s^2). Peak ground velocity is given in m/s. Values are for "firm ground" (NBCC 2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are specified in **bold** font. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. ***These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.***

Ground motions for other probabilities:

Probability of exceedance per annum	0.010	0.0021	0.001
Probability of exceedance in 50 years	40%	10%	5%
Sa(0.05)	0.043	0.146	0.244
Sa(0.1)	0.060	0.184	0.296
Sa(0.2)	0.054	0.159	0.252
Sa(0.3)	0.043	0.123	0.193
Sa(0.5)	0.031	0.087	0.137
Sa(1.0)	0.015	0.044	0.069
Sa(2.0)	0.0060	0.020	0.032
Sa(5.0)	0.0012	0.0047	0.0080
Sa(10.0)	0.0006	0.0019	0.0032
PGA	0.032	0.100	0.161
PGV	0.021	0.067	0.110

References

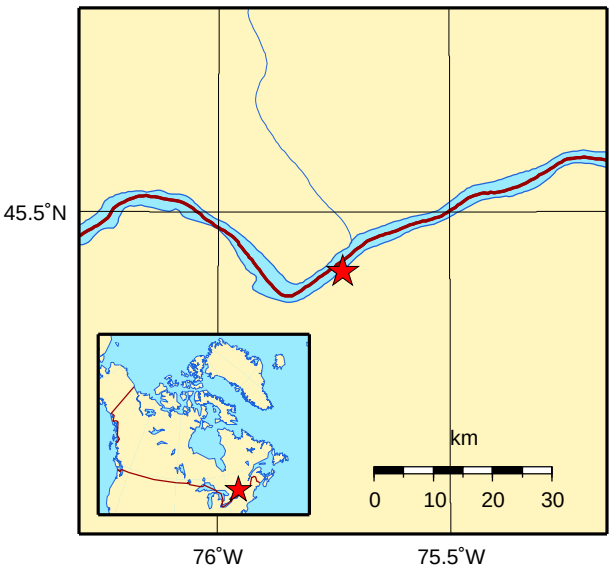
National Building Code of Canada 2015 NRCC no. 56190;
Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

User's Guide - NBC 2015, Structural Commentaries NRCC no. xxxxxx (in preparation)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File 7893 Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

See the websites *www.EarthquakesCanada.ca* and *www.nationalcodes.ca* for more information

Aussi disponible en français



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