Geotechnical Investigation

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Geotechnical Investigation
Proposed New Findlay Creek Public School
820 Miikana Road. Southeast Corner of Miikana Road and Kelly Farm Drive
Findlay Creek Community

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Executive Summary

EXP Services Inc. (EXP) is pleased to present the results of the geotechnical investigation completed for the Proposed New Findlay Creek Public School to be located in the Findlay Creek Community at Civic address of 820 Miikana Road, Ottawa, ON, i.e. at the southeast Corner of Miikana Road and Kelly Farm Drive (Figure 1). This work was completed under EXP standing offer 21-019 with the Ottawa District School Board (OCDSB). Written authorization to proceed with this geotechnical investigation was provided by the OCDSB via Purchase Order Number: 333220032339 dated March 25, 2022.

The proposed development will consist of a two storey basementless school building, with an attached one storey daycare structure. The proposed school development will also include the construction of outdoor sports fields, play areas, parking lot with access roads, a paved bus loop and areas for future portables and pathways.

N45 Architecture Inc. (N45) drawing C2, titled "Site Grading, Erosion and Sediment Control Plan" dated June, 2022 indicates that the proposed final floor elevation will be 95.6 m Elevation. Footings of the proposed school are therefore expected to be set at a depth of 1.5 m below the finished floor, i.e. Elevation 94.1 m. Drawing C2 also indicates the proposed sports field will be at an elevation of 97.5 m and the proposed parking lot will be at elevation will range from 95.2 m to 94.9 m, sloping downwards to the south. This result in a grade raise of up to approximately 1.4 m within the building footprint, up to approximately 1.7 m at the sports field and a cut of approximately 1.0 in the parking area.

The test hole (boreholes and test pits) fieldwork was undertaken in two (2) stages. The first stage completed between April 4 and April 6, 2022 and consists the drilling of twelve (12) boreholes (Borehole Nos. 1 to 12, 13 and 14) advanced to termination/auger refusal depths ranging from 1.2 m to 5.2 m (Elevation 93.9 m to 89.9 m). On May 5, 2022, the second stage of the investigation was carried out, consisting of a total of eleven (11) testpits (Testpit Nos. 10, 11A, 12, 14, 14A and 15 to 20) excavated throughout the site to termination or refusal depths ranging from 0.9 m to 3.1 m (Elevation 94.6 m to 91.9 m). In addition to this, five (5) additional testpits (Testpit Nos. 2, 5, 6, 11 and 13) were excavated at or just adjacent to the corresponding borehole number in order to further examine the subsurface conditions and to establish whether the refusal to augers was met on boulders or on the surface of the bedrock. The borehole logs at these locations have incorporated the results of the testpits.

The borehole information indicates the subsurface conditions consist of a surficial layer of topsoil or fill extending to depths of 0.2m to 2.2 m (Elevation 95.8 m to 92.5 m). In three of the boreholes a topsoil layer was encountered underlying the fill, encountered at 0.5 m to 0.7 m depths and was found to be 200 mm to 400 mm thick. Underlying the fill or topsoil was either a deposit of silt to sand, glacial till or silt to sand underlain by glacial till. The silt and sand extended to depths ranging from 0.5 m and 1.9 depth (Elevation 95.4 m to 92.9 m). The glacial till was contacted at depths of 0.2 m to 2.2 m (Elevation 95.8 m to 92.5 m).

Refusal to augers was encountered at 1.2 m to 3.3 m (Elevation 94.1 m to 91.6 m) in Borehole Nos. 01 to 13. Bedrock was confirmed by coring or by testpit excavation at depths of 0.9 m to 2.9 m (Elevation 94.6 m to 92.1 m) in Borehole No. 14 and Test Pits Nos. 10, 12, 14, 14A and 15 to 20.

The groundwater level was found to be deeper than the installation depth of the installed well screens, 2.9 to 5.2 (Elevation 92.0 m to 90.1 m). In the Golder report in Borehole 16-104 recorded groundwater level of 4.3 m depth (Elevation 91.6 m). Additional groundwater readings should be collected to confirm the groundwater table at the site.

Based on the results from the Multi-channel Analysis of Surface Waves (MASW) survey (shear wave velocity) shown in Appendix A and comparison of the survey results with Table 4.1.8.4.A of the 2012 Ontario Building Code (as amended May 2, 2019), the site classification for seismic response is **Class C**. The subsurface soils are not susceptible to liquefaction during a seismic event.

Based on a review of the boreholes located within the footprint of the proposed school building, the footings, at the design underside of footing elevation of Elevation 94.1 m, the encountered soil was either fill, sand and silt or glacial till. The topsoil (surficial and buried) and the existing fill, which extends as deep as Elevation 92.5 m, are not suitable to support the footings and, where present, would have to be excavated, removed and replaced with an engineered fill pad that is constructed on top of the undisturbed native soil. Therefore, the footings that will support the proposed school building will have to extend to either approved undisturbed native soil or founded on a properly constructed engineered fill pad constructed on the approved undisturbed native soil.

Square spread footings having a maximum width and length of 3.0 m and strip footings having a maximum width of 1.5 m founded on approved native soil founded or founded on a properly constructed engineered fill pad constructed on the approved undisturbed native soil may be designed for a bearing capacity at serviceability limit state (SLS) of 150 kPa and factored geotechnical resistance at ultimate limit state (ULS) of 225 kPa. The factored geotechnical resistance value at ULS includes a resistance factor of 0.5. The total and differential settlements of well designed and constructed footings placed in accordance with the above recommendations are expected to be less than 25 mm and 19 mm respectively. The SLS and factored ULS values are valid provided the site grade raise to a maximum of 2.0 m is respected.

Perimeter drains should be provided for the proposed building. Underfloor drains are not required.

All excavations must be undertaken in accordance with the Occupational Health and Safety Act (OHSA), Ontario Reg. 213/91. Based on the definitions provided in OHSA, the subsurface soils on site are considered to be Type 3 and as such the sidewalls of the excavation must be cut back at 1H:1V from the bottom of the excavation. Below the groundwater level, the excavation side slopes are expected to slough and eventually stabilize at a slope of 3H:1V to 2H:1V. Excavation of the bedrock, if required, will required line drilling or blasting. Hoe ramming may be possible, but progress expected to be very slow.

It has been assumed that excavation will be carried out to depths ranging from 0.5 m to 2.2 m depths (Elevation 95.2 m to Elevation 92.5 m), where native soil was encountered. Based on these results, it is anticipated that excavations at this site will be above the recorded groundwater elevation.

It is anticipated that the majority of the material required for backfilling purposes in the interior and exterior of the building and for trench backfill would have to be imported and should preferably conform to the recommendation stated in the report.

Pavement structure for surface parking area should consist of 65 mm of asphaltic concrete for light duty areas and parking areas and 110 mm for the bus turn around. In either case the asphaltic concrete is to be underlain by 150 mm of OPSS 1010 Granular A and 450 mm of Granular B Type II for parking areas and 600 mm for the bus turn around.

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

1. Introduction

EXP Services Inc. (EXP) is pleased to present the results of the geotechnical investigation completed for the Proposed New Findlay Creek Public School to be located in the Findlay Creek Community at Civic address of 820 Miikana Road, Ottawa, ON, i.e. at the southeast Corner of Miikana Road and Kelly Farm Drive (Figure 1). This work was completed under EXP standing offer 21-019 with the Ottawa District School Board (OCDSB). Written authorization to proceed with this geotechnical investigation was provided by the OCDSB via Purchase Order Number: 333220032339 dated March 25, 2022.

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N45 Architecture Inc. (N45) drawing C2, titled "Site Grading, Erosion and Sediment Control Plan" dated June, 2022 indicates that the proposed final floor elevation will be 95.6 m Elevation. Footings of the proposed school are therefore expected to be set at a depth of 1.5 m below the finished floor, i.e. Elevation 94.1 m. Drawing C2 also indicates the proposed sports field will be at an elevation of 97.5 m and the proposed parking lot will be at elevation will range from 95.2 m to 94.9 m, sloping downwards to the south. This result in a grade raise of up to approximately 1.4 m within the building footprint, up to approximately 1.7 m at the sports field and a cut of approximately 1.0 in the parking area.

The geotechnical investigation was undertaken to:

a) Establish the subsurface soil and groundwater conditions at twelve (12) borehole and sixteen (16) testpit locations;

b) Classify the site for seismic site response in accordance with the requirements of the 2012 Ontario Building Code (as amended May 2, 2019) 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) Provide comment regarding slab-on-grade construction and the requirement for perimeter and underfloor drainage systems;

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

g) Provide pipe bedding requirements for underground services;

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

i) Recommend pavement structure thicknesses for access road and parking lot; and,

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

The comments and recommendations given in this report are based on the assumption that the above-described design concepts will proceed into construction. If changes are made either in the design phase or during construction, this office must be retained to review these modifications. The result of this review may be a modification of our recommendations or it may require additional field or laboratory work to check whether the changes are acceptable from a geotechnical viewpoint.

2. Site Description

The site for the proposed new Findlay Creek Public School is located at the municipal address of 820 Miikana Road, Ottawa, ON and bounded to the north by Miikana Road and to the west by Kelly Farm Drive. Residential developments bound the site to the south and to the east. A topographical survey plan was completed by Farley, Smith and Denis Surveying Inc. in April 2022 and indicates that the grades at the site generally ranged between 94.2 m to 96.4 m and are variable across the site. The southeast corner of the site has been sloped to raise the grade from approximately 96.0 to as high as 98.1 m to match the grade of the surrounding properties.

At the time of the investigation the site is vacant and appears to have been previously stripped of almost all the vegetation. The exception to this is one tree and localized patches of grass. The ground at the site is uneven and cobble and boulder size rocks are present across the site. There are also various piles of fill or boulder/cobble present at the site.

At the southeast corner of the site there is a low-lying area of poor drainage where ponding water was noted. Localized pondering of water was also present throughout the site.

Photographs collected during the investigation are presented in Appendix A.

3. Existing Geotechnical Report

A geotechnical report prepared by Golder Associates (Golder) for the entire subdivision entitled "Proposed Residential Development Remer and Idone Lands Ottawa, Ontario" dated January 2017 was available to EXP as background material. Review of the report indicates that a total of three (3) Boreholes, BH13-07, 13-08 and BH16-104 were drilled at the site.

The general subsurface conditions recorded in the Golder report indicate a layer of topsoil which extended to depth of 0.1 m to 0.23 m (Elevation 97.8 m to 94.7 m). In boreholes BH13-7 and BH16-104 the topsoil was underlain by a layer of loose to compact silty sand. Glacial till was contacted at depths to depth of 0.2 m to 1.5 m (Elevation 97.8 m to 93.4 m), underlying the silty sand in borehole BH13-7 and BH16-104 and underlying the topsoil in BH13-8. Auger refusal was encountered at depths of 2.7 m to 4.5 m (Elevation 95.4 m to 91.3 m).

In 16-104 the installed piezometer recorded a groundwater level of 4.3 m depth (Elevation 91.6 m).

The information from these investigations have been the information incorporated into this report. The borehole logs from this investigation are included in Appendix B.

4. Procedure

4.1 Fieldwork

4.1.1 Boreholes

The test hole (boreholes and test pits) fieldwork was undertaken in two (2) stages. The first stage completed between April 4 and April 6, 2022 and consists the drilling of twelve (12) boreholes (Borehole Nos. 1 to 1, 13 and 14) advanced to termination/auger refusal depths ranging from 1.9 m to 5.2 m (Elevation 93.1 m to 89.9 m). On May 5, 2022, the second stage of the investigation was carried out, consisting of a total of eleven (11) testpits (Testpit Nos. 10, 11A, 12, 14A to 20) excavated throughout the site to refusal depths ranging from 0.9 m to 2.8 m (Elevation 94.6 m to 93.1 m). In addition to this, five (5) additional testpits (Testpit Nos. 2, 5, 6, 11 and 13) were excavated at or just adjacent to the corresponding borehole number in order to further examine the subsurface conditions and to establish whether the refusal to augers was met on boulders or on the surface of the bedrock. The borehole logs at these locations have incorporated the results of the testpits.

The borehole and testpit locations and geodetic elevations were established on site by EXP and are shown on the Testhole Location Plan, Figure 2. The fieldwork was supervised on a full-time basis by a representative from EXP.

The borehole locations were cleared of private and public underground services, prior to the start of drilling operations. The boreholes were drilled using a CME-45c track mounted drill rig and a CME-75 truck mounted drill rig equipped with continuous flight hollow stem augers, washboring, rock coring and soil sampling capabilities. Standard penetration tests (SPTs) were performed in all the boreholes a depth interval of generally at 0.75 m with soil samples retrieved by the split-barrel sampler. The boreholes were advanced beyond the depth of refusal in three (3) boreholes by conventional coring techniques using the N-size core barrel. A field record of wash water return, colour of wash water and any sudden drops of the drill rods were kept during rock coring operations. The subsurface soil conditions in each borehole were logged with each soil sample placed in a labelled plastic bags. Similarly, the rock cores were visually examined, placed in a core box, identified and logged.

Nineteen (19) mm diameter standpipes with slotted section were installed in selected boreholes for long-term monitoring of the groundwater levels. The standpipes were installed in accordance with EXP standard practice and the installation configuration is documented on the respective borehole log. The boreholes were backfilled upon completion of drilling.

Test pits were carried out with a Deere 380G type excavator. Soil samples (grab samples) of the different soil types exposed in the test pits were retrieved and the soil conditions from the test pits were logged with each soil sample placed in a labeled plastic bag. The test pits were backfilled upon completion of excavating.

On completion of the test hole fieldwork, the soil samples were transported to the EXP laboratory in Ottawa.

4.1.2 Multi-channel Analysis of Surface Waves (MASW) Survey

A multi-channel analysis of surface waves (MASW) survey of the site was carried out on July 7, 2022.

4.2 Laboratory Testing Program

A summary of the soil sample laboratory testing program is shown in Table I. The laboratory testing program for selected soil samples were undertaken in accordance with the American Society for Testing and Materials (ASTM). The corrosion analysis of selected soil samples was undertaken in accordance with the methods outlined in the Laboratory Certificate of Analysis report shown in Appendix C.

Table I: Summary of Laboratory Testing Program

Type of Test	Number of Tests Completed
Soil Samples	
Moisture Content Determination	86
Unit Weight Determination	18
Grain Size Analysis	5
Atterberg Limit Determination	4
Corrosion Analysis (pH, sulphate, chloride and resistivity)	2

5. Geology of the Site and Available Information

5.1 Surficial Geology Maps

The surficial geology was reviewed via the Google Earth applications published by the Ontario Ministry of Energy, Northern Development and Mines available le via www.mndm.gov.on.ca/en/mines-and-minerals/applications/ogsearth/surficial-geology and was last modified on May 23, 2017. The map indicates the Site is underlain by stone-poor, sandy silt to silt and sand-textured till on Paleozoic terrain. Organic Deposits are present to the west of the site. The surficial deposits are shown in Image 1 below.

Stone-poor, sandy silt to silty sand-textured glacial till

Organic Deposits: peat, muck, marl

Image 1 – Surficial Geology

5.2 Bedrock Geology Maps

The bedrock geology was reviewed via the Ontario Ministry of Energy, Northern Development and Mines OGS Earth map "Paleozoic Geology of Southern Ontario" published in 2007 indicates the site is underlain by limestone and dolostone bedrock of the Oxford formation. The bedrock geology is show in Image 2 below.

Limestone and dolostone bedrock of the Oxford formation

Image 2 – Bedrock Geology

6. Subsurface Conditions and Groundwater Levels

A detailed description of the subsurface conditions and groundwater levels from the borehole and testpits are given on the attached Borehole and Testpit Logs, Figure Nos. 3 to 24. The borehole and testpit 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.

Borehole and testpits were drilled to provide representation of subsurface conditions as part of a geotechnical exploration program and are not intended to provide evidence of potential environmental conditions.

It should be noted that the soil boundaries indicated on the borehole and testpit logs are inferred from non-continuous sampling and observations during drilling operations. These boundaries are intended to reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. The "Note on Sample Descriptions" preceding the borehole and testpit logs form an integral part of this report and should be read in conjunction with this report.

A review of the borehole and testpit logs indicates the following subsurface conditions with depth and groundwater level measurements.

6.1 Topsoil

A 300 mm and 700 mm thick surficial topsoil layer was encountered in Test Pits No. 14, 19 and 20.

6.2 Fill

Fill was encountered surficially or underlying the topsoil in all testpits and boreholes at the site. The fill extends to depths of 0.2 m to 2.2 m (Elevation 95.8 m to 92.5 m). The fill is variable but generally consists of sand with varying amounts of gravel and silt. The fill contains cobbles and boulders which were likely imported from nearby residential excavations. The fill also contained construction debris such as asphaltic concrete, roots and topsoil deposits at some locations. The standard penetration test (SPT) N-values of the fill range from the hammer weight to 26 indicating the fill is in a very loose to compact state. The moisture content and unit weights of the fill is 5 percent to 27 percent and 20.4 kN/m^3 to 22.9 kN/m^3, respectively.

The results from the grain-size analysis conducted on one (1) sample of the fill are summarized in Table II. The grain-size distribution curve is shown in Figure 26.

Table II: Summary of Results from Grain-Size Analysis -Fill Samples

Borehole (BH) No. – Sample (SS) No.	Depth (m)	Grain-Size Analysis (%)			Soil Classification (USCS)
		Gravel	Sand	Fines (Silt and Clay)	
TP11 SS1	0.2-0.4	19	47	34	Silty Sand with Gravel (SM)

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

6.3 Burried Topsoil Soil

A topsoil layer was encountered beneath the fill at depths of 0.5 m to 1.0 m (Elevation 95.0 m and Elevation 94.2 m) in Borehole/Test Pit No. 2 and Test Pits No. 13 and 14A, respectively. The buried topsoil ranges in thickness from 200 mm to 400 mm.

6.4 Silt and Sand to Silt

A deposit which ranged in consistency from silty sand to silt (here after referred to as the sand and silt layer) was contacted beneath the fill or topsoil Boreholes Nos. 2, 6, 7, 11, 13 and 14, in the corresponding additional testpits as well as Test Pits Nos. 7, 11A, 14A, 16 and 20. This deposit extends to depths ranging from of 0.5 m and 1.9 depth (Elevation 95.4 m to 92.9 m). The SPT N-values of this deposit range from 8 to 18 indicating the sand and silt is in a loose to compact state. The moisture content and unit weights range from ranges from 10 to 30 percent and 18.7 kN/m^3 to 21.5 N/m^3, respectively.

The results from the grain-size analysis conducted on two (2) samples are summarized in Table III. The grain-size distribution curves are shown in Figures 27 to 28.

Table III: Summary of Results from Grain-Size Analysis and Atterberg Limit Determination Silt/Sand and Silt Samples

Borehole (BH) No. – Sample (SS) No.	Depth (m)	Grain-Size Analysis (%) and Atterberg Limits					
		Gravel	Sand	Silt	Clay	Plasticity Index	Soil Classification (USCS)
TP 16 S2	0.9-1.1	2	55	33	10	N.P.	Silty Sand (SM)
BH6 SS2	0.8 - 1.4	0	3	86	11	N.P.	Silt (ML)

N.P = Non-plastic

Based on a review of the results of the grain-size analysis, the soil may be classified as ranging from a silty sand (SM) to silt (ML) in accordance with the USCS.

6.5 Silty sand and gravel Glacial Till

A deposit of glacial till was contacted beneath the fill or sand and silt at depths of 0.2 m to 2.2 m (Elevation 95.8 m to Elevation 92.5 m) in all the testholes with the exception of Borehole No. 14 and Test Pits Nos. 14, 14A and 20. The glacial till contains varying amounts of gravel, sand, silt and clay within the soil matrix as well as cobbles and boulders. The SPT N-values of the glacial till range from 1 to 94 indicating the glacial till is in a very loose to very dense state. Higher N values with low sampler penetration such as N equal to 50 for 50 mm sampler penetration into the glacial till are likely a result of the split spoon sampler making contact with a cobble or boulder within the glacial till. The natural moisture content of the glacial till is 3 percent to 17 percent and the natural unit weight is 22.6 kN/m^3 to 23.9 kN/m^3.

The results from the grain-size analysis conducted on two (2) samples of the glacial till are summarized in Table IV. The grain-size distribution curves are shown in Figures 29 and 30.

Table IV: Summary of Results from Grain-Size Analysis and Atterberg Limit Determination Glacial Till Samples

Borehole (BH) No. – Sample (SS) No.	Depth (m)	Grain-Size Analysis (%) and Atterberg Limits					
		Gravel	Sand	Silt	Clay	Plasticity Index	Soil Classification (USCS)
TP 15 S2	1.0 - 1.2	18	40	39	3	N.P.	Silty sand with Gravel (SM)
TP 5 SS2	3.0 - 3.6	29	37	31	3	N.P.	Silty sand with Gravel (SM)

N.P = Non-plastic

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

6.6 Auger Refusal and Bedrock

Borehole Nos. 03, 09 and 14 were extended past the depth of auger refusal through rock coring. In Borehole Nos. 03 and 09 the refusal was shown to be cobble or boulder within the glacial till. In Borehole No. 14 rock coring encountered limestone bedrock at 1.3 m depth (Elevation 93.7 m). The total core recovery (TCR) within Borehole No. 14 ranged from 84 percent to 100 percent and has a rock quality designation (RQD) ranging from 36 percent to 55 percent indicating a poor to fair quality rock.

A summary of the auger refusal depths and the depth to bedrock confirmed by coring the bedrock are shown in Table V.

Table V: Summary of Auger and Soil Sampler Refusal and Bedrock Depths (Elevations) in Boreholes

Borehole (BH) No.	Ground Surface Elevation (m)	Auger/Excavator Refusal Depth (m) (Elevation)	Depth of confirmed bedrock by coring of excavation (m)	Comment wrt to Depth (Elevation) of Bedrock Surface
BH-01	94.74	2.9 (91.8)	--	Auger Refusal at 2.9 m (91.8 m). Borehole terminated at 3.4 m (91.3 m).
TP/BH-02	94.96	2.4 (92.6)	--	Auger Refusal at 2.4 m (92.6 m). Test Pit Terminated at 3.1 m (92.2 m) within glacial till.
BH-03	95.33	1.2 (94.1)	--	Auger Refusal at 1.2 m (94.1 m). Borehole terminated within glacial till at 5.2 m (90.1 m).
BH-04	94.55	3.0 (91.6)	--	Auger Refusal at 3.0 m (91.6 m). Borehole terminated at 3.2 m (91.4 m) within glacial till.
TP/BH-05	95.06	1.2 (93.9)	--	Auger Refusal at 1.2 m (93.9 m). Excavator Refusal at 2.9 m (92.2)
TP/BH-06	94.53	2.3 (92.2) /2.4 (92.1)	--	Auger Refusal at 2.3 m (92.2 m). Excavator Refusal at 2.4 m (92.1) on Bedrock
BH-07	94.98	3.1 (91.9)	--	Auger Refusal at 3.1 m (91.9 m).
BH-08	95.86	3.1 (92.8)	--	Auger Refusal at 3.1 m (92.8 m).
BH-09	95.12	1.8 (93.3)	--	Auger Refusal at 1.8 m (93.3 m). Borehole terminated at 5.2 m (89.9 m) within glacial till.
TP/BH-11	96.08	2.6 (93.5)	--	Auger Refusal at 2.6 m (93.5 m). Test Pit Terminated at 3.0 m (93.1) within glacial till.
TP/BH-13	95.15	2.0 (93.2)/ 2.2 (93.0)	--	Auger Refusal at 2.0 m (93.2 m). Excavator Refusal at 2.2 m (93.0 m).
BH-14	94.99	1.3 (93.7)	1.3 (93.7)	Auger Refusal at 1.3 m (93.7 m). 3.3 m of bedrock cored below 1.3 m depth.
TP-10	95.94	2.8 (93.1)	2.8 (93.1)	Excavator Refusal at 2.8 m (93.1 m) on observed bedrock.
TP-11A	95.9	1.3 (94.6)	--	Excavator Refusal at 1.3 m (94.6 m).
TP-12	95.7	2.6 (93.1)	2.6 (93.1)	Excavator Refusal at 2.6 m (93.1 m) on observed bedrock.
TP-14	94.99	1.1 (93.9)	1.1 (93.9)	Excavator Refusal at 1.1 m (93.9 m) on observed bedrock.
TP-14A	95.69	1.9 (93.8)	1.9 (93.8)	Excavator Refusal at 1.9 m (93.8 m) on observed bedrock.
TP-15	94.6	1.5 (93.1)	1.5 (93.1)	Excavator Refusal at 1.5 m (93.1 m) on observed bedrock.
TP-16	95.88	1.5 (94.4)	1.5 (94.4)	Excavator Refusal at 1.5 m (94.4 m) on observed bedrock.
TP-17	96.01	2.0 (94.0)	2.0 (94.0)	Excavator Refusal at 2.0 m (94.0 m) on observed bedrock.
TP-18	95.77	2.3 (93.5)	2.3 (93.5)	Excavator Refusal at 2.3 m (93.5 m) on observed bedrock.
TP-19	94.65	0.9 (93.8)	0.9 (93.8)	Excavator Refusal at 0.9 m (93.8 m) on observed bedrock.
TP-20	95.99	1.4 (94.6)	1.4 (94.6)	Excavator Refusal at 1.4 m (94.6 m) on observed bedrock.

Unit weight determination and unconfined compressive strength tests were conducted on two (2) rock core sections and the results are summarized in Table VI.

Table VI: Summary of Unconfined Compressive Strength Test Results – Bedrock Cores				
Borehole (BH) No. – Run No.	Depth (m)	Unit Weight (kN/m^3)	Unconfined Compressive Strength (MPa)	Classification of Rock with respect to Strength
BH14 Run2	1.9-2.4	27.1	88.0	R4
BH14 Run3	3.0-3.5	27.6	239.8	R5

A review of the test results in Table VI indicates the strength of the rock may be classified as strong to very strong in accordance with the Canadian Foundation Engineering Manual (CFEM), Fourth Edition, 2006.

Photographs of the rock cores are shown in Appendix D.

In the Golder report, auger refusal was encountered at depths of 2.7 m to 4.5 m (Elevation 95.4 m to 91.3 m). In borehole BH 16-104 the borehole was extended past the depth of refusal by 0.5 m by coring, extending from 4.5 m to 5.0 m (Elevation 91.3 m to 90.8) and the borehole records indicate that this is probable bedrock. It should be noted that a rock core run of 0.5 m could be boulder or cobble within the glacial till.

6.7 Groundwater Level Measurements

A summary of the groundwater level measurements taken in the boreholes equipped with standpipes is shown in Table VII.

Table VII: Summary of Groundwater Level Measurements					
Borehole No. (BH)	Ground Surface Elevation (m)	Date of Measurement (Elapsed Time in Days from Date of Installation)	Depth Below Ground Surface (Elevation), m	Date of Measurement (Elapsed Time in Days from Date of Installation)	Depth Below Ground Surface (Elevation), m
BH-01	94.74	44 days	Dry to 2.9 (91.8)	204 days	Dry to 2.9 (91.8)
BH-03	95.33	43 days	Dry to 5.2 (90.1)	203 days	Dry to 5.2 (90.1)
BH-07	94.98	44 days	Dry to 3.0 (92.0)	204 days	Dry to 3.0 (92.0)
BH-09	95.12	43 days	Dry to 4.6 (90.5)	203 days	Dry to 4.2 (90.9)

The groundwater level was found to be deeper than the installation depth than the installed well screens, 2.9 to 5.2 (Elevation 92.0 m to 90.1 m). In the Golder report in boreholes 16-104 recorded groundwater level of 4.3 m depth (Elevation 91.6 m).

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

7.1 Site Classification for Seismic Site Response

Based on the results from the Multi-channel Analysis of Surface Waves (MASW) survey (shear wave velocity) shown in Appendix A and comparison of the survey results with Table 4.1.8.4.A of the 2012 Ontario Building Code (as amended May 2, 2019), the site classification for seismic response is Class C.

7.2 Liquefaction Potential of Soils

The subsurface soils are not susceptible to liquefaction during a seismic event.

8. Grade Raise Restrictions

Based on the borehole information, the site is underlain by sand and silt or glacial till that are not susceptible to consolidation settlement due to loads from raising the grades at the site, from building foundations and lowering the groundwater level.

N45 drawing C2, titled "Site Grading, Erosion and Sediment Control Plan" dated June 2022 indicates the proposed finished floor elevation will be set at Elevation 95.6 m. The proposed sports field will be at an elevation of 97.5 m and the proposed parking lot will be at elevation will range from 95.2 m to 94.9 m, sloping downwards to the south. This result in a grade raise of up to approximately 1.4 m within the building footprint, up to approximately 1.7 m at the sports field and a cut of approximately 1.0 in the parking area.

A maximum grade raise of 2.0 m is considered acceptable from a geotechnical point of view.

9. Site Grading

For budgeting purposes, the contractor should assume that all existing fill, surficial and buried topsoil (organic) layers and organic stained soils within the footprints of the proposed building, portable(s), sports field, parking lots and access roads would require removal and replacement with well-compacted fill as indicated below.

Site grading within the **proposed building footprint** should consist of the removal of all existing fill, surficial and buried topsoil (organic) layers and organic stained soils down to the native undisturbed material. The native subgrade should be examined by a geotechnician. Any loose/soft areas identified during the subgrade examination should be excavated, removed and replaced with Ontario Provincial Standard Specification (OPSS) Granular B Type II material compacted to 98 percent standard Proctor maximum dry density (SPMDD). Once the subgrade has been approved, the grades may be raised to the design underside footing and floor slab elevation by the construction of an engineered fill pad constructed in accordance with Section 9 of this report.

Site grading within the **proposed portable area** should consist of the removal of all existing fill, surficial and buried topsoil (organic) layers and organic stained soils down to the native undisturbed material. The native subgrade should be examined by a geotechnician. Any loose/soft areas identified during the subgrade examination should be excavated, removed and replaced with Ontario Provincial Standard Specification (OPSS) Granular B Type II material compacted to 98 percent standard Proctor maximum dry density (SPMDD). Once the subgrade has been approved, the grades may be raised to the design subgrade level by the construction of an engineered fill pad constructed in accordance with the procedure in Section 9 of this report.

Site grading within the **proposed sports field, parking lot and access road areas** should consist of the removal of all existing fill, surficial and buried topsoil (organic) layers and organic stained soils down to the native undisturbed material. The native subgrade should be proofrolled in the presence of a geotechnician. Any loose/soft areas identified during the proofrolling process should be excavated, removed and replaced with Ontario Provincial Standard Specification (OPSS) Granular B Type II or OPSS Select Subgrade Material (SSM) compacted to 95 percent standard Proctor maximum dry density (SPMDD). Alternatively, portions of the excavated and removed existing fill that is free of debris, cobbles, boulders and topsoil (organic soils), may be reused to raise the site grades to the design subgrade level. The suitability of re-using the existing fill to raise the grades will have to be further assessed at time of construction by examining the fill material and conducting additional tests on the material.

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

10. Foundation Considerations

The design finished floor elevation of the proposed school building is Elevation 95.6 m. Based on a review of the borehole information, it is considered feasible to support the proposed building by spread and strip footings. It is our understanding that the design elevation of the underside of the footings will be Elevation 94.1 m. Based on a review of the boreholes located within the footprint of the proposed school building, the footings, at the design underside of footing elevation of Elevation 94.1 m, the encountered soil was either fill, sand and silt or glacial till. The topsoil (surficial and buried) and the existing fill, which extends as deep as Elevation 92.5 m, are not suitable to support the footings and, where present, would have to be excavated, removed and replaced with an engineered fill pad that is constructed on top of the undisturbed native soil. Therefore, the footings that will support the proposed school building will have to extend to either approved undisturbed native soil or founded on a properly constructed engineered fill pad constructed on the approved undisturbed native soil.

Square spread footings having a maximum width and length of 3.0 m and strip footings having a maximum width of 1.5 m founded on approved native soil founded or founded on a properly constructed engineered fill pad constructed on the approved undisturbed native soil may be designed for a bearing capacity at serviceability limit state (SLS) of 150 kPa and factored geotechnical resistance at ultimate limit state (ULS) of 225 kPa. The factored geotechnical resistance value at ULS includes a resistance factor of 0.5. The total and differential settlements of well designed and constructed footings placed in accordance with the above recommendations are expected to be less than 25 mm and 19 mm respectively. The SLS and factored ULS values are valid provided the site grade raise to a maximum of 2.0 m is respected.

If the founding depth for the proposed footings will be at a lower elevation than Elevation 94.1 m, EXP should be contacted to provide updated SLS and factored ULS values for the footings.

The construction of the engineered fill pad should consist of the removal of all existing fill, surficial and buried topsoil (organic) layers and organic stained soils down to the native undisturbed sand and silt or glacial till. The native subgrade should be examined by a geotechnician. Any loose/soft areas identified during the subgrade examination should be excavated, removed and replaced with Ontario Provincial Standard Specification (OPSS) Granular B Type II material compacted to 98 percent standard Proctor maximum dry density (SPMDD). Once the native subgrade has been approved, the grades may be raised to the design underside footing and floor slab elevation by the construction of an engineered fill pad. The excavation for the removal of fill and topsoil layers should extend to a sufficient distance beyond the limits of the proposed structure to accommodate a 1.0 m wide horizontal bench of engineered fill that extends beyond the perimeter of the proposed building on all sides, which should thereafter be sloped at an inclination of 1H to 1V down to the approved subgrade. The engineered fill should consist of OPSS Granular B Type II material that is placed in 300 mm thick lifts and each lift compacted to 100 percent SPMDD. The placement and compaction of the engineered fill can in this way be undertaken to the founding level of the footings. From the footing level to the underside of the floor slab, each lift of the Granular B Type II material should be compacted to 98 percent of SPMDD. The engineered fill should be placed under the full-time supervision of a geotechnician working under the direction of a geotechnical engineer. In-place density tests should be undertaken on each lift of the engineered fill to ensure that it is properly compacted prior to placement of subsequent lift.

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

A minimum of 1.5 m of earth cover should be provided to the footings to protect them from damage due to frost penetration. The frost cover should be increased to 2.1 m for unheated structures if snow will not be removed from their vicinity. If snow will be removed from the vicinity of the unheated structures, the frost cover should be increased to 2.4 m. Rigid insulation thermally equivalent to the required soil cover may be used instead of the soil cover. Alternatively, a combination of rigid insulation and soil cover may be used to achieve the required frost protection for the footings.

The recommended factored geotechnical resistance at ULS and bearing pressure at SLS have been calculated by EXP from the borehole information for the design stage only. The investigation and comments are necessarily on-going as new information of underground conditions becomes available. For example, more specific information is available with respect to conditions between boreholes when foundation construction is underway. The interpretation between boreholes and the recommendations of this report must therefore be checked through field monitoring provided by an experienced geotechnical engineer to validate the information for use during the construction stage.

11. Floor Slab and Drainage Requirements

The floor slab for the proposed building may be designed and constructed as a slab-on-grade placed on a 200 mm thick 19 mm sized clear stone bed placed on a minimum 300 mm thick engineered fill pad set on the approved native subgrade constructed in accordance with Section 9 of this report. The clear stone would minimize the capillary rise of moisture from the sub-soil to the floor slab. Alternatively, the floor slab may be cast on a 200 mm thick bed of OPSS Granular A overlain by a vapour barrier. Adequate saw cuts should be provided in the floor slabs to control cracking.

Perimeter drains should be provided for the proposed building. Underfloor drains are not required based on the proposed grade raise and the low water table.

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

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

12. Excavation and De-Watering Requirements

12.1 Excess Soil Management

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

12.2 Excavation

Excavations for the construction of the foundations and underground services of the proposed facility are expected to extend to depths of 3 to 4 m below grade. These excavations will be undertaken in the fill, sand and silt and glacial till. The excavations are anticipated to be above or slightly below the groundwater table.

Excavations maybe undertaken by conventional heavy equipment capable of removing debris, cobbles and boulders present within the overburden soils and fill.

The excavation within the subsurface soils should comply with the most recent Occupational Health and Safety Act (OHSA), Ontario Regulations 213/91 (August 1, 1991). Based on the definitions contained in OHSA, the subsurface soils at the site are classified as Type 3 soil and excavation sidewalls must be cut back at 1H:1V from the bottom of the excavation. Below the groundwater table, the excavation side slopes are expected to slough and will eventually stabilize at a slope of 2H:1V to 3H:1V. If space restrictions prevent open cut excavations, underground services may be installed within the confines of a prefabricated support system which is designed and installed in accordance with the above-noted regulations.

Any excavation of bedrock would require the use of line drilling and blasting techniques. Hoe ramming is also possible, but progress is expected to be slow. Contractor bidding on this project must review available data and decide on their own the best method for the excavation of the bedrock if deemed required.

It is recommended that a pre-construction condition survey of adjacent building(s) and infrastructure be undertaken prior to any earth (soil) and rock excavation work, blasting or construction operations. It is also recommended that vibration monitoring of adjacent neighboring structures and infrastructure located within the construction zone of influence be undertaken during construction or blasting to ensure the existing structures and infrastructure are not damaged. Prior to the commencement of blasting, a detailed blast methodology should be submitted by the Contractor.

Excavations at the site are not expected to experience a base-heave type of failure.

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.

12.3 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. In areas of high infiltration or in areas where more permeable soil layers may exist, a higher seepage rate should be anticipated. Therefore, the need of high capacity pumps to keep the excavation dry should not be ignored.

Based on the recorded groundwater levels during the EXP 2022 investigation the piezometers at the site were found to be dry and therefore the groundwater table was below the screen depth at the piezometers which ranged from 2.9 to 5.2 (Elevation 92.0 m to 90.1 m). It has been assumed that excavation will be carried out to depths ranging from 0.5 m to 2.2 m depths

(Elevation 95.2 m to Elevation 92.5 m), where native soil was encountered. Based on these results, it is anticipated that excavations at this site will be above the recorded groundwater elevation.

It should be noted that where encountered, in the Golder investigation, groundwater was encountered at 4.3 m depth (Elevation 91.6 m).

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

13. Pipe Bedding Requirements

For site servicing, it is anticipated that the subgrade for the proposed underground services will consist of engineered fill, silt and sand and glacial till.

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

It is recommended that the pipe bedding be 300 mm thick and consist of OPSS Granular A. The bedding material should be placed along the sides and on top of the pipe to provide a minimum cover of 300 mm. The bedding should be compacted to at least 98 percent of the SPMDD.

The bedding thickness may be further increased in areas where the subgrade becomes disturbed.

Since paved surfaces will be located over service trenches, it is recommended that the trench backfill material within the frost zone (up to 1.8 m below finished grade), should match the existing material in the roadway to minimize differential frost heaving of the subgrade. The trench backfill should be placed in 300 mm thick lifts and each lift should be compacted to 95 percent SPMDD.

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

It has been assumed that site services will be constructed within the parking areas and in the bus loop the east and southwest of the proposed school, respectively. It should be noted that in Test Pit No, 12 the weathered bedrock surface was encountered at 2.6 m in depth. In testpit TP-11A, excavator refusal was encountered at 1.3 m depth on the either the bedrock surface or a very large boulder. In the proposed bus loop bedrock was visually confirmed at TP/BH-14 at 1.3 (95.0) and excavator refusal was encountered at 2.0 (93.2) in TP/BH-13. The refusal may indicate the bedrock surface or cobble/boulder within the glacial till.

Shallow bedrock and large boulders should be expected during the installation of any services at the site and contractors bidding on this work should anticipate these conditions.

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

The on-site soils to be excavated are fill, sand and silt and glacial till. The existing fill and native soils (with the exception of the boulders and cobbles in the fill or till) from above the groundwater table may be used as subgrade fill in the landscaped areas (except areas of future portable) provided that their moisture content remains within +/- 2 percent of the optimum value as established by ASTM Method D698-12e1. However, these soils are susceptible to moisture absorption due to precipitation and therefore should be protected from the elements if stockpiled on site. The compactability of these soils should be assessed during early stages of construction. The native soils below the groundwater table are expected to be too wet for adequate compaction and should be discarded. They may, however, be used for general grading purposes in the landscape areas if left in the sun to dry or mixed with drier material.

It is anticipated that the majority of the material required for backfilling purposes in the interior and exterior of the building and for trench backfill would have to be imported and should preferably conform to the following specifications:

- Engineered Fill under footings - OPSS 1010 Granular B Type II – Compacted to 100 percent of the SPMDD;
- Engineered Fill under the floor slab - OPSS 1010 Granular B Type II – Compacted to 98 percent of the SPMDD;
- Backfill material for footing trenches and against foundation walls located outside the building – OPSS 1010 Granular B Type II - Compacted to 95 percent of the SPMDD; and,
- Trench backfill and subgrade fill in parking area and access roads – OPSS 1010 Select Subgrade Material (SSM) - Compacted to 95 percent of the SPMDD.

15. Access Roads and Parking Lot

Pavement structures for the surface parking lot and access roads are given on Table VI below for the anticipated engineered fill, fill, silt and sand and glacial till subgrades. The pavement structures are based upon the assumption that the subgrade will be properly prepared and assumes a functional design life of 15 to 18 years. The proposed functional design life represents the number of years to the first rehabilitation, assuming regular maintenance is carried out.

Table VIII: Recommended Pavement Structure Thicknesses			
Pavement Layer	**Compaction Requirements**	**Computed Pavement Structure**	
		Light Duty Traffic (Parking Lots - Cars Only)	**Heavy Duty (Parking Lots, bus turn arounds and access Roads)**
Asphaltic Concrete	92-97 percent MRD	65 mm HL3/SP12.5 mm/ Cat.B (PG 58-34)	50 mm HL3/SP12.5 Cat. B 60 mm HL8/SP 19 Cat. B (PG 64-28)
OPSS 1010 Granular A Base (crushed limestone)	100% percent SPMDD	150 mm	150 mm
OPSS 1010 Granular B Type II Sub-base	100 percent SPMDD	450 mm	600 mm
Notes: 1. SPMDD denotes standard Proctor maximum dry density, ASTM, D-698-12e2. 2. MRD denotes Maximum Relative Density, ASTM D2041. The upper 300 mm of the subgrade fill must be compacted to 98% SPMDD.			

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

1. As part of the subgrade preparation, the proposed parking area and access roads should be stripped of topsoil and other obviously unsuitable material. The subgrade should be properly shaped, crowned, then proofrolled with a heavy vibratory roller in the full-time presence of a representative of this office. Any soft or spongy subgrade areas detected should be sub excavated and properly replaced with suitable approved backfill compacted to 95 percent SPMDD (ASTM D698-12e2).
2. The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure that uniform subgrade moisture and density conditions are achieved. The need for adequate drainage cannot be over-emphasized. Subdrains should be installed on both sides of the access road(s). Subdrains must be installed in the proposed parking area at low points and should be continuous between catchbasins to intercept excess surface and subsurface moisture and to prevent subgrade softening. This will ensure no water collects in the granular course, which could result in pavement failure during the spring thaw. The location and extent of subdrains required within the paved areas should be reviewed by this office in conjunction with the proposed site grading.
3. To minimize the problems of differential movement between the pavement and catchbasins/manhole due to frost action, the backfill around the structures should consist of free-draining granular preferably conforming to OPSS Granular B Type II material. Weep holes should be provided in the catchbasins/manholes to facilitate drainage of any water that may accumulate in the granular fill.
4. The most severe loading conditions on light-duty pavement areas and the subgrade may occur during construction. Consequently, special provisions such as restricted lanes, half-loads during paving, temporary construction roadways, etc., may be required, especially if construction is carried out during unfavorable weather.

5. The finished pavement surface should be free of depressions and should be sloped (preferably at a minimum cross fall of 2 percent) to provide effective surface drainage towards catch basins. Surface water should not be allowed to pond adjacent to the outside edges of paved areas.
6. Relatively weaker subgrade may develop over service trenches at subgrade level. These areas may require the use of thicker/coarser sub-base material and the use of a geotextile at the subgrade level. If this is the case, it is recommended that additional 150 mm thick granular sub-base, OPSS Granular B Type II, should be provided in these areas, in addition to the use of a geotextile at the subgrade level.
7. The granular materials used for pavement construction should conform to Ontario Provincial Standard Specifications (OPSS 1010) for Granular A and Granular B Type II and should be compacted to 100 percent of the SPMDD.

The asphaltic concrete used, and its placement should meet OPSS 1150 or 1151 requirements. It should be compacted from 92 percent to 97 percent of the MRD (ASTM D2041). Asphalt placement should be in accordance with OPSS 310 and OPSS 313.

It is recommended that EXP be retained to review the final pavement structure design and drainage plans prior to construction to ensure they are consistent with the recommendations of this report.

16. Corrosion Potential

Chemical tests limited to pH, sulphate, chloride and resistivity were undertaken on two (2) soil samples. A summary of the results is shown in Table IX. The laboratory certificate of analysis is shown in Appendix C.

Table IX: Corrosion Test Results on Soil Samples

Borehole – Sample No.	Soil Type	Depth (m)	pH	Sulphate (%)	Chloride (%)	Resistivity (ohm-cm)
TP5 S2	Glacial Till	0.75- 1.0	8.19	0.0069	0.0002	5750
BH13 SS2	Silty Sand	2.5-4.5	7.71	0.0016	0.0003	10300

The results indicate the soils have a negligible sulphate attack on subsurface concrete. The concrete should be designed in accordance with CSA A.23.1-14.

The results of the resistivity tests indicate that the silty sand is non-corrosive and the and sand and the glacial till is mildly corrosive and to bare steel as per the National Association of Corrosion Engineers (NACE). Appropriate measures should be taken to protect the buried bare steel from corrosion.

17. Tree Planting Restrictions

Based on the soil types encountered at the site, there are no restrictions to tree planting (from a geotechnical perspective) on Site.

18. Additionnal Comments

All earthwork activities from placement and compaction of fill in the service trenches to subgrade preparation, placement and compaction of granular materials and asphaltic concrete should be inspected by qualified geotechnicians to ensure that construction of the sewers and pavement proceeds according to the specifications. All the footing beds should also be examined by a geotechnical engineer to ensure that the design bearing pressure is available at the founding level and that the footing beds have been properly cleaned.

The bedrock/auger refusal depths across the site were variable. Consideration should be given to further investigation along the alignment of any proposed utilities.

19. General Comments

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

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

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

Sincerely

Daniel Wall, M. Eng., P.Eng.
Geotechnical Engineer
Earth & Environment

Ismail M. Taki, M. Eng., P.Eng.
Senior Manager, Eastern Region
Earth & Environment

Figures

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HORIZONTAL 1:20,000

exp Services Inc. 100-2650 Queensview Drive Ottawa, ON K2B 8H6 **www.exp.com**	DESIGN DW DRAWN AS DATE MAY 2022 FILE NO OTT-00245378-W0	GEOTECHNICAL INVESTIGATION. PROPOSED NEW FINDLAY CREEK PUBLIC SCHOOL 820 MIIKANA ROAD, OTTAWA SITE LOCATION PLAN	SCALE 1:20,000 SKETCH NO FIG 1

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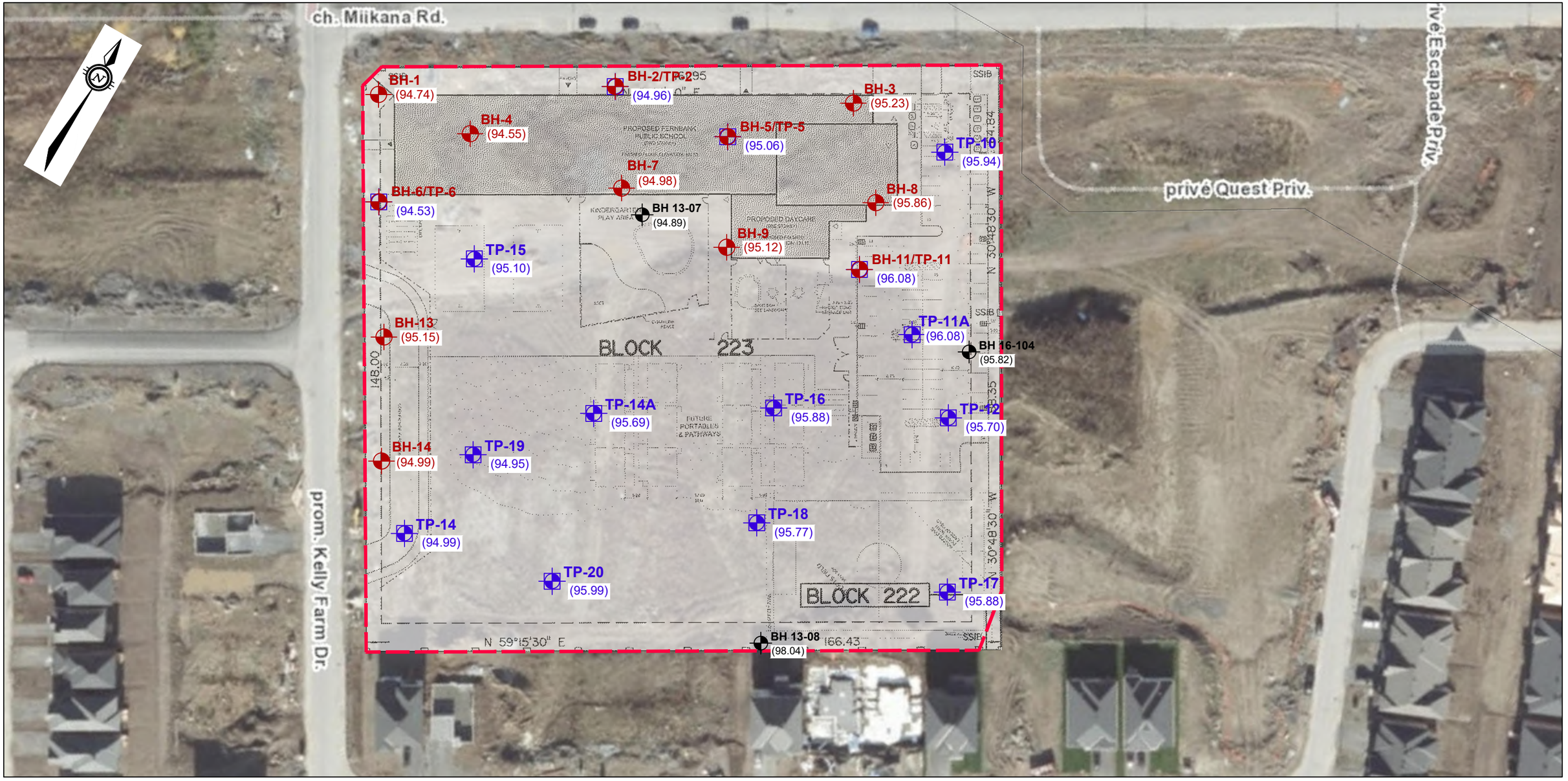

LEGEND

- PROPERTY LINE
- BH-1 (94.74) — BOREHOLE LOCATION, NUMBER (GROUND SURFACE ELEVATION) EXP 2022 INVESTIGATION
- TP-10 (95.94) — TEST PIT LOCATION, NUMBER (GROUND SURFACE ELEVATION) EXP 2022 INVESTIGATION
- BOREHOLE LOCATION, NUMBER (GROUND SURFACE ELEVATION) GOLDER 2017 INVESTIGATION

NOTES:

1. THE BOUNDARIES AND ROCK/SOIL TYPES HAVE BEEN ESTABLISHED ONLY AT TEST HOLE LOCATIONS. BETWEEN TEST HOLES THEY ARE ASSUMED AND MAY BE SUBJECT TO CONSIDERABLE ERROR.
2. SOIL AND ROCK SAMPLES 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. TOPSOIL QUANTITIES SHOULD NOT BE ESTABLISHED FROM THE INFORMATION AT THE TEST HOLE LOCATIONS.
5. THIS DRAWING FORMS PART OF THE REPORT PROJECT NUMBER AS REFERENCED AND SHOULD BE USED ONLY IN CONJUNCTION WITH THIS REPORT.
6. BASE PLAN INFORMATION OBTAINED FROM W.J. JOHNSTON SURVEYING LTD DATED APRIL 28, 2020.

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HORIZONTAL 1:1250

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DESIGN	DW
DRAWN	AS
DATE	Nov 2022
FILE NO	OTT-00245378-W0

GEOTECHNICAL INVESTIGATION.
PROPOSED NEW FINDLAY CREEK PUBLIC SCHOOL
820 MIIKANA ROAD, OTTAWA

TESTHOLE LOCATION PLAN

SCALE 1:1,250

SKETCH NO FIG 2

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Notes On Sample Descriptions

1. All sample descriptions included in this report follow the Canadian Foundations Engineering Manual soil classification system. This system follows the standard proposed by the International Societv for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by **exp** Services Inc. also follow the same system. Different classification systems may be used by others; one such system is the Unified Soil Classification. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.

ISSMFE SOIL CLASSIFICATION

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

0.002 0.006 0.02 0.06 0.2 0.6 2.0 6.0 20 60 200

EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

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

UNIFIED SOIL CLASSIFICATION

2. Fill: Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.

3. Till: The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

Log of Borehole BH-01

Project No: OTT-00245378-W0

Project: Fernbank Public School

Location: Kelly Farm Dr. at Miikana Rd., Ottawa, ON

Figure No. 3

Page. 1 of 1

Date Drilled: 'April 5, 2022

Drill Type: CME-45C Track- Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: D.W.

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 Silty sand, with gravel, cobbles, boulders, organic pockets, wood/root fragments and debris (wire), brown, moist, (loose to compact)	94.74	0	6		SS1	
				1	26		SS2	
				2	15		SS3	22.9
		GLACIAL TILL Silty sand with gravel, cobbles, shale fragments and boulders, brown, moist, (very dense)	92.5		94		SS4	
		Auger Refusal at 2.9 m Depth		3	18 then 50 / 150 mm		SS5	
		Borehole terminated at 3.4 m Depth	91.3					

LOG OF BOREHOLE OTT-00245378 - KELLY FARM DR. AT MIIKANA RD BH LOGS.GPJ TROW OTTAWA.GDT 10/26/22

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter standpipe was installed as shown.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00245378-W0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
5/19/22	>2.9	2.9
10/26/2022	>2.9	

CORE DRILLING RECORD

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

Log of Borehole BH-02

Project No: OTT-00245378-W0

Project: Fernbank Public School

Location: Kelly Farm Dr. at Miikana Rd., Ottawa, ON

Figure No. 4

Page. 1 of 1

Date Drilled: 'April 4, 2022

Drill Type: CME-45C Track- Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: D.W.

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 sand with gravel, cobbles, topsoil pockets and asphalt fragments/construction debris, brown, moist, (compact)	94.96	0
		TOPSOIL ~ 300 mm	94.5	
		SILT With sand and rootlets, brown, moist to wet, (loose to compact)	94.2	1
		GLACIAL TILL Silty sand with gravel, cobbles, boulders and shale fragments, brown, moist	93.3	2
		Auger Refusal at 2.4 m Depth. Continued on Test Pit Log TP-02.	92.6	

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

12 — SS1

8 — 19.7 SS2

17 — SS3

20 / 25 mm then bouncing — SS4

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-00245378-W0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
		2.2

CORE DRILLING RECORD

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

LOG OF BOREHOLE OTT-00245378 - KELLY FARM DR. AT MIIKANA RD BH LOGS.GPJ TROW OTTAWA.GDT 10/26/22

Log of Test Pit TP-02

Project No: OTT-00245378-W0

Project: Fernbank Public School

Location: Kelly Farm Dr. at Miikana Rd., Ottawa, ON

Figure No. 4a

Page. 1 of 1

Date Drilled: 'May 5, 2022

Drill Type: Deere 380G Excavator

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

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	Depth Below Ground m	Depth
		FILL Silty sand with gravel, cobbles, topsoil pocket and, asphalt fragments/construction debris, brown, moist	94.96	0
			94.5	
		TOPSOIL	94.2	
		SILT With sand and rootlets, brown, moist to wet		1
			93.3	
		GLACIAL TILL Silty sand with gravel, cobbles, boulders and shale fragments, brown, moist		2
			91.9	3
		Test Pit Terminated at 3.1 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
S1	
S2	
S3	

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test Pit backfilled upon completion of excavation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00245378-W0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Upon Completion	dry	open

CORE DRILLING RECORD

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

LOG OF TEST PIT OTT-00245378 FERNBANK SCHOOL TP LOGS.GPJ TROW OTTAWA.GDT 10/21/22

Log of Borehole BH-03

Project No: OTT-00245378-W0

Project: Fernbank Public School

Location: Kelly Farm Dr. at Miikana Rd., Ottawa, ON

Figure No. 5

Page. 1 of 1

Date Drilled: 'April 6, 2022

Drill Type: CME-45C Track- Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: D.W.

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 Silty sand with gravel, topsoil and rootlets, dark brown, moist, (compact)	95.33	0	11	×	SS1	21.5
		GLACIAL TILL Silty sand with gravel, cobbles and boulders, brown, moist, (dense)	94.6	1	28 then 50 /75 mm	×	SS2	
		Auger refusal on boulders at 1.2 m depth.					Run 1	
				2			Run 2	
				3	42	×	SS3	
				4			Run 3	
		Very loose below 4.6 m depth. Rock fragments in sample spoon		5	3	×	SS4	
		Borehole Terminated at 5.2 m Depth	90.1					

LOG OF BOREHOLE OTT-00245378 - KELLY FARM DR. AT MIIKANA RD BH LOGS.GPJ TROW OTTAWA.GDT 10/26/22

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter standpipe was installed as shown.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00245378-W0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
5/19/22	>5.2	open
10/26/2022	>5.2	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	1.2 - 1.5	100	50
2	1.5 - 2.9	50	32
3	3.7 - 4.6	40	0

Log of Borehole BH-04

Project No: OTT-00245378-W0

Project: Fernbank Public School

Location: Kelly Farm Dr. at Miikana Rd., Ottawa, ON

Figure No. 6

Page. 1 of 1

Date Drilled: 'April 5, 2022

Drill Type: CME-45C Track- Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: D.W.

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 Silty sand with gravel, rootlets and topsoil pockets, brown, wet, (very loose)	94.55	0	1		SS1	
		FILL Silty sand, trace rootlets, brown, moist to wet, (loose)	93.9	1	7		SS2	20.4
		GLACIAL TILL Silty sand with gravel, cobbles and boulders, brown, moist to wet (compact to dense)	93.2	2	8 then 50/125 mm		SS3	
					39		SS4	
		Auger Refusal at 3.0 m Depth	91.4	3	10 then bouncing		SS5	
		Borehole Terminated at 3.2 m Depth						

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-00245378-W0

WATER LEVEL RECORDS

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

CORE DRILLING RECORD

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

LOG OF BOREHOLE OTT-00245378 - KELLY FARM DR. AT MIIKANA RD BH LOGS.GPJ TROW OTTAWA.GDT 10/26/22

Log of Borehole BH-05

Project No: OTT-00245378-W0

Project: Fernbank Public School

Location: Kelly Farm Dr. at Miikana Rd., Ottawa, ON

Date Drilled: 'April 4, 2022

Drill Type: CME-45C Track- Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: D.W.

Figure No. 7

Page. 1 of 1

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 Sandy silt with gravel, cobbles, boulders, topsoil and rootlets, brown, moist, (loose to compact)	95.06	0	10 (20 40 60 80; 50 100 150 200 kPa)	(250 500 750; 20 40 60)	SS1	21.7
		GLACIAL TILL Silty sand with gravel, cobbles, and boulders, brown, moist, (dense)	94.5	1	38 then 50/125 mm		SS2	23.9
		Auger Refusal at 1.2 m Depth Continued on Test Pit Log TP-05.	93.9					

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-00245378-W0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
		2.5

CORE DRILLING RECORD

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

LOG OF BOREHOLE OTT-00245378 - KELLY FARM DR. AT MIIKANA RD BH LOGS.GPJ TROW OTTAWA.GDT 10/26/22

Log of Test Pit TP-05

Project No: OTT-00245378-W0

Project: Fernbank Public School

Location: Kelly Farm Dr. at Miikana Rd., Ottawa, ON

Figure No. 7a

Page. 1 of 1

Date Drilled: 'May 5, 2022

Drill Type: Deere 380G Excavator

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

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	Depth Below Ground 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 Sandy silt with gravel, cobbles, boulders, topsoil and rootlets, brown, moist	95.06	0	20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60	S1	
			94.5					
		GLACIAL TILL Silty sand with gravel, cobbles, and boulders, brown, moist		1			S2	
				2				
			92.2					
		Excavator Refusal at 2.9 m Depth						

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test Pit backfilled upon completion of excavation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00245378-W0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Upon Completion	dry	open

CORE DRILLING RECORD

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

LOG OF TEST PIT OTT-00245378 FERNBANK SCHOOL TP LOGS.GPJ TROW OTTAWA.GDT 10/21/22

Log of Borehole BH-06

Project No: OTT-00245378-W0

Project: Fernbank Public School

Location: Kelly Farm Dr. at Miikana Rd., Ottawa, ON

Figure No. 8

Page. 1 of 1

Date Drilled: 'April 5, 2022

Drill Type: CME-45C Track- Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: D.W.

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 Silty sand with gravel, cobbles, boulders, topsoil, rootlets and construction debris, brown, moist, (very loose)	94.53	0	Hammer Weight		SS1	
			93.5	1	18		SS2	20.6
		SANDY SILT With gravel, roots and organics, dark grey to black, wet	93.3					
		SILT With sand, brown, moist to wet, (compact)	92.9		15		SS3	
		GLACIAL TILL Silty sand with gravel, cobbles and boulders, brown, moist, (compact)		2				
			92.2		50/50 mm		SS4	
		Auger Refusal at 2.3 m Depth **Continued on Test Pit Log TP-06**						

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

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon 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-00245378-W0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
		2.0

CORE DRILLING RECORD

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

LOG OF BOREHOLE OTT-00245378 - KELLY FARM DR. AT MIIKANA RD BH LOGS.GPJ TROW OTTAWA.GDT 10/26/22

Log of Test Pit TP-06

Project No: OTT-00245378-W0

Project: Fernbank Public School

Location: Kelly Farm Dr. at Miikana Rd., Ottawa, ON

Figure No. 8a

Page. 1 of 1

Date Drilled: 'May 5, 2022

Drill Type: Deere 380G Excavator

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

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	Depth Below Ground m	Depth
		FILL Silty sand with gravel, cobbles, boulders, topsoil, rootlets and construction debris, brown, moist, (loose)	94.53	0
			93.5	
		SANDY SILT With gravel, roots and organics, dark grey to black, wet	93.3	1
		SILT With sand, brown, moist to wet	92.9	
		GLACIAL TILL Silty sand with gravel, cobbles and boulders, brown, moist	92.1	2
		Excavator Refusal at 2.4 m Depth on Bedrock		

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
S1	
S2	
S3	21.5
S4	

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test Pit backfilled upon completion of excavation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00245378-W0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Upon Completion	dry	open

CORE DRILLING RECORD

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

LOG OF TEST PIT OTT-00245378 FERNBANK SCHOOL TP LOGS.GPJ TROW OTTAWA.GDT 10/21/22

Log of Borehole BH-07

Project No: OTT-00245378-W0

Project: Fernbank Public School

Location: Kelly Farm Dr. at Miikana Rd., Ottawa, ON

Figure No. 9

Page. 1 of 1

Date Drilled: 'April 5, 2022

Drill Type: CME-45C Track- Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: D.W.

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 Silty sand with gravel, cobbles and boulders, rootlets and minor pockets of organics, brown, moist, (loose to compact)	94.98	0	14		SS1	21.9
		SANDY SILT Brown, wet	94.0	1	8		SS2	20.9
		GLACIAL TILL Silty sand with gravel, cobbles and boulders, brown to grey, wet, (compact)	93.4	2	27		SS3	
					29 then 50/125 mm		SS4	
			91.9	3	50/ 75 mm		SS5	
		Auger Refusal at 3.1 m Depth						

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

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter standpipe was installed as shown.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00245378-W0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
5/19/22	>3.0	2.8
10/26/2022	>3.0	

CORE DRILLING RECORD

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

LOG OF BOREHOLE OTT-00245378 - KELLY FARM DR. AT MIIKANA RD BH LOGS.GPJ TROW OTTAWA.GDT 10/26/22

Log of Borehole BH-08

Project No: OTT-00245378-W0

Project: Fernbank Public School

Location: Kelly Farm Dr. at Miikana Rd., Ottawa, ON

Figure No. 10

Page. 1 of 1

Date Drilled: 'April 4, 2022

Drill Type: CME-45C Track- Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: D.W.

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 sand with gravel, cobbles, boulders, topsoil pockets and rootlets, brown, moist, (loose)	95.86	0
		GLACIAL TILL Silty sand with gravel, cobbles and boulders, brown, moist, (compact)	95.2	1
				2
			92.8	3
		Auger Refusal at 3.1 m Depth		

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

9
8 then 50/60 mm
26
34 then 50 / 75 mm
50 / 50 mm

SAMPLES	Natural Unit Wt. kN/m³
SS1	21.4
SS2	
SS3	
SS4	
SS5	

LOG OF BOREHOLE OTT-00245378 - KELLY FARM DR. AT MIIKANA RD BH LOGS.GPJ TROW OTTAWA.GDT 10/26/22

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-00245378-W0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
		2.6

CORE DRILLING RECORD

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

Log of Borehole BH-09

Project No: OTT-00245378-W0

Project: Fernbank Public School

Location: Kelly Farm Dr. at Miikana Rd., Ottawa, ON

Figure No. 11

Page. 1 of 1

Date Drilled: 'April 6, 2022

Drill Type: CME-45C Track- Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: D.W.

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 Sandy silt with rootlets and topsoil pockets, dark brown, moist, (compact)	95.12	0	14	×	SS1	21.2
		GLACIAL TILL Silty sand with gravel, cobbles and boulders, brown, moist, (dense)	94.4	1	35	×	SS2	22.6
		Auger refusal on cobble or boulder at 1.8 m depth.		2	36 then 50/125 mm	×	SS3	
							Run 1	
				3	4 then 50 / 0 mm	×	SS4	
				4			Run 2	
				5	1		SS5	
		Borehole Terminated at 5.2 m Depth	89.9					

LOG OF BOREHOLE OTT-00245378 - KELLY FARM DR. AT MIIKANA RD BH LOGS.GPJ TROW OTTAWA.GDT 10/26/22

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter standpipe was installed as shown.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-00245378-W0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
5/19/22	>4.6	
10/26/2022	>4.2	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	1.8 - 3.2	72	0
2	3.5 - 4.6	66	20

Log of Borehole BH-11

Project No: OTT-00245378-W0

Project: Fernbank Public School

Location: Kelly Farm Dr. at Miikana Rd., Ottawa, ON

Figure No. 12

Page. 1 of 1

Date Drilled: 'April 5, 2022

Drill Type: CME-45C Track- Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: D.W.

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 Silty sand with gravel, roots, rootlets, topsoil pockets and wood, brown, moist, (loose)	96.08	0	5		SS1	
		SANDY SILT With gravel, roots and organic pockets, dark brown, moist, (compact)	95.5	1	18		SS2	21.2
		GLACIAL TILL Silty sand with gravel, cobbles, and boulders, brown, moist, (very dense)	94.6	2	66		SS3	
			93.5		6, then 50 / 50 mm		SS4	
		Auger Refusal at 2.6 m Depth Continued on Test Pit Log TP-11.						

LOG OF BOREHOLE OTT-00245378 - KELLY FARM DR. AT MIIKANA RD BH LOGS.GPJ TROW OTTAWA.GDT 10/26/22

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-00245378-W0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)
		2.3

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

Log of Test Pit TP-11

Project No: OTT-00245378-W0

Project: Fernbank Public School

Location: Kelly Farm Dr. at Miikana Rd., Ottawa, ON

Figure No. 12a

Page. 1 of 1

Date Drilled: 'May 5, 2022

Drill Type: Deere 380G Excavator

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

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	Depth Below Ground m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		FILL Silty sand with gravel, roots, rootlets, topsoil pockets and wood, brown, moist	96.08	0	20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60	S1	
			95.5				S2	21.5
		SANDY SILT With gravel, roots and organic pockets, dark brown, moist		1				
			94.6					
		GLACIAL TILL Silty sand with gravel, cobbles and boulders, brown, moist Boulders up to 1.5 m observed.		2			S3	
			93.1	3				
		Test Pit Terminated at 3.0 m Depth						

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test Pit backfilled upon completion of excavation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00245378-W0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Upon Completion	dry	open

CORE DRILLING RECORD

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

LOG OF TEST PIT OTT-00245378 FERNBANK SCHOOL TP LOGS.GPJ TROW OTTAWA.GDT 10/21/22

Log of Borehole BH-13

Project No: OTT-00245378-W0

Project: Fernbank Public School

Location: Kelly Farm Dr. at Miikana Rd., Ottawa, ON

Figure No. 13

Page. 1 of 1

Date Drilled: 'April 5, 2022

Drill Type: CME-45C Track- Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: D.W.

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 Sandy silt with gravel, cobbles and topsoil pockets, brown, moist, (compact)	95.15	0
		TOPSOIL	94.6	
		SILTY SAND Brown, wet (loose)	94.2	1
		GLACIAL TILL Silty sand with gravel, cobbles, boulders, brown to grey, moist, (dense) Auger Refusal at 2.0 m Depth	93.4 93.1	2
		Borehole terminated at 2.1 m Depth **Continued on Test Pit Log TP-13.**		

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

SS1: 24
SS2: 8
SS3: 61

SAMPLES	Natural Unit Wt. kN/m³
SS1	
SS2	20.9
SS3	

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-00245378-W0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD

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

LOG OF BOREHOLE OTT-00245378 - KELLY FARM DR. AT MIIKANA RD BH LOGS.GPJ TROW OTTAWA.GDT 10/26/22

Log of Test Pit TP-13

Project No: OTT-00245378-W0

Project: Fernbank Public School

Location: Kelly Farm Dr. at Miikana Rd., Ottawa, ON

Figure No. 13a

Page. 1 of 1

Date Drilled: 'May 5, 2022

Drill Type: Deere 380G Excavator

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

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	Depth Below Ground m	Depth
		FILL Silty sand with gravel, cobbles, boulders and topsoil pockets, brown, moist	95.15	0
			94.6	
		TOPSOIL	94.2	
		SILTY SAND Brown to dark brown, moist to wet		1
			93.4	
		GLACIAL TILL Silty sand with gravel, cobbles and boulders, brown, moist	93.0	2
		Excavator Refusal at 2.2 m Depth on Bedrock Surface		

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
S1	
S2	18.7
S3	
S4	

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test Pit backfilled upon completion of excavation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00245378-W0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Upon Completion	dry	open

CORE DRILLING RECORD

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

LOG OF TEST PIT OTT-00245378 FERNBANK SCHOOL TP LOGS.GPJ TROW OTTAWA.GDT 10/21/22

Log of Borehole BH-14

Project No: OTT-00245378-W0

Project: Fernbank Public School

Location: Kelly Farm Dr. at Miikana Rd., Ottawa, ON

Figure No. 14

Page. 1 of 1

Date Drilled: 'April 6, 2022

Drill Type: CME-75 Truck- Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: D.W.

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 Sandy silt with gravel, topsoil inclusions, brown, moist, (compact)	94.99	0	10		SS1	
			94.7					
		SANDY SILT Brown, moist, (compact)		1	14		SS2	
			93.7				Run 1	
		LIMESTONE BEDROCK Grey, slightliy weathered		2			Run 2	
				3			Run 3	
				4			Run 4	
			90.4					
		Borehole Terminated at 4.6 m Depth						

LOG OF BOREHOLE OTT-00245378 - KELLY FARM DR. AT MIIKANA RD BH LOGS.GPJ TROW OTTAWA.GDT 10/26/22

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-00245378-W0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	1.3 - 1.5	100	55
2	1.5 - 3	93	49
3	3 - 3.9	84	36
4	3.9 - 4.6	97	43

Log of Test Pit TP-10

Project No: OTT-00245378-W0

Project: Fernbank Public School

Location: Kelly Farm Dr. at Miikana Rd., Ottawa, ON

Figure No. 15

Page. 1 of 1

Date Drilled: 'May 5, 2022

Drill Type: Deere 380G Excavator

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

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	Depth Below Ground m	Depth
		FILL Silty sand and gravel, with roots and rootles, grey, moist, compact	95.94	0
			95.6	
		FILL Silty sand with gravel, cobbles, boulders, topsoil pockets, construction debris, brown, moist		1
			94.6	
		GLACIAL TILL Silty sand with gravel, cobbles and boulders, brown, moist		2
			93.1	
		Excavator Refusal at 2.8 m Depth on Boulders or Bedrock		

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
S1	
S2	
S3	

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test Pit backfilled upon completion of excavation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00245378-W0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Upon Completion	dry	open

CORE DRILLING RECORD

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

LOG OF TEST PIT OTT-00245378 FERNBANK SCHOOL TP LOGS.GPJ TROW OTTAWA.GDT 10/21/22

Log of Test Pit TP-11A

Project No: OTT-00245378-W0

Project: Fernbank Public School

Location: Kelly Farm Dr. at Miikana Rd., Ottawa, ON

Figure No. 16

Page. 1 of 1

Date Drilled: 'May 5, 2022

Drill Type: Deere 380G Excavator

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

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	Depth Below Ground m	Depth
		FILL Silty sand, with gravel, roots and rootlets, brown, moist	95.9	0
		SANDY SILT With organics and roots, dark grey to black, moist	95.6	
		GLACIAL TILL Silty sand with gravel, cobbles and boulders, brown, moist	95.4	1
		Excavator Refusal at 1.3 m Depth on Boulders or Bedrock	94.6	

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
S1	
S2	20.0
S3	

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test Pit backfilled upon completion of excavation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00245378-W0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Upon Completion	dry	open

CORE DRILLING RECORD

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

LOG OF TEST PIT OTT-00245378 FERNBANK SCHOOL TP LOGS.GPJ TROW OTTAWA.GDT 10/21/22

Log of Test Pit TP-12

Project No: OTT-00245378-W0

Project: Fernbank Public School

Location: Kelly Farm Dr. at Miikana Rd., Ottawa, ON

Figure No. 17

Page. 1 of 1

Date Drilled: 'May 5, 2022

Drill Type: Deere 380G Excavator

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

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	Depth Below Ground m	Depth
		FILL Silty sand with gravel, cobbles, boulders and roots/rootlets, dark brown, moist	95.7	0
		GLACIAL TILL Silty sand with gravel, cobbles and boulders, brown, moist	94.7	1
			93.2	2
		WEATHERED BEDROCK **Excavator Refusal at 2.6 m Depth on Bedrock Surface**	93.1	

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
S1	
S2	

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test Pit backfilled upon completion of excavation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00245378-W0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Upon Completion	dry	open

CORE DRILLING RECORD

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

LOG OF TEST PIT OTT-00245378 FERNBANK SCHOOL TP LOGS.GPJ TROW OTTAWA.GDT 10/21/22

Log of Test Pit TP-14

Project No: OTT-00245378-W0

Project: Fernbank Public School

Location: Kelly Farm Dr. at Miikana Rd., Ottawa, ON

Figure No. 18

Page. 1 of 1

Date Drilled: 'May 5, 2022

Drill Type: Deere 380G Excavator

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

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	Depth Below Ground m	Depth
		TOPSOIL ~ 300 mm	94.99	0
		SANDY SILT Trace gravel, brown, moist	94.7	
			93.9	1
		Excavator Refusal at 1.1 m Depth on Bedrock Surface		

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: S1

Natural Unit Wt. kN/m³

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test Pit backfilled upon completion of excavation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00245378-W0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Upon Completion	dry	open

CORE DRILLING RECORD

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

LOG OF TEST PIT OTT-00245378 FERNBANK SCHOOL TP LOGS.GPJ TROW OTTAWA.GDT 10/21/22

Log of Test Pit TP-14A

Project No: OTT-00245378-W0

Project: Fernbank Public School

Location: Kelly Farm Dr. at Miikana Rd., Ottawa, ON

Figure No. 19

Page. 1 of 1

Date Drilled: 'May 5, 2022

Drill Type: Deere 380G Excavator

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

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	Depth Below Ground m	Depth
		FILL Silty sand with gravel, cobbles and boulders, brown, moist	95.69	0
		TOPSOIL ~ 200 mm	95.0	
		SANDY SILT Trace organics and roots, brown, moist	94.8	1
		SILTY SAND Grey, wet	94.2	
		Excavator Refusal at 1.9 m Depth on Bedrock Surface	93.8	

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
S1	
S2	
S3	

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test Pit backfilled upon completion of excavation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00245378-W0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Upon Completion	dry	open

CORE DRILLING RECORD

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

LOG OF TEST PIT OTT-00245378 FERNBANK SCHOOL TP LOGS.GPJ TROW OTTAWA.GDT 10/21/22

Log of Test Pit TP-15

Project No: OTT-00245378-W0

Project: Fernbank Public School

Location: Kelly Farm Dr. at Miikana Rd., Ottawa, ON

Figure No. 20

Page. 1 of 1

Date Drilled: 'May 5, 2022

Drill Type: Deere 380G Excavator

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

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	Depth Below Ground m	Depth
		FILL Silty sand with gravel, cobbles, boulders, topsoil pockets, and construction debris, dark brown, moist	94.6	0
		GLACIAL TILL Silty sand with gravel, cobbles and boulders, brown, moist	93.7	1
		WEATHERED BEDROCK	93.3	
		Excavator Refusal at 1.5 m Depth on Bedrock Surface	93.1	

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
S1	
S2	

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test Pit backfilled upon completion of excavation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00245378-W0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Upon Completion	dry	open

CORE DRILLING RECORD

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

Log of Test Pit TP-16

Project No: OTT-00245378-W0

Project: Fernbank Public School

Location: Kelly Farm Dr. at Miikana Rd., Ottawa, ON

Figure No. 21

Page. 1 of 1

Date Drilled: 'May 5, 2022

Drill Type: Deere 380G Excavator

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

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	Depth Below Ground m	Depth
		FILL Silty sand with gravel, cobbles, boulders and topsoil pockets, brown, moist	95.88	0
		SANDY SILT With organics and roots, dark grey to dark brown, moist	95.5	
		SILTY SAND Brown, moist	95.0	1
		WEATHERED BEDROCK	94.6	
		Excavator Refusal at 1.5 m Depth on Bedrock Surface	94.4	

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
S1	
S2	

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test Pit backfilled upon completion of excavation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00245378-W0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Upon Completion	dry	open

CORE DRILLING RECORD

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

LOG OF TEST PIT OTT-00245378 FERNBANK SCHOOL TP LOGS.GPJ TROW OTTAWA.GDT 10/21/22

Log of Test Pit TP-17

Project No: OTT-00245378-W0

Project: Fernbank Public School

Location: Kelly Farm Dr. at Miikana Rd., Ottawa, ON

Figure No. 22

Page. 1 of 1

Date Drilled: 'May 5, 2022

Drill Type: Deere 380G Excavator

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

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	Depth Below Ground m	Depth
		FILL Silty sand with gravel, cobbles, boulders, topsoil pockets, brown, moist	96.01	0
		GLACIAL TILL Silty sand with gravel, cobbles and boulders, brown, moist	95.8	
			94.3	1
		WEATHERED BEDROCK	94.0	2
		Excavator Refusal at 2.0 m Depth on Bedrock Surface		

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
S1	
S2	
S3	

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test Pit backfilled upon completion of excavation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00245378-W0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Upon Completion	dry	open

CORE DRILLING RECORD

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

LOG OF TEST PIT OTT-00245378 FERNBANK SCHOOL TP LOGS.GPJ TROW OTTAWA.GDT 10/21/22

Log of Test Pit TP-18

Project No: OTT-00245378-W0

Project: Fernbank Public School

Location: Kelly Farm Dr. at Miikana Rd., Ottawa, ON

Figure No. 23

Page. 1 of 1

Date Drilled: 'May 5, 2022

Drill Type: Deere 380G Excavator

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

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	Depth Below Ground m	Depth
		FILL Silty sand with gravel, cobbles, boulders, topsoil pockets and construction debris, dark brown, moist	95.77	0
		GLACIAL TILL Silty sand with gravel, cobbles and boulders, brown, moist	95.4	
		WEATHERED BEDROCK	94.0	1
		Excavator Refusal at 2.3 m Depth on Bedrock Surface	93.5	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
S1	
S2	

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test Pit backfilled upon completion of excavation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00245378-W0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Upon Completion	dry	open

CORE DRILLING RECORD

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

LOG OF TEST PIT OTT-00245378 FERNBANK SCHOOL TP LOGS.GPJ TROW OTTAWA.GDT 10/21/22

Log of Test Pit TP-19

Project No: OTT-00245378-W0

Project: Fernbank Public School

Location: Kelly Farm Dr. at Miikana Rd., Ottawa, ON

Figure No. 24

Page. 1 of 1

Date Drilled: 'May 5, 2022

Drill Type: Deere 380G Excavator

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

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	Depth Below Ground m	Depth
		TOPSOIL	94.65	0
			94.3	
		FILL Silty sand with gravel, cobbles and boulders, brown, moist	94.1	
		GLACIAL TILL Silty sand with gravel, cobbles and boulders, grey, moist	93.8	
		Excavator Refusal at 0.9 m Depth on Bedrock Surface		

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: S1 at 94.1

Natural Unit Wt. kN/m³

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test Pit backfilled upon completion of excavation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00245378-W0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Upon Completion	dry	open

CORE DRILLING RECORD

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

LOG OF TEST PIT OTT-00245378 FERNBANK SCHOOL TP LOGS.GPJ TROW OTTAWA.GDT 10/21/22

Log of Test Pit TP-20

Project No: OTT-00245378-W0

Project: Fernbank Public School

Location: Kelly Farm Dr. at Miikana Rd., Ottawa, ON

Figure No. 25

Page. 1 of 1

Date Drilled: 'May 5, 2022

Drill Type: Deere 380G Excavator

Datum: Depth Below Ground

Logged by: M.Z. Checked by: I.T.

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	Depth Below Ground m	Depth
		TOPSOIL ~ 700 mm	95.99	0
			95.3	
		SANDY SILT With clay, brown, moist	94.9	1
		WEATHERED BEDROCK	94.6	
		Excavator Refusal at 1.4 m Depth on Bedrock Surface		

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: S1

Natural Unit Wt. kN/m³

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test Pit backfilled upon completion of excavation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00245378-W0

WATER LEVEL RECORDS

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

CORE DRILLING RECORD

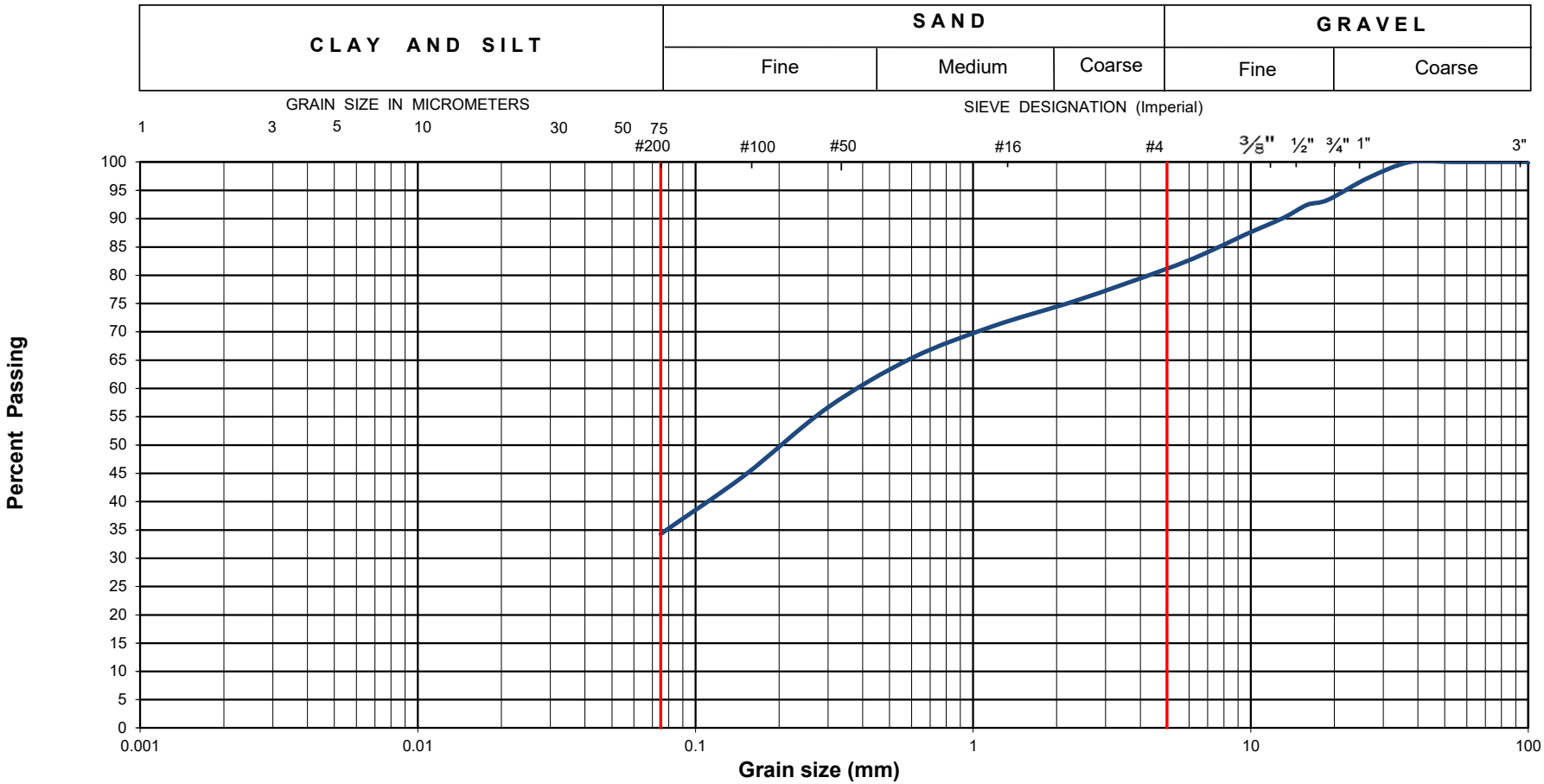
Run No.	Depth (m)	% Rec.	RQD %

LOG OF TEST PIT OTT-00245378 FERNBANK SCHOOL TP LOGS.GPJ TROW OTTAWA.GDT 10/21/22

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

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

Unified Soil Classification System



EXP Project No.:	**OTT-00245378-W0**	**Project Name :**	**Geotechnical Investigation - New Findlay Creek Public School**						
Client :	**OCDSB**	**Project Location :**	**820 Mikana Road**						
Date Sampled :	**May 5, 2022**	**Borehole No:**		**TP11**	**Sample:**		**S1**	**Depth (m) :**	**0.2-0.4**
Sample Composition :		**Gravel (%)**	**19**	**Sand (%)**	**47**	**Silt & Clay (%)**	**34**	**Figure :**	**26**
Sample Description :		**Silty Sand with Gravel (SM)**							

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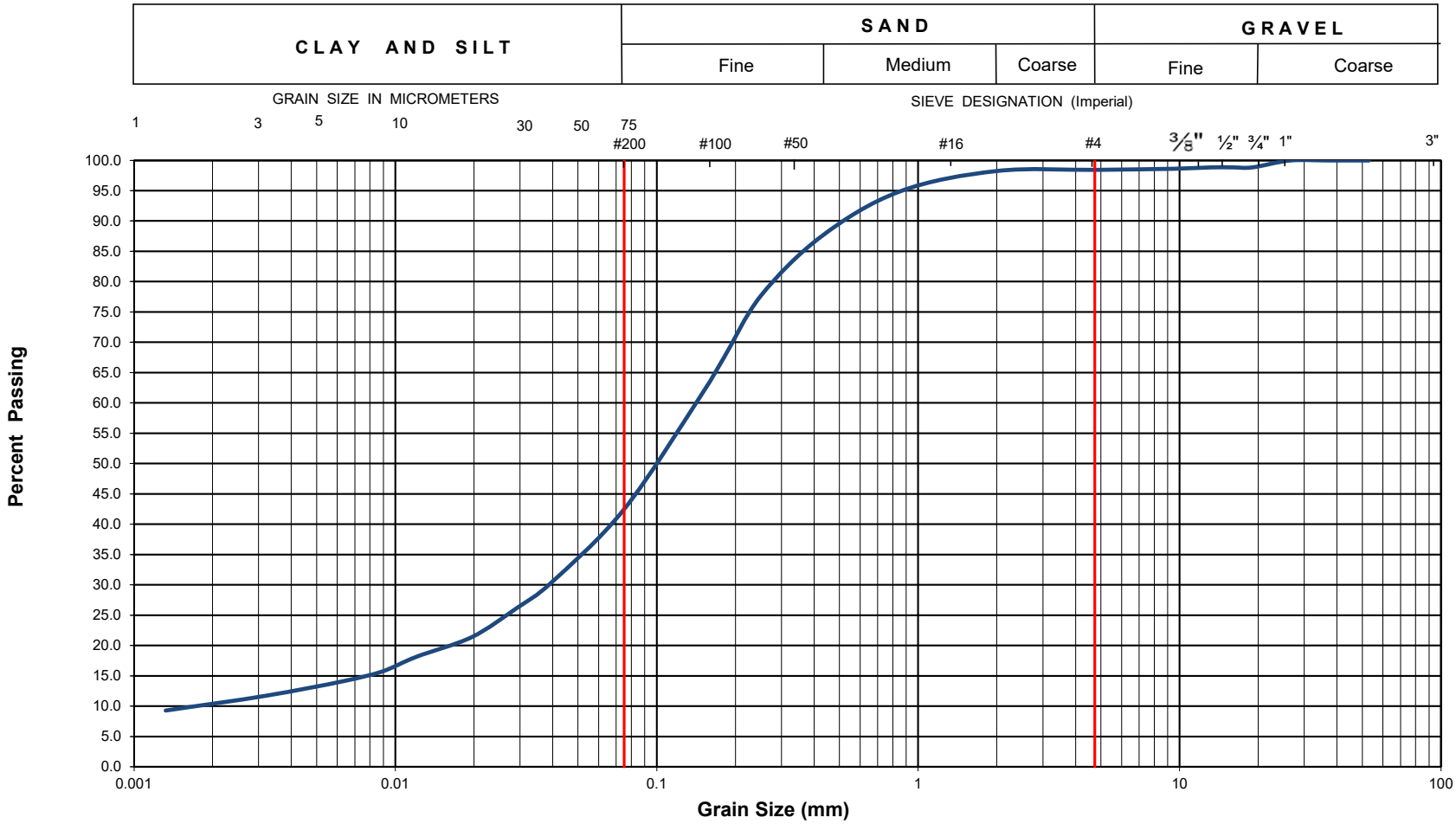
Ottawa, ON K2B 8H6

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

Unified Soil Classification System



EXP Project No.:	**OTT-00245378-W0**	**Project Name :**	**Proposed New Findlay Creek Public School**						
Client :	**Ottawa Carleton District School Board**	**Project Location :**	**820 Mikana Road, Ottawa**						
Date Sampled :	**May 5, 2022**	**Borehole No:**	**TP 16**		**Sample No.:**	**S2**		**Depth (m) :**	**0.9-1.1**
Sample Description :		**% Silt and Clay**	**43**	**% Sand**	**55**	**% Gravel**	**2**	**Figure :**	**27**
Sample Description :		**Silty Sand (SM)**							

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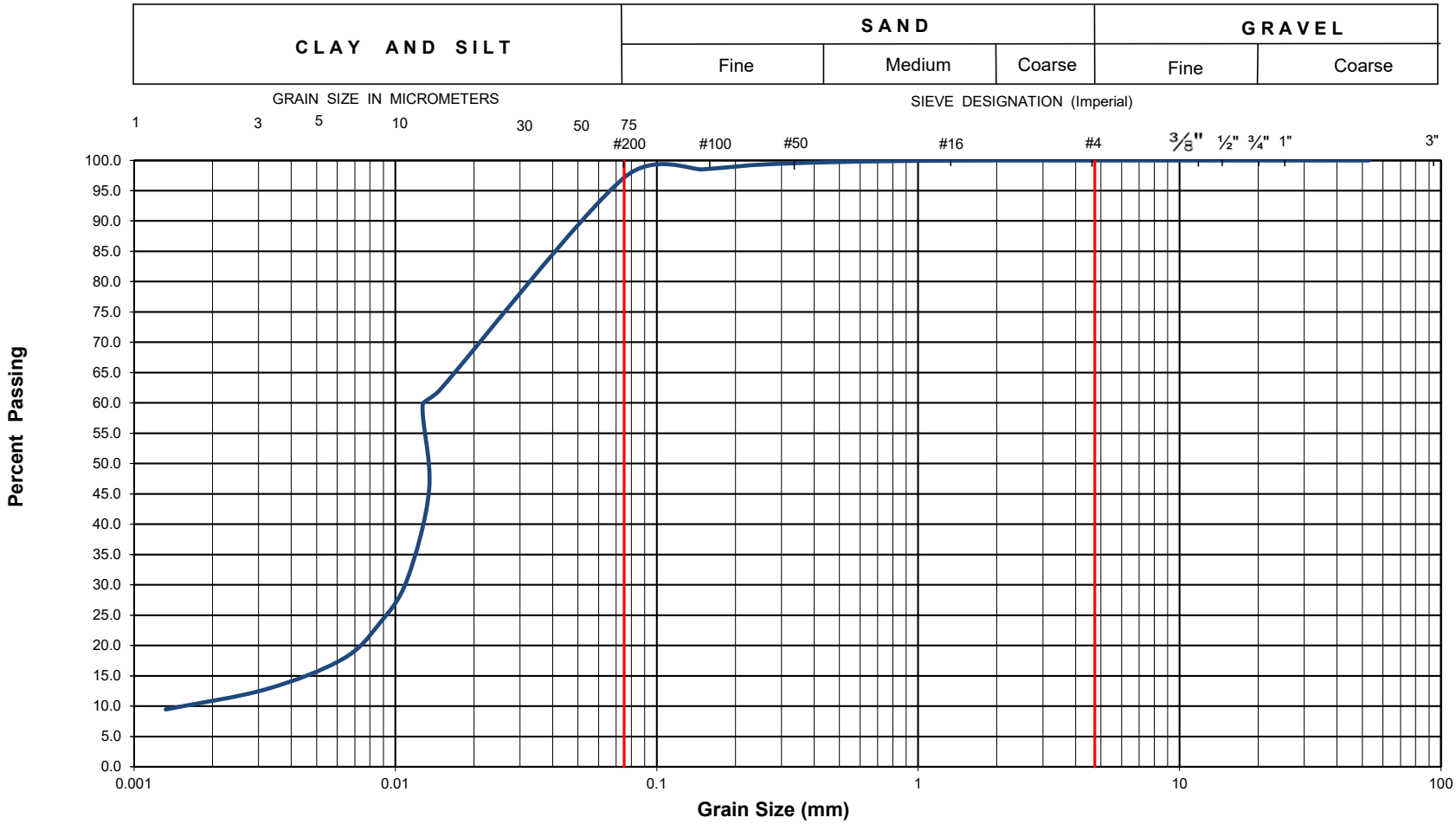
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

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

Unified Soil Classification System



EXP Project No.:	**OTT-00245378-W0**	**Project Name :**	**Proposed New Findlay Creek Public School**						
Client :	**Ottawa Carleton District School Board**	**Project Location :**	**820 Mikana Road, Ottawa**						
Date Sampled :	**April 5, 2022**	**Borehole No:**	**BH 6**		**Sample No.:**	**SS2**		**Depth (m) :**	**0.8-1.4**
Sample Description :		**% Silt and Clay**	**97**	**% Sand**	**3**	**% Gravel**	**0**	**Figure :**	**28**
Sample Description :		**Silt (ML)**							

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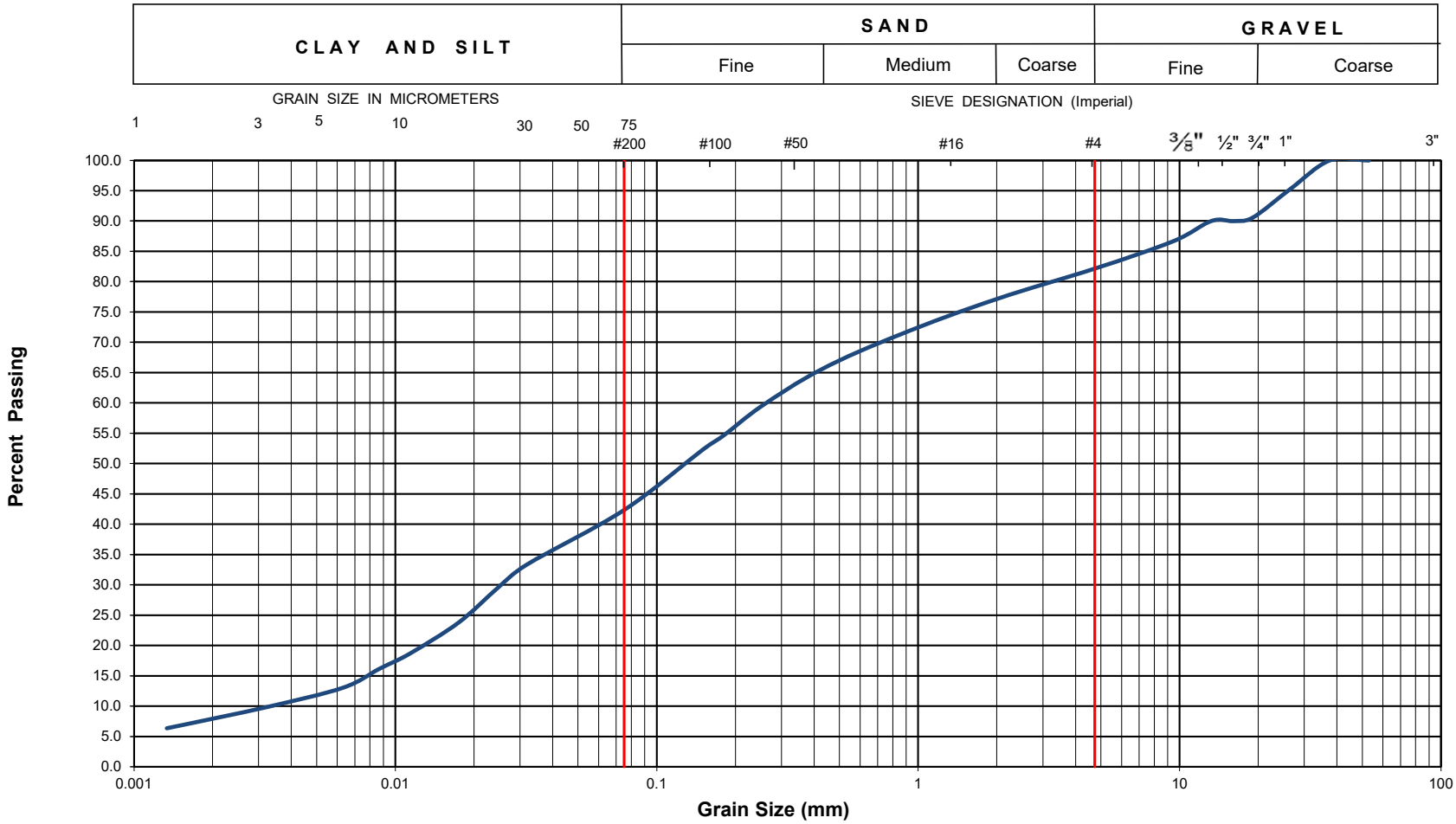
Ottawa, ON K2B 8H6

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

Unified Soil Classification System

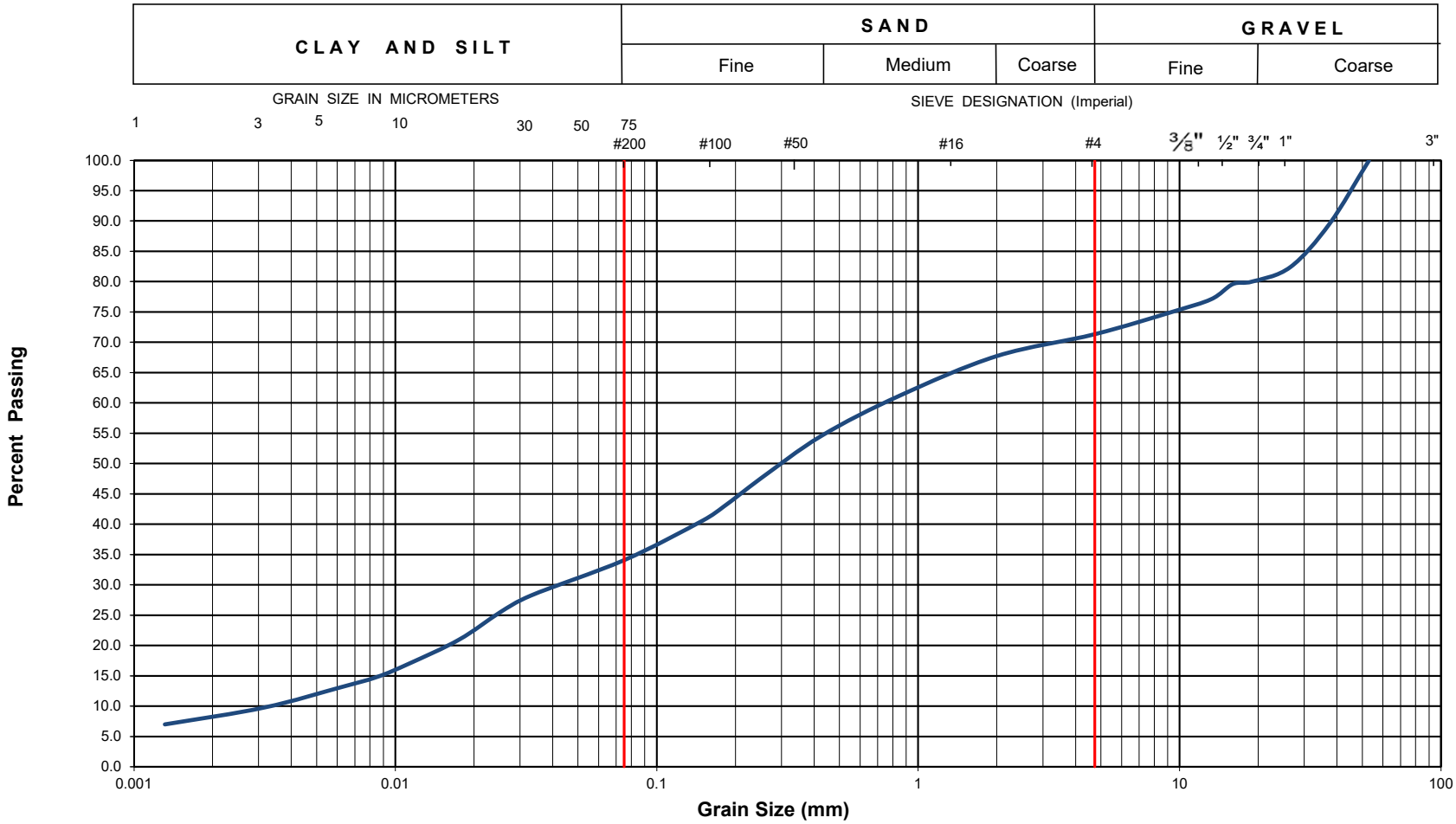


EXP Project No.:	**OTT-00245378-W0**	**Project Name :**	**Proposed New Findlay Creek Public School**						
Client :	**Ottawa Carleton District School Board**	**Project Location :**	**820 Mikana Road, Ottawa**						
Date Sampled :	**May 5, 2022**	**Borehole No:**	**TP 15**		**Sample No.:**	**S2**		**Depth (m) :**	**1.0-1.2**
Sample Description :		**% Silt and Clay**	**42**	**% Sand**	**40**	**% Gravel**	**18**	**Figure :**	**29**
Sample Description :		**Silty Sand with Gravel (SM)**							

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

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

Unified Soil Classification System



EXP Project No.:	**OTT-00245378-W0**	**Project Name :**	**Proposed New Findlay Creek Public School**						
Client :	**Ottawa Carleton District School Board**	**Project Location :**	**820 Mikana Road, Ottawa**						
Date Sampled :	**May 5, 2022**	**Borehole No:**	**TP 5**		**Sample No.:**	**S2**		**Depth (m) :**	**0.8-1.0**
Sample Description :		**% Silt and Clay**	**34**	**% Sand**	**37**	**% Gravel**	**29**	**Figure :**	**30**
Sample Description :		**Silty Sand with Gravel (SM)**							

Appendix A – Site Photos

Photograph 1: Onsite cobbles and boulders

Photograph 2: Onsite fill piles

Photograph 3: Additional onsite fill piles

Photograph 4: Onsite boulders

Photograph 5: Low lying area of poor drainage

Photograph 6: Grade change at property extent

Appendix B – Borehole logs from previous investigations

PROJECT: 13-1121-0083

RECORD OF BOREHOLE: 13-7

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: September 24, 2013

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		94.89							
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL		0.00							
		Loose to compact brown SILTY SAND		0.15	1	50 DO	5				
1					2	50 DO	10				
				93.37							
		Very dense brown SILTY SAND, some gravel, trace clay, with cobbles and boulders (GLACIAL TILL)		1.52	3	50 DO	>50				
2					4	50 DO	>50		○		
				92.07							
3		End of Borehole Auger Refusal		2.82							
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: ALB
CHECKED: PAS

MIS-BHS 001 1311210083.GPJ GAL-MIS.GDT 01/20/16 JM/JEM

PROJECT: 13-1121-0083

RECORD OF BOREHOLE: 13-8

SHEET 1 OF 1

LOCATION: See Site Plan

BORING DATE: September 24, 2013

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		98.04							
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL		0.00 / 97.81							
		Very dense brown SILTY SAND, some gravel, trace clay, with cobbles and boulders (GLACIAL TILL)		0.23	1	50 DO	4				
1					2	50 DO	52				
					3	50 DO	>50		○	MH	
2					4	50 DO	>50				
				95.37							
		End of Borehole Auger Refusal		2.67							
3											
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: ALB
CHECKED: PAS

MIS-BHS 001 1311210083.GPJ GAL-MIS.GDT 01/20/16 JM/JEM

PROJECT: 13-1121-0083-1046

RECORD OF BOREHOLE: 16-104

SHEET 1 OF 2

LOCATION: See Site Plan

BORING DATE: September 30, 2016

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		95.82							
0	Power Auger 200 mm Diam. (Hollow Stem)	TOPSOIL - (SM) SILTY SAND; dark brown; moist		0.00							
		(SM) SILTY SAND; brown; non-cohesive, dry, loose		0.15	1	SS	6				
				95.06							
1		(SM) SILTY SAND, some gravel; brown, contains cobbles and boulders (GLACIAL TILL); non-cohesive, dry to moist, very dense		0.76	2	SS	>50				Silica Sand
2					3	SS	66				Bentonite Seal
				93.31							
3	Wash Boring HQ Core	(SM) gravelly SILTY SAND; brown, contains dolostone fragments, cobbles and boulders (GLACIAL TILL); non-cohesive, moist, compact to very dense		2.51	4	SS	13				
					5	SS	>50				Silica Sand
4					6	SS	>50				Standpipe
				91.33							
	Rotary Drill NQ Core	Probable Limestone Bedrock		4.49	C1	RC	DD				
				90.82							
5		End of Borehole		5.00							
6											
7											
8											
9											
10											

WL in Standpipe at Elev. 91.55 m on Nov. 11, 2016

DEPTH SCALE
1 : 50

LOGGED: KM
CHECKED: CK

Golder Associates

MIS-BHS 001 1311210083.GPJ GAL-MIS.GDT 01/18/17 JM/JEM

PROJECT: 13-1121-0083-1046

RECORD OF DRILLHOLE: 16-104

SHEET 2 OF 2

LOCATION: See Site Plan

DRILLING DATE: September 30, 2016

DATUM: Geodetic

INCLINATION: -90° AZIMUTH: —

DRILL RIG: CME-850

DRILLING CONTRACTOR: CCC

JN - Joint; FLT - Fault; SHR- Shear; VN - Vein; CJ - Conjugate
BD- Bedding; FO- Foliation; CO- Contact; OR- Orthogonal; CL - Cleavage
PL - Planar; CU- Curved; UN- Undulating; ST - Stepped; IR - Irregular
PO- Polished; K - Slickensided; SM- Smooth; Ro - Rough; MB- Mechanical Break
BR - Broken Rock
NOTE: For additional abbreviations refer to list of abbreviations & symbols.

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. / DEPTH (m)	RUN No.	COLOUR / % RETURN / FLUSH	RECOVERY: TOTAL CORE %	RECOVERY: SOLID CORE %	R.Q.D. %	FRACT. INDEX PER 0.25 m	DISCONTINUITY DATA: B Angle	DISCONTINUITY DATA: DIP w.r.t. CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	Jcon	Jr	Ja	HYDRAULIC CONDUCTIVITY K, cm/sec	Diametral Point Load Index (MPa)	RMC -Q' AVG.	
		BEDROCK SURFACE		91.33																
5	Rotary Drill / NQ Core	Probable Limestone Bedrock		4.49	1	5	100	100	100	0	0	0								Standpipe
				90.82																
		End of Drillhole		5.00																WL in Standpipe at Elev. 91.55 m on Nov. 11, 2016

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: KM
CHECKED: CK

MIS-RCK 004 1311210083.GPJ GAL-MISS.GDT 01/18/17 JM/JEM

Appendix C – Laboratory Certificate of Analysis

AGAT Laboratories

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

CLIENT NAME: EXP SERVICES INC
2650 QUEENSVIEW DRIVE, UNIT 100
OTTAWA, ON K2B8H6
(613) 688-1899
ATTENTION TO: Daniel Wall
PROJECT: OTT-00245378-W
AGAT WORK ORDER: 22Z896003
SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Lab Manager
DATE REPORTED: May 24, 2022
PAGES (INCLUDING COVER): 5
VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

Notes

Disclaimer:

- *All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.*
- *All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.*
- *AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.*
- *This Certificate shall not be reproduced except in full, without the written approval of the laboratory.*
- *The test results reported herewith relate only to the samples as received by the laboratory.*
- *Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.*
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AGAT Laboratories

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

Certificate of Analysis

AGAT WORK ORDER: 22Z896003

PROJECT: OTT-00245378-W

CLIENT NAME: EXP SERVICES INC

ATTENTION TO: Daniel Wall

SAMPLING SITE:EXP

SAMPLED BY:Kelly Farm Drive

Inorganic Chemistry (Soil)

DATE RECEIVED: 2022-05-16

DATE REPORTED: 2022-05-24

					BH#13 SS2 2.
			SAMPLE DESCRIPTION:	TP5 S2 0.8-1.0m	5-4.5
			SAMPLE TYPE:	Soil	Soil
			DATE SAMPLED:	2022-05-05	2022-04-05
Parameter	Unit	G / S	RDL	3865809	3865823
Chloride (2:1)	µg/g		2	2	3
Sulphate (2:1)	µg/g		2	69	16
pH (2:1)	pH Units		NA	8.19	7.71
Electrical Conductivity (2:1)	mS/cm		0.005	0.174	0.097
Resistivity (2:1) (Calculated)	ohm.cm		1	5750	10300

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

3865809 EC, pH, Chloride and Sulphate were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil). Resistivity is a calculated parameter.

3865823 EC, pH, Chloride and Sulphate were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil). Resistivity is a calculated parameter. Samples were received and analyzed beyond recommended hold times.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:

AGAT Laboratories

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

Quality Assurance

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 22Z896003

PROJECT: OTT-00245378-W

ATTENTION TO: Daniel Wall

SAMPLING SITE:EXP

SAMPLED BY:Kelly Farm Drive

Soil Analysis

RPT Date: May 24, 2022			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Inorganic Chemistry (Soil)															
Chloride (2:1)	3865809	3865809	2	2	NA	< 2	95%	70%	130%	103%	80%	120%	101%	70%	130%
Sulphate (2:1)	3865809	3865809	69	69	0.0%	< 2	93%	70%	130%	101%	80%	120%	99%	70%	130%
pH (2:1)	3865809	3865809	8.19	8.18	0.1%	NA	96%	80%	120%	NA			NA		
Electrical Conductivity (2:1)	3865809	3865809	0.174	0.174	0.0%	< 0.005	96%	80%	120%	NA			NA		

Comments: NA signifies Not Applicable.
pH duplicates QA acceptance criteria was met relative as stated in Table 5-15 of Analytical Protocol document.

Duplicate NA: results are under 5X the RDL and will not be calculated.

Certified By:

AGAT Laboratories

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Method Summary

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 22Z896003

PROJECT: OTT-00245378-W

ATTENTION TO: Daniel Wall

SAMPLING SITE:EXP

SAMPLED BY:Kelly Farm Drive

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Chloride (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	modified from EPA 9045D and MCKEAGUE 3.11	PH METER
Electrical Conductivity (2:1)	INOR-93-6075	modified from MSA PART 3, CH 14 and SM 2510 B	PC TITRATE
Resistivity (2:1) (Calculated)	INOR-93-6036	McKeague 4.12, SM 2510 B,SSA #5 Part 3	CALCULATION

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

Chain of Custody Record

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

Report Information:

Company: EXP Services Inc. Ottawa
Contact: Daniel Wall
Address: 2650 Queensview dr. Unit 100
Ottawa, ON, K2B 8H6
Phone: 613-688-1899 Fax:
Reports to be sent to:
1. Email: daniel.wall@exp.com
2. Email:

Project Information:

Project: OTT-00245378-W
Site Location: Kelly farm drive
Sampled By: EXP
AGAT ID #: PO:
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☑ No ☐
Company:
Contact:
Address:
Email:

Regulatory Requirements:

(Please check all applicable boxes)

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

☐ Excess Soils R406
Table (Indicate One)
☐ Regulation 558
☐ CCME

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

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

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

Sample Matrix Legend

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

Laboratory Use Only

Work Order #: 22Z896003
Cooler Quantity: n/a - one bag
Arrival Temperatures: 24.5 | 24.4 | 24.4 → 23 | 16.6 | 16.9
Custody Seal Intact: ☐ Yes ☐ No ☐ N/A
Notes: ice pack

Turnaround Time (TAT) Required:

Regular TAT (Most Analysis) ☑ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

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

OR Date Required (Rush Surcharges May Apply):

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

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

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI, DOC (Y/N)	O. Reg 153: Metals & Inorganics	Metals - ☐ CrVi ☐ Hg ☐ HWSB	BTEX, F1-F4 PHCs	Analyze F4G if required ☐ Yes ☐ No	PAHs	Total PCBs ☐ Aroclor	VOC	O. Reg 558: Landfill Disposal Characterization TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Excess Soils SPLP Rainwater Leach SPLP: ☐ Metals ☐ VOCs ☐ SVOCs	Excess Soils Characterization Package pH, ICPMS Metals, BTEX, F1-F4	Salt - EC/SAR	pH	Sulphate	Chloride	Resistivity				Potentially Hazardous or High Concentration (Y/N)
TP5 SS2 0.8-1.0m	May 5	AM/PM	1	S														✓	✓	✓	✓				
BH#17 SS2 2.5-4.5	April 5	AM/PM	1	S														✓	✓	✓	✓				
		AM/PM																							
		AM/PM																							
		AM/PM																							
		AM/PM																							
		AM/PM																							
		AM/PM																							
		AM/PM																							
		AM/PM																							
		AM/PM																							

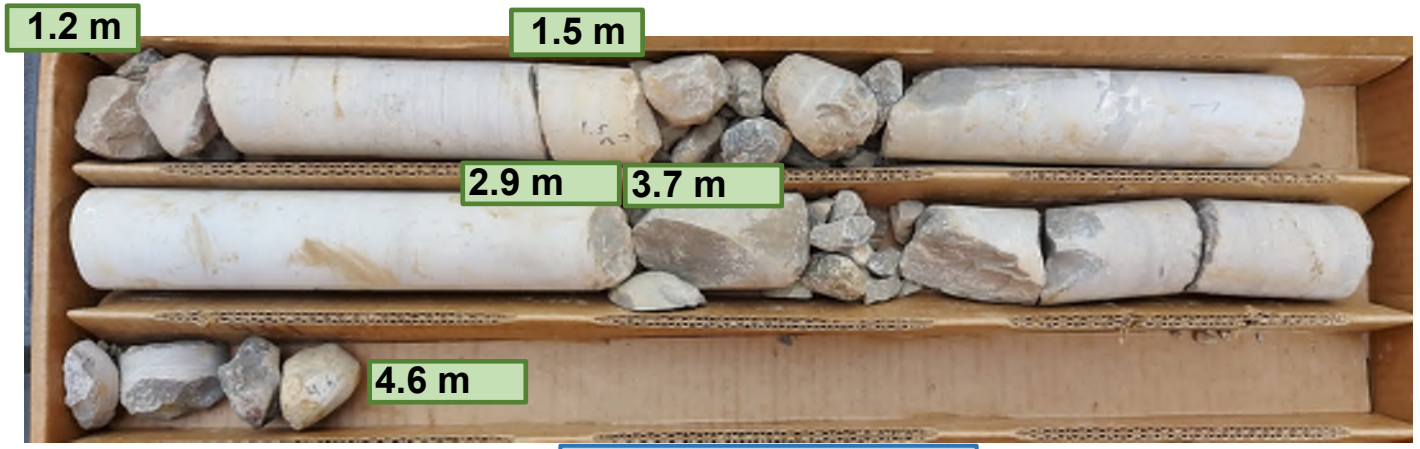
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
Jeff MacMillan	May 16/22	3:15pm		MAY 16 2022	15h30
Samples Relinquished By (Print Name and Sign):	MAY 16 2022	16h00	Samples Received By (Print Name and Sign):	17/5/22	902
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time

Page 1 of 1
N°: T114964

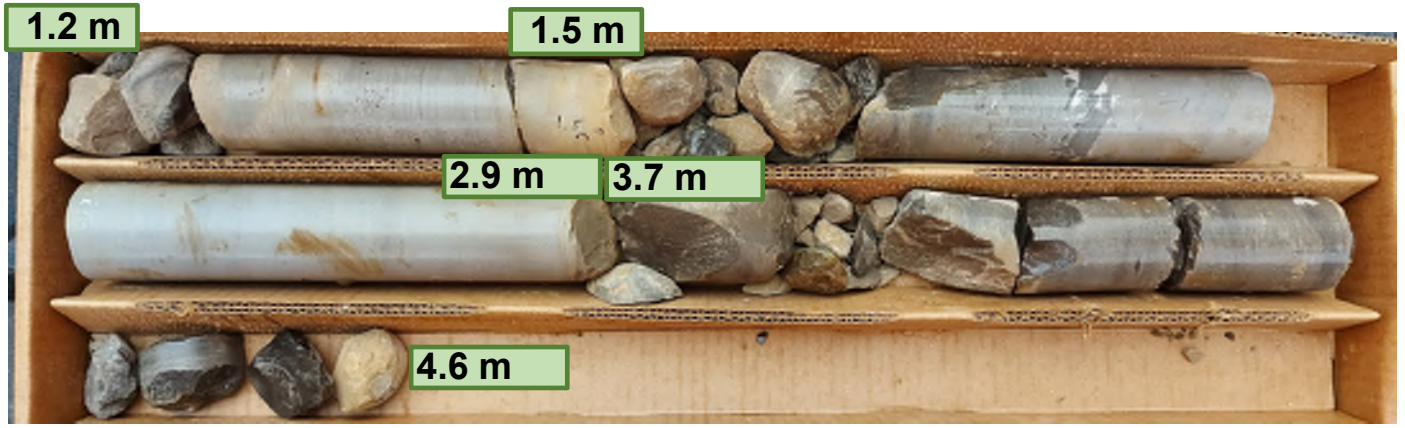
Pink Copy - Client | Yellow Copy - AGAT | White Copy - AGAT

Appendix D – Rock Core Photographs

DRY BEDROCK CORES



WET BEDROCK CORES



EXP Services Inc. **www.exp.com**
t: +1.613.688.1899 | f: +1.613.225.7337
2650 Queensview Drive, Suite 100
Ottawa, ON K2B 8H6, Canada

borehole no.	core runs	project	project no.
BH-3	Run 1: 1.2 m - 1.5 m Run 2: 1.5 m - 2.9 m Run 2: 3.7 m - 4.6 m	Location: Proposed New Findlay Creek Public School	OTT-00245378-W0
date cored		Rock Core Photographs	FIG D-1
Apr 06, 2022			

DRY BEDROCK CORES

WET BEDROCK CORES

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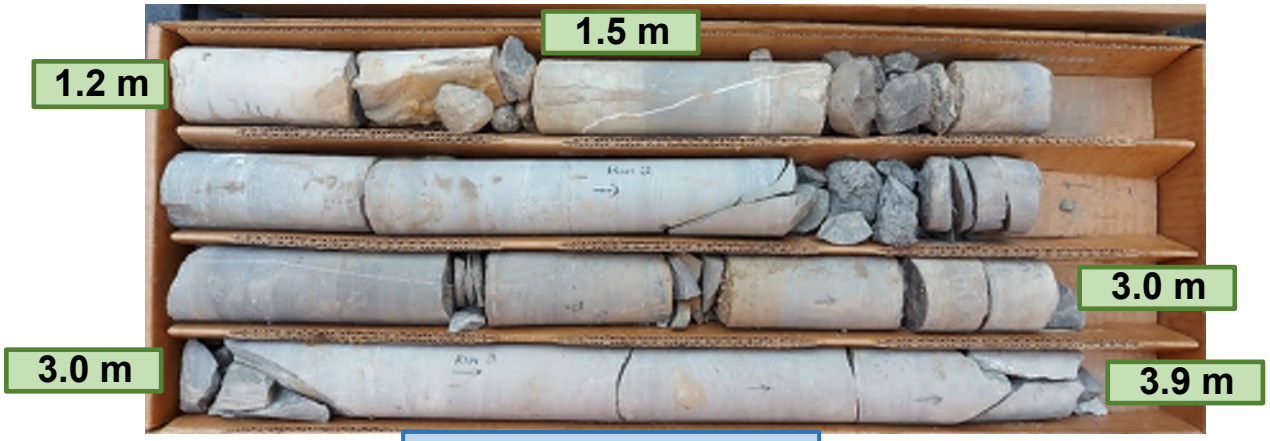
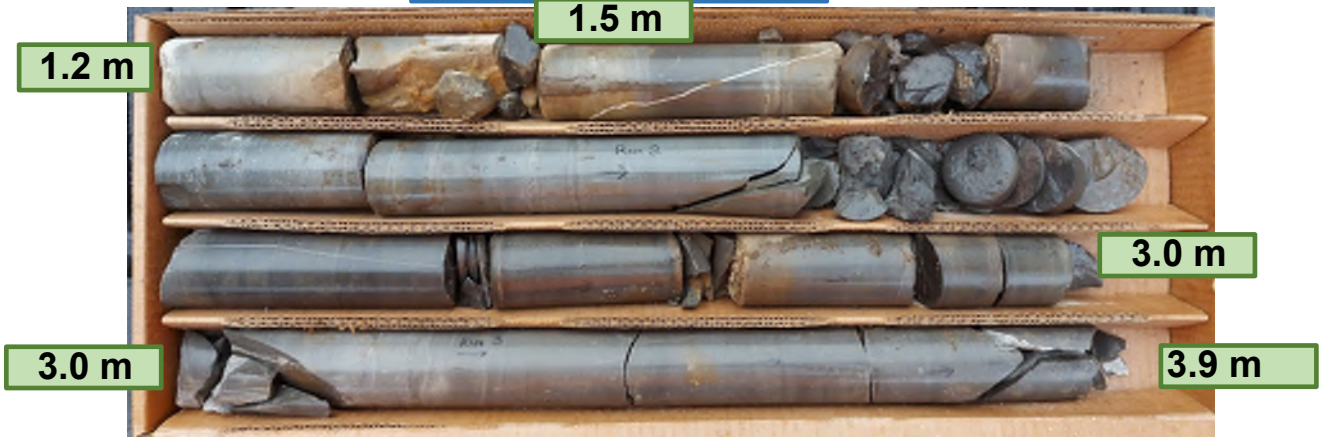
2650 Queensview Drive, Suite 100
Ottawa, ON K2B 8H6, Canada

borehole no.	core runs	project	project no.
BH-9	Run 1: 1.8 m - 3.2 m Run 2: 3.5 m - 4.6 m	Location: Proposed New Findlay Creek Public School	OTT-00245378-W0
date cored Apr 06, 2022		Rock Core Photographs	FIG D-2

DRY BEDROCK CORES



WET BEDROCK CORES



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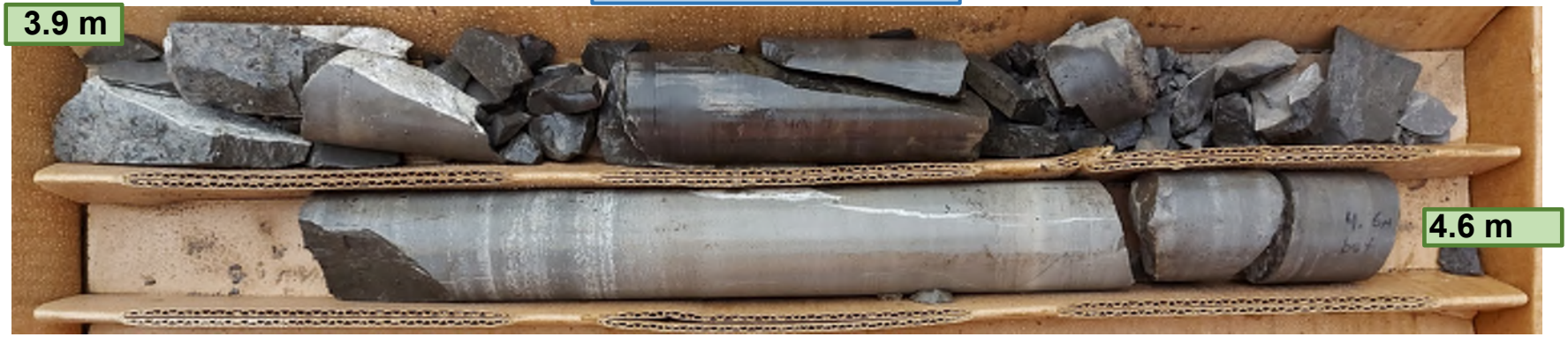
Ottawa, ON K2B 8H6, Canada

borehole no.	core runs	project	project no.
BH-14	Run 1: 1.2 m - 1.5 m Run 2: 1.5 m - 3.0 m Run 3: 3.0 m - 3.9 m	Location: Proposed New Findlay Creek Public School	OTT-00245378-W0
date cored Apr 06, 2022		Rock Core Photographs	FIG D-3

DRY BEDROCK CORES

WET BEDROCK CORES



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

borehole no.	core runs	project	project no.
BH-14	Run 4: 3.9 m - 4.6 m	Location: Proposed New Findlay Creek Public School	OTT-00245378-W0
date cored		Rock Core Photographs	FIG D-4
Apr 06, 2022			

Appendix E – Geophysics GPR MASW report

GEOPHYSICS GPR INTERNATIONAL INC.

100 – 2545 Delorimier Street
Longueuil (Québec)
Canada J4K 3P7

Tel. : (450) 679-2400
Fax : (514) 521-4128
info@geophysicsgpr.com
www.geophysicsgpr.com

June 7th, 2022

Transmitted by email: Ismail.Taki@exp.com
Our Ref.: GPR-22-03837a

Mr. Ismail Taki, M.Eng., P.Eng.
Senior Manager, Earth & Environment, Eastern Region
exp Services inc.
100 – 2650 Queensview Drive
Ottawa ON K2B 8H6

Subject: **Shear Wave Velocity Sounding for the Site Class Determination**
Miikana Road, Ottawa (ON)

Dear Sir,

Geophysics GPR International inc. has been mandated by **exp** Services inc. to carry out seismic shear wave surveys on a property located east of Miikana Road and Kelly Farm Drive corner, in Ottawa (ON). The geophysical investigation used the Multi-channel Analysis of Surface Waves (MASW), the Spatial AutoCorrelation (SPAC), and the seismic refraction methods. From the subsequent results, the seismic shear wave velocity values were calculated for the soil and the rock, to determine the Site Class.

The surveys were carried out on May 19th, 2022, by Mr. Timothy Ward, tech., Louis-Emmanuel Warnock, tech. & Zak Castonguay, trainee. Figure 1 shows the regional location of the site and Figure 2 illustrates the location of the main seismic spread. Both figures are presented in the Appendix.

The following paragraphs briefly describe the survey design, the principles of the testing methods, and the results presented in tables and graphs.

MASW PRINCIPLE

The *Multi-channel Analysis of Surface Waves* (MASW) and the *SPatial AutoCorrelation* (SPAC or MAM for *Microtremors Array Method*) are seismic methods used to evaluate the shear wave velocities of subsurface materials through the analysis of the dispersion properties of the Rayleigh surface waves ("ground roll"). The MASW is considered an "active" method, as the seismic signal is induced at known location and time in the geophones' spread axis. Conversely, the SPAC is considered a "passive" method, using the low frequency "signals" produced far away. The method can also be used with "active" seismic source records. The SPAC method allows deeper Vs soundings, but generally with a lower resolution for the surface portion. Its dispersion curve can then be merged with the one of higher frequency from the MASW to calculate a more complete inversion. The dispersion properties are expressed as a change of phase velocities with respect to frequencies. Surface wave energy will decay exponentially with depth. Lower frequency surface waves will travel deeper and thus be more influenced by deeper velocity layering than the shallow higher frequency waves. The inversion of the Rayleigh wave dispersion curve yields a shear wave (V_S) velocity depth profile (sounding).

Figure 3 schematically outlines the basic operating procedure for the MASW method. Figure 4 illustrates an example of one of the MASW/SPAC records, the corresponding spectrogram analysis and resulting 1D V_S model.

INTERPRETATION

The main processing sequence involved data inspection and edition when required; spectral analysis ("phase shift" for MASW, and "cross-correlation" for SPAC); picking the fundamental mode; and 1D inversion of the MASW and SPAC shot records using the SeisImagerSW™ software. The data inversions used a nonlinear least squares algorithm.

In theory, all the shot records for a given seismic spread should produce a similar shear-wave velocity profile. In practice, however, differences can arise due to energy dissipation, local surface seismic velocities variations, and/or dipping of overburden layers or rock. In general, the precision of the calculated seismic shear wave velocities (V_S) is of the order of 15% or better.

More detailed descriptions of these methods are presented in *Shear Wave Velocity Measurement Guidelines for Canadian Seismic Site Characterization in Soil and Rock*, Hunter, J.A., Crow, H.L., et al., Geological Surveys of Canada, General Information Product 110, 2015.

SURVEY DESIGN

The longer seismic acquisition spread was laid with a geophone spacing of 3.0 metres, using 24 geophones (Figure 2). Two shorter seismic spreads, with geophone spacing of 0.5 and 1.0 metre, were dedicated to the near surface materials. The seismic records were produced with a seismograph Terraloc Pro 2 (from ABEM Instrument), and the geophones were 4.5 Hz. An 8 kg sledgehammer was used as the energy source with impacts being recorded off both ends of the seismic spreads.

The seismic records counted 4096 data, sampled at 1000 µs for the MASW surveys, and 40 µs for the seismic refraction. The records included a pre-trigged portion of 10 ms. A stacking procedure was also used to improve the Signal / Noise ratio for the seismic records.

The shear wave depth sounding can be considered as the average of the bulk area within the geophone spread, especially for its central half-length.

RESULTS

From seismic refraction (V_P), the rock depth was calculated at 3 metres (± 1 metre). Its calculated seismic velocity (V_S) was 1950 m/s for its shallow portion.

The MASW calculated V_S results are illustrated at Figure 5.

The $\overline{V}_{S30}$ value results from the harmonic mean of the shear wave velocities, from the surface to 30 metres deep. It is calculated by dividing the total depth of interest (30 metres) by the sum of the time spent in each velocity layer from the surface down to 30 metres, as:

$$\overline{V}_{S30} = \frac{\sum_{i=1}^{N} H_i}{\sum_{i=1}^{N} H_i / V_i} \quad | \quad \sum_{i=1}^{N} H_i = 30 \text{ m}$$

(N: number of layers; H_i : thickness of layer "i" ; V_i : V_S of layer "i")

Thus, the $\overline{V}_{S30}$ value represents the seismic shear wave velocity of an equivalent homogeneous single layer response, between the surface and 30 metres deep.

The calculated $\overline{V}_{S30}$ value of the actual site is 1080.3 m/s (Table 1), corresponding to the Site Class "B". Nevertheless, the Site Classes A and B are not to be used if there is 3 metres or more of unconsolidated material between the rock and the bottom of the spread footing or mat foundation.

In the case there would be 1 metre or less of unconsolidated material between the rock and the bottom of the foundations, the $\overline{V}_{S30}$* value would greater than 1500 m/s, allowing to use the Site Class "A" (Table 2).

CONCLUSION

Geophysical surveys were carried out to identify the Site Class on a property located south of Miikana Road, in Ottawa (ON). The seismic surveys used the MASW and the SPAC analysis, and the seismic refraction method to calculate the $\overline{V}_{S30}$ value. Its calculation is presented at Table 1.

The $\overline{V}_{S30}$ value of the actual site is 1080 m/s, corresponding to the Site Class "B" (760 < $\overline{V}_{S30}$ ≤ 1500 m/s), as determined through the MASW and SPAC methods, Table 4.1.8.4.-A of the NBC, and the Building Code, O. Reg. 332/12. It must be noted that Site Classes A and B are not to be used if there is 3 metres or more of unconsolidated material between the rock and the bottom of the spread footing or mat foundation.

In the case the bottom of the foundation would be 1.0 metre or less from the rock surface, the $\overline{V}_{S30}$* value would greater than 1500 m/s, allowing to use the Site Class "A" ($\overline{V}_{S30}$ > 1500 m/s).

It must be noted that other geotechnical information gleaned on site; including the presence of liquefiable soils, very soft clays, high moisture content etc. (cf. Table 4.1.8.4.A of the NBC) can supersede the Site classification provided in this report based on the $\overline{V}_{S30}$ value.

The V_S values calculated are representative of the in situ materials and are not corrected for the total and effective stresses.

Hoping the whole to your satisfaction, we remain yours truly,

Jean-Luc Arsenault, M.A.Sc., P.Eng.
Senior Project Manager

LICENSED PROFESSIONAL ENGINEER
J.-L. ARSENAULT
100148122
PROVINCE OF ONTARIO
2022-06-07

Figure 1: Regional location of the Site
(source: *OpenStreetMap*©)

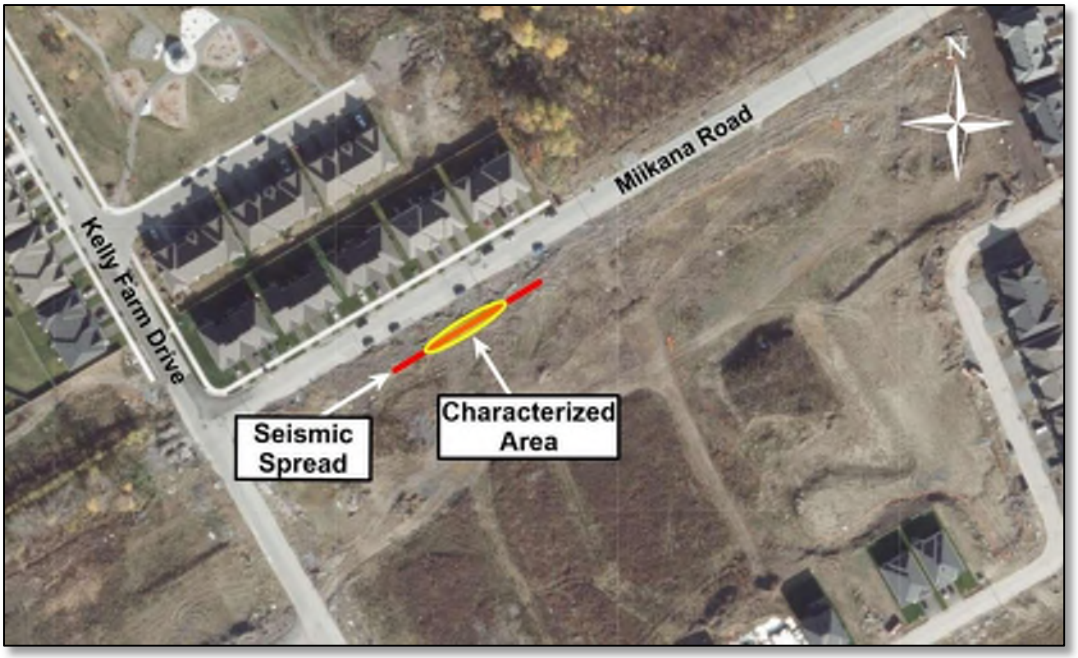

Figure 2: Location of the seismic spreads
(source: *geoOttawa*)

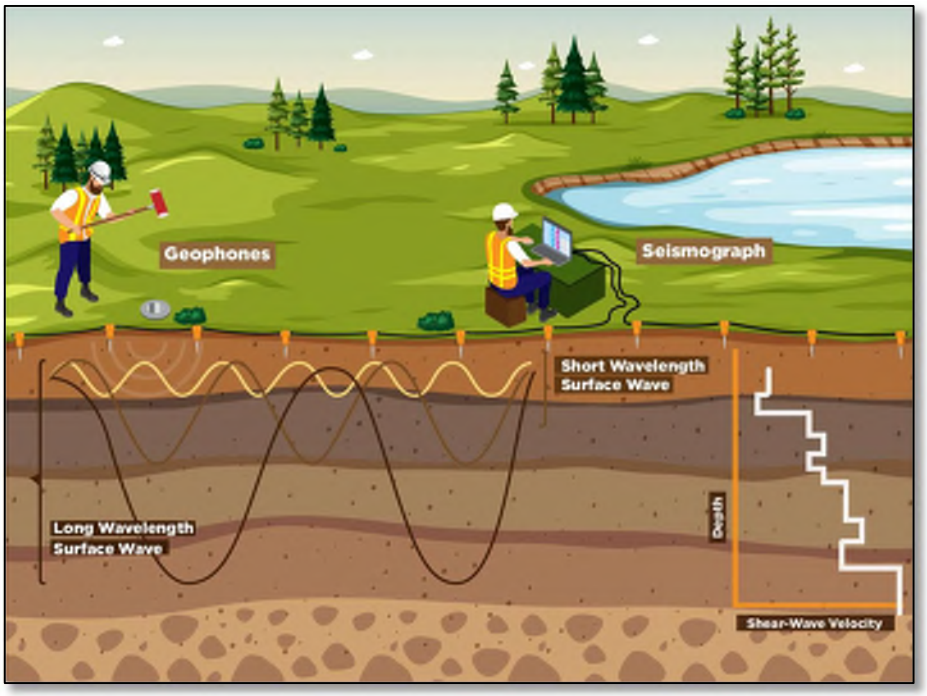

Figure 3: MASW Operating Principle

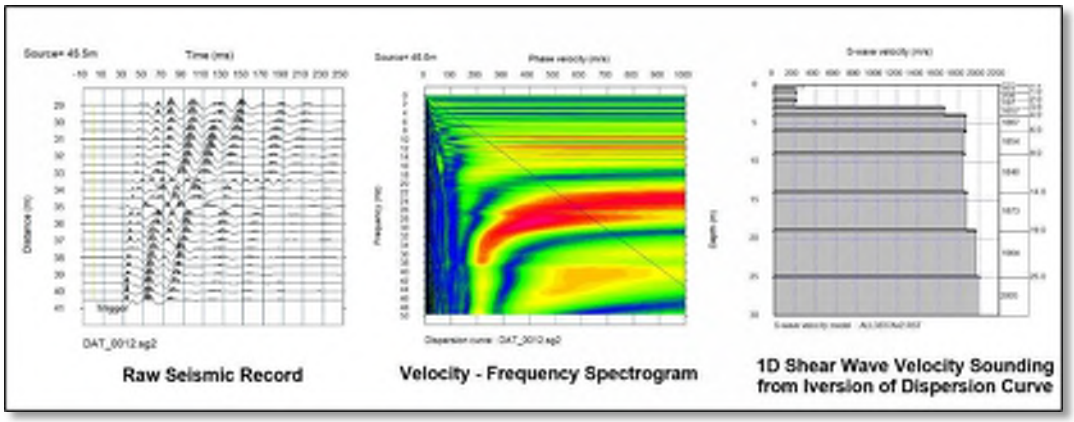

Figure 4: Example of a MASW/SPAC record, Phase Velocity - Frequency curve of the Rayleigh wave and resulting 1D Shear Wave Velocity Model

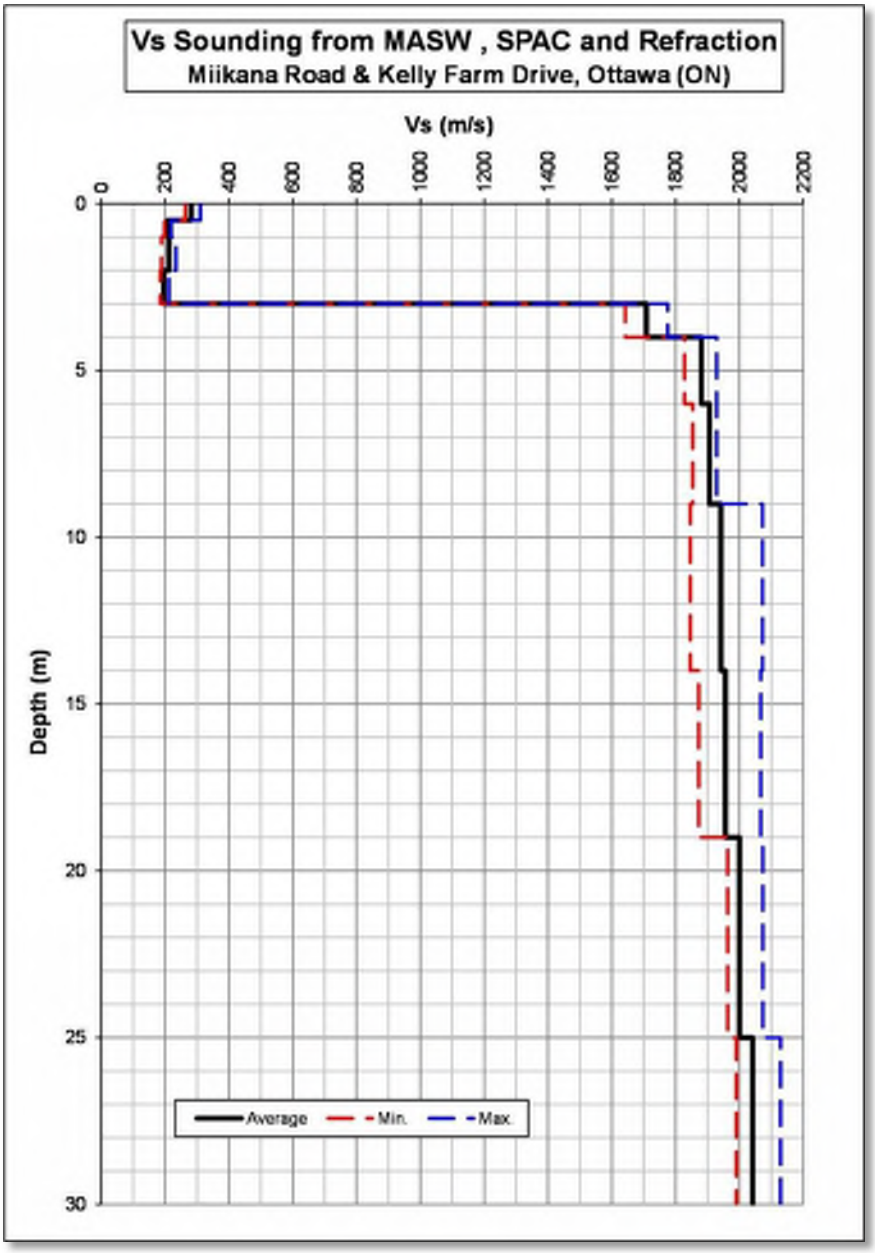

Figure 5: MASW Shear-Wave Velocity Sounding

TABLE 1
V_{S30} Calculation for the Site Class (actual site)

Depth	Vs			Thickness	Cumulative Thickness	Delay for Avg. Vs	Cumulative Delay	Vs at given Depth
	Min.	Average	Max.					
(m)	(m/s)	(m/s)	(m/s)	(m)	(m)	(s)	(s)	(m/s)
0	263.4	282.2	311.4	**Grade Level (May 19, 2022)**				
0.5	197.9	208.2	219.2	0.50	0.50	0.001772	0.001772	282.2
1.0	188.6	212.8	235.0	0.50	1.00	0.002402	0.004173	239.6
2.0	184.7	196.3	212.0	1.00	2.00	0.004699	0.008872	225.4
3.0	1642.0	1709.1	1775.6	1.00	3.00	0.005095	0.013967	214.8
4.0	1827.7	1880.4	1929.0	1.00	4.00	0.000585	0.014552	274.9
6.0	1853.7	1906.6	1928.8	2.00	6.00	0.001064	0.015616	384.2
9.0	1845.7	1941.8	2072.5	3.00	9.00	0.001573	0.017189	523.6
14.0	1872.5	1956.5	2066.9	5.00	14.00	0.002575	0.019764	708.4
19.0	1963.0	2000.0	2073.5	5.00	19.00	0.002556	0.022320	851.3
25.0	1990.1	2041.5	2129.4	6.00	25.00	0.003000	0.025320	987.4
30				5.00	30.00	0.002449	0.027769	1080.3

V_{S30} (m/s)	**1080.3**
Class	**B (1)**

(1) The Site Classes A and B are not to be used if there is 3 metres or more of unconsolidated materials between the rock and the bottom of the spread footing or mat foundation.

TABLE 2
Limit for the Site Class A

Depth	Vs			Thickness	Cumulative Thickness	Delay for Avg. Vs	Cumulative Delay	Vs at given Depth
	Min.	Average	Max.					
(m)	(m/s)	(m/s)	(m/s)	(m)	(m)	(s)	(s)	(m/s)
0	263.4	282.2	311.4	**Limit for Site Class A (1 metre of soil)**				
0.5	197.9	208.2	219.2					
1.0	188.6	212.8	235.0					
2.0	184.7	196.3	212.0					
3.0	1642.0	1709.1	1775.6	1.00	1.00	0.005095	0.005095	196.3
4.0	1827.7	1880.4	1929.0	1.00	2.00	0.000585	0.005680	352.1
6.0	1853.7	1906.6	1928.8	2.00	4.00	0.001064	0.006744	593.1
9.0	1845.7	1941.8	2072.5	3.00	7.00	0.001573	0.008318	841.6
14.0	1872.5	1956.5	2066.9	5.00	12.00	0.002575	0.010892	1101.7
19.0	1963.0	2000.0	2073.5	5.00	17.00	0.002556	0.013448	1264.1
25.0	1990.1	2041.5	2129.4	6.00	23.00	0.003000	0.016448	1398.3
32.0				7.00	30.00	0.003429	0.019877	1509.3

V_{S30}* (m/s)	**1509.3**
Class	**A**

Legal Notification

This report was prepared by EXP Services for the account of Ottawa Carleton District School Board.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. EXP Services Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this project.

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