Geotechnical Investigation

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Executive Summary

EXP Services Inc. (EXP) is pleased to present the results of the geotechnical investigation completed for the proposed OCSB Barrhaven Elementary School, 135 Main Halyard Lane, Ottawa, Ontario (Figure 1). Written authorization to proceed with this geotechnical investigation was provided by the Ottawa Catholic School Board.

Design plans indicate the proposed school building will be a single-story structure with no basement and will be supported by footings. The proposed school development will also include the construction of a future portable area, soccer fields, parking lots and access roads, landscaped areas and the installation of underground municipal services. The ground floor of the proposed school building will be at Elevation 94.50 m and the founding elevation of the footings will be Elevation 92.85 m. The proposed maximum site grade raise at the site will be 3.0 m from the original 2011/2015 ground surface elevation of the site.

A Phase One Environmental Site Assessment (ESA) of the site was undertaken by EXP and is presented in a separate report dated March 17, 2021.

The borehole information indicates the subsurface conditions at the site consist of fill to depth ranging from 1.8 m to 2.2 m (Elevation 91.5 m to Elevation 91.2 m) underlain by loose to compact sandy silt to silty sand to depths of 2.9 m to 3.3 m (Elevation 90.3 m to Elevation 90.1 m) followed by a deep compressible silty clay deposit. The groundwater level is at a 2.5 m depth (Elevation 90.7 m).

Test pits located north and east of the location of the proposed school building indicate the presence of a heterogenous fill extending to depths ranging between 0.9 m and 3.5 m (Elevation 91.6 m to Elevation 90.4 m) underlain by native sandy silt and silty clay. Seepage of water was noted in several test pits at 0.3 m to 1.4 m depths (Elevation 93.1 m to Elevation 92.5 m). It is our understanding that the fill has been deposited on the school site over the years by the developer/contractor from the adjacent residential subdivision.

Based on the borehole information and Table 4.1.8.4.A of the 2012 Ontario Building Code (OBC) as amended May 2, 2019, the site classification for seismic site response is estimated to be **Class E.** The subsurface soils are not susceptible to liquefaction during a seismic event.

The maximum 3.0 m site grade raise proposed at the school site in conjunction with footing loads will result in consolidation settlement of the silty clay that will be higher than the normally tolerable limits. Several options were considered to reduce future consolidation settlement of the silty clay to within tolerable limits and are as follows:

1. Pre-loading/Surcharging the Silty Clay – supporting the proposed school building by footings founded on the engineered fill pad portion of the pre-load/surcharge,
2. Pile foundations and structural slab; and
3. Pile foundation and slab-on-grade.

The owner and design team for this project decided to proceed with option no. 1: pre-loading/surcharging (with wick drains) program for the location of the proposed school building and for the location of the trench for the proposed underground municipal services that will service the proposed school building; the service trench that runs from Main Halyard Lane located along the west property line of the proposed school site to the proposed school building.

The engineering analysis determined that for a 4.0 m high pre-load/surcharge fill pad (with wick drains installed in the silty clay) constructed to Elevation 95.5 m, the target settlement is 265 mm. The pre-load/surcharge fill pad should consist of 3.0 m thick engineered fill pad and 1.0 m thick pre-load material constructed within the footprint of the proposed building.

The portion of the existing surcharge fill pile (Area H pile) that extends into the footprint of the proposed building requires removal down to the native soil. The excavation for the construction engineered fill pad should extend to the native soil. The engineered fill material should consist of Ontario Provincial Standard Specification (OPSS) Granular B Type II material placed on the approved native soil and compacted to 100 percent standard Proctor maximum dry density (SPMDD). The 1.0 m thick pre-load material may consist of any type of fill material that is nominally packed in place. Once the settlement monitoring data indicates the target settlement has been achieved, the 1.0 m thick pre-load fill material is removed from the engineered fill pad

and construction of the proposed building may proceed with footings founded within the engineered fill pad at the design elevation of Elevation 92.85 m.

The pre-loading/surcharging program for the proposed school building started in October 2021 with the installation of the wick drains, placement, construction of the engineered fill pad and the pre-load fill pad and installation of settlement monitoring points. This site work was completed in December 2021. The monitoring of the settlement of the silty clay began on completion of the construction of the surcharge/preload program and is currently in progress. An additional 1 m of pre-load fill was added to the surcharge/pre-load area during the period between May 6 and 13, 2022 to further expedite the consolidation settlement of the underlying silty clay deposit.

Once the pre-load/surcharge program has reached the target settlement, the construction of the proposed school building may start. The footings for the proposed school building founded at the design elevation of Elevation 92.85 m on the prepared engineered fill pad may be designed for a bearing pressure at serviceability limit state (SLS) of 75 kPa and factored geotechnical resistance at ULS of 125 kPa. The factored geotechnical resistance at ULS includes a geotechnical resistance factor of 0.5.

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

The lowest level floor slab (ground floor) of the proposed building may be designed as a slab-on-grade constructed on the engineered fill pad. Perimeter drains are recommended. 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.

Seepage of the surface and subsurface water into the excavations is anticipated and it should be possible to collect water entering the excavations at low points and to remove it by conventional pumping techniques.

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 requirement presented in Section 12 of the report.

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

1. Introduction

EXP Services Inc. (EXP) is pleased to present the results of the geotechnical investigation completed for the proposed OCSB Barrhaven Elementary School, 135 Main Halyard Lane, Ottawa, Ontario (Figure 1). Written authorization to proceed with this geotechnical investigation was provided by the Ottawa Catholic School Board.

Design plans indicate the proposed school building will be a single-story structure with no basement and will be supported by footings. The proposed school development will also include the construction of a future portable area, soccer fields, parking lots and access roads, landscaped areas and the installation of underground municipal services. The ground floor of the proposed school building will be at Elevation 94.50 m and the founding elevation of the footings will be Elevation 92.85 m. The proposed maximum site grade raise at the site will be 3.0 m from the original 2011/2015 ground surface elevation of the site.

A Phase One Environmental Site Assessment (ESA) of the site was undertaken by EXP and is presented in a separate report dated March 17, 2021.

The geotechnical investigation was undertaken to:

a) Establish the subsurface soil and groundwater conditions at five (5) boreholes and eleven (11) test pits located on the site,

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; and

i) Recommend pavement structure thicknesses for pathways, access roads and parking lots.

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. Background Information and Site Description

This section of the report discusses the condition of the proposed school site from the first geotechnical investigation conducted at the site in 2011 to the fieldwork for EXP's geotechnical investigation conducted in March 2021.

Prior to the placement of fill piles on the proposed school site, a geotechnical investigation and a supplemental geotechnical investigation were completed in 2011 and 2015 respectively by the Paterson Group Inc. (Paterson) for the residential subdivision surrounding the proposed school property on the north and east sides of the school site. The findings from the two (2) geotechnical investigations are presented in the Paterson report titled, *Geotechnical Investigation – Proposed Residential Development, 3387 Borrisokane Road, Ottawa dated May 1, 2017 (Report:PG3621-1 Revision 5).* Information provided in the Paterson report was used in the preparation of this geotechnical investigation report.

The original condition of the proposed school site, prior to placement of fill piles and at the time of the Paterson 2011 boreholes and 2015 test pits consisted of agricultural land with a drainage ditch running through approximately the middle of the proposed school site in a north-south direction.

The 2011 geotechnical investigation includes nine (9) boreholes located throughout the proposed residential subdivision and on the proposed school site. The 2015 geotechnical investigation includes seven (7) test pits located throughout the proposed residential subdivision. At the time of the 2011 and 2015 geotechnical investigations, the ground surface elevation of the proposed residential subdivision ranged from Elevation 92.00 m to Elevation 91.40 m with the ground surface elevation at the school site at Elevation 91.90 m based on information from one (1) borehole located on the proposed school site (Borehole No. 7). A review of the information from the Paterson boreholes and test pits indicates that beneath a surficial topsoil layer, the proposed residential subdivision site and the school site are underlain by a silty sand layer followed by a deep compressible silty clay deposit.

At the time of and following the issuance of the Paterson May 1, 2017 geotechnical report, earthwork activities comprising of the placement of fill piles for surcharge programs was undertaken for the proposed surrounding residential subdivision. Portions of the north (Area J fill pile) and west fill piles (Area H fill pile) from the subdivision development encroached onto the proposed school site. The ground surface elevation in Area J was raised to Elevation +/- 95.65 m to satisfy a 2 m surcharge required for the proposed residential development. Fill was also placed in August 2020 to September 2020, for a surcharge program located in Area H (Pile H). The elevation of the ground surface for this surcharge program was raised to Elevation +/- 95.80 m to satisfy a total fill height of 4.4 m. The easterly portion of the surcharge Area H encroached onto the school site with a portion of the surcharged area extending into the footprint of the proposed school building. It is our understanding that the portion of the fill piles placed on the proposed school site consisted of a mixture of clay, silt, sand and gravel and was placed without compacting the fill material.

In 2020/2021, additional fill was placed in the east portion of the proposed school site to raise the grades to the range of Elevation +/- 92.9 m to Elevation +/- 94.0 m in the east portion of the proposed school site for the purpose of constructing a site access road and a lay-down area for the outdoor storage of construction supplies and equipment.

In addition, fill piles (stockpiles) of various heights (depths) and composition were deposited throughout the north and east portions of the site by the developer/contractor from the adjacent residential subdivision. The contractor for this school project should refer to the most recent topographical survey plan for details regarding the locations and elevations (heights) of these stockpiles.

3. Procedure

The borehole drilling program consists of five (5) boreholes; Borehole Nos. 2, 4, 12, 14 and 15 completed on March 30 and 31, 2021. Borehole No. 2 was advanced to a cone refusal depth of 29.1 m below existing grade and the remaining boreholes were advanced to termination depths of 4.9 m to 8.5 m. The remaining boreholes could not be undertaken due to access restrictions imposed by the conservation authority due to the presence of a drainage ditch. The fieldwork was supervised on a full-time basis by a representative from EXP.

On May 17, 2022, eleven (11) test pits (Test Pit Nos. 2, 5 to 7 and 9 to 15) were excavated in the north and east portions of the site to termination depths ranging from 1.4 m to 3.7 m below existing grade. The purpose of the test pits was to collect additional data on the depth (elevation) and composition of the fill that was placed on the site by the developer/contractor from the adjacent residential subdivision. Test Pit Nos. 1, 3, 4 and 8 could not be excavated due to access issues related to saturated soft ground, ponded water and the height/slope of the fill stockpiles.

The borehole and test pit locations and geodetic elevations were established on site by EXP and are shown on the test hole location plan, Figure 2.

The borehole and test pit locations were cleared of private and public underground services, prior to the start of drilling operations. The boreholes were drilled using a CME-55 track mounted drill rig equipped with continuous flight hollow stem augers and soil sampling capabilities. Auger samples were obtained from the ground surface to a 0.6 m depth in all of the boreholes. Standard penetration tests (SPTs) were performed in all the boreholes at 0.75 m to 1.5 m depth intervals with the soil samples retrieved by the split-barrel sampler. Dynamic cone penetration test (DCPT) was conducted in Borehole No. 2 from a 8.5 m depth to cone refusal depth at 29.1 m below existing grade. The shear strength of the clayey soils was measured by conducting penetrometer and in-situ vane tests at selected depth intervals. Relatively undisturbed samples (Shelby tube samples) of the clayey soils were retrieved at selected depth intervals.

A 19 mm diameter standpipe with slotted section was installed in Borehole No. 4 for long-term monitoring of the groundwater level. The standpipe was installed in accordance with EXP standard practice and the installation configuration is documented on the respective borehole log. All boreholes were backfilled upon completion of drilling and the installation of the standpipe.

The test pits were excavated with a mechanical shovel and samples taken at selected depth intervals in some of the test pits. The water level in the test pits was observed during and upon completion of excavating the test pits. All test pits were backfilled upon completion of the excavation of the test pit.

All the soil samples were visually examined in the field for textural classification, logged, preserved in plastic bags and identified. On completion of the fieldwork, all soil samples were transported to the EXP laboratory in Ottawa.

A summary of the soil sample laboratory testing program is shown in Table I.

Table I: Summary of Laboratory Testing Program

Type of Test	Number of Tests Completed
Soil Samples	
Moisture Content Determination	36
Unit Weight Determination	10
Grain Size Analysis	3
Atterberg Limit Determination	3
One-Dimensional Consolidation Test	1

4. Subsurface Conditions and Groundwater Levels

A detailed description of the subsurface conditions and groundwater levels from the boreholes and test pits are given on the attached borehole logs, Figures 3 to 7 and test pits logs, Figures 11 to 21. The borehole and test pit logs and related information depict subsurface conditions only at the specific locations and times indicated. Subsurface conditions and water levels at other locations may differ from conditions at the locations where sampling was conducted. The passage of time also may result in changes in the conditions interpreted to exist at the locations where sampling was conducted.

Boreholes were drilled and test pits excavated to provide representation of subsurface conditions as part of a geotechnical exploration program and are not intended to provide evidence of potential environmental conditions.

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

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

4.1 Boreholes

4.1.1 Fill

A surficial fill was contacted in all five (5) boreholes extending to depths of 1.8 m to 2.2 m (Elevation 91.5 m to Elevation 91.2 m). The top 0.8 m and 0.9 m of the fill to Elevation 92.7 m to Elevation 92.3 m consists of granular fill underlain by blast-rock fill with only granular fill present in Borehole No. 12. The granular/blast rock fill is underlain by silty sand and gravel fill that contains boulders and cobbles. A 200 mm thick organic layer is present at a 1.5 m depth within the silty sand and gravel fill in Borehole No. 4. Based on the standard penetration test (SPT) N-values of 11 to 49, the silty sand and gravel fill is in a compact to dense state. The moisture content of the granular fill /blast-rock fill ranges from 3 percent to 18 percent. The moisture content of the silty sand and gravel fill is 12 percent to 27 percent. The unit weight of the silty sand and gravel fill is 20.5 kN/m^3 to 23.8 kN/m^3.

4.1.2 Sandy Silt to Silty Sand

The fill is underlain by a sandy silt to silty sand that extends to depths of 2.9 m to 3.3 m (Elevation 90.3 m to Elevation 90.1 m). Based on the SPT N-values of 4 to 23, the sandy silt to silty sand is in a loose to compact state. The natural moisture content of the sandy silt to silty sand is 16 percent to 25 percent.

Grain size analysis and Atterberg limit determination were conducted on one (1) sample of the sandy silt to silty sand and the test results are summarized in Table II. The grain size distribution curve is shown in Figure 8. The results of the Atterberg limits determination indicates the tested soil sample is non-plastic.

Table II: Summary of Grain-size Analysis and Atterberg Limits Test Results – Sandy Silt Sample

Borehole No. – Sample No.	Depth (m)	Grain-size Analysis (%)			Atterberg Limits (%)				Soil Classification (USCS)
		Gravel	Sand	Fines (Silt and Clay)	Natural Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index	
BH 2 – SS4	2.3 – 2.9	2	31	67	20	-	-	-	Sandy Silt (ML)

Based on a review of the results of the grain-size analysis and Atterberg limits, the tested soil sample may be classified as a sandy silt (ML) in accordance with the Unified Soil Classification System (USCS).

4.1.3 Silty Clay

A silty clay was contacted beneath the sandy silt to silty sand at 2.9 m to 3.3 m depths (Elevation 90.3 m to Elevation 90.1 m). in all five (5) boreholes. Borehole Nos. 4, 12, 14 and 15 terminated within the silty clay at 4.9 m to 8.5 m depths (Elevation 88.3 m to Elevation 84.7 m). The sampling of the silty clay in Borehole No. 2 extends to an 8.5 m depth (Elevation 84.8 m) below which the borehole was advanced to cone refusal by conducting the unsampled dynamic cone penetration test (DCPT). At selected depths, the silty clay has stains in the form of black bands, contains shell fragments and exhibits a sulphur-type odour.

The undrained shear strength of the silty clay ranges from 14 kPa to 48 kPa indicating the silty clay has a soft to firm consistency. The sensitivity values of the silty clay are 2.7 to 8.0 indicating the silty clay has a medium sensitivity to sensitive nature. The natural moisture content of the silty clay is 21 percent to 53 percent. The natural unit weight of the silty clay is 17.5 kN/m^3.

Grain size analysis and Atterberg limit determination were conducted on two (2) samples of the silty clay and the test results are summarized in Table III. The grain size distribution curve is shown in Figures 9 and 10.

Table III: Summary of Grain-size Analysis and Atterberg Limits Test Results – Silty Clay Samples

Borehole No. – Sample No.	Depth (m)	Grain-size Analysis (%)			Atterberg Limits (%)				Soil Classification (USCS)
		Gravel	Sand	Fines (Silt and Clay)	Natural Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index	
BH 2 – SS5	3.0 – 3.6	0	19	81	32	21	14	7	Silty Clay with Sand of Low Plasticity (CL-ML)
BH 2 – SS7	5.2 – 5.8	0	8	92	46	28	16	12	Silty Clay of Low Plasticity (CL)

Based on a review of the results of the grain-size analysis and Atterberg limits, the tested soil sample may be classified as a silty clay of low plasticity (ML-CL to CL) in accordance with the USCS.

One dimensional consolidation test was performed on one (1) sample of the silty clay. The test results are summarized in Table IV and presented in Appendix A.

Table IV: One-Dimensional Oedometer Test Results - Silty Clay Sample

Borehole No.- Sample No.	Sample Depth (m)	σ'_{v0} (kPa)	w_c (%)	γ (kN/m^3)	σ'_p (kPa)	e_o	c_r	c_c	OCR
BH2 – ST6	4.0 – 4.6	72	40	17.5	110	1.165	0.019	0.51	1.5

σ'_{v0} = calculated effective overburden pressure (kPa); W_c: natural moisture content (%); γ: estimated natural unit weight; σ'_p = pre-consolidation pressure (kPa); e_o = initial void ratio; C_r = re-compression index; C_c = compression index;

OCR-Over-Consolidation Ratio

Based on a review of the consolidation test results, the over-consolidation ratio is greater than one indicating the silty clay is slightly over-consolidated.

4.1.4 Inferred Boulders or Bedrock

Dynamic cone penetration test (DCPT) conducted in Borehole No. 2 encountered cone refusal at a 29.1 m depth (Elevation 64.2 m). Cone refusal may have been met on possible cobbles or boulders within the inferred glacial till or on possible bedrock.

4.1.5 Groundwater Level Measurements

In the standpipe installed in Borehole No. 4, the groundwater level measured on June 3, 2021 (92 days after the completion of drilling of the borehole) indicated the groundwater level was at a 2.5 m depth (Elevation 90.7 m).

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

4.2 Test Pits

The test pits indicated the fill consists of a heterogeneous mixture of gravel, sand, silt and clay with cobbles and boulders, blast-rock fill of cobble/boulder sizes, organics in the form of topsoil and construction debris such as geotextile. The fill extends to depths of 0.9 m to 3.5 m (Elevation 91.6 m to Elevation 90.4 m) and is underlain by native sandy silt and silty clay. The water level in Test Pit Nos. 5, 6, 11 to 13 and 15 ranges from 0.3 m to 1.4 m depths (Elevation 93.1 m to Elevation 92.5 m). Several areas of ponded water were observed on the ground surface at the time of the test pit fieldwork. It is our understanding that the fill has been deposited on the school site over the years by the developer/contractor from the adjacent residential subdivision.

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

5.1 Site Classification for Seismic Site Response

Based on the borehole information and Table 4.1.8.4.A of the 2012 Ontario Building Code (OBC) as amended May 2, 2019, the site classification for seismic site response is estimated to be **Class E.**

5.2 Liquefaction Potential of Soils

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

6. Grade Raise and Foundation Considerations

6.1 Proposed School Building

Design plans indicate the proposed school building will be a single-story structure with no basement and will be supported by footings. The proposed school development will also include the construction of a future portable area, soccer fields, parking lots and access roads, landscaped areas and the installation of underground municipal services. The ground floor of the proposed school building will be at Elevation 94.50 m and the footings will be founded at Elevation 92.85 m. The proposed maximum site grade raise will be 3.0 m from the original 2011/2015 ground surface elevation of the site. It is our understanding that preliminary design of the proposed school building indicates that the footings will be designed for a bearing pressure at serviceability limit state (SLS) of 75 kPa and a factored geotechnical resistance at ultimate limit state (ULS) of 125 kPa. The factored geotechnical resistance at ULS includes a geotechnical resistance factor of 0.5.

The results from the consolidation test completed as part of this geotechnical investigation and consolidation test results from the 2017 Paterson report indicate the silty clay is slightly over-consolidated. Therefore, the silty clay is prone to large settlements on application of any additional loads. At the time of the 2017 Paterson geotechnical investigation, a surcharge loading program was initiated for the new residential subdivision surrounding the school site. The purpose of the program was to consolidate the silty clay so that future settlements of the silty clay from loads imposed by the fill placed to raise the grades at the subdivision site to the design elevation and loads imposed by footing foundations would be within normally tolerable limits.

As with the subdivision site, the maximum 3.0 m site grade raise proposed at the school site in conjunction with footing loads will result in consolidation settlement of the silty clay that will be higher than the normally tolerable limits. Several options were considered to reduce future consolidation settlement of the silty clay to within tolerable limits and are as follows:

6.1.1 Option No. 1 – Pre-Loading/Surcharging Program of the School Site

The purpose of pre-loading/surcharging the compressible silty clay (with or without wick drains) on site within the footprint of the proposed building and prior to the construction of the proposed building, is to load the silty clay by placing soil fill material that will accelerate the consolidation settlement of the silty clay to a target settlement value, so that future settlement of the proposed building will be within the normal tolerable limits of 25 mm total and 19 mm differential settlement. The target settlement and time to achieve the target settlement is determined by engineering analysis and is a function of the compressibility and permeability properties of the silty clay and the design grade raise and the bearing pressure at serviceability limit (SLS) of the footings for the proposed school building. The monitoring of the settlement of the silty clay is required during the pre-loading/surcharging stage to determine when the target settlement has been achieved and when construction of the proposed building may proceed. Settlement monitoring plates are installed on site within the pre-load/surcharge area to monitor the settlement of the underlying silty clay.

6.1.2 Option No. 2 – Pile Foundations and Structural Slab

With this option, there is no delay in start of construction of the proposed school building, however, this option may be more costly than the remaining options. The proposed school building may be founded on piles driven to bedrock anticipated at approximately a 29.1 m depth (Elevation 64.2 m). The floor slab may be designed as a structural slab also supported by the piles. The estimated consolidation settlement of the silty clay due to the site grade raise beyond the school building footprint will have to be estimated and compared with the permissible total settlement of underground service connections to confirm if the consolidation settlement is within tolerable limits or exceeds the tolerable limits of the underground services.

6.1.3 Option No. 3 – Pile Foundations and Slab-on-Grade Construction

With this option, there is also no delay in the start of the construction of the proposed building however, this option may be costly but anticipated to be less costly than Option No. 2. For this option, the school building is supported by pile foundation and the ground floor is designed as a slab-on-grade supported by either light-weight fill (LWF) or a combination of engineered fill placed to the permissible grade raise level and LWF. The anticipated consolidation settlement of the silty clay will have to be compared with the tolerable settlements of the underground services as in Option No. 2.

6.1.4 Selected Option

The owner and design team for this project decided to proceed with option no. 1: pre-loading/surcharging (with wick drains) program for the location of the proposed school building and for the location of the trench for the proposed underground municipal services that will service the proposed school building; the service trench that runs from Main Halyard Lane located along the west property line of the proposed school site to the proposed school building.

The engineering analysis determined that for a 4.0 m high pre-load/surcharge fill pad (with wick drains installed in the silty clay) constructed to Elevation 95.5 m, the target settlement is 265 mm. The pre-load/surcharge fill pad should consist of 3.0 m thick engineered fill pad and 1.0 m thick pre-load material constructed within the footprint of the proposed building.

The portion of the existing surcharge fill pile (Area H pile) that extends into the footprint of the proposed building requires removal down to the native soil. The excavation for the engineered fill pad should extend to native soil with all existing fill excavated and removed from the excavation. The engineered fill material should consist of Ontario Provincial Standard Specification (OPSS) Granular B Type II material placed on the approved native soil and compacted to 100 percent standard Proctor maximum dry density (SPMDD). The 1.0 m thick pre-load material may consist of any type of fill material that is nominally packed in place. Once the settlement monitoring data indicates the target settlement has been achieved, the 1.0 m thick pre-load fill material is removed from the engineered fill pad and construction of the proposed building may proceed with footings founded within the engineered fill pad at the design elevation of Elevation 92.85 m.

The pre-loading/surcharging program for the proposed school building started in October 2021 with the installation of the wick drains, placement, construction of the engineered fill pad and the pre-load fill pad and installation of settlement monitoring points. This site work was completed in December 2021. The monitoring of the settlement of the silty clay began on completion of the construction of the surcharge/preload program and is currently in progress. An additional 1 m of pre-load fill was placed on the pre-load/surcharge area during the period from May 6 to 11,2022 to expedite the consolidation settlement of the silty clay deposit.

The location of the proposed school building and features of the development, the location of the engineered fill pad and the location of the settlement monitoring plates are shown in Figure 2.

6.1.5 Footings

Once the pre-load/surcharge program has reached the target settlement, the construction of the proposed school building may start. The footings for the proposed school building founded at the design elevation of Elevation 92.85 m on the prepared engineered fill pad may be designed for a bearing pressure at serviceability limit state (SLS) of 75 kPa and factored geotechnical resistance at ULS of 125 kPa. The factored geotechnical resistance at ULS includes a geotechnical resistance factor of 0.5.

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

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

The following sections of this report discusses the geotechnical items for the proposed school development including site grading requirements, slab-on-grade construction, excavation and de-watering requirements, pipe bedding details, backfilling requirements and pavement structure recommendations for areas to be paved as part of the proposed school development.

7. Site Grading

The site grading plan (Revision No. 7 dated April 27, 2022) indicates the following approximate site grade raise above the current 2022 site grades anticipated for feature areas of the proposed school development located beyond (outside of) the surcharge/preload fill areas:

- Parking lot and access road – Beyond the surcharge-pre-load area for the storm and sanitary sewer that cross the parking lot, the site grade raise will vary up to +/- 1.0 m with some cut areas.
- Soccer fields – The site grade raise will be up to +/- 0.3 m with the majority of the fields being a cut area.
- Landscaped area between the soccer fields and the future potable area – The site grade raise will be +/- 0.6 m with some cut areas.
- Future portable areas – The site grade raise area will be up to +/- 0.6 m with some cut areas.
- Paved area along the east side of the proposed school building beyond the engineered fill pad – The grades will slope away from the building at a 2 percent gradient from the floor slab at Elevation 94.50 m to Elevation 93.90 m and Elevation 93.85 m at the easterly edge or limit of the paved area.

Since the above areas are located beyond the pre-load/surcharge area, the silty clay under the weight of the existing fill (including scattered fill piles) is considered to be experiencing on-going consolidation settlement that is expected to result in total and differential settlements beyond tolerable limits. Settlement of the silty clay will also continue under the weight of the additional fill to be placed to achieve the design site grade raises noted above. These settlements are anticipated to be on-going for years. Therefore, as a result of the on-going settlement, periodic maintenance of the paved, landscaped and soccer field areas will be required in the future. This maintenance should be included as part of the overall maintenance program for the school development.

The fill currently on site int these areas is considered to comprise of a heterogeneous mixture of gravel, sand, silt and clay with cobbles and boulders (blast-rock fill) and organics (such as topsoil) that was not compacted. Further, it is not known if the original topsoil layer was removed prior to the placement of the existing fill. Therefore, the existing fill in its current condition may not be able to provide uniform support to the above features of the school development. To improve the support capability of the existing fill, it is recommended that site grading within the footprint of the paved areas that include the parking lot, access road and along the east side of the school building, soccer fields and landscaped areas should consist of the excavation and removal of the fill down to the design subgrade level. The exposed subgrade should be proofrolled using a suitable 10-tonne roller and reviewed by a geotechnician prior to placement of fill. Any soft or spongy subgrade areas detected should be sub excavated and properly replaced with Ontario Provincial Standard Specification (OPSS) Granular B Type II material compacted to 95 percent SPMDD. It is recommended that a woven geotextile be placed on the approved surface of the subgrade prior to placement of any fill. This must be allowed for by the contractor and installed if directed by the geotechnical engineer. For the proposed areas to be paved, contractors bidding on this project should assume that all of the existing fill will need to be removed down to the native soil.

Once the subgrade has been prepared and approved, the site grades may be raised to the approved design subgrade level by the placement of soil fill meeting the requirements of OPSS select subgrade material (SSM) placed in 300 mm thick lifts and compacted to 95 percent of the SPMDD. In wet soft areas, crusher-run granular material may be required in the lower levels of the required fill zone to raise the site grades, for the purpose of stabilizing the subgrade. In place density tests should be performed on each lift of placed material to ensure that it has been compacted to the project specifications.

It is understood that portable classrooms will be built at the site in the future. The portable classrooms may be supported by a concrete block-type footings set on an engineered fill pad. Excavation in the area of the engineered fill pad for the portable classrooms would consist of removing all unsuitable materials to the design subgrade level. The exposed subgrade should then be proofrolled and approved by a geotechnician. Any loose/soft areas of the exposed subgrade at the design founding level should be excavated, removed and replaced with OPSS Granular B Type II material compacted to 100 percent SPMDD.

The excavation for the engineered fill pad should extend a sufficient distance beyond the outside edge of the exterior footings all around the proposed portable classroom to accommodate a 1.0 m wide bench of engineered fill from the outside edge of footing which is thereafter sloped at an inclination of 1H:1V down to the surface of the approved prepared subgrade.

The engineered fill should be placed in the excavation in 300 mm thick lifts and each lift compacted to 100 percent standard Proctor maximum dry density (SPMDD). The engineered fill should consist of Ontario Provincial Standard Specification (OPSS) Granular B Type II. 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 the subsequent lift.

EXP can provide the bearing pressure at Serviceability Limit State (SLS) and factored geotechnical resistance at Ultimate Limit State (ULS) and frost protection measures once additional design details regarding the portables are available.

Since the portables will be located in an area of the site covered with existing fill and settlement of the underlying silty clay is considered to be on-going, there is a possibility that the future portables may undergo total and differential settlements that will exceed the tolerable limits for a portable-type structure. In this case, the portables would require re-levelling on a periodic basis in the future.

8. Floor Slab and Drainage Requirements

Provided that the predicted (target) settlement has been achieved by the preload/surcharge operation that is currently underway, the lowest level floor slab (ground floor) of the proposed school building will be founded on the engineered fill pad and may be constructed as slab-on-grade provided it is set on a bed of well compacted 19 mm clear stone of at least 200 mm thick placed on the engineered fill pad. 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 1010 Granular A overlain by a vapour barrier. Adequate saw cuts should be provided in the floor slab to control cracking

It is recommended that perimeter drains should be provided for the proposed school building. Underfloor drains are not required.

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.

9. Excavation and De-Watering Requirements

9.1 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.

9.2 Excavation

Excavations for the construction of the foundations of the proposed school building, paved areas, soccer field, future portables and underground services are expected to extend to a depth of 2.0 m to 3.0 m below the final grade. These excavations will be undertaken within the engineered fill pad within the footprint of the school building and within the existing fill and silty clay in the remaining areas of the site and are expected to be at or above the groundwater table.

Excavations maybe undertaken by using heavy equipment capable of removing construction debris, cobbles and boulders within the existing fill.

The excavation within the subsurface soils should comply with the most recent Occupational Health and Safety Act (OHSA), Ontario Regulation 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. If excavations extend 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 regulation.

The bases of excavations that extend to a 1.0 m below the surface of the native silty clay are not anticipated to undergo base heave-type failure.

It is anticipated that temporary gravel roads may be required to gain access to the site by heavy construction equipment during construction.

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.

9.3 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 (such as the sandy silt to silty sand seams and layers) may exist, a higher seepage rate should be anticipated. In this case, high-capacity pumps may be required to keep the excavation dry.

The dewatering of excavations on site during short-term construction operations is not expected to adversely impact adjacent existing structures and infrastructure. Further, since the lowest floor slab and the footings for the proposed school building will be founded within the engineered fill pad located above the groundwater level, the permanent perimeter drainage system recommended for the proposed building is also not expected to adversely impact adjacent existing structures and infrastructure.

If less than 50 m^3 of water are to be pumped per day, no permits are required. If between 50 m^3 and 400 m^3 of water is to be pumped per day, then the activity should be registered on the Environmental Activity and Sector Registry (EASR), an online registry maintained by the Ministry of the Environment, Conservation and Parks (MECP). If more than 400 m^3 of water is to be pumped per day, then a Category 3 Permit to Take Water (PTTW) is required.

Since water taking can be groundwater, storm water, or a combination of both, the most likely potential for significant volumes of water requiring removal from an excavation at the site is storm water. If a major rain event occurs while a large excavation is open, then it is possible that the total accumulation of water within the excavation will exceed 50 m^3. If that occurs, then it may be removed without a permit by pumping over several days during which no single-day water-taking is more than 50 m^3. Alternatively, a maximum of 400 m^3 of water may be pumped per day once the online EASR application form is filled out and the fee is paid. The EASR application may be completed by the property owner or their delegate. EXP would be pleased to assist with the EASR, should it be deemed necessary. Per the terms of the EASR, the total quantities of water actually removed from the excavation must be reported to the MECP.

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.

10. Pipe Bedding Requirements and Settlement of Services

10.1 Pipe Bedding Requirements – Within Pre-Load/Surcharge Area

For site servicing, it is anticipated that the subgrade for the proposed underground services will consist of engineered fill, existing fill and silty clay.

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. In areas of soft subgrade, a 300 mm thick sub-bedding of OPSS Granular B Type II material completely wrapped with non-woven geotextile should be placed beneath the Granular A bedding.

Since paved surfaces are anticipated to 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.

It is anticipated that paved surfaces will be located over service trenches. In this case, it is recommended that the trench backfill material within the frost zone up to 1.5 m below finished grade, should match the existing material in the paved roadway, provided the material is determined to be suitable for re-use as backfill material. The matching of materials minimizes differential frost heave of the subgrade material. If the trench backfill material is different than the material in the sidewalls of the trench, a 3H:1V frost taper should be provided to minimize differential frost heave. The trench backfill should be placed in 300 mm thick lifts and each lift compacted to 95 percent SPMDD.

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

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

10.2 Settlement of Underground Services – Beyond Pre-Load/Surcharge Area

Two (2) storm sewers will be located outside of the pre-load/surcharge area where the settlement of the silty clay is considered to be on-going. One (1) storm sewer runs from the proposed parking lot, from storm-manhole (STMH-1) southeast to the landscaped area at catchbasin-manhole (CBMH-1). The second storm sewer runs from the southeast storm sewer in a northeast direction to a catchbasin (CB-3) located south of the proposed soccer field. To minimize the settlement of the two (2) storm sewers, it is recommended that the trenches for the proposed storm sewers above the minimum 300 mm thick pipe cover material be backfilled with light-weight fill (LWF) consisting of Geofoam EPS 22 or equivalent in areas exposed to vehicular traffic and Geofoam EPS 19 or equivalent in landscaped areas.

The LWF should be covered with 600 mm thick layer of soil fill or the pavement structure. The LWF blocks should be tightly fitted to the walls of the excavation without voids. The LWF blocks should be fixed on all sides to the adjacent blocks with Building Grip PL300 construction adhesive. If another layer of light weight blocks is required, it should be installed at right angles to the previous layer with blocks fitting tightly leaving no voids. The LWF should be covered with geotextile (such as Terrafix 270R or equivalent) prior to placement of soil or granular fill.

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

The on-site soils to be excavated are engineered fill, existing fill and silty clay. The silty clay is not considered suitable for re-use as material beneath structural elements and for backfilling purposes. However, this material may be re-used for general grading purposes in landscaped areas. The suitability of the excavated fill and engineered fill will have to be assessed by additional examination and testing at time of construction.

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. The listed materials should be placed in 300 mm thick lifts and compacted to the specified degree of compaction indicated below.

- Engineered Fill under the footings and floor slab - OPSS 1010 Granular B Type II – compacted to 100 percent SPMDD beneath footings for the proposed school building and future portables and to 98 percent SPMDD beneath the floor slabs,
- Backfill material for footing trenches and against foundation walls located inside and outside the building – OPSS 1010 Granular B Type II - compacted to 98 percent SPMDD inside the building and 95 percent of the SPMDD outside the building; and
- Trench backfill and subgrade fill for parking lot, access roads, landscaped areas and soccer fields – OPSS 1010 Select Subgrade Material (SSM) - compacted to 95 percent of the SPMDD.

12. Access Roads and Parking Lots

Pavement structures for the paved area along the east side of the proposed building, parking lot and access roads are given on Table V below for the anticipated fill subgrade. The pavement structures are based upon the assumption that the subgrade will be properly prepared and assumes a functional design life of fifteen (15) to eighteen (18) years. The proposed functional design life represents the number of years to the first rehabilitation, assuming regular maintenance is carried out. The subgrade is expected to be existing fill placed by the developer/contractor during the early stages of site development and/or imported OPSS Granular B Type II or select subgrade material (SSM) used to raise the grades.

Table V: Recommended Pavement Structure Thicknesses

Pavement Layer	Compaction Requirements	Landscaped Paved Areas (Pathways)	Pavement Design Light Duty Vehicles (Cars)	Heavy Duty Vehicles (Buses and Trucks)
Asphaltic Concrete (PG 58-34)	92 to 97 percent MRD*	50 mm HL3	40 mm HL3/SP12.5 Category B 40 mm HL8/SP19.0 Cat B	50 mm HL3/SP12.5 Caty B 60 mm HL8/SP19.0 Cat B
OPSS 1010 Granular A Base	100 percent SPMDD**	150 mm	150 mm	150 mm
OPSS 1010 Granular B Sub-Base, Type II	100 percent SPMDD**	300 mm	450 mm	600 mm
NOTE: Geotextile to be placed over approved competent subgrade as directed by the geotechnical engineer (should be allowed for by the contractor)				

MRD Denotes maximum relative density. ASTM D2041
SPMDD Denotes standard Proctor maximum dry density, ASTM-D698-12e2.

Additional comments on the construction of the paved pathways, paved area along the east side of the proposed building, access road and parking lot are as follows:

1. As part of the subgrade preparation, the proposed paved landscaped areas, parking areas and access roads should be stripped of unsuitable material as well any unsuitable fill placed by developer. 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). It is noted that in some areas of the site, fill of variable composition was placed by the developer and contractor during the early stages of development. Fill piles are also scattered throughout the site. Therefore, an allowance must be made in the contract for the removal of unsuitable fill material at subgrade level or the removal of the original topsoil layer that was left in place prior to placement of the existing fill.
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 and access roadway 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.
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 and/or temporary construction roadways 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 two (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. It should be noted that due to on-going consolidation of the silty clay under the weight of the fill, maintenance of the paved areas and landscaped areas may be required on a periodic basis over the years. This maintenance should form part of on-going maintenance program of the facility.
7. It is recommended that a geotextile be placed on the surface of the subgrade prior to placement of any granular sub-base. This must be allowed for by the contractor and installed if directed by the geotechnical engineer.
8. 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.
9. 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.

13. Soccer Fields

Test Pit No. 5 is located within the footprint of a proposed soccer field and indicates that the fill extends to a 3.5 m depth (Elevation 90.5 m) and is underlain by native sandy silt. It is recommended that 600 mm of the existing fill below the design subgrade level for the soccer field should be excavated and removed. The exposed subgrade should be proofrolled using a suitable 10-tonne roller and reviewed by a geotechnician prior to placement of fill. Any soft or spongy subgrade areas detected should be sub excavated and properly replaced with Ontario Provincial Standard Specification (OPSS) Granular B Type II material compacted to 95 percent SPMDD. It is recommended that a woven geotextile be placed on the approved surface of the subgrade prior to placement of any fill. The geotextile must be allowed for by the contractor and installed if directed by the geotechnical engineer.

Once the subgrade has been prepared and approved, the site grades may be raised to the approved design subgrade level by the placement of soil fill meeting the requirements of OPSS select subgrade material (SSM) placed in 300 mm thick lifts and compacted to 95 percent of the SPMDD. In wet soft areas, crusher-run granular material may be required in the lower levels of the required fill zone to raise the site grades, for the purpose of stabilizing the subgrade. In place density tests should be performed on each lift of placed material to ensure that it has been compacted to the project specifications.

The base and sub-base materials should be compacted to at least 95 percent of SPMDD. The soccer fields should be equipped with sub-drains. The designer of the soccer field should be consulted for the final design of the soccer field.

14. Additional Comments

All earthwork activities from placement and compaction of fill in the service trenches to subgrade preparation, engineered fill pad construction, 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.

15. General Comments

The comments given in this report are intended only for the guidance of design engineers. The number of test holes required to determine the localized underground conditions between test holes 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.

Yours truly,

Susan M. Potyondy, P.Eng.
Senior Project Manager, Geotechnical Services
Earth and Environment

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

Figures

0 150m 300m 600m

HORIZONTAL 1:15,000

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DATE: MAY 2022	CLIENT: OTTAWA CATHOLIC SCHOOL BOARD	project no.: OTT-21003218-A0
DESIGN: S.P. / CHECKED: I.T.		scale: ~1:15,000
DRAWN BY: T.M. / A.S.	TITLE: SITE LOCATION PLAN OCSB BARRHAVEN ELEMENTARY SCHOOL, 135 MAIN HALYARD LANE, OTTAWA, ON	FIG 1

Filename: E:\OTT\OTT-21003218-A0\60 Execution\65 Drawings\21003218 FIG-1.dwg
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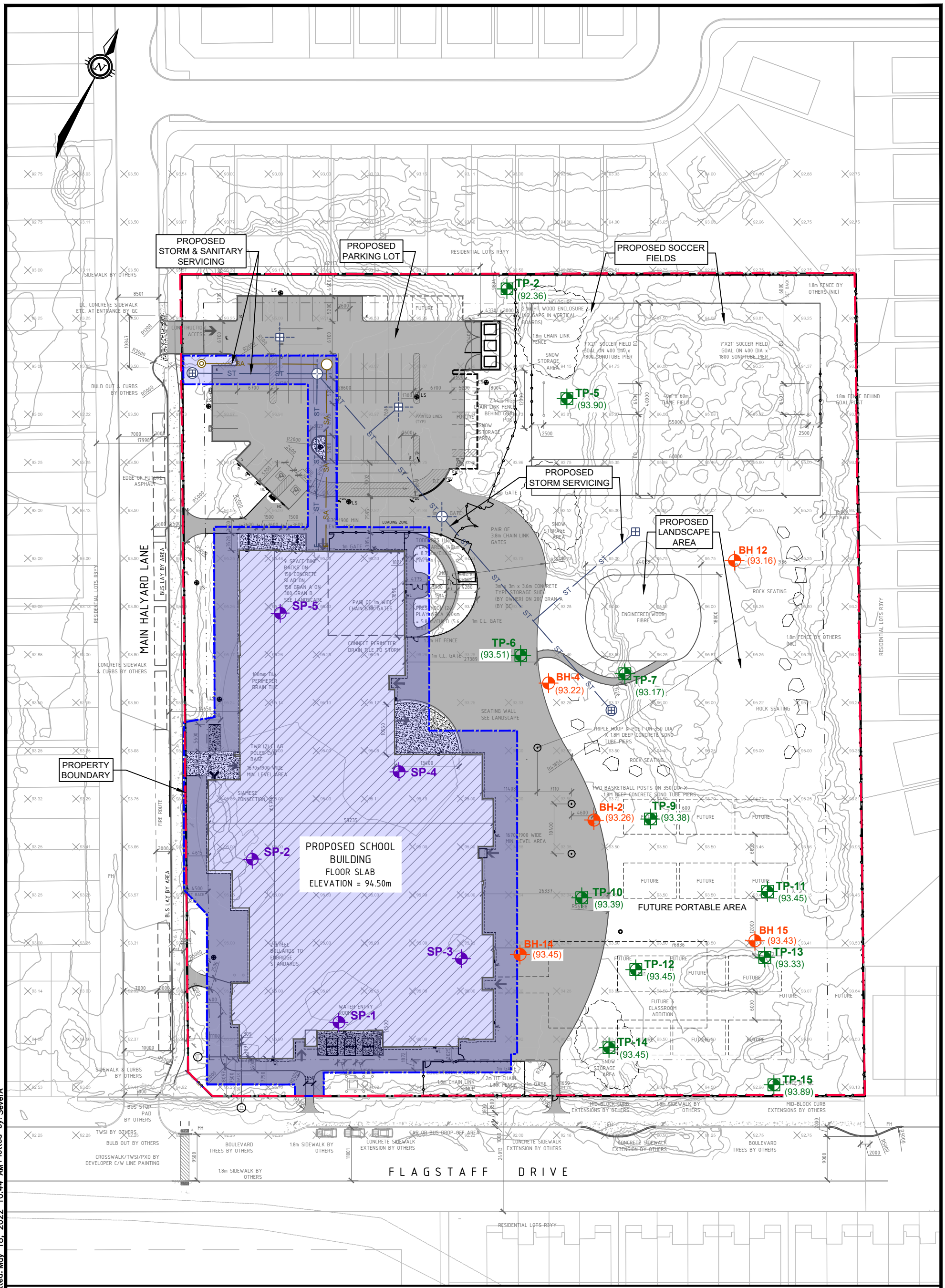

LEGEND:

- BH-2 (93.26) — BOREHOLE LOCATION, NUMBER (GROUND SURFACE ELEVATION)
- SP-1 — SETTLEMENT MONITORING POINT
- TP-2 (92.36) — TEST PIT LOCATION, NUMBER (GROUND SURFACE ELEVATION)
- PROPOSED SCHOOL BUILDING
- PROPOSED PAVED AREA
- LIMIT OF ENGINEERED FILL PAD

HORIZONTAL 1:750 (0, 5m, 10m, 30m)

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DESIGN	S.P.
DRAWN	A.S.
DATE	MAY 2022
FILE NO	OTT-21003218-A0

PROPOSED OCSB BARRHAVEN ELEMENTARY SCHOOL, 135 MAIN HALYARD LANE, OTTAWA, ONTARIO

TEST HOLE LOCATION PLAN

SCALE 1:750

SKETCH NO FIG 2

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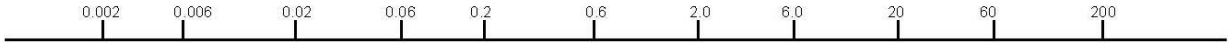
Notes On Sample Descriptions

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		



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 BH02

Project No: OTT-21003218-A0

Project: Proposed OCSB Barrhaven Elementary School

Location: 135 Main Halyard Lane, Ottawa, ON

Figure No. 3

Page. 1 of 3

Date Drilled: 'March 31, 2021

Drill Type: CME-55 Track Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: AN Checked by: SMP

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		GRANULAR FILL Granular A type crushed granular material, grey	93.26	0
		Over		
		BLAST-ROCK FILL Cobble and boulder sizes, grey	92.5	
		FILL Silty sand and gravel with cobbles and boulders, brown, moist, (dense) difficult augering from 0.8 m to 1.5 m depths	91.5	1
		SANDY SILT Brown, moist to wet, (compact)		2
		SILTY CLAY With sand, low plasticity, sensitive, dark grey, wet, (firm)	90.3	3
				4
		SILTY CLAY Low plasticity, sensitive, dark grey, wet, (firm)	88.8	5
		with black bands from 6.1 m to 8.2 m depths		6
				7
				8
		Dynamic Cone Penetration Test (DCPT) conducted from 8.5 m to 29.1 m depths.	84.8	9
				10

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

48
23
15
Hammer Weight
38 kPa
s=8.0
34 kPa
s=7.0
Hammer Weight
29 kPa
Hammer Weight
43 kPa

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

SAMPLES	Natural Unit Wt. kN/m³
AS1	
SS2	23.8
SS3	
SS4	
SS5	
ST6	17.5
SS7	
ST8	
SS9	

Continued Next Page

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-21003218-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	4.6	7.6

CORE DRILLING RECORD

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

LOG OF BOREHOLE BH LOGS - 21003218.GPJ TROW OTTAWA.GDT 5/17/22

Log of Borehole BH02

Project No: OTT-21003218-A0

Project: Proposed OCSB Barrhaven Elementary School

Figure No. 3

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
		Dynamic Cone Penetration Test (DCPT) conducted from 8.5 m to 29.1 m depths. *(continued)*	83.26	10	20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60		
				11				
				12				
				13				
				14				
				15				
				16				
				17				
				18				
				19				
				20				
				21				
				22				

Continued Next Page

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-21003218-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	4.6	7.6

CORE DRILLING RECORD

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

LOG OF BOREHOLE BH LOGS - 21003218.GPJ TROW OTTAWA.GDT 5/17/22

Log of Borehole BH02

Project No: OTT-21003218-A0

Project: Proposed OCSB Barrhaven Elementary School

Figure No. 3

Page. 3 of 3

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa (20 40 60 80 / 50 100 150 200)	Combustible Vapour Reading (ppm) 250 500 750 / Natural Moisture Content % Atterberg Limits (% Dry Weight) 20 40 60	SAMPLES	Natural Unit Wt. kN/m³
		Dynamic Cone Penetration Test (DCPT) conducted from 8.5 m to 29.1 m depths. *(continued)*	71.26	22				
				23				
				24				
				25				
				26				
				27				
				28				
			64.2	29				
		Cone Refusal at 29.1 m Depth						

LOG OF BOREHOLE BH LOGS - 21003218.GPJ TROW OTTAWA.GDT 5/17/22

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-21003218-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	4.6	7.6

CORE DRILLING RECORD

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

Log of Borehole BH04

Project No: OTT-21003218-A0

Project: Proposed OCSB Barrhaven Elementary School

Location: 135 Main Halyard Lane, Ottawa, ON

Figure No. 4

Page. 1 of 1

Date Drilled: 'March 30, 2021

Drill Type: CME-55 Track Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: AN Checked by: SMP

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

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

GWL	SYMBOL	SOIL DESCRIPTION	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
		GRANULAR FILL Granular A type crushed granular material, grey	92.92	0			AS1	
		Over **BLAST-ROCK FILL** Cobble and boulder sizes, grey	92.0					
		FILL Silty sand and gravel with cobbles and boulders, brown, moist, (compact to dense) ~ 200 mm thick organic layer with decayed wood chips at 1.5 m depth	90.9	1	44		SS2	23.2
					17		SS3	20.5
▽		**SILTY SAND** Grey, wet, (loose)	90.42	2	5		SS4	
		SILTY CLAY With sand, shell fragments, black bands, medium sensitivity, dark grey, wet, (soft to firm)	89.9	3	2		SS5	
					38 kPa			
					s=4.0			
					Hammer Weight		SS6	
					29 kPa			
					s=3.0			
				5	Hammer Weight		SS7	
					29 kPa			
				6				
					Hammer Weight		SS8	
				7	14 kPa			
					19 kPa			
					Hammer Weight		SS9	
				8	24 kPa			
			84.4					
		Borehole Terminated at 8.5 m Depth						

LOG OF BOREHOLE BH LOGS - 21003218.GPJ TROW OTTAWA.GDT 5/17/22

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter standpipe installed as shown.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-21003218-A0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Completion	4.6	N/A
June 3, 2021	2.5	

CORE DRILLING RECORD

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

Log of Borehole BH12

Project No: OTT-21003218-A0

Project: Proposed OCSB Barrhaven Elementary School

Location: 135 Main Halyard Lane, Ottawa, ON

Figure No. 5

Page. 1 of 1

Date Drilled: 'March 30, 2021

Drill Type: CME-55 Track Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: AN Checked by: SMP

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

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

GWL	SYMBOL	SOIL DESCRIPTION	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
		GRANULAR FILL Granular A type crushed granular material, grey	93.16	0			AS1	
			92.4					
		FILL Silty sand and gravel, brown to grey, moist, (compact)		1	16		SS2	22.6
			91.3	2	14		SS3	21.2
		SILTY SAND Brown, wet, (loose)			6		SS4	
			90.3	3	48 kPa s=5.0			
		SILTY CLAY With sand, medium sensitivity to sensitive, dark grey, wet, (firm)			5		SS5	
				4	38 kPa s=5.3			
					Hammer Weight		SS6	
			88.3		38 kPa s=2.7			
		Borehole Terminated at 4.9 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-21003218-A0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)
Completion	4.3	4.6

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

LOG OF BOREHOLE BH LOGS - 21003218.GPJ TROW OTTAWA.GDT 5/17/22

Log of Borehole BH14

Project No: OTT-21003218-A0

Project: Proposed OCSB Barrhaven Elementary School

Location: 135 Main Halyard Lane, Ottawa, ON

Figure No. 6

Page. 1 of 1

Date Drilled: 'March 30, 2021

Drill Type: CME-55 Track Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: AN Checked by: SMP

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

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

GWL	SYMBOL	SOIL DESCRIPTION	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
		GRANULAR FILL Granualr A type crushed granular fill, grey	93.45	0			AS1	
		Over **BLAST-ROCK FILL** Cobble and boulder sizes, grey, moist	92.7					
		FILL Silty sand and gravel, cobbles and boulders, brown, moist, (dense)		1	38		SS2	21.6
					49		SS3	
		difficult augering from 1.5 m to 2.2 m depths	91.3	2				
		SILTY SAND Brown, moist, (compact)			14		SS4	22.1
				3	3		SS5	
		SILTY CLAY With sand and black bands, sensitive, dark grey, wet, (soft to firm)	90.2	4	34 kPa 34 kPa s=4.7			
					Hammer Weight		SS6	
				5	29 kPa s=4.0			
				6	Hammer Weight		SS7	
				7	24 kPa			
					Hammer Weight		SS8	
				8	38 kPa s=4.0			
			85.0					
		Borehole Terminated at 8.5 m Depth						

LOG OF BOREHOLE BH LOGS - 21003218.GPJ TROW OTTAWA.GDT 5/17/22

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-21003218-A0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)
Completion	4.6	7.6

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

Log of Borehole BH15

Project No: OTT-21003218-A0

Project: Proposed OCSB Barrhaven Elementary School

Location: 135 Main Halyard Lane, Ottawa, ON

Figure No. 7

Page. 1 of 1

Date Drilled: 'March 31, 2021

Drill Type: CME-55 Track Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: AN Checked by: SMP

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

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

GWL	SYMBOL	SOIL DESCRIPTION	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
		GRANULAR FILL Granular A type crushed granular material, grey Over **BLASTED ROCK FILL** Cobbles and boulders, grey	93.43 92.6	0		×	AS1	
		FILL Silty sand and gravel, brown and grey, moist, (compact)		1	15 ○	×	SS2	22.0
				2	11 ○	×	SS3	20.7
		SILTY SAND Brown, moist to wet, (loose)	91.4		4 ○	×	SS4	
				3	Hammer Weight ○	×	SS5	
		SILTY CLAY With sand, medium sensitivity to sensitive, dark grey, wet, (firm)	90.1	4	38 kPa +S s=3.2 Hammer Weight ○	×	SS6	
				5	38 kPa +S s=5.3			
		Borehole Terminated at 5.5 m Depth	87.9					

LOG OF BOREHOLE BH LOGS - 21003218.GPJ TROW OTTAWA.GDT 5/17/22

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-21003218-A0

WATER LEVEL RECORDS

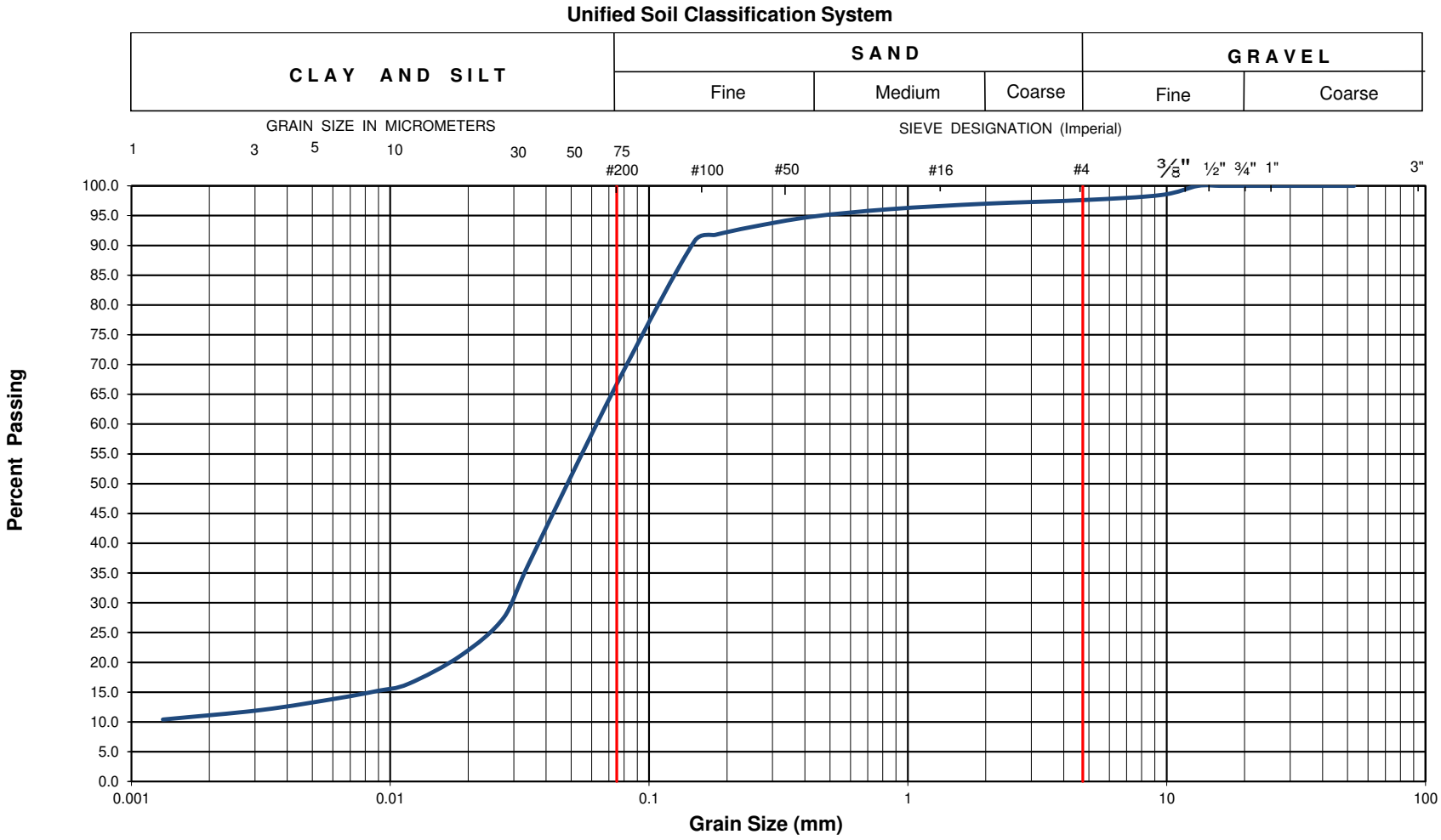
Date	Water Level (m)	Hole Open To (m)
Completion	4.3	4.6

CORE DRILLING RECORD

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

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

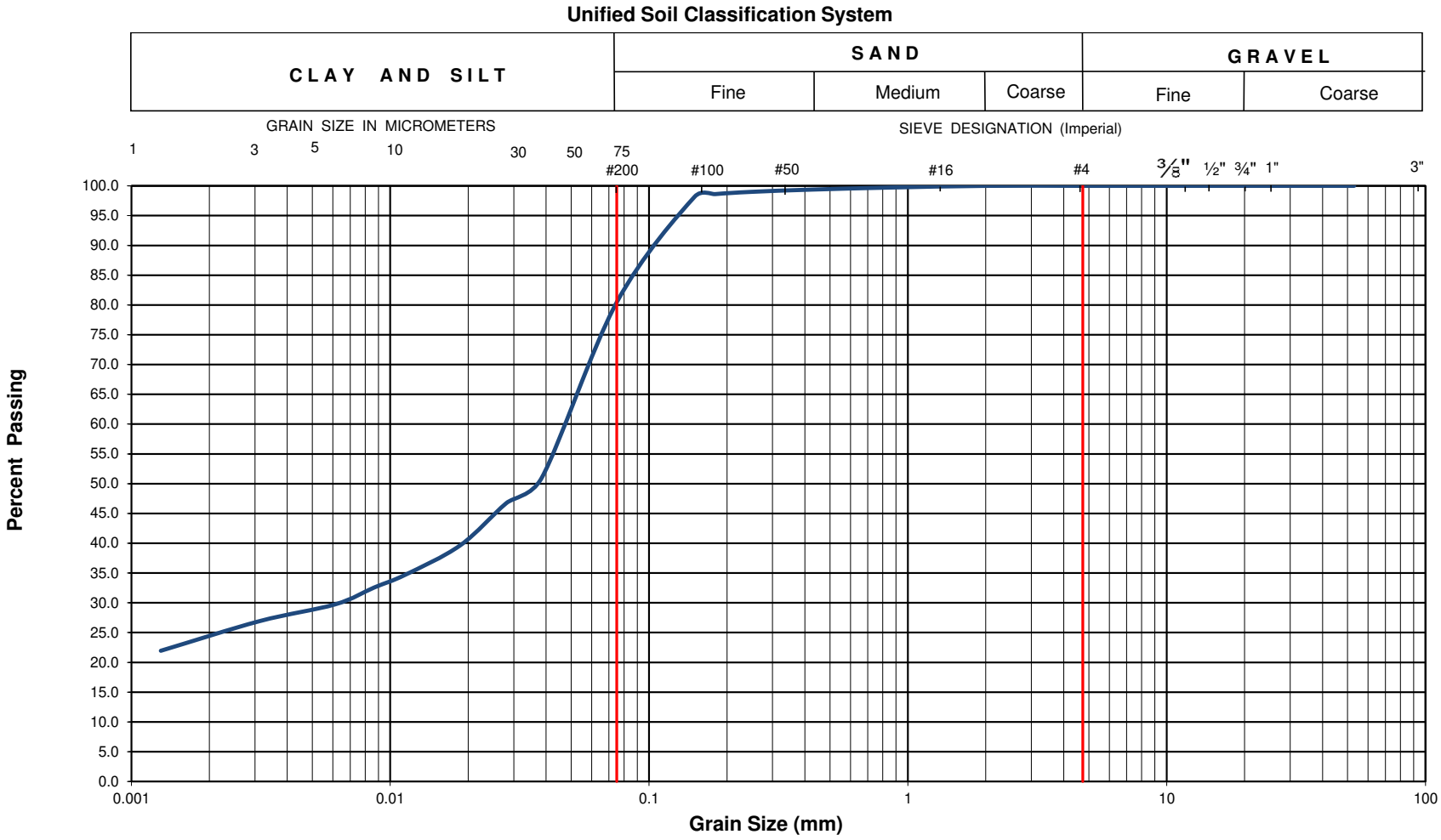
Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422



EXP Project No.:	**OTT-21003218-A0**	**Project Name :**	**Proposed OCSB Barrhaven Elementary School**						
Client :	**Ottawa Catholic School Board**	**Project Location :**	**135 Main Halyard Lane, Ottawa, Ontario**						
Date Sampled :	**March 31, 2021**	**Borehole No:**	**BH2**		**Sample No.:**	**SS4**		**Depth (m) :**	**2.3-2.9**
Sample Description :		**% Silt and Clay**	**67**	**% Sand**	**30**	**% Gravel**	**3**	**Figure :**	**8**
Sample Description :		**SANDY SILT (ML)**							

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

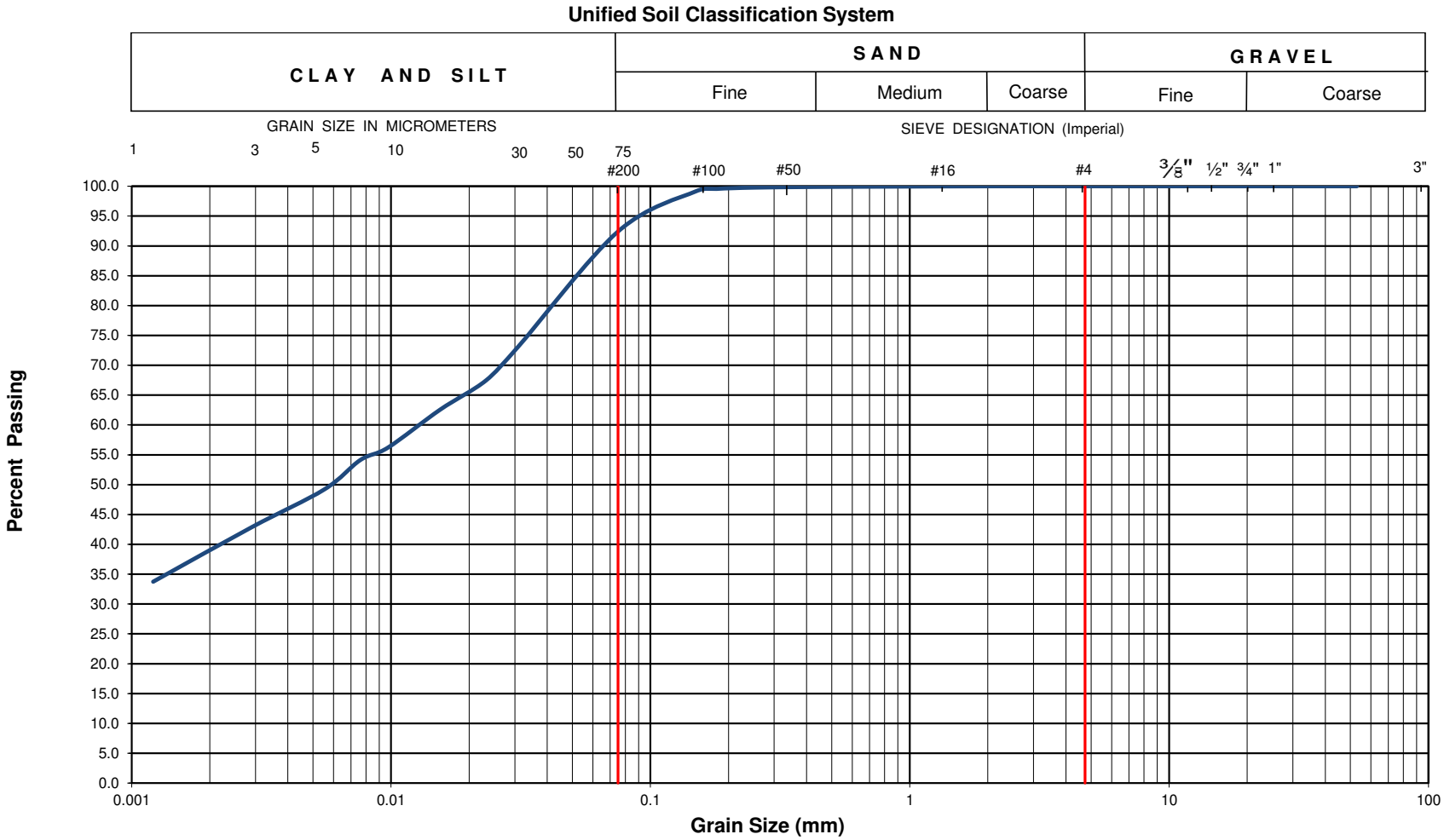
Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422



EXP Project No.:	**OTT-21003218-A0**	**Project Name :**	**Proposed OCSB Barrhaven Elementary School**						
Client :	**Ottawa Catholic School Board**	**Project Location :**	**135 Main Halyard Lane, Ottawa, Ontario**						
Date Sampled :	**March 31, 2021**	**Borehole No:**	**BH2**	**Sample No.:**	**SS5**	**Depth (m) :**	**3.0-3.6**		
Sample Description :		**% Silt and Clay**	**81**	**% Sand**	**19**	**% Gravel**	**0**	**Figure :**	**9**
Sample Description :	**SILTY CLAY with Sand of Low Plasticity (CL-ML)**								

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



EXP Project No.:	**OTT-21003218-A0**	**Project Name :**	**Proposed OCSB Barrhaven Elementary School**						
Client :	**Ottawa Catholic School Board**	**Project Location :**	**135 Main Halyard Lane, Ottawa, Ontario**						
Date Sampled :	**March 31, 2021**	**Borehole No:**	**BH2**	**Sample No.:**	**SS7**	**Depth (m) :**	**5.2-5.8**		
Sample Description :		**% Silt and Clay**	**92**	**% Sand**	**8**	**% Gravel**	**0**	**Figure :**	**10**
Sample Description :		**SILTY CLAY of Low Plasticity (CL)**							

Log of Borehole TP-02

Project No: OTT-21003218-A0

Project: Proposed OCSB Barrhaven Elementary School

Location: 135 Main Halyard Lane, Ottawa, ON

Figure No. 11

Page. 1 of 1

Date Drilled: 'May 17, 2022

Drill Type: Mechnical Shovel - 320

Datum: Geodetic Elevation

Logged by: MZ Checked by: SMP

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		TOPSOIL FILL With construction debris such as geoxtextile pieces, brown and dark brown, wet	92.36	0	20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60		
		SILTY CLAY Brown to grey, moist	91.5	1				
		Test Pit Terminated at 1.4 m Depth	91.0					

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Test pit backfilled upon completion of excavating operation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-21003218-A0

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

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

LOG OF BOREHOLE TP LOGS - 21003218 - COPY.GPJ TROW OTTAWA.GDT 5/18/22

Log of Borehole TP-05

Project No: OTT-21003218-A0

Project: Proposed OCSB Barrhaven Elementary School

Location: 135 Main Halyard Lane, Ottawa, ON

Figure No. 12

Page. 1 of 1

Date Drilled: 'May 17, 2022

Drill Type: Mechnical Shovel - 320

Datum: Geodetic Elevation

Logged by: MZ Checked by: SMP

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		FILL Crusher-run limestone with boulders up to 0.6 m depth underlain by dark brown sandy silty clay with gravel and topsoil inclusions, moist	93.9	0
		FILL Clayey sand and gravel with cobbles to sandy clay, some gravel and boulders, light brown to dark brown, moist to wet	92.5	1
		SANDY SILT Grey, wet	90.4	2
		Test Pit Terminated at 3.7 m Depth Note: 1) Water seeping into test pit at 1.4 m depth.	90.2	3

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

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

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. Test pit backfilled upon completion of excavating operation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-21003218-A0

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

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

LOG OF BOREHOLE TP LOGS - 21003218 - COPY.GPJ TROW OTTAWA.GDT 5/18/22

Log of Borehole TP-06

Project No: OTT-21003218-A0

Project: Proposed OCSB Barrhaven Elementary School

Location: 135 Main Halyard Lane, Ottawa, ON

Figure No. 13

Page. 1 of 1

Date Drilled: 'May 17, 2022

Drill Type: Mechnical Shovel - 320

Datum: Geodetic Elevation

Logged by: MZ Checked by: SMP

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		FILL Crusher-run limestone to sand and gravel, some boulders and cobbles, grey, wet	93.51	0
			92.8	
		FILL Sand and gravel with cobbles and boulders to dark organic clay, some organic topsoil inclusions, light to dark brown, moist to wet		1
			91.3	2
		SANDY SILT Grey, wet	91.1	
		Test Pit Terminated at 2.4 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

Note:

1)Water seeping into test pit at 0.7 m depth

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Test pit backfilled upon completion of excavating operation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-21003218-A0

WATER LEVEL RECORDS

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

CORE DRILLING RECORD

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

LOG OF BOREHOLE TP LOGS - 21003218 - COPY.GPJ TROW OTTAWA.GDT 5/18/22

Log of Borehole TP-07

Project No: OTT-21003218-A0

Project: Proposed OCSB Barrhaven Elementary School

Location: 135 Main Halyard Lane, Ottawa, ON

Figure No. 14

Page. 1 of 1

Date Drilled: 'May 17, 2022

Drill Type: Mechnical Shovel - 320

Datum: Geodetic Elevation

Logged by: MZ Checked by: SMP

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		FILL Silty clay to sandy clay, some sand and gravel, cobbles, boulders, brown to grey, moist	93.17	0
				1
				2
			91.0	
		SANDY SILT Some clay, grey, wet	90.8	
		Test Pit Terminated at 2.4 m Depth		

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

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

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. Test pit backfilled upon completion of excavating operation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-21003218-A0

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

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

LOG OF BOREHOLE TP LOGS - 21003218 - COPY.GPJ TROW OTTAWA.GDT 5/18/22

Log of Borehole TP-09

Project No: OTT-21003218-A0

Project: Proposed OCSB Barrhaven Elementary School

Location: 135 Main Halyard Lane, Ottawa, ON

Figure No. 15

Page. 1 of 1

Date Drilled: 'May 17, 2022

Drill Type: Mechnical Shovel - 320

Datum: Geodetic Elevation

Logged by: MZ Checked by: SMP

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

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

GWL	SYMBOL	SOIL DESCRIPTION	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 clay, some sand and gravel, cobbles, boulders and topsoil inclusions, brown to grey, moist	93.38	0	20 40 60 80 / 50 100 150 200	250 500 750 / 20 40 60		
		SANDY SILT Some clay, grey, wet	90.9 / 90.8	1				
		Test Pit Terminated at 2.6 m Depth		2				

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Test pit backfilled upon completion of excavating operation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-21003218-A0

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

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

LOG OF BOREHOLE TP LOGS - 21003218 - COPY.GPJ TROW OTTAWA.GDT 5/18/22

Log of Borehole TP-10

Project No: OTT-21003218-A0

Project: Proposed OCSB Barrhaven Elementary School

Location: 135 Main Halyard Lane, Ottawa, ON

Figure No. 16

Page. 1 of 1

Date Drilled: 'May 17, 2022

Drill Type: Mechnical Shovel - 320

Datum: Geodetic Elevation

Logged by: MZ Checked by: SMP

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		FILL Crusher-run limestone to sand and gravel, some boulders and cobbles, grey wet	93.39	0
			92.8	
		GEOTEXTILE	92.7	
		FILL Sand and gravel wiht some cobbles (200 mm thick)OVER silty clay fill with some sand and gravel, dark grey, moist		1
				2
		SANDY SILT Grey, wet	91.2 91.0	
		Test Pit Terminated at 2.4 m Depth		

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

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

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. Test pit backfilled upon completion of excavating operation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-21003218-A0

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

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

LOG OF BOREHOLE TP LOGS - 21003218 - COPY.GPJ TROW OTTAWA.GDT 5/18/22

Log of Borehole TP-11

Project No: OTT-21003218-A0

Project: Proposed OCSB Barrhaven Elementary School

Location: 135 Main Halyard Lane, Ottawa, ON

Figure No. 17

Page. 1 of 1

Date Drilled: 'May 17, 2022

Drill Type: Mechnical Shovel - 320

Datum: Geodetic Elevation

Logged by: MZ Checked by: SMP

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		FILL Crusher-run limestone mixed with silty clay, brown and grey, wet	93.45	0
		GEOTEXTILE	93.2 93.1	
		FILL Silty clay, some sand and gravel, cobbles, topsoil inclusions, moist, brown		1
		SANDY SILT Trace gravel, grey, wet.	91.6	2
		Test Pit Terminated at 2.3 m Depth	91.2	

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

Note:

1) Water seeping into test pit at 0.3 m depth.

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Test pit backfilled upon completion of excavating operation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-21003218-A0

WATER LEVEL RECORDS

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

CORE DRILLING RECORD

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

LOG OF BOREHOLE TP LOGS - 21003218 - COPY.GPJ TROW OTTAWA.GDT 5/18/22

Log of Borehole TP-12

Project No: OTT-21003218-A0

Project: Proposed OCSB Barrhaven Elementary School

Location: 135 Main Halyard Lane, Ottawa, ON

Figure No. 18

Page. 1 of 1

Date Drilled: 'May 17, 2022

Drill Type: Mechnical Shovel - 320

Datum: Geodetic Elevation

Logged by: MZ Checked by: SMP

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		FILL Blast rock fill , some sand and gravel and cobbles, grey, wet	93.45	0
		GEOXTEXTILE	92.8 92.7	
		FILL Sand and gravel (200 mm thick) OVER clayey silt to clay with boulders and cobbles, some topsoil inclusions or pockets, dark brown , moist		1
		SANDY SILT Grey, wet	91.4 91.2	2
		Test Pit Terminated at 2.3 m Depth		

Note:

1) Water seeping into test pit at 0.7 m depth.

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

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. Test pit backfilled upon completion of excavating operation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-21003218-A0

WATER LEVEL RECORDS

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

CORE DRILLING RECORD

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

LOG OF BOREHOLE TP LOGS - 21003218 - COPY.GPJ TROW OTTAWA.GDT 5/18/22

Log of Borehole TP-13

Project No: OTT-21003218-A0

Project: Proposed OCSB Barrhaven Elementary School

Location: 135 Main Halyard Lane, Ottawa, ON

Figure No. 19

Page. 1 of 1

Date Drilled: 'May 17, 2022

Drill Type: Mechnical Shovel - 320

Datum: Geodetic Elevation

Logged by: MZ Checked by: SMP

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		FILL Blast rock fill , some sand, gravel and cobbles, grey, wet	93.33	0
		GEOTEXTILE	92.7 92.7	
		FILL Clayey silt with sand and gravel pockets or seams, cobbles, topsoil inclusions, dark brown, moist		1
		SANDY SILT Grey, wet	91.3 91.1	2
		Test Pit Terminated at 2.3 m Depth		

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

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

SAMPLES

Natural Unit Wt. kN/m³

Note:

1) Water seeping into test pit at 0.6 m depth.

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Test pit backfilled upon completion of excavating operation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-21003218-A0

WATER LEVEL RECORDS

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

CORE DRILLING RECORD

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

LOG OF BOREHOLE TP LOGS - 21003218 - COPY.GPJ TROW OTTAWA.GDT 5/18/22

Log of Borehole TP-14

Project No: OTT-21003218-A0

Project: Proposed OCSB Barrhaven Elementary School

Location: 135 Main Halyard Lane, Ottawa, ON

Figure No. 20

Page. 1 of 1

Date Drilled: 'May 17, 2022

Drill Type: Mechnical Shovel - 320

Datum: Geodetic Elevation

Logged by: MZ Checked by: SMP

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		FILL Crusher-run limestone with boulders and blast rock, grey, moist to wet	93.45	0
			92.6	
		FILL Clayey silt with sand and gravel, cobbles, topsoil inclusions, dark brown, moist		1
			91.7	
		SANDY SILT Trace gravel, brown, wet	91.5	2
		Test Pit Terminated at 2.0 m Depth		

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

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

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole data requires interpretation by EXP before use by others
2. Test pit backfilled upon completion of excavating operation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-21003218-A0

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

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

LOG OF BOREHOLE TP LOGS - 21003218 - COPY.GPJ TROW OTTAWA.GDT 5/18/22

Log of Borehole TP-15

Project No: OTT-21003218-A0

Project: Proposed OCSB Barrhaven Elementary School

Location: 135 Main Halyard Lane, Ottawa, ON

Figure No. 21

Page. 1 of 1

Date Drilled: 'May 17, 2022

Drill Type: Mechnical Shovel - 320

Datum: Geodetic Elevation

Logged by: MZ Checked by: SMP

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		FILL Crusher-run limestone, grey, wet	92.89	0
		FILL Clayey silt with sand and gravel, cobbles, boulders, topsoil inclusions and rootlets, dark brown , moist	92.6	
		SANDY SILT Grey, moist	91.5	1
		Test Pit Terminated at 2.3 m Depth	90.6	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

Note :

1) Water seeping into test pit at 0.3 m depth.

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Test pit backfilled upon completion of excavating operation.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-21003218-A0

WATER LEVEL RECORDS

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

CORE DRILLING RECORD

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

LOG OF BOREHOLE TP LOGS - 21003218 - COPY.GPJ TROW OTTAWA.GDT 5/18/22

Appendix A - Consolidation Test Results

Stantec Consulting Ltd.
400 - 1331 Clyde Avenue, Ottawa ON K2C 3G4

May 12, 2021
File: 121623683

Attention: Ismail Taki, M.Eng., P.Eng.
Exp Services Inc
2650 Queensview Drive
Suite 100
Ottawa, Ontario, Canada, K2B 8H6
Tel: 1-613-853-1350
E-mail: ismail.taki@exp.com

Dear Mr. Taki,

Reference: Consolidation Test Results, Exp Services Inc., File #21003218: BH 2, TW6, 13-15 ft. sampled on March 31, 2021

This letter presents the results of one-dimensional consolidation test carried out on the above referenced sample in accordance with ASTM D2435/D2435M – 11(2020). The test results are provided in the attached tables and figures.

This letter provides test results only and does not constitute any interpretation or engineering recommendations with respect to material suitability or specification compliance.

We trust the information presented herein meets your present requirements. Should you have any questions or require additional information, please do not hesitate to contact us.

Regards,

Stantec Consulting Ltd.

Rajib Dey Ph.D., P.Eng.
Geotechnical Engineer
Direct: 905 944-6190
Mobile: 709 693-0418
Rajib.Dey@stantec.com

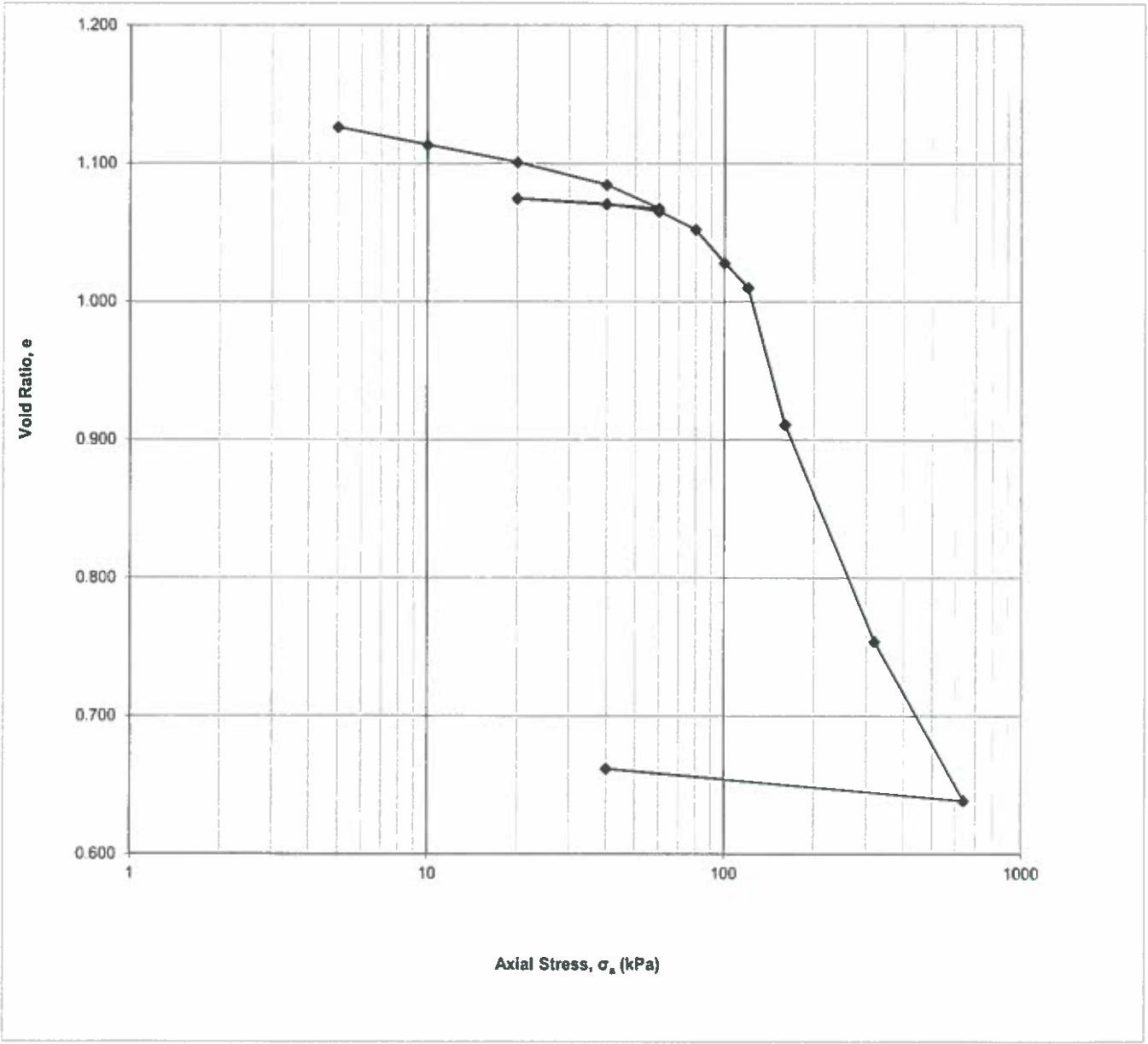
v:\01216\active\laboratory_standing_offers\2021 laboratory standing offers\121623683 exp services inc\march 31, one consolidation, file# 21003218\121623683_let_consolidation_bh 2 tw6 docx

Stantec

One-Dimensional Consolidation Properties of Soils Using Incremental Loading

ASTM D2435/D2435M - 11(2020)

Project	**Exp, File# 21003218**
Project No.	**121623683**
Borehole No.	**BH 2**
Sample No.	**TW-6**
Sample Depth	**13-15 ft.**



Stantec

Stantec Consulting Ltd.

Checked by: D. Boateng Date: May 12, 2021
Approved by: R. Dey Date: May 12, 2021

One-Dimensional Consolidation Test using Incremental Loading
ASTM D2435/D2435M - 11(2020)

Specimen Details

Project Name	Exp, File# 21003218
Project Location	3387 Borrisokane Rd, Otta, ON
Borehole	BH 2
Sample No.	TW-6
Depth	13-15 ft.
Sample Date	March 31, 2021
Test Number	One
Technician Name	Daniel Boateng

Soil Description & Classification

Silty clay, dark grey, moist

Specific Gravity of Solids	2.750
Average water content of trimmings %	40.08
Additional Notes (information source, occurence and size of large isolated particles etc.)	
1. Specific gravity of solids assummed, 2. Piece of rock retained on 26.5mm sieve found within 7" recovered sample, 3. Sample has strong organic odour	

Initial Specimen Conditions

Height	mm	20.00
Diameter	mm	50.00
Area	mm^2	1963
Volume	mm^3	39270
Mass	g	69.87
Dry Mass	g	49.88
Density	Mg/m^3	1.779
Dry Density	Mg/m^3	1.270
Water Content	%	40.08
Degree of Saturation	%	94.6
Height of Solids	mm	9.24
Initial Void Ratio		1.165

Final Specimen Conditions

Water Content	%	25.22
Final Void Ratio		0.662
Final Height	mm	15.35

Stantec

Stantec Consulting Ltd.

Filename: V:\01216\active\laboratory_standing_offers\2021 Laboratory Standing Offers\12162368\ Date: May 12, 2021 | Checked by: D. Boateng | Date: May 12, 2021 | Approved by: R. Dey | Date:

One-Dimensional Consolidation Test using Incremental Loading
ASTM D2435/D2435M - 11(2020)

Specimen Details

Project Name	Exp, File# 21003218
Project Location	3387 Borrisokane Rd, Otta, ON
Borehole	BH 2
Sample No.	TW-6
Depth	13-15 ft.
Sample Date	March 31, 2021
Test Number	One
Technician Name	Daniel Boateng

Test Procedure

Date Started		April 23, 2021
Date Finished		May 8, 2021
Machine Number		Frame C
Cell Number		C
Ring Number		C
Trimming Procedure		Cutting ring/ Trimming turntable
Moisture Condition		Inundated
Axial Stress at Inundation	kPa	5
Water Used		Deaired tap water
Test Method		A
Interpretation Procedure for c_v		2

All Departures from Outlined ASTM D2435/D2435M-11 (2020)Procedure

Calculations

Load Increment	Increment Duration min	Axial Stress σ_a kPa	Corrected Deformation ΔH mm	Specimen Height H mm	Axial Strain ε_a %	Void Ratio e
Seating	0.0	0	0.0000	20.0000	0.00	1.165
1	1440.0	5	0.3589	19.6411	1.79	1.126
2	1440.0	10	0.4772	19.5228	2.39	1.113
3	1440.0	20	0.5934	19.4066	2.97	1.101
4	1440.0	40	0.7436	19.2564	3.72	1.085
5	1440.0	60	0.9022	19.0978	4.51	1.067
6	1440.0	20	0.8368	19.1632	4.18	1.074
7	1440.0	40	0.8727	19.1273	4.36	1.071
8	1440.0	60	0.9215	19.0785	4.61	1.065
9	1440.0	80	1.0442	18.9558	5.22	1.052
10	1440.0	100	1.2661	18.7339	6.33	1.028
11	1440.0	120	1.4327	18.5673	7.16	1.010
12	1440.0	160	2.3483	17.6517	11.74	0.911
13	1440.0	320	3.7986	16.2014	18.99	0.754
14	1440.0	640	4.8624	15.1376	24.31	0.639
15	1440.0	40	4.6501	15.3499	23.25	0.662

Stantec

Stantec Consulting Ltd.

Filename: V:\01216\active\laboratory_standing_offers\2021 Laboratory Stan
Date: May 12, 2021
Checked by: D. Boateng
Date: May 12, 2021
Approved by: R. Dey
Date: May 12, 2021

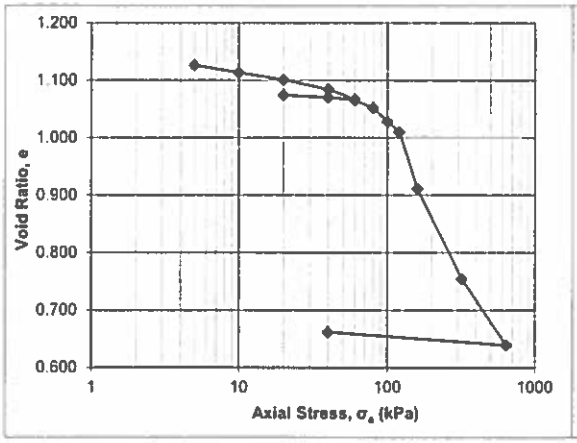
One-Dimensional Consolidation Test using Incremental Loading
ASTM D2435/D2435M - 11(2020)

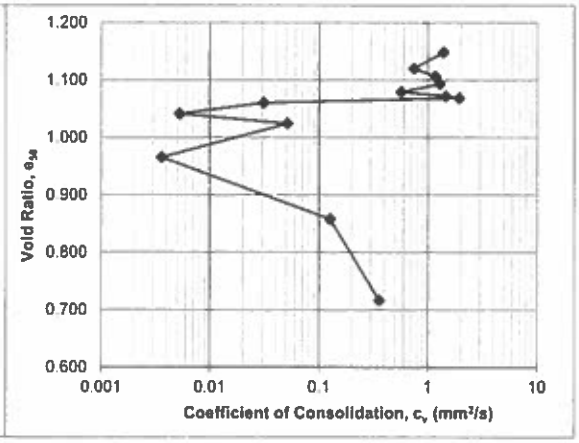
Specimen Details

Job Ref.	Exp, File# 21003218
Job Location	3387 Borrisokane Rd, Otta, ON
Borehole	BH 2
Sample No.	TW-6
Depth	13-15 ft.
Sample Date	March 31, 2021
Test Number	One
Technician Name	Daniel Boateng

Calculations

		Calculated using Interpretation Procedure 2				Interpretation Procedure 1		Interpretation Procedure 2	
Load Increment	Axial Stress $\sigma_{a,\ average}$ kPa	Corrected Deformation ΔH_{50} mm	Specimen Height H_{50} mm	Axial Strain $\varepsilon_{a,50}$ %	Void Ratio e_{50}	Time t_{50} sec	Coeff. Consol. c_v mm²/s	Time t_{90} sec	Coeff. Consol. c_v mm²/s
Seating	0								
1	3	0.1543	19.8457	0.77	1.148			60	1.39E+00
2	8	0.4161	19.5839	2.08	1.120			109	7.49E-01
3	15	0.5403	19.4597	2.70	1.107			68	1.18E+00
4	30	0.6633	19.3367	3.32	1.093			62	1.29E+00
5	50	0.7919	19.2081	3.96	1.079			136	5.74E-01
6	40	0.8670	19.1330	4.34	1.071				
7	30	0.8565	19.1435	4.28	1.072			53	1.47E+00
8	50	0.8909	19.1091	4.45	1.069			40	1.93E+00
9	70	0.9676	19.0324	4.84	1.060			2475	3.10E-02
10	90	1.1428	18.8572	5.71	1.041			14325	5.26E-03
11	110	1.3018	18.6982	6.51	1.024			1448	5.12E-02
12	140	1.8426	18.1574	9.21	0.966			19352	3.61E-03
13	240	2.8374	17.1626	14.19	0.858			492	1.27E-01
14	480	4.1432	15.8568	20.72	0.717			148	3.60E-01
15	340	4.8010	15.1990	24.01	0.645				





Stantec	Project No.: 121623683 Project Name: Exp, File# 21003218	Photo Log

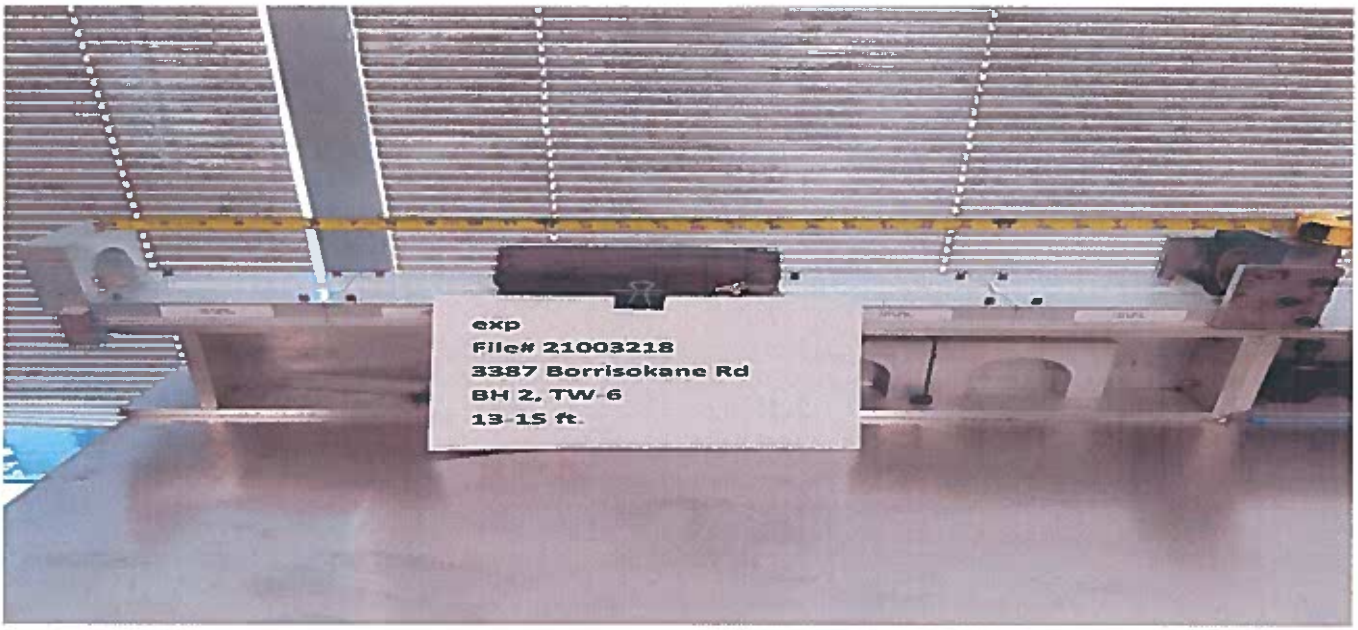


Photo No.: 1	Borehole: BH 2 TW-6	Depth: 13 – 15 ft

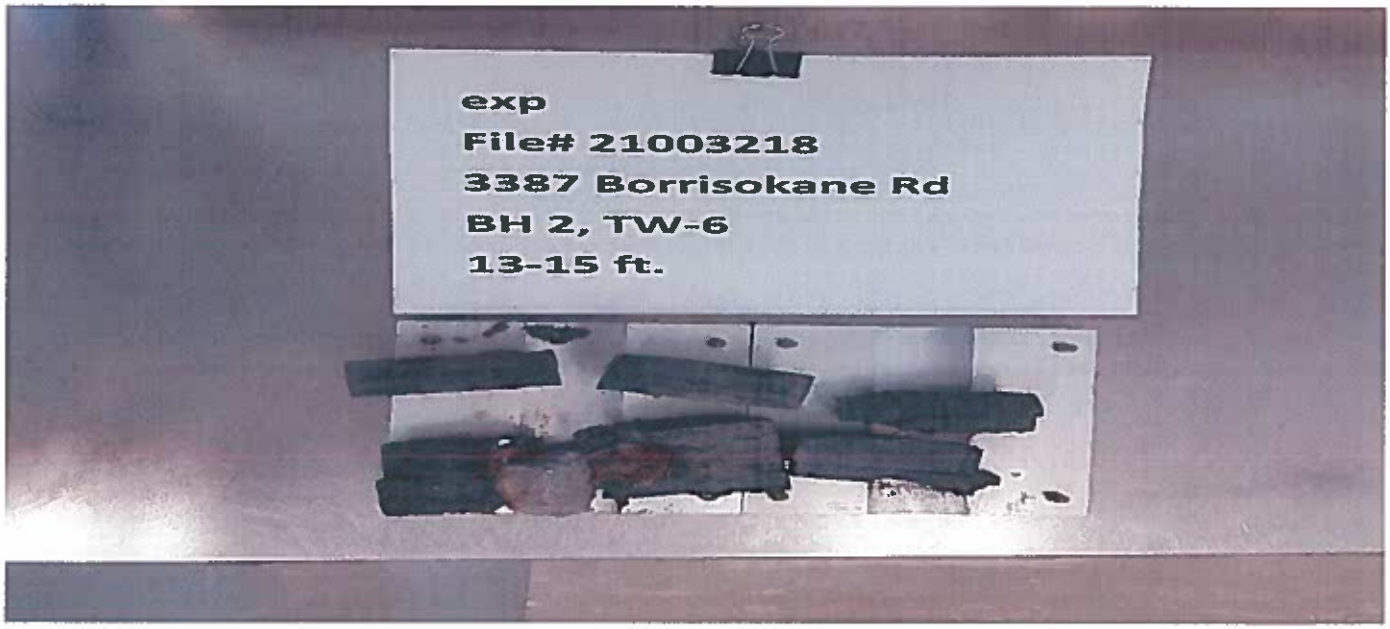


Photo No.: 2	Borehole: BH 2 TW-6	Depth: 13 – 15 ft

Appendix B – Legal Notification

Legal Notification

This report was prepared by EXP Services for the account of Ottawa Catholic 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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