Geotechnical Investigation
East Urban Center Elementary School,
700 Spring Valley Drive, Ottawa, Ontario

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Project Name
Proposed Spring Valley Trails Elementary School
Joshua Street and Spring Valley Drive, Ottawa, ON

Project Number
OTT-23012778-E0

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Executive Summary

A geotechnical investigation was undertaken at the site of the proposed East Urban Centre Elementary School to be located at the property registered by the street address of 700 Soring Valley Drive, i.e. in the northeast corner of the intersection of Joshua Street and Spring Valley Drive in the City of Ottawa, Ontario (Figure 1). This work was authorized by the Ottawa Carleton District School Board (OCDSB) under Standing Offer Number 24-008 This investigation is additional to a preliminary investigation undertaken at the site by EXP in 2019 under project number OTT-00245378-A0, dated March 18, 2019. All the factual data gathered during the 2019 investigation has been incorporated in the current report and this and supersedes the preliminary geotechnical investigation report

It is proposed to construct a two-storey basementless school building to be located in the southwest part of the site (Figure 2). A parking lot will be located north of the school building. The remainder of the lot will be used for playgrounds and portable classrooms in the future. On average, approximately 1 m of additional fill will be placed on the site as part of the site development.

The investigation has revealed that the site contains fill which extends to a depth of 0.9 m to 1.45 m. The fill is underlain by stiff to hard silty clay crust to 3.0 m to 4.0 m depth. Beneath the desiccated silty clay crust, soft to hard silty clay extends to 16.8 m to 18.9 m depth. Shale bedrock of Billings Formation was encountered under the glacial till and extends to a depth of 26.9 m to 32.0 m. A perched water table is present in the desiccated silty clay. The stabilized groundwater table is expected at the interface of desiccated silty clay crust and the underlying grey silty clay.

Based on shear wave velocity measurements at the site to 30 m depth, the site has been classified as **Class 'D'** for seismic site classification. The on-site soils at the site are not susceptible to liquefaction during a seismic event.

The investigation has revealed that the geotechnical conditions at the site are not suitable for founding the proposed school building on spread and strip footings as the clay is weak and very compressible. Settlements in the order of 50 m due to placement of additional fill on the site and 25 to 35 mm due to the foundation loads were computed for a total of 75 mm to 85 mm. These settlements will exceed the normally tolerable limits of 25 mm total and 19 mm differential movements.

It is recommended that the proposed structure should be founded on closed end pipe or steel H piles driven to practical refusal in the glacial till or in bedrock. The factored geotechnical resistance at ULS and the negative skin friction that the piles will be subjected to are given on Table IV. The allowable load on the piles may be computed by subtracting the negative skin friction from the structural capacity of the piles.

The floor slab of the school building may be constructed as slab-on-grade provided all the existing fill down to the underlying silty clay crust is removed and replaced with engineered fill.

Excavations at the site may be undertaken by conventional mechanical equipment. It should be feasible to collect the water entering the excavation in perimeter ditches and to remove it by pumping from sumps.

The above and other related considerations have been discussed in greater detail in the accompanying report.

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1 Introduction

A geotechnical investigation was undertaken at the site of the proposed East Urban Elementary School to be located at the site registered by the street address of 700 Spring Valley Drive, i.e. at the northeast quadrant of the intersection of Joshua Street and Spring Valley Drive in the City of Ottawa, Ontario (Figure 1). This investigation was authorized by the OCDSB under EXP SOA Number 24-008. This investigation is additional to a previous investigation undertaken at the site in 2019 and reported under EXP project number OTT-00245378-A0, dated March 18, 2019. All the factual data gathered during the preliminary investigation has been incorporated in the current report. Therefore, this report supersedes the preliminary geotechnical investigation report.

The preliminary 2019 investigation comprised of drilling five boreholes (Boreholes 19-01 to 19-05) to 8.23 m to 27.0 m below the ground surface. In addition, dynamic core penetration tests were performed in the base of Boreholes 2 and 4 to refusal at 22.2 m and 22.8 m depth respectively. Shale bedrock was proven in one of the boreholes at 26.32 m depth. The Borehole Logs and laboratory testing results of the 2019 investigation have been included in Appendix A and this information has been included in the tables and relevant sections of the report for the purpose of making design recommendations.

This geotechnical investigation was undertaken to:

a) Establish the subsurface soil, bedrock and groundwater conditions at the site;

b) Assess liquefaction potential of the on-site soils and seismic site classification in accordance with requirements of the 2022 Ontario Building Code (OBC);

c) Comment on grade-raise restrictions at the site;

d) Discuss the feasibility of construction of the proposed structure on spread and strip footings and the Serviceability Limit State (SLS) and factored Ultimate Limit State bearing pressures that will likely be available to design the footings. Also, provide recommendations for option of pile foundations.

e) Determine the suitability of construction of the floor slab of the building as a slab-on-grade and recommend drainage requirements;

f) Discuss excavation conditions and dewatering requirements anticipated during construction;

g) Comment on backfilling requirements and suitability of the on-site soils for backfilling purposes;

h) Provide pavement structure thicknesses for access roads and parking areas; and

i) Comment on subsurface concrete requirements and on the corrosion potential of the subsurface soils on buried steel structures.

j) Discuss Tree Planting Requirements

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

2 Site and Project Description

2.1 Site Description

The site is located in the northeast quadrant of the intersection of Spring Valley Drive and Joshua Street in the City of Ottawa, Ontario. It is currently covered with vegetation.

The ground surface at the site slopes down from the northern boundary of the site to the southern boundary from Elevation 75.71 m to Elevation 71.7 m. It is approximately level in the east-west direction. The southeast part of the site is a wet swampy area. Fill have been placed by others throughout the site.

2.2 Project Description

Preliminary plans call for the proposed building to be located in the southwest part of the site and the parking lot will be located in the northwest part of the site. The school building will comprise of two storeys with no basement. A single-storey daycare centre will also be incorporated in the school building. Preliminary design data revealed the finished floor slab level of the school building was provided as Elevation 73.3 m. It is understood that a site grading plan is currently not available and the finished floor elevation is subject to change. It has been assumed that the external grade especially in the vicinity of the building will be approximately 150 mm lower than the floor slab, i.e., at Elevation 73.15 m approximately.

3 Surficial and Bedrock Geology

3.1 Surficial Geology

Available information indicates that the surficial geology of the site comprises of clay and silt underlying erosional terraces, upper part of marine deposits removed to variable depths by fluvial erosion so in places clay is uniform blue grey; unit includes lenses, bars and channel fills of sand and pockets of non-marine silt that were formed during terrace (or channel) cuttings.

3.2 Bedrock Geology

The bedrock at the site consists of black shale with some brown shale of Billings Formation. The shale is pyritiferrous, calcareous, and fissile. It belongs to the Ordovician system and was formed some 450 million years ago.

4 Procedure

The fieldwork for this investigation was undertaken between May 23 and May 29, 2024, and comprised the drilling of sixteen (16) boreholes across the site to termination depths ranging between 2.1 m and 32.0 m below existing grade. In addition, dynamic cone penetration test was performed in the base of Boreholes 24-08 to refusal at 21.2 m. In addition, ten (10) test pits were excavated at the site with a mechanical shovel on June 26, 2024, to a depth of 1.5 m to 2.1 m. The fieldwork was supervised on a full-time basis by a technician from EXP.

The locations of the boreholes and test pits were established and surveyed on site by EXP. Elevations of the boreholes refer to the geodetic datum. Prior to drilling the boreholes and excavating the test pits, their locations were cleared of any public and private underground services by a local contractor. The borehole and test pit locations are shown on the Borehole Location Plan, Figure 2.

The fieldwork for this investigation was undertaken using a CME-55 track-mounted drill rig equipped with continuous flight hollow-stem augers and rock coring capabilities and with a mechanical shovel. Standard penetration tests (ASTM 1586) were performed in all the boreholes at regular depth intervals and soil samples retrieved by the split-barrel sampler. Relatively undisturbed thin wall tube samples of the silty clay were also obtained from selected depths. The undrained shear strength of the cohesive soils was established by performing in-situ field vane tests. The presence of the bedrock was proven by coring techniques using NQ-size core barrel in Borehole 24-01 and Borehole 24-08 and in BH-3 drilled in 2019. During core drilling of the bedrock, a record was kept of any sudden drops of the drill rods, colour of wash water and wash water return. Grab samples were collected from various depths of the testpits.

Water levels were measured in the open boreholes on completion of drilling. In addition, long-term groundwater monitoring installation consisting of 19 mm diameter polyvinyl chloride (PVC) standpipes with slotted sections were placed in Borehole Nos. 24-01, 24-03, 24-04, 24-08, 24-09, 24-11 and 24-13. The standpipe piezometers were installed in accordance with EXP standard practice and their installation configuration is documented on the respective borehole log. All the boreholes were backfilled on completion.

All the soil samples were visually examined in the field for textural classification, logged, preserved in plastic bags and identified. Similarly, all the rock cores were visually examined, placed in core boxes, identified and logged. On completion of the fieldwork, all the soil samples and rock cores were transported to the EXP laboratory in the City of Ottawa where they were visually examined in the laboratory by a geotechnical engineer and borehole logs prepared. The engineer also assigned the laboratory testing, which consisted of performing the following tests on selected soil samples in accordance with the American Society for Testing and Materials (ASTM) procedures.

Natural Moisture Content ..... 123 tests

Natural Unit Weight ..... 3 tests

Grain-size Analysis ..... 6 tests

Atterberg Limits Determination ..... 6 tests

Compressive strength on Rock Core ..... 2 tests

pH, Sulphate, Chloride and Electrical Resistivity Analyses ..... 3 tests

The results of the moisture content, natural unit weight, grain size analyses, and Atterberg Limit tests performed on selected soil samples are given on Table 1. The results of the one-dimensional consolidation tests performed on the clay samples are given on Table 2.

Table 1: Results of Grain Size Analyses and Atterberg Limit Tests on Soil Samples									
BH#	Depth (m)	Grain Size Analyses(%)				Atterberg Limits (%)			USCS Classification
		Clay & Silt		Sand	Gravel	Liquid Limit	Plastic Limit	Plasticity Index	
19-03	2.3 – 2.9	68	28	4	0	58	23.3	34.7	(CH) Fat Clay
19-03	3.8 – 4.3	71	27	2	0	54.3	23.4	30.9	(CH) Fat Clay
19-03	17.2 – 17.8	9	20	71	-				(GP) Poorly Graded Gravel
24-01	0.8 – 1.4	55	28	17	0				Silty Clay, some sand and Gravel Fill
24-01	2.3 – 2.7	80	20	0	0	51	23	28	(CH) Fat Clay
24-01	7.6 – 8.2	73	27	0	0	40	21	19	(CL-ML) Silty Clay
24-01	18.3 – 18.9	6	37	42	15	Non-Plastic			(SM) Silty Sand, some Gravel
24-05	3.0 – 3.6					62.9	24.7	38.2	(CH) Fat Clay
24-08	6.1 – 6.7					51.6	25.8	25.8	(CH) Fat Clay
24-10	9.1 – 9.7					46.3	26.1	20.2	(CL) Lean Clay
24-09	0.8 – 1.4	43	23	34	0				Sandy Lean Clay- Fill
24-11	0 – 0.6	33	24	41	2				Clayey Silty Sand Fill

Table 2: Results of Consolidation Tests on Clay Samples										
BH#	Depth (m)	Moisture Content (%)	Unit Weight kN/m³	σ_{vo}' kPa	σ_p' kPa	e_o kPa	C_{cr}	C_c	OCR	OC Pressure (kPa)
24-05	3.0 – 3.6	57.4	16.4	56.0	230	1.581	0.0955	0.7273	4.1	159
24-08	6.1 – 6.7	80.7	15.1	75.0	145	2.224	0.1077	1.60	1.93	55.0
24-10	9.1 – 9.7	74.8	15.4	91.0	160	2.057	0.097	1.33	1.76	59.0

σ_{vo}' = Effective overburden pressure
σ_p' = Effective preconsolidation pressure
e_o = Initial void ratio
C_{cr} = Re-compression index
C_c = Compression index
OCR = Over consolidation pressure

The results of the one-dimensional consolidation test results are attached in Appendix B.

5 Subsurface Soil and Groundwater Conditions

A detailed description of the subsurface soil, bedrock and groundwater conditions encountered in the boreholes is given on the borehole and Test Pit logs, Figures 3 to 28 inclusive. The borehole logs and related information depict subsurface conditions only at the specific locations and times indicated. Subsurface conditions and water levels at other locations may differ from conditions at the locations where sampling was conducted. The passage of time may also result in changes in the conditions interpreted to exist at the locations where sampling was conducted.

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

A review of the borehole logs indicates the following subsurface soil, bedrock and groundwater conditions with depth.

5.1 Topsoil

A surficial layer of topsoil was not encountered at the site except in Test Pits 24-04, 24-05 and 24-10 where 100 to 150 m of surficial topsoil was present.

5.2 Fill

Underlying the topsoil in Test Pits 24-04, 24-05 and 24-10 and from the existing ground surface in the other test pits and boreholes, fill extends to a depth of 0.9 m to 1.45 m (Elevation 70.4 m to 74.7 m). This fill was also encountered in all the boreholes and extended to a depth of 0.9 m to 2.3 m, i.e., Elevation 70.2 m to 71.4 m. The fill is a random mixture of topsoil, silty sand and silty clay with some organics and gravel and construction debris. It is very loose to loose as indicated by its standard penetration resistance values ('N' values) of 3 to 10. The results of three grain size analyses performed on the fill samples are given in Figures 29 to 31. A review of these figures indicates that the fill comprised of 33 to 55 percent clay, 23 to 28 percent silt and 17 to 41 percent sand.

5.3 Buried Topsoil

A 50 mm to 400 mm thick topsoil layer was encountered in TP 24-01 and TP 24-09 and in Boreholes 24-17 and 24-18. It is possible that this the original topsoil and may be present in other areas throughout the site.

5.4 Silty Clay Crust

The fill or topsoil is underlain by a thin desiccated silty clay crust in all the boreholes, which extended to a depth of 3.0 m to 4.0 m (Elev. 68.2 m to 69.4 m). The crust is 1.3 m to 1.9 m thick. It is hard to stiff as indicated by its undrained shear strength, which varied from 53 kPa to 216 kPa. The natural moisture content of the crust varied from 31 to 50 percent. Three grain-size analyses performed on the silty clay crust yielded a composition of 68 to 80 percent clay, 20 to 28 percent silt, and 0 percent sand (Figures 8, 9 in Appendix A and Figure 32). A review of Table 2 indicates that the silty clay crust sample from Borehole 24-05 from 3.0 m to 3.6 m depth is overconsolidated by 159.0 kPa approximately. Its recompression and compression indices are 0.0955 and 0.7273 respectively. Its moisture content was 57.4 percent with a unit weight of 16.4 kN/m^3. All the test pits and Boreholes 24-14 to BH 24-18 were terminated in this stratum.

5.5 Silty Clay

The silty clay crust is underlain by silty clay in all the boreholes and extends to borehole termination depth of 4.9 m to 8.8 m in Boreholes 19-01 and 19-05 and in Boreholes 24-02, 24-03, 24-04, 24-06, 24-09 and in Boreholes 24-11 to 24-13. In Boreholes 19-02 to 19-04 and in Boreholes 24-01, 24-05 and 24-08, the silty clay extended or was interpreted to extend to a depth of 16.8 m to 18.9 m (Elevation 53.7 to 55.8 m). The silty clay is soft to hard as indicated by its shear strength which varied from 24 kPa to 144 kPa. Its moisture content and unit weight varied from 57.4 to 80.7 percent and 15.1 to 16.4 kN/m^3. A grain size analysis performed on this stratum yielded a soil composition of 73 percent clay and 27 percent silt (Figures 33). Four Atterberg Limit tests performed on this stratum indicated that the liquid and plastic limits of the clay varied from 40 to 62.9 percent and 21 percent to 26.1 percent. The plasticity index of the clay varied from 19 to 38.2 percent.

A review of Table 2 indicates that the clay is overconsolidated by 55 to 59 kPa approximately. Its recompression and compression indices vary from 0.097 to 0.1077 and 1.33 to 1.60 respectively.

5.6 Glacial Till

The silty clay in Borehole 19-02 to 19-04 and 24-01, 24-05 and 24-08 is underlain by glacial till which extended to a depth of or greater than 21.2 m to 26.3 m (Elevation 45.5 to 50.7 m). All these boreholes were terminated in the till except for Boreholes 19-03, 24-01 and 24-08 where they were extended by coring into the bedrock. The till comprises of 9 to 46 percent clay and silt, 20 to 42 percent sand, and 15 to 71 percent gravel (Figure 34 and Appendix A). It is compact to very dense as indicated by N values of 23 to 50 blows for 50 mm penetration of the split barrel sampler. Its moisture content varied from 4 to 14 percent.

5.7 Shale Bedrock

The till in Boreholes 19-03, 24-01 and 24-08 is underlain by weathered shale bedrock which extends to the maximum cored depth of 29.6 m to 32.0 m (Elevation 39.7 m to 46.3 m). A Total Core Recovery (TCR) and Rock Quality Designation (RQD) of 96.7 percent to 100 percent and 0 to 67 percent respectively was encountered indicating that the shale is of very poor to fair quality. Unconfined compression strength completed on two rock cores revealed a compressive strength ranging between 24.6 MPa to 63.7 MPa. The unit weight of the shale bedrock was established as 25.7 KN/m3.

5.8 Groundwater

Water levels were measured in the boreholes on completion of drilling and subsequently in piezometers installed in selected boreholes. The readings obtained have been tabulated on Table 3. Recorded water levels varied from at the ground surface to 3.2 m depth below the ground surface. The exception to this is Borehole 24-08 where water level was recorded 2.4 m above the ground surface, indicating the presence of some artesian pressure at this location. Majority of the readings represent perched water in the desiccated silty clay. The stabilized groundwater table is expected at or close to the interface of desiccated silty clay crust and the underlying grey silty clay.

Table 3: Water Level Readings				
BH#	**Elapsed Time**	**Water Level Depth (m)**	**Elevation (m)**	**Hole Open to (m)**
19-01	On completion February 27, 2019	3.0 1.9	68.9 70.0	7.6 -
19-02	On completion February 27, 2019	3.0 0.8	69.0 71.2	7.6 -
19-03	On completion	1.2	71.4	26.9
19-04	On completion February 27, 2019	2.7 1.1	70.7 72.3	6.0 -
19-05	On completion	2.4	71.4	7.6
24-01	May 10, 2024 June 26, 2024	3.0 At ground surface	68.7 71.7	- -
24-02	May 27, 2024	3.0	69.0	-
24-03	May 27, 2024	3.7	68.2	7.5
24-04	June 26, 2024	At ground surface	71.7	-
24-06	May 24, 2024	Wet	-	7.3
24-08	May 29, 2024 June 26, 2024	3.2 At ground surface	69.6 72.8	- Water flowing from BH, indicating Artesian Pressure
24-09	June 26, 2024	1.1	72.3	-
24-11	June 26, 2024	1.05	72.4	-

Another set of groundwater measurements are recommended prior to finalizing this report.

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

6 Grade Raise Restrictions

The geotechnical investigation has revealed that the site contains up to 2.3 m of fill. It is understood that this fill was placed around 2006 to bring the school parcel to the same elevation or slightly higher than the elevation of the adjacent streets during grading of the subdivision. In addition, it is proposed to place an additional 0 m to 1.7 m of fill on the site to raise the grade as the site is low lying and is wet and swampy in some areas. As a result, the site grade would have been raised by up to 3.1 m in the building area.

The investigation has also revealed that the existing fill on the site is underlain by silty clay which extends to a maximum depth of 16.8 to 18.9 m. The clay has a thin upper desiccated crust which varies in thickness from 1.3 m to 1.9 m. The underlying clay is generally soft to firm and highly compressible. Settlements of the silty clay due to grade raise fill were estimated to be 50 mm approximately assuming that the consolidation of the clay due to placement of the 2006 fill is complete. Settlement of the clay due to the foundation loads were computed as 25 mm to 35 mm. Therefore, total settlements were estimated to vary from 75 mm to 85 mm. These settlements of a structure founded on spread and strip footings will exceed the tolerable limits. Therefore, proposed grade raise is acceptable provided the school building is founded on pile foundation which would transfer the building loads to an underlying more competent soil stratum or to bedrock.

7 Site Grading

Site grading within the footprint of the proposed building, paved areas, future portables and outdoor sports fields should consist of the excavation and removal of all existing surficial topsoil and organic stained soils, fill and buried original topsoil layer from the site down to the native undisturbed clay. It may be possible to leave some of the existing fill in the landscaped areas pending further evaluation

The exposed subgrade should be reviewed by a geotechnician prior to placement of engineered fill to raise the site grades. Granular B Type II in accordance with Ontario Provincial Standard Specification (OPSS) 1010 should be used as engineered fill to raise the site grades to the underside of the floor slab inside the proposed building. The engineered fill should be placed in 300 mm thick lifts and compacted to 98 percent of the standard Proctor maximum dry density (SPMDD) in the interior of the building. Exterior to the building against foundation walls and in footing trenches, OPSS 1010 Granular B Type II should be placed and compacted to 95 percent of the SPMDD.

For the proposed outdoor sports fields, parking lot and access roads, the site grades may be raised to the design subgrade level by the placement of soil fill meeting the requirements of OPSS 1010 select subgrade material (SSM) placed in 300 mm thick lifts and compacted to 95 percent of the SPMDD. In any wet soft areas, crusher-run granular material may be required in the lower levels of the fill to stabilize 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.

8 Seismic Site Classification and Liquefaction Potential of On-Site Soils

8.1 Seismic Site Classification

The investigation has revealed that the site contains some surficial fill underlain by silty clay, which extends to 16.8 m to 18.9 m. The silty clay is underlain by sandy gravel till to 21.2 m to 26.3 m depth. Black shale bedrock of Billings Formation underlies the sandy gravel till.

As part of the preliminary geotechnical investigation in 2019, Geophysics GPR International Inc. was commissioned to carry out seismic shear-wave surveys on the site. Based on the results of the survey, the average shear-wave velocity to 30 m depth (V_s30) was established by GPR as 189 m/s. On this basis, the site has been classified as **Class D** in accordance with Table 5.1.8.4A of the Ontario Building Code. The results of the shear-wave velocity survey have been presented in Appendix C.

8.2 Assessment of Liquefaction Potential of On-Site Soils

A total of seven (7) Atterberg Limit tests were performed on the silty clay crust and the underlying soft to stiff silty clay. The results of the Atterberg Limit tests have been presented in Table 1. A review of this table indicates that the Plasticity Index of the silty clay varies from 19 percent to 38.2 percent. Canadian Foundation Engineering Manual (5^{th} Edition) indicates that if a fine-grained soil has a plasticity index greater than 12, the soil can be assumed to have “clay-like” behaviour where the degradation of the shear stiffness and pore pressure generation are relatively low and for design purposes these soils are generally considered not susceptible to seismic liquefaction.

The median shear-wave velocity of the underlying till varies from 297 m/s to 371 m/s. Therefore, the glacial till is also not susceptible to liquefaction during a seismic event.

9 Foundation Considerations

9.1 Feasibility of Founding the Proposed Structure on Spread and Strip Footings

The feasibility of founding the proposed structure on spread and strip footing foundation was investigated. The on-site silty clay has a limited capacity to support loads as the upper desiccated crust is very thin and the underlying silty clay is weak and highly compressible based on the results of the consolidation tests.

A settlement analysis was undertaken to determine the anticipated settlement of the structure due to placement of grade raise fill and the anticipated building loads. Settlement of the proposed structure due to placement of an average 1 m of additional grade raise fill were computed to be in the order of 50 mm. Settlements of a 2 m x 2 m spread footing designed to carry a load of 100 kPa was estimated to be in the order of 25 mm to 35 mm. Therefore, the total settlements of the structure are expected to be in the order of 75 mm to 85 mm. In addition, the differential settlements are also expected to be large due to varying amount of additional fill that will be placed in the building area during site regrading. For example, in the vicinity of Borehole 24-09, there will be a cut of approximately 0.3 m whereas the additional filled to be placed in the vicinity of Borehole 24-04 will be in the order of 1.7 m. These settlements will exceed the normally tolerable settlements of 25 mm total and 19 mm differential movements. Therefore, construction of the proposed structure on spread and strip footings is not recommended.

9.2 Pile Foundations

9.2.1 End Bearing Capacity of Steel H and Pipe Piles

Closed end pipe or steel H piles driven to practical refusal in the lower portions of the glacial till or the underlying bedrock are considered to be the most suitable type of foundations. Bedrock was proven to be at depths of 25.81 to 26.32 m in Borehole 3, 24-01 and 24-08 (Elevation 45.5 m to 47.0 m) and was found to be fractured in the upper levels. Pipe piles are expected to be more economical compared to H piles although their installation may present some problems. Because of the presence of cobbles and boulders in the till, it is possible that the piles may meet refusal at different depths. It is also possible that some of the piles may drive through the till and meet refusal in the underlying bedrock at approximate Elevation ranging between 45.0 m to 46.5 m. Therefore, it will be necessary to analyze a greater number of piles than normal with the pile driving analyser (PDA) during driving of the piles to ensure that they are capable of adequately supporting design loads (a 10 % of the piles are recommended to be tested using PDA). Also, pipe piles if driven in a group or cluster may result in heave and/or lateral displacement of pipe piles already driven. Conversely, it is possible that steel H piles may not meet refusal in the till and drive to the underlying bedrock.

Since the piles are expected to meet refusal in the till or the bedrock, the factored geotechnical resistance at ultimate limit state (ULS) will govern the design. The factored geotechnical resistance values at ULS for various pile sections are given in Table 4. The factored geotechnical resistance values at ULS are based on steel piles with a yield strength of 350 MPa and concrete compressive strength of 35 MPa and a resistance factor of 0.4.

It is noted that the piles will be subjected to down-drag forces (negative skin friction) due to consolidation of the silty clay as a result of grade raise or permanently lowering the groundwater table at the site. The negative skin friction that the piles would be subjected to is also listed in Table 4. The allowable load on a pile may be computed by subtracting the negative skin friction from the structure capacity of the piles.

Table 4: Factored Geotechnical Resistance at Ultimate Limit State (ULS) of Piles and Estimated Down-Drag Forces on Piles			
Type of Pile	**Size**	**Factored Geotechnical Resistance at ULS (kN)**	**Unfactored Down-Drag Forces (kN)**
Steel Pipe	245 mm O.D. by 10 mm wall thickness	930	275
	245 mm O.D. by 12 mm wall thickness	1,105	275
	324 mm O.D. by 12 mm wall thickness	2,1480	365
Steel H	HP 310 x 79	1200	435
	HP 310 x 94	1500	440
	HP 310 x 110	1775	445
	HP 310 x 125	2000	450

Settlements induced by the allowable load on piles computed as recommended are expected to be less than normally tolerated limits of 25 mm total and 19 mm differential movements. It is difficult to estimate the settlement of the driven piles more precisely since the depth at which the piles will meet refusal cannot be accurately estimated for reasons given previously. The modulus of subgrade reaction of the weathered and shattered shale bedrock encountered at the site may be assumed as 600 MPa/m. it is recommended that the values in Table 4 be updated once the final grades at the site are set.

The site is underlain by glacial till with cobbles and boulders in the lower levels. It is therefore recommended that the piles should be equipped with a driving shoe to protect them from damage during driving as per Ontario Provincial Standard Drawing (OPSD) 3001.100, Type II dated November 2010 (Figure 35).

To achieve the capacity given previously, the pile-driving hammer must seat the pile in the overburden without overstressing the pile material. For guidance purposes, it is estimated that a hammer with rated energy of 54 kJ to 70 kJ (40,000 to 52,000 ft. lbs.) per blow would be required to drive the piles to practical refusal. Practical refusal is considered to have been achieved at a set of 5 blows for 6 mm or less of pile penetration. However, the driving criteria for a particular hammer-pile system must be established at the beginning of the project using the Pile Driving Analyzer.

A number of test piles should be monitored with the Pile Driving Analyzer during the initial driving and re-striking at the beginning of the project as noted above. This monitoring will allow for the evaluation of transferred energy into the pile from the hammer, determination of driving criteria and an evaluation of the ultimate bearing capacity of the piles. Depending on the results of the pile driving analysis, the pile capacity may have to be proven by at least one pile load test for each pile type before production piling begins. If necessary, the pile load test should be performed in accordance with ASTM D 1143.

Closed end pipe piles tend to displace a relatively large volume of soil. When driven in a cluster or group, they may tend to jack up or displace the adjacent piles in the group. Therefore, the elevation and the location of the top of each pile in a group should be monitored immediately after driving and after all the piles in the group have been driven. This is to ensure that the piles are not heaving or being displaced. Any piles found to heave more than 3 mm should be re-tapped.

Piles driven at the site may be subject to relaxation i.e. loss of set with time. It is therefore recommended that all the piles should be re-tapped at least 24 hours after initially driving and at 24-hour intervals thereafter until it can be proven that relaxation is no longer a problem.

The installation of the piles at the site should be monitored on a full-time basis by a geotechnician working under the direction and supervision of a qualified geotechnical engineer to verify that the piles are driven in accordance with the project specifications.

The concrete grade beams and pile caps for heated structures should be protected from frost action by providing the beams and caps with 1.5 m of earth cover. For non-heated structures, the pile caps and beams should be provided with 2.4 m of earth cover in areas where the snow will be removed and 2.1 m of earth cover where the snow will not be removed. Alternatively, frost protection may be provided by rigid insulation or a combination of rigid insulation and earth cover. A 50 mm concrete mud slab is recommended to be placed at the underside of grade beams and pile caps.

Temporary granular roads and mats will be required to provide access to the pile driving rig. The thickness of the required granular mat will have to be established by the piling contractor, based on the type of piling rig that will be used on site and subsurface conditions.

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

9.2.2 Uplift Resistance of Piles

The computed factored ULS geotechnical uplift resistance of the piles is given in Table 5. The factored ULS geotechnical uplift resistance is based on an embedment length of 29.5 m and includes a factored geotechnical resistance of 0.30. The factored uplift resistances listed on Table 5 do not include the dead weight of the piles.

Table 5: Factored Uplift Resistance at ULS of Steel Pipe and H Piles

Type of Pile	Size	Factored Geotechnical Uplift Resistance at ULS (kN)
Steel Pipe	245 mm OD x 10 mm wall thickness	150
	245 mm OD x 12 mm wall thickness	150
	324 mm OD x 12 mm wall thickness	195
Steel H	HP 310 x 79	233
	HP 310 x 94	236
	HP 310 x 110	238
	HP310 x 125	240

10 Floor Slab and Drainage Requirements

The site contains u to 2.0 in the building area and throughout the site. In addition, on average approximately 1.0 m of additional fill is to be placed in the building area. It is recommended that all the existing fill and buried topsoil in the building area should be sub-excavated to the underlying desiccated silty clay. The exposed surface should be reviewed and proofrolled if directed. Any soft areas encountered should be sub-excavated and replaced with OPSS Granular Type II fill and compacted to 98 percent Standard Proctor Maximum Dry Density (SPMDD). Engineered fill to raise the grade may then be placed in 300 mm lifts and each lift compacted to at least 98 percent SPMDD. The placement and compaction of the fill can in this manner be undertaken to the subgrade level.

It is recommended that a minimum of 300 mm of clear stone should be provided under the slab-on-grade to prevent capillary rise of moisture.

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

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

11 Excavations and De-Watering Requirements

11.1 Excess Soil Management

Ontario Regulation 406/19 made under the Environmental Protection Act (November 28, 2019) is scheduled to be implemented on January 1, 2021. The new regulation will dictate the testing protocol that will be required for the management and disposal of excess soils. As set forth in the regulation, specific analytical testing protocols will need to be implemented and followed based on the volume of soil to be managed. 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. Disposal of any excess soils must be completed as per the recommendation stated in environmental site assessment reports completed at the site by others.

11.2 Excavations

The geotechnical conditions at the site consist of surficial fill beneath which silty clay extends to 16.8 m to 18.9 m depth. The perched groundwater level was measured at 0.8 m to 1.9 m depth below existing grade.

Details regarding the location, lateral extent and depths of the excavations were not available at the time of this preliminary geotechnical investigation. It is assumed that excavations will extend to a depth of 2 m to 3 m below the existing ground surface and will be below the perched water table in some areas. Therefore, some seepage of water into the excavations should be anticipated. However, it should be possible to collect the water at low points and to remove it by pumping. A base-heave type of failure of the excavation extending to the silty clay is not anticipated.

Excavation of the overburden soil may be undertaken with conventional mechanical equipment.

All excavations at the site should comply with the most recent edition of Occupational Health and Safety Act (OHSA), Ontario Regulations 213/91 (August 1, 1991). The excavations in the soils above the groundwater table are considered to be Type 3 soil as defined by OHSA and as such must be cut back at 1H:1V from the base of the excavation. Excavations below the groundwater table are expected to slough and are anticipated to stabilize at a slope of 2H:1V to 3H:1V.

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.

11.3 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 or at low points and to remove it by pumping from sumps. In areas of high infiltration or in areas where more permeable soil layers may exist, higher water seepage should be anticipated. Therefore, the need of high-capacity pumps to keep the excavation dry should not be overlooked.

It is noteworthy that new legislation came into force in Ontario on March 29, 2016 to regulate groundwater takings for construction dewatering purposes. Prior to March 29, 2016, a Category 2 Permit to Take Water (PTTW) was required from the Ontario Ministry of the Environment and Climate Change (MOECC) for groundwater takings related to construction dewatering, where taking volumes in excess of 50 m^3/day, but less than 400 m^3/day, and the taking duration was no more than 30 consecutive days. The new legislation replaces the Category 2 PTTW for construction dewatering with a new process under the Environmental Activity and Sector Registry (EASR). The EASR

is an on-line registry, which allows persons engaged in prescribed activities, such as water takings, to register with the MOECC instead of applying for a PTTW.

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

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

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

The on-site soils to be excavated are the existing fill and silty clay. The fill is random and contains organics. It is not suitable for backfilling. However, it may be used for landscaping purposes.

- Existing fill free of boulders, debris may be used as fill in landscaped areas only.
- Excavated silty clay is considered too wet for adequate compaction and should be discarded or used in landscaped areas only.

Therefore, it is anticipated that the majority of the material required for backfilling in the interior and exterior of the building, in service trenches, for subgrade and for site grading purposes would have to be imported and should preferably conform to the following specifications:

- Engineered Fill under footings - OPSS 1010 Granular B, Type II, compacted to 100 percent of the SPMDD;
- Engineered Fill under building slab, inclusive of any services trenches in the interior of the building - OPSS 1010 Granular B, Type II, compacted to 98 percent of the SPMDD;
- Backfill of service trenches exterior to the building – OPSS 1010 Granular B Type I OR II above the groundwater table and OPSS 1010 Granular B Type II below the groundwater table, compacted to 95 percent of the SPMDD; and
- Trench backfill and subgrade fill in parking areas, access roadways – OPSS 1010 Select Subgrade Material (SSM), OR on-site dry glacial till material (if approved and as noted above) and compacted to 95 percent of the SPMDD.

12.1 Clay Dykes

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

The underground services should be designed to accommodate the estimated consolidation settlements.

13 Subsurface Concrete Requirements and Corrosion Potential of Subsurface Soil on Buried Steel

Chemical tests limited to pH, sulphate, chloride and electrical resistivity were undertaken on two (2) selected soil samples and the results are shown in Table 6. The laboratory certificate of analysis for the chemical tests is shown in Appendix A.

Table 6: Results of pH, Chloride, Sulphate and Resistivity Tests on Selected Soil Samples

Borehole No. - Sample No.	Soil	Depth (m)	pH	Sulphate (%)	Chloride (%)	Resistivity (ohm.cm)
Threshold Values			<5	>0.1	>0.04	<1500 ohm.cm Corrosive
19-2 – SS2	Fill	0.76 – 1.4	7.89	0.0041	0.0010	3533 - Mildly corrosive
19-3 – SS3	Fill	1.5 – 2.1	7.71	0.0036	0.0027	2899 – Mildly corrosive
19-3 – SS4	Silty Clay Crust	2.3 – 2.9	7.44	0.0031	0.0034	3448 – Mildly corrosive
19-3 – SS6	Silty Clay	3.8 – 4.4	7.78	0.0038	0.0045	2024 – Mildly corrosive
19-4 – SS2	Fill	0.76 – 1.4	7.41	0.0026	0.0021	3704 – Mildly corrosive
24-03 – SS6	Clay	3.8 – 4.3	9.52	0.0068	0.0062	1996 - Corrosive to moderately corrosive
24-08 – SS4	Brown Silty Clay	2.3 – 2.7	8.48	0.0051	0.0035	5952 - Mildly corrosive
24-08 – SS9	Grey Silty Clay	7.6 – 8.2	9.84	0.0100	0.0083	1282 - Corrosive to moderately corrosive

The results indicate a soil with sulphate and chloride content of less than 0.1 percent and 0.04 percent respectively. These concentrations of sulphate and chloride would have a negligible potential of sulphate and chloride attack on subsurface concrete. However, the concrete should be dense, well compacted and cured.

The results of the resistivity tests indicate that the soil is mildly corrosive to corrosive to underground bare steel structures. A corrosion expert should be contacted to provide corrosion protection recommendations if steel is to be buried on the site.

14 Pavement Structure for Access Roads and Parking Areas

Site grading plan was not available at the time of the preparing of this report. Consequently, the subgrade elevation of the access road and parking areas are not available. Assuming that the finished elevation of the access roads and parking areas will also be close to the exterior grade adjacent to the building (Elevation 73.15 m), the subgrade of the areas to be paved is estimated to be in the fill or in the silty clay. It is therefore recommended that once the excavations have been completed to the subgrade level, the subgrade should be examined. Areas where the subgrade is in the fill or fill underlain by buried topsoil should be sub-excavated to the underlying silty clay and backfilled with engineered fill OPSS Granular BII) compacted to 98 percent Standard Proctor Maximum Dry Density to the subgrade level.

Pavement structure thicknesses required for the light duty and heavy-duty roadways (fire route) were computed and are shown on Table 7. The thicknesses are based upon an estimate of the subgrade soil properties determined from visual examination, textural classification of the soil samples and functional design life of 15 to 18 years. The proposed functional design life represents the number of years to the first rehabilitation, assuming regular maintenance is carried out.

Table 7: Recommended Pavement Structure Thicknesses for Access Roads and Parking Areas

Pavement Layer	Compaction Requirements	Light Duty (Cars and Parking)	Heavy Duty (Fire Route)
Asphaltic Concrete (PG 58-34)	92 - 97% MRD	65 mm HL3 or SP12.5 Cat B	50 mm HL3 or SP12.5 Cat B 60 mm HL8 or SP19 Cat B
OPSS 1010 Granular 'A' Base (crushed limestone)	100% SPMDD*	150 mm	150 mm
OPSS 1010 Granular 'B' Sub-base, Type II	100% SPMDD*	450 mm	600 mm

Notes:
MRD denotes Maximum Relative Density – ASTM D-2041, SPMDD denotes Standard Proctor Maximum Dry Density, ASTM-D698-12e2, Asphaltic Concrete in accordance with OPSS 1150 (Marshall Mixes) or OPSS 1151 (Superpave Mixes)

The foregoing design assumes that construction is carried out during dry periods and that the subgrade is stable under the load of construction equipment. If construction is carried out during wet weather, and heaving or rolling of the subgrade is experienced, additional thickness of granular material and/or geotextile may be required.

Additional comments on the construction of parking area are as follows:

1. 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 subexcavated and replaced with OPSS Granular B, Type II fill compacted to 98% SPMDD (ASTM D698-12e2).
2. The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure that uniform subgrade moisture and density conditions are achieved. The need for adequate drainage cannot be over-emphasized. Sub-drains must be installed on both sides of the access roads, in the proposed parking areas. The sub-drains should be installed at low points and should be continuous between catch basins 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 requirement and location and extent of subdrainage required within the paved areas will have to be established once the grades at the site are finalized.

3. To minimize the problems of differential movement between the pavement and catchbasins/ manholes due to frost action, the backfill around the structures should consist of free-draining granular preferably conforming to OPSS 1010 Granular B, Type II material. Weep holes should be provided in the catchbasins/manholes to facilitate drainage of the granular fill.
4. The most severe loading conditions on light-duty pavement areas and the subgrade may occur during construction. Consequently, special provisions such as restricted lanes, half-loads during paving, etc., may be required, especially if construction is carried out during unfavorable weather.
5. The finished pavement surface should be free of depressions and should be sloped (preferably at a minimum cross fall of 2 percent) to provide effective surface drainage towards catch basins. Surface water should not be allowed to pond adjacent to the outside edges of paved areas.
6. Relatively weaker subgrade may develop over service trenches at subgrade level if wet soils is used to backfill of the service trenches. Therefore, only dry and compactible material should be used to backfill service trenches as recommended in Section 12 of the report.
7. The granular materials used for pavement structure should conform to OPSS 1010 for Granular A and Granular B Type II and should be compacted to 100 percent of the SPMDD.
8. The asphaltic concrete used, and its placement should meet OPSS 1150 or 1151 requirements. It should be compacted to 92 to 97 percent of the Marshall Relative Density (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 that they are consistent with the recommendations of this report.

15 Tree Planting Restrictions

The modified plasticity index of the upper brown desiccated clay crust is estimated at 28 percent and for the grey clay the modified plasticity index is estimated to range from 20 percent to 38 percent.

The City of Ottawa document titled, “Tree Planting in Sensitive Marine Clay Soils – 2017 Guidelines” indicates that for a modified plasticity index of less than 40 percent, the soil has a low/medium potential for soil volume change and the tree planting restrictions and setbacks from structures should follow the 2017 guidelines.

A landscape architect should be consulted to ensure the applicable tree planting restrictions and setbacks for the proposed school development are in accordance with the 2017 guidelines.

16 Additional Comments

All earthwork activities from placement and compaction of fill to subgrade level, placement and compaction of granular materials for roadways and parking areas should be inspected by qualified geotechnicians to ensure that construction proceeds according to the specifications. Pile driving on the site should be monitored full-time by a geotechnician working under the direction and supervision of a geotechnical engineer to ensure that they have been installed satisfactorily.

The investigation and comments are necessarily on-going as new information of underground conditions becomes available. For example, more specific information is available with respect to conditions between borehole locations when construction is underway. The interpretation between the boreholes, as well as the recommendations of this report, must, therefore, be checked through field inspections provided by EXP to validate the information for use during the construction stage.

17 General Comments

The comments given in this report are intended only for the guidance of design engineers. The number of boreholes required to determine the localized underground conditions, between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc., would be much greater than has been carried out for 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 in no way reflects on the environmental aspects of the soils. Should specific information be required, additional testing may be necessary.

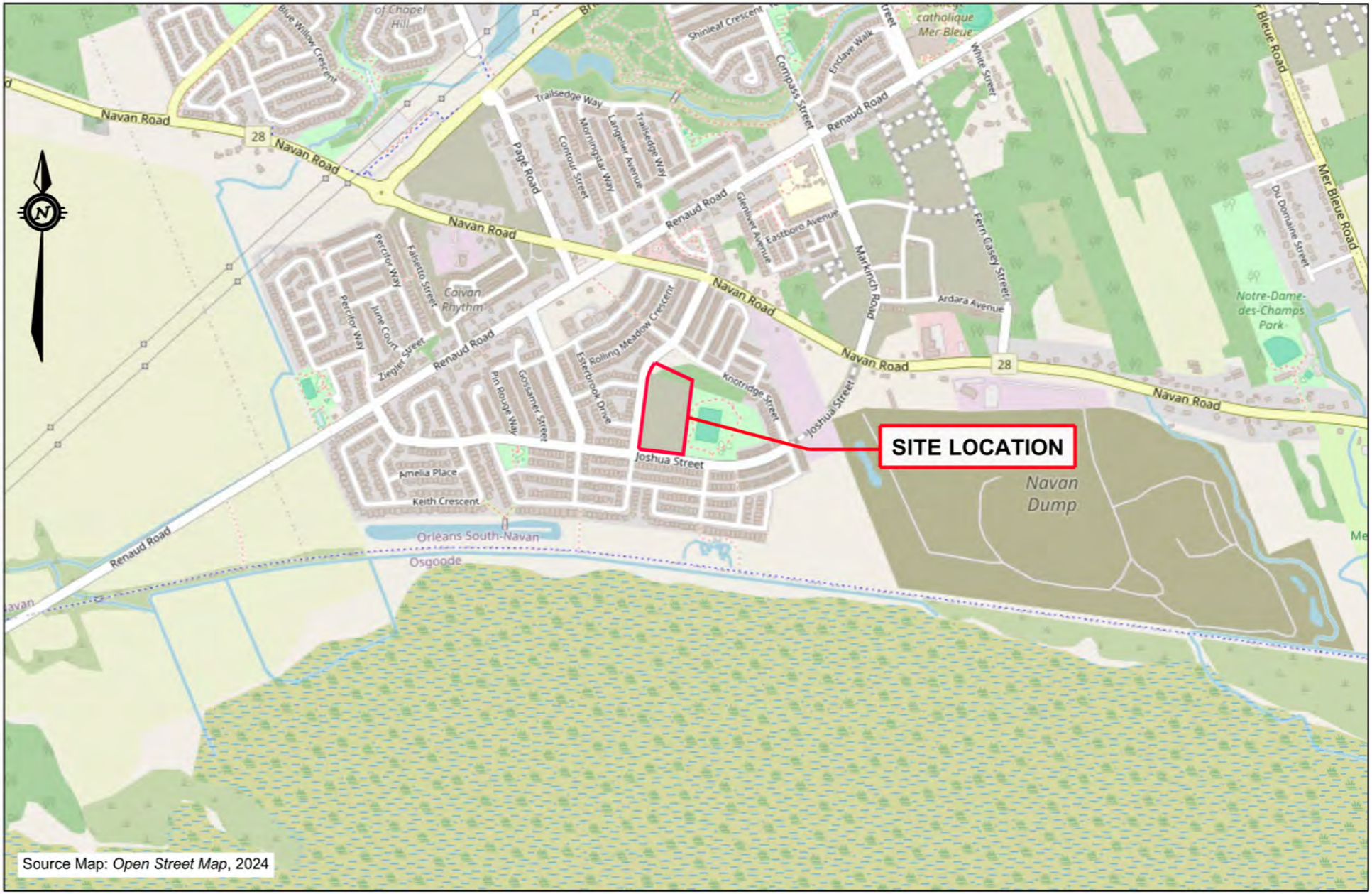
We trust this report is satisfactory for your purposes. If you have any questions regarding our submission, please do not hesitate to contact this office.

Sincerely,

Surinder K. Aggarwal, M.Sc., P.Eng.
Geotechnical Engineer, Geotechnical Services
Earth and Environment

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

FIGURES



0 150m 300m 600m

HORIZONTAL 1:15,000

exp Services Inc.
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Ottawa, ON K2B 8H6
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DESIGN	IT
DRAWN	AS
DATE	MAY 2024
FILE NO	OTT-23012778-E0

GEOTECHNICAL INVESTIGATION
OCDSB EAST URBAN CENTRE ELEMENTARY SCHOOL
700 SPRING VALLEY DRIVE, OTTAWA, ON

SITE LOCATION PLAN

SCALE 1:15,000
SKETCH NO FIG 1

Filename: E:\OTT\OTT-23012778-E0\60 Execution\65 Drawings\Geotechnical\OTT-23012778-E0_Geo_700-Spring-Valley-Drive.dwg
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NOTES:

1. THE BOUNDARIES AND SOIL TYPES HAVE BEEN ESTABLISHED ONLY AT TEST HOLE LOCATIONS. BETWEEN TEST HOLES THEY ARE ASSUMED AND MAY BE SUBJECT TO CONSIDERABLE ERROR.
2. SOIL AND ROCK SAMPLES WILL BE RETAINED IN STORAGE FOR THREE MONTHS AND THEN DESTROYED UNLESS THE CLIENT ADVISES THAT AN EXTENDED TIME PERIOD IS REQUIRED.
3. TEST HOLE ELEVATIONS SHOULD NOT BE USED TO DESIGN BUILDING(S) OR FLOOR SLABS OR PARKING LOT(S) GRADES.
4. TOPSOIL QUANTITIES SHOULD NOT BE ESTABLISHED FROM THE INFORMATION AT THE TEST HOLE LOCATIONS.
5. THIS DRAWING FORMS PART OF THE REPORT PROJECT NUMBER AS REFERENCED AND SHOULD BE USED ONLY IN CONJUNCTION WITH THIS REPORT.
6. BASE SURVEY PLAN INFORMATION OBTAINED FROM *FARLEY, SMITH & DENIS SURVEYING LTD.*, BLOCK 131 REGISTERED PLAN 4M–1465, CITY OF OTTAWA, DATED MAY 7, 2024.

LEGEND

PROPERTY LINE

PROPOSED NEW ELEMENTARY SCHOOL BUILDING

BH-1 — BOREHOLE NO. & LOCATION (2024)

BH1 — BOREHOLE NO. & LOCATION (2019 INVESTIGATION)

TP-1 — TEST PIT NO. & LOCATION (2024)

(71.71m) — GROUND SURFACE ELEVATION (m)

0 10m 20m 40m

HORIZONTAL 1:1000

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DATE	JULY 2024
FILE NO	OTT–23012778–E0

GEOTECHNICAL INVESTIGATION
OCDSB EAST URBAN CENTRE ELEMENTARY SCHOOL
700 SPRING VALLEY DRIVE, OTTAWA, ON

TEST HOLE LOCATION PLAN

SCALE 1:1,000

SKETCH NO FIG 2

Filename: E:\OTT\OTT-23012778-E0\60 Execution\65 Drawings\Geotechnical\OTT-23012778-E0_Geo_700-Spring-Valley-Drive.dwg
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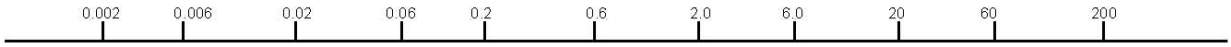
Notes On Sample Descriptions

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

ISSMFE SOIL CLASSIFICATION

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



EQUIVALENT GRAIN DIAMETER IN MILLIMETRES

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

UNIFIED SOIL CLASSIFICATION

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

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

Log of Test Pit TP-24-01

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Location: 700 Spring Valley Dr, Orleans, ON K1W 0H2

Figure No. 3

Page. 1 of 1

Date Drilled: 'June 26, 2024

Drill Type: Backhoe

Datum: Geodetic Elevation

Logged by: A.N Checked by: I.T.

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		FILL Organic topsoil underlain by mixture of sand, silty clay, brown to grey, moist	75.71	0
		ORIGINAL TOPSOIL ~50 mm thick	74.7	
		SILTY CLAY CRUST Brown, moist	74.7	1
			73.6	2
		Test Pit Terminated at 2.1 m Depth		

Standard Penetration Test N Value: 20 40 60 80

Shear Strength: 50 100 150 200 kPa

168

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/Test Pit data requires Interpretation by exp. before use by others
2. Test Pit Backfiled upon Completion
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-23012778-E0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	Dry	

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

LOG OF TEST PIT 700 SPRING VALLEY DRIVE TESTPITS.GPJ TROW OTTAWA.GDT 7/24/24

Log of Test Pit TP-24-02

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Location: 700 Spring Valley Dr, Orleans, ON K1W 0H2

Figure No. 4

Page. 1 of 1

Date Drilled: 'June 26, 2024

Drill Type: Backhoe

Datum: Geodetic Elevation

Logged by: A.N Checked by: I.T.

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		FILL Organic topsoil underlain by mixture of sand, silty clay, occasional cobbles, brown to grey, moist	72.91	0
			71.5	1
		SILTY CLAY CRUST Brown, moist	71.1	
		Test Pit Terminated at 1.8 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/Test Pit data requires Interpretation by exp. before use by others
2. Test Pit Backfiled upon Completion
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-23012778-E0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	1.8	

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

LOG OF TEST PIT 700 SPRING VALLEY DRIVE TESTPITS.GPJ TROW OTTAWA.GDT 7/24/24

Log of Test Pit TP-24-03

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Figure No. 5

Page. 1 of 1

Location: 700 Spring Valley Dr, Orleans, ON K1W 0H2

Date Drilled: 'June 26, 2024

Drill Type: Backhoe

Datum: Geodetic Elevation

Logged by: A.N Checked by: I.T.

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

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 Organic topsoil underlain by mixture of sand, silty clay, occasional cobbles, plastic bags, brown to grey, moist	74.21	0	20 40 60 80 50 100 150 200	250 500 750 20 40 60		
			72.8	1				
		SILTY CLAY CRUST Brown, moist						
			72.1	2				
		Test Pit Terminated at 2.1 m Depth						

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test Pit Backfiled upon Completion
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-23012778-E0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	2.1	

CORE DRILLING RECORD

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

LOG OF TEST PIT 700 SPRING VALLEY DRIVE TESTPITS.GPJ TROW OTTAWA.GDT 7/24/24

Log of Test Pit TP-24-04

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Location: 700 Spring Valley Dr, Orleans, ON K1W 0H2

Figure No. 6

Page. 1 of 1

Date Drilled: 'June 26, 2024

Drill Type: Backhoe

Datum: Geodetic Elevation

Logged by: A.N Checked by: I.T.

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		TOPSOIL ~100 mm thick	73.49	0
		FILL Mixture of silty sand and silty clay, brown to grey, moist	73.4	
			72.1	1
		SILTY CLAY CRUST Brown, moist	71.9	
		Test Pit Terminated at 1.6 m Depth		

Standard Penetration Test N Value: 20 40 60 80

Shear Strength: 50 100 150 200 kPa

Combustible Vapour Reading (ppm): 250 500 750

Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test Pit Backfiled upon Completion
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-23012778-E0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	1.5	

CORE DRILLING RECORD

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

LOG OF TEST PIT 700 SPRING VALLEY DRIVE TESTPITS.GPJ TROW OTTAWA.GDT 7/24/24

Log of Test Pit TP-24-05

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Figure No. 7

Page. 1 of 1

Location: 700 Spring Valley Dr, Orleans, ON K1W 0H2

Date Drilled: 'June 26, 2024

Drill Type: Backhoe

Datum: Geodetic Elevation

Logged by: A.N Checked by: I.T.

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		TOPSOIL ~150 mm thick	72.17	0
		FILL Organic topsoil underlain by mixture of sand, silty clay, occasional cobbles, brown to grey, moist	72.0	
		SILTY CLAY CRUST Brown, moist	71.4	1
		Test Pit Terminated at 1.8 m Depth Note: Test pit located in a wet/swampy area - Filled with water from surface upon completion	70.7	

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/Test Pit data requires Interpretation by exp. before use by others
2. Test Pit Backfiled upon Completion
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-23012778-E0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	0.6	

CORE DRILLING RECORD

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

LOG OF TEST PIT 700 SPRING VALLEY DRIVE TESTPITS.GPJ TROW OTTAWA.GDT 7/24/24

Log of Test Pit TP-24-06

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Location: 700 Spring Valley Dr, Orleans, ON K1W 0H2

Figure No. 8

Page. 1 of 1

Date Drilled: 'June 26, 2024

Drill Type: Backhoe

Datum: Geodetic Elevation

Logged by: A.N Checked by: I.T.

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		FILL Mixture of silty sand and silty clay, brown to grey, moist	72.24	0
				1
		SILTY CLAY CRUST Brown, moist	71.0	
			70.4	
		Test Pit Terminated at 1.8 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

196

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test Pit Backfiled upon Completion
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-23012778-E0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	1.2	

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

LOG OF TEST PIT 700 SPRING VALLEY DRIVE TESTPITS.GPJ TROW OTTAWA.GDT 7/24/24

Log of Test Pit TP-24-07

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Location: 700 Spring Valley Dr, Orleans, ON K1W 0H2

Figure No. 9

Page. 1 of 1

Date Drilled: 'June 26, 2024

Drill Type: Backhoe

Datum: Geodetic Elevation

Logged by: A.N Checked by: I.T.

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		FILL Mixture of silty sand and silty clay, occasional boulders, brown to grey, moist	72.06	0
			70.6	1
		SILTY CLAY CRUST Brown, moist	70.2	
		Test Pit Terminated at 1.9 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

168

SAMPLES

Natural Unit Wt. kN/m³

LOG OF TEST PIT 700 SPRING VALLEY DRIVE TESTPITS.GPJ TROW OTTAWA.GDT 7/24/24

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test Pit Backfiled upon Completion
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-23012778-E0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	1.5	

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

Log of Test Pit TP-24-08

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Figure No. 10

Page. 1 of 1

Location: 700 Spring Valley Dr, Orleans, ON K1W 0H2

Date Drilled: 'June 26, 2024

Drill Type: Backhoe

Datum: Geodetic Elevation

Logged by: A.N Checked by: I.T.

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		FILL Mixture of silty sand and silty clay, occasional boulders, brown to grey, moist	71.93	0
		FILL Silty Sand, with clay and rootlets, oxidized stains, moist	70.9	1
		SILTY CLAY CRUST Brown, moist	70.4	
		Test Pit Terminated at 1.8 m Depth	70.1	

Standard Penetration Test N Value: 20 40 60 80

Shear Strength kPa: 50 100 150 200

Combustible Vapour Reading (ppm): 250 500 750

Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SAMPLES

Natural Unit Wt. kN/m³

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test Pit Backfiled upon Completion
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-23012778-E0

WATER LEVEL RECORDS

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

CORE DRILLING RECORD

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

LOG OF TEST PIT 700 SPRING VALLEY DRIVE TESTPITS.GPJ TROW OTTAWA.GDT 7/24/24

Log of Test Pit TP-24-09

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Location: 700 Spring Valley Dr, Orleans, ON K1W 0H2

Figure No. 11

Page. 1 of 1

Date Drilled: 'June 26, 2024

Drill Type: Backhoe

Datum: Geodetic Elevation

Logged by: A.N Checked by: I.T.

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		FILL Mixture of silty sand and silty clay, occasional boulders, carpet and wood pieces, rootles, brown to grey, moist	72.17	0
		ORIGINAL TOPSOIL 300 mm to 400 mm thick	70.8	
		SILTY CLAY CRUST Brown, moist	70.4	1
		Test Pit Terminated at 2.1 m Depth	70.1	2

Standard Penetration Test N Value: 20 40 60 80

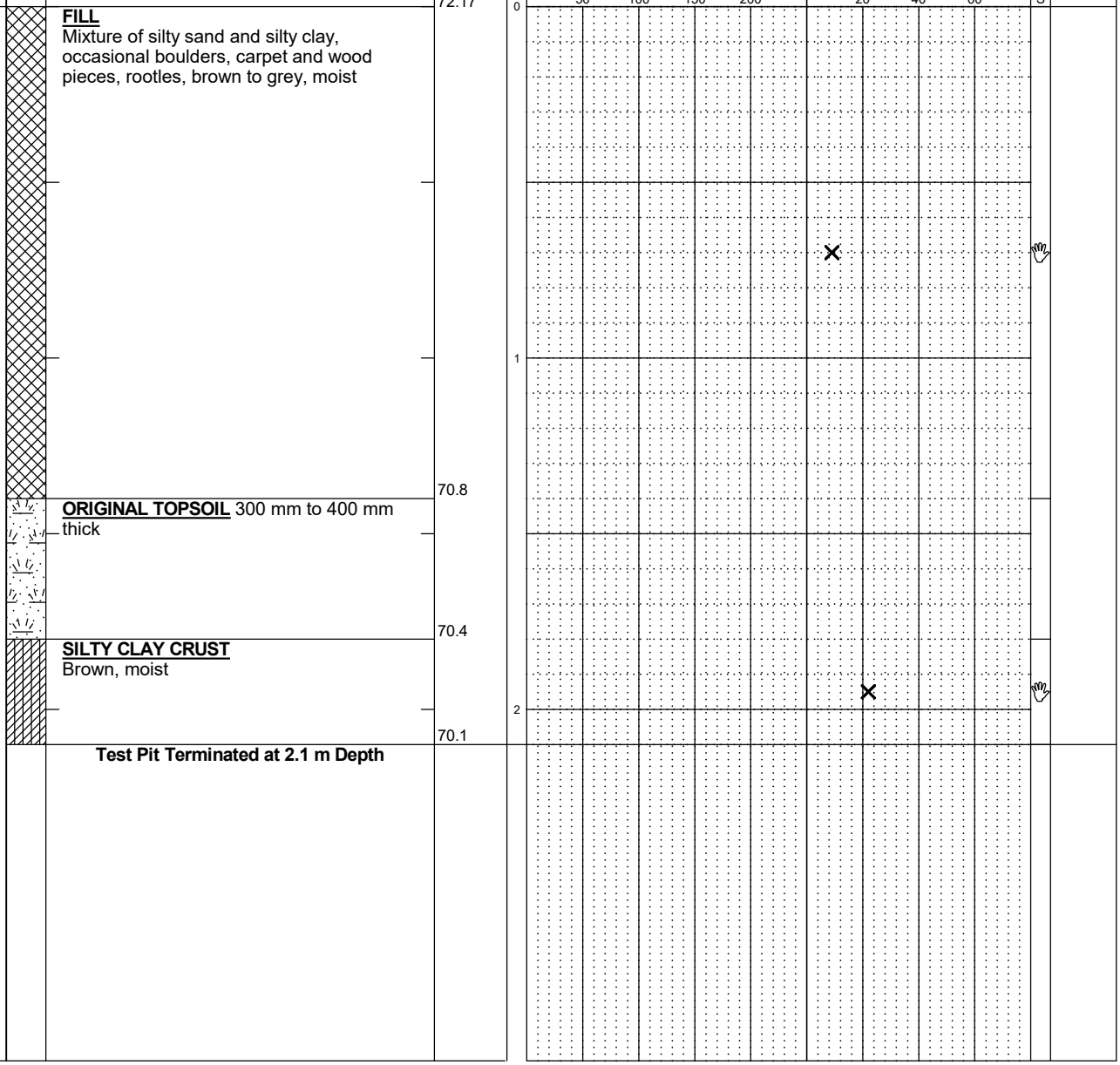
Shear Strength: 50 100 150 200 kPa

Combustible Vapour Reading (ppm): 250 500 750

Natural Moisture Content % Atterberg Limits (% Dry Weight): 20 40 60

SAMPLES

Natural Unit Wt. kN/m³



NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. Test Pit Backfiled upon Completion
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-23012778-E0

WATER LEVEL RECORDS

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

CORE DRILLING RECORD

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

LOG OF TEST PIT 700 SPRING VALLEY DRIVE TESTPITS.GPJ TROW OTTAWA.GDT 7/24/24

Log of Test Pit TP-24-10

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Location: 700 Spring Valley Dr, Orleans, ON K1W 0H2

Figure No. 12

Page. 1 of 1

Date Drilled: 'June 26, 2024

Drill Type: Backhoe

Datum: Geodetic Elevation

Logged by: A.N Checked by: I.T.

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		FILL Mixture of silty sand and silty clay, occasional boulders, large pieces of asphalt (100 mm thick), wood, platic bags, garbage, brown to grey, moist	71.96	0
		SILTY CLAY CRUST Brown, moist	70.6	1
		Test Pit Terminated at 2.0 m Depth	70.0	2

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/Test Pit data requires Interpretation by exp. before use by others
2. Test Pit Backfiled upon Completion
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-23012778-E0

WATER LEVEL RECORDS

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

CORE DRILLING RECORD

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

LOG OF TEST PIT 700 SPRING VALLEY DRIVE TESTPITS.GPJ TROW OTTAWA.GDT 7/24/24

Log of Borehole BH24-01

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Location: 700 Spring Valley Dr, Orleans, ON K1W 0H2

Figure No. 13

Page. 1 of 3

Date Drilled: 'May 28, 2024

Drill Type: CME 75 Track-Mounted Drill Rig

Datum: Geodetic Elevation

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

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		TOPSOIL ~100 mm thick	71.71	0				
		FILL Silty sand, silty clay, rootlets, brown, wet, (loose)	71.6		4		AS1	
				1	4		SS2	
		SILTY CLAY CRUST Brown, moist, (stiff to very stiff)	70.2		5 144 kPa		SS3	
				2	Hammer Weight		SS4	
					67 kPa s = 9.3			
				3	Hammer Weight		SS5	
		SILTY CLAY Dark grey, wet, (stiff)	68.2		67 kPa s = 9.3			
					Hammer Weight		SS6	
					62 kPa s = 13			
					Hammer Weight		SH7	
				5	57 kPa s = 6			
				6	Hammer Weight		SS8	
					57 kPa s = 8			
				7	Hammer Weight		SS9	
					76 kPa s = 11			
				9	Hammer Weight		SS10	
				10	81 kPa s = 34			

Continued Next Page

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter Pizometer 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-23012778-E0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
June 26, 2024	0.0	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	24.5 - 25.9	0	0
2	26.2 - 26.6	100	0
3	26.6 - 28.2	98	20
4	28.2 - 29	80	0
5	29 - 30.5	100	34
6	30.5 - 32	100	68

LOG OF BOREHOLE 700 SPRING VALLEY DRIVE.GPJ TROW OTTAWA.GDT 7/17/24

Log of Borehole BH24-01

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Figure No. 13

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
SILTY CLAY Dark grey, wet, (stiff) *(continued)*	61.71	10–12				
		12	Hammer Weight		SS11	
		13	62 kPa s = 4			
		14–15				
		15	Hammer Weight		SS12	
		16	76 kPa no remold			
	54.1	17				
GLACIAL TILL Silty sand with gravel, trace clay, cobbles and boulders, grey, moist, (compact to very dense)		18	24		SS13	
		19–21				
		21	46, then 50 for 50mm		SS14	
		22				

Continued Next Page

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter Pizometer 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-23012778-E0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
June 26, 2024	0.0	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	24.5 - 25.9	0	0
2	26.2 - 26.6	100	0
3	26.6 - 28.2	98	20
4	28.2 - 29	80	0
5	29 - 30.5	100	34
6	30.5 - 32	100	68

LOG OF BOREHOLE 700 SPRING VALLEY DRIVE.GPJ TROW OTTAWA.GDT 7/17/24

Log of Borehole BH24-01

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Figure No. 13

Page. 3 of 3

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation 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
		GLACIAL TILL Silty sand with gravel, trace clay, cobbles and boulders, grey, moist, (compact to very dense) *(continued)*	49.71	22				
				23				
				24	80, then 50 for 50mm		SS15	
				25			RUN1	
			45.5	26				
		WEATHERED SHALE BEDROCK Very poor to fair quality, dark grey to dark brown					RUN2	
				27			RUN3	
				28			RUN4	
				29			RUN5	
				30				
				31			RUN6	
			39.7	32				
		Borehole Terminated at 32.0 m Depth						

LOG OF BOREHOLE 700 SPRING VALLEY DRIVE.GPJ TROW OTTAWA.GDT 7/17/24

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter Pizometer 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-23012778-E0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
June 26, 2024	0.0	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	24.5 - 25.9	0	0
2	26.2 - 26.6	100	0
3	26.6 - 28.2	98	20
4	28.2 - 29	80	0
5	29 - 30.5	100	34
6	30.5 - 32	100	68

Log of Borehole BH24-02

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Figure No. 14

Page. 1 of 1

Location: 700 Spring Valley Dr, Orleans, ON K1W 0H2

Date Drilled: 'May 27, 2024

Drill Type: CME 75 Track-Mounted Drill Rig

Datum: Geodetic Elevation

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

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		TOPSOIL ~100 mm thick	72.04	0				
		71.9						
		FILL Silty sand, silty clay, topsoil, trace gravel, brown to grey, moist, no odour, no stains, (loose)			6		SS1	
				1	6		SS2	
			70.2		11, 96 kPa		SS3	
		SILTY CLAY CRUST Light brown, wet, (firm to stiff)		2				
		Brown stains at 2.3 m depth.			6		SS4	
				3	2, 96 kPa		SS5	
			68.5					
		SILTY CLAY Dark grey to grey, wet, (firm to stiff)			48 kPa, s = 7, Hammer Weight		SS6	
					43 kPa, s = 4.5, Hammer Weight		SS7	
				5	72 kPa, s = 15			
		Black stains below 6.0 m depth		6	Hammer Weight		SS8	
				7	62.4 kPa, s = 13			
					Hammer Weight		SS9	
				8	72 kPa, s = 10			
			63.2					
		Borehole Terminated at 8.8 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-23012778-E0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Upon completion	4.6	

CORE DRILLING RECORD

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

LOG OF BOREHOLE 700 SPRING VALLEY DRIVE.GPJ TROW OTTAWA.GDT 7/17/24

Log of Borehole BH24-03

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Figure No. 15

Page. 1 of 1

Location: 700 Spring Valley Dr, Orleans, ON K1W 0H2

Date Drilled: 'May 27, 2024

Drill Type: CME 75 Track-Mounted Drill Rig

Datum: Geodetic Elevation

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

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 ~150 mm thick	71.91	0				
		71.8						
		FILL Silty sand, silty clay, topsoil, vegetation, brown, moist, (very loose to loose)			1		SS1	
				1	9		SS2	
		70.2			12 144 kPa		SS3	
		SILTY CLAY CRUST Brown, moist, (very stiff to stiff)		2	2		SS4	
					67 kPa s = 5.6			
		68.9		3				
		SILTY CLAY Dark grey, wet to very wet, (stiff)			Hammer Weight		SS5	
					53 kPa s = 7.6			
					Hammer Weight		SS6	
					62 kPa s = 13			
					Hammer Weight		SS7	
				5	72 kPa s = 15			
				6				
					Hammer Weight		SS8	
					67 kPa s = 9.3			
				7				
					Hammer Weight		SS9	
				8				
					77 kPa s = 11			
		63.1						
		Borehole Terminated at 8.8 m Depth						

LOG OF BOREHOLE 700 SPRING VALLEY DRIVE.GPJ TROW OTTAWA.GDT 7/17/24

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter Pizometer 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-23012778-E0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)
Upon completion	3.7	

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

Log of Borehole BH24-04

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Location: 700 Spring Valley Dr, Orleans, ON K1W 0H2

Figure No. 16

Page. 1 of 1

Date Drilled: 'May 24, 2024

Drill Type: CME 75 Track-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: S.A.

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		FILL Sandy silty clay, topsoil inclusion, organics, wet, (loose)	71.66	0	3	×	SS1	
		SILTY CLAY CRUST Light brown, moist, (stiff to very stiff)	70.6	1	15 150 kPa	×	SS2	
				2	10 96 kPa 90 kPa s = 9	×	SS3	
		SILTY CLAY Grey to dark grey, wet, (firm to stiff)	68.7	3	2	×	SS4	
				4	44 kPa s = 18			
				5	Hammer Weight	×	SS5	
				6	Hammer Weight 43 kPa no remold	81.1 ×	SS6	
				7	Hammer Weight	×	SS7	
			63.8		38 kPa no remold			
		Borehole Terminated at 7.9 m Depth						

LOG OF BOREHOLE 700 SPRING VALLEY DRIVE.GPJ TROW OTTAWA.GDT 7/17/24

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter stand pipe 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-23012778-E0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)
June 26, 2024	0.0	

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

Log of Borehole BH24-05

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Location: 700 Spring Valley Dr, Orleans, ON K1W 0H2

Figure No. 17

Page. 1 of 2

Date Drilled: 'May 27, 2024

Drill Type: CME 75 Track-Mounted Drill Rig

Datum: Geodetic Elevation

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

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		FILL Silty sand, clay mixed with organic soil, rootlets, moist, brown, (very loose)	71.92	0	2		SS1	
		Swampy area; water at ground surface		1	1		SS2	
		SILTY CLAY CRUST Brown, moist, (stiff to very stiff)	70.2	2	9		SS3	
					1		SS4	
		SILTY CLAY Dark grey, wet, (stiff)	68.9	3	106 kPa, s = 4.9; Hammer Weight		SS5	
					58 kPa, s = 8; Hammer Weight	83	SS6	
				5	62 kPa, s = 9; Hammer Weight	83	SS7	
				6	67 kPa, s = 9.3; Hammer Weight		SS8	
				7	68 kPa, s = 14; Hammer Weight		SS9	
				8	72 kPa, s = 30			
		Borehole Terminated at 8.5 m depth. Dynamic Cone Penetration Test (DCPT) conducted next to BH24-5 from 1.5 m depth to cone refusal at 21.2 m depth.	63.4	9				
				10				

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-23012778-E0

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

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

LOG OF BOREHOLE 700 SPRING VALLEY DRIVE.GPJ TROW OTTAWA.GDT 7/17/24

Log of Borehole BH24-05

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Figure No. 17

Page. 2 of 2

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		Borehole Terminated at 8.5 m depth.	61.92	10
		Dynamic Cone Penetration Test (DCPT) conducted next to BH24-5 from 1.5 m depth to cone refusal at 21.2 m depth. *(continued)*		11
				12
				13
				14
				15
				16
				17
			54.3	18
		GLACIAL TILL Silty sand and gravel with cobbles and boulders		19
				20
			50.7	21
		Cone Refusal at 21.2 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/m^3

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-23012778-E0

WATER LEVEL RECORDS

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

CORE DRILLING RECORD

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

LOG OF BOREHOLE 700 SPRING VALLEY DRIVE.GPJ TROW OTTAWA.GDT 7/17/24

Log of Borehole BH24-06

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Figure No. 18

Page. 1 of 1

Location: 700 Spring Valley Dr, Orleans, ON K1W 0H2

Date Drilled: 'May 24, 2024

Drill Type: CME 75 Track-Mounted Drill Rig

Datum: Geodetic Elevation

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

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		FILL Silty sand, clay mixed with organic soil, rootlets, moist, brown, (very loose)	72.01	0	4		SS1	
		SANDY SILT Brown, (compact)	71.1	1	14; 144 kPa		SS2	
		SILTY CLAY CRUST Light brown, moist, (very stiff to firm)	70.8	2	12; 84 kPa		SS3	
				3	53 kPa, s = 4.5			
		SILTY CLAY Grey to dark grey, wet, (stiff)	69.0	4	1; 43 kPa, s = 18		SS5	
				5	Hammer Weight; 24 kPa, no remold		SS6	
				6	Hammer Weight		SS7	
				7	29 kPa, no remold			
				8	Hammer Weight		SS8	
			63.8					
		Borehole Terminated at 8.2 m Depth						

LOG OF BOREHOLE 700 SPRING VALLEY DRIVE.GPJ TROW OTTAWA.GDT 7/17/24

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. Borehole backfilled upon completion of drilling.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. Log to be read with EXP Report OTT-23012778-E0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)
Upon completion	no water	7.3

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

Log of Borehole BH24-08

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Figure No. 19

Page. 1 of 3

Location: 700 Spring Valley Dr, Orleans, ON K1W 0H2

Date Drilled: 'May 29, 2024

Drill Type: CME 75 Track-Mounted Drill Rig

Datum: Geodetic Elevation

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

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		FILL Silty sand and clay, topsoil, grass, moist, (loose)	72.81	0	7	×	SS1	
				1	6	×	SS2	
		SILTY CLAY CRUST Brown, moist, (stiff)	71.4	2	14	×	SS3	
				3	8	×	SS4	
		SILTY CLAY Dark grey to grey, wet to very wet, (firm to stiff)	69.8		1	×	SS5	
					43 kPa, s = 18			
				4	Hammer Weight	×	SS6	
					67 kPa, s = 28			
				5	Hammer Weight	81 ×	SS7	
					62 kPa, s = 26			
		Black stains below 6.1 m depth		6		81 ×	ST8	15.1
					62 kPa, s = 26			
				7				
					Hammer Weight	×	SS9	
				8	72 kPa, s = 30			
				9		×	ST10	15.4
					73 kPa, s = 30			
				10				

Continued Next Page

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter Pizometer 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-23012778-E0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Upon completion	4.6	
June 26, 2024	Artesian	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	23.7 - 25.8	22	0
2	25.8 - 27.4	90	50
3	27.4 - 28.9	100	61

LOG OF BOREHOLE 700 SPRING VALLEY DRIVE.GPJ TROW OTTAWA.GDT 7/17/24

Log of Borehole BH24-08

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Figure No. 19

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation 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
		Start running casing and wash-boring from 10.1 m to refusal at 23.7 m depth	62.81 62.7	10				
				11				
				12				
				13				
				14				
				15				
				16				
				17				
				18				
		GLACIAL TILL Silty sand and gravel with possible cobbles and boulders	54.3	19				
				20				
				21				
				22				

Continued Next Page

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter Pizometer 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-23012778-E0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Upon completion	4.6	
June 26, 2024	Artesian	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	23.7 - 25.8	22	0
2	25.8 - 27.4	90	50
3	27.4 - 28.9	100	61

LOG OF BOREHOLE 700 SPRING VALLEY DRIVE.GPJ TROW OTTAWA.GDT 7/17/24

Log of Borehole BH24-08

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Figure No. 19

Page. 3 of 3

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation 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
		GLACIAL TILL Silty sand and gravel with possible cobbles and boulders *(continued)*	50.81	22				
				23				
				24				
				25			RUN1	
			47.0	26				
		WEATHERED SHALE BEDROCK Poor to fair quality					RUN2	
				27				
				28			RUN3	
			43.9					
		Borehole Terminated at 28.9 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter Pizometer 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-23012778-E0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Upon completion	4.6	
June 26, 2024	Artesian	

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	23.7 - 25.8	22	0
2	25.8 - 27.4	90	50
3	27.4 - 28.9	100	61

LOG OF BOREHOLE 700 SPRING VALLEY DRIVE.GPJ TROW OTTAWA.GDT 7/17/24

Log of Borehole BH24-09

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Location: 700 Spring Valley Dr, Orleans, ON K1W 0H2

Figure No. 20

Page. 1 of 1

Date Drilled: 'May 24, 2024

Drill Type: CME 55 Track-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: S.A.

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		FILL Sandy silty clay, moist, brown, (compact)	73.36	0	11		SS1	
				1	6		SS2	
				2	6		SS3	
		SILTY CLAY CRUST Light brown, moist, (very stiff)	71.3					
				3	15 140 kPa s = 4.7		SS4	
		SILTY CLAY Grey, wet, (firm)	69.4	4	2		SS5	
				5	29 kPa no remold			
					Hammer Weight	82.3	SS6	
				6	34 kPa no remold			
				7	Hammer Weight	80.5	SS7	
					43 kPa no remold			
			65.5					
		Borehole Terminated at 7.9 m Depth						

LOG OF BOREHOLE 700 SPRING VALLEY DRIVE.GPJ TROW OTTAWA.GDT 7/17/24

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter Pizometer 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-23012778-E0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)
June 26, 2024	1.1	

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

Log of Borehole BH24-11

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Figure No. 21

Page. 1 of 1

Location: 700 Spring Valley Dr, Orleans, ON K1W 0H2

Date Drilled: 'May 24, 2024

Drill Type: CME 75 Track-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: S.A.

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, topsoil inclusion, moist, brown, (loose)	73.5	0	8		SS1	
				1	7		SS2	
					9		SS3	
		SILTY CLAY CRUST Light brown, moist, (stiff to firm)	71.6	2	12 — 84 kPa		SS4	
				3	6 — 72 kPa		SS5	
		SILTY CLAY Grey, wet, (firm)	70.0	4	48 kPa, s = 10			
				5	1		SS6	
			68.3					
		Borehole Terminated at 5.2 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter stand pipe 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-23012778-E0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
June 26, 2024	1.1	

CORE DRILLING RECORD

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

LOG OF BOREHOLE 700 SPRING VALLEY DRIVE.GPJ TROW OTTAWA.GDT 7/17/24

Log of Borehole BH24-12

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Figure No. 22

Page. 1 of 1

Location: 700 Spring Valley Dr, Orleans, ON K1W 0H2

Date Drilled: 'May 23, 2024

Drill Type: CME 75 Track-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: S.A.

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, moist, light brown, (loose)	72	0	3	×	SS1	
				1	9	×	SS2	
		SILTY CLAY CRUST Light brown, moist, (stiff to very stiff)	70.5	2	16; 120 kPa ▲	×	SS3	
					5	×	SS4	
		SILTY CLAY Grey, wet, (firm)	69.0	3	60 kPa +S; 48 kPa +S; s = 9.6	×		
					Hammer Weight	×	SS6	
			67.1		48 kPa +S; s = 20			
		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-23012778-E0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Upon completion	3.7	4.3

CORE DRILLING RECORD

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

LOG OF BOREHOLE 700 SPRING VALLEY DRIVE.GPJ TROW OTTAWA.GDT 7/17/24

Log of Borehole BH24-13

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Location: 700 Spring Valley Dr, Orleans, ON K1W 0H2

Figure No. 23

Page. 1 of 1

Date Drilled: 'May 23, 2024

Drill Type: CME 55 Track-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: S.A.

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 ~150 mm thick	71.69	0				
		FILL Silty clay with topsoil inclusions, gravel, cobbles, sandy layers, brown and black, moist, (compact)	71.5		25	×	SS1	
				1	11	×	SS2	
		SILTY CLAY CRUST Light brown, moist, (very stiff)	70.2		17, 144 kPa ▲	×	SS3	
				2	11, 108 kPa ▲	×	SS4	
				3	140 kPa +, s = 5.6	×		
		SILTY CLAY Grey, wet, (firm)	67.9	4	1	×	SS6	
			66.8		53 kPa +, no remold	×		
		Borehole Terminated at 4.9 m Depth						

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. A 19 mm diameter stand pipe 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-23012778-E0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
June 26, 2024	0.3	

CORE DRILLING RECORD

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

LOG OF BOREHOLE 700 SPRING VALLEY DRIVE.GPJ TROW OTTAWA.GDT 7/17/24

Log of Borehole BH24-14

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Location: 700 Spring Valley Dr, Orleans, ON K1W 0H2

Figure No. 24

Page. 1 of 1

Date Drilled: 'May 24, 2024

Drill Type: CME 55 Track-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: S.A.

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 (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
		FILL Silty clay with topsoil inclusions, brown, moist, (loose)	72.56	0	4	×	SS1	
		SILTY CLAY CRUST With sand seams, light brown, moist, (stiff)	71.6	1	12	×	SS2	
					13 96	×	SS3	
		Borehole Terminated at 2.1 m Depth	70.5	2				

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-23012778-E0

WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)
Upon completion	no water	no cave-in

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

LOG OF BOREHOLE 700 SPRING VALLEY DRIVE.GPJ TROW OTTAWA.GDT 7/17/24

Log of Borehole BH24-15

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Location: 700 Spring Valley Dr, Orleans, ON K1W 0H2

Figure No. 25

Page. 1 of 1

Date Drilled: 'May 23, 2024

Drill Type: CME 55 Track-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: S.A.

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, with topsoil inclusions, brown, moist, (loose)	73.12	0	6	×	SS1	
				1	17	×	SS2	
		SILTY CLAY CRUST Light brown, moist, (stiff)	71.9					
				2	11, 72 kPa	×	SS3	
		Borehole Terminated at 2.1 m Depth	71.0					

Standard Penetration Test N Value: 20 40 60 80

Shear Strength kPa: 50 100 150 200

Combustible Vapour Reading (ppm): 250 500 750

Natural Moisture Content % / Atterberg Limits (% Dry Weight): 20 40 60

NOTES:

1. Borehole data requires interpretation by EXP before use by others
2. 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-23012778-E0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Upon completion	no water	no cave-in

CORE DRILLING RECORD

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

LOG OF BOREHOLE 700 SPRING VALLEY DRIVE.GPJ TROW OTTAWA.GDT 7/17/24

Log of Borehole BH24-16

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Location: 700 Spring Valley Dr, Orleans, ON K1W 0H2

Figure No. 26

Page. 1 of 1

Date Drilled: 'May 23, 2024

Drill Type: CME 55 Track-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: S.A.

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 (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
		FILL Silty clay with topsoil inclusions, brown, moist, (loose)	71.86	0	5	×	SS1	
				1	8	×	SS2	
		SILTY CLAY CRUST Brown, moist, (very stiff)	70.2	2	23, 144 kPa	×	SS3	
		Borehole Terminated at 2.1 m Depth	69.8					

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-23012778-E0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Upon completion	no water	no cave-in

CORE DRILLING RECORD

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

LOG OF BOREHOLE 700 SPRING VALLEY DRIVE.GPJ TROW OTTAWA.GDT 7/17/24

Log of Borehole BH24-17

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Location: 700 Spring Valley Dr, Orleans, ON K1W 0H2

Figure No. 27

Page. 1 of 1

Date Drilled: 'May 23, 2024

Drill Type: CME 55 Track-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: S.A.

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 (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
		FILL Silty clay with sand pockets, to silty sand with clay pockets, brown and grey, moist, (compact)	72.55	0	12	×	SS1	
				1	13	×	SS2	
		TOPSOIL ~200 mm thick	70.9		12	168 kPa ▲ ×	SS3	
		SILTY CLAY CRUST Light brown, moist, (very stiff)	70.7	2				
		Borehole Terminated at 2.1 m Depth	70.5					

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-23012778-E0

WATER LEVEL RECORDS

Date	Water Level (m)	Hole Open To (m)
Upon completion	no water	no cave-in

CORE DRILLING RECORD

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

LOG OF BOREHOLE 700 SPRING VALLEY DRIVE.GPJ TROW OTTAWA.GDT 7/17/24

Log of Borehole BH24-18

Project No: OTT-23012778-E0

Project: OCDSB East Urban Center Elementary, Geotechnical and Environmental Investigation

Location: 700 Spring Valley Dr, Orleans, ON K1W 0H2

Figure No. 28

Page. 1 of 1

Date Drilled: 'May 24, 2024

Drill Type: CME 55 Track-Mounted Drill Rig

Datum: Geodetic Elevation

Logged by: M.Z. Checked by: S.A.

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 (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
		FILL Silty clay, some sand, topsoil inclusions, brown, moist, (compact)	73.74	0	11	×	SS1	
				1	8	×	SS2	
		TOPSOIL ~400 mm thick	72.1					
			71.7	2	13	×	SS3	
		SANDY SILT Light brown, damp, (compact)	71.6					
		Borehole Terminated at 2.1 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-23012778-E0

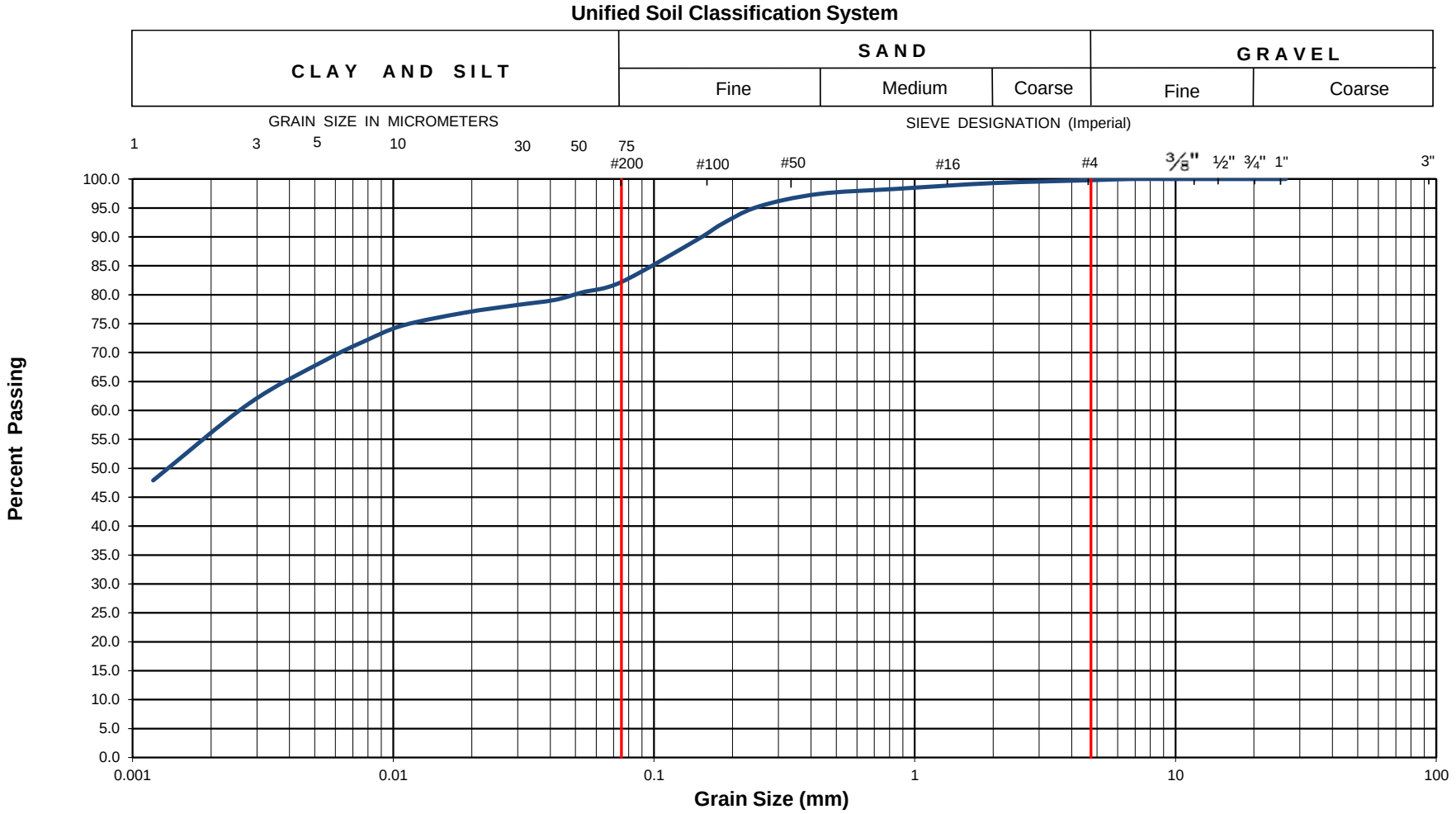
WATER LEVEL RECORDS		
Date	Water Level (m)	Hole Open To (m)
Upon completion	no water	no cave-in

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

LOG OF BOREHOLE 700 SPRING VALLEY DRIVE.GPJ TROW OTTAWA.GDT 7/17/24

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

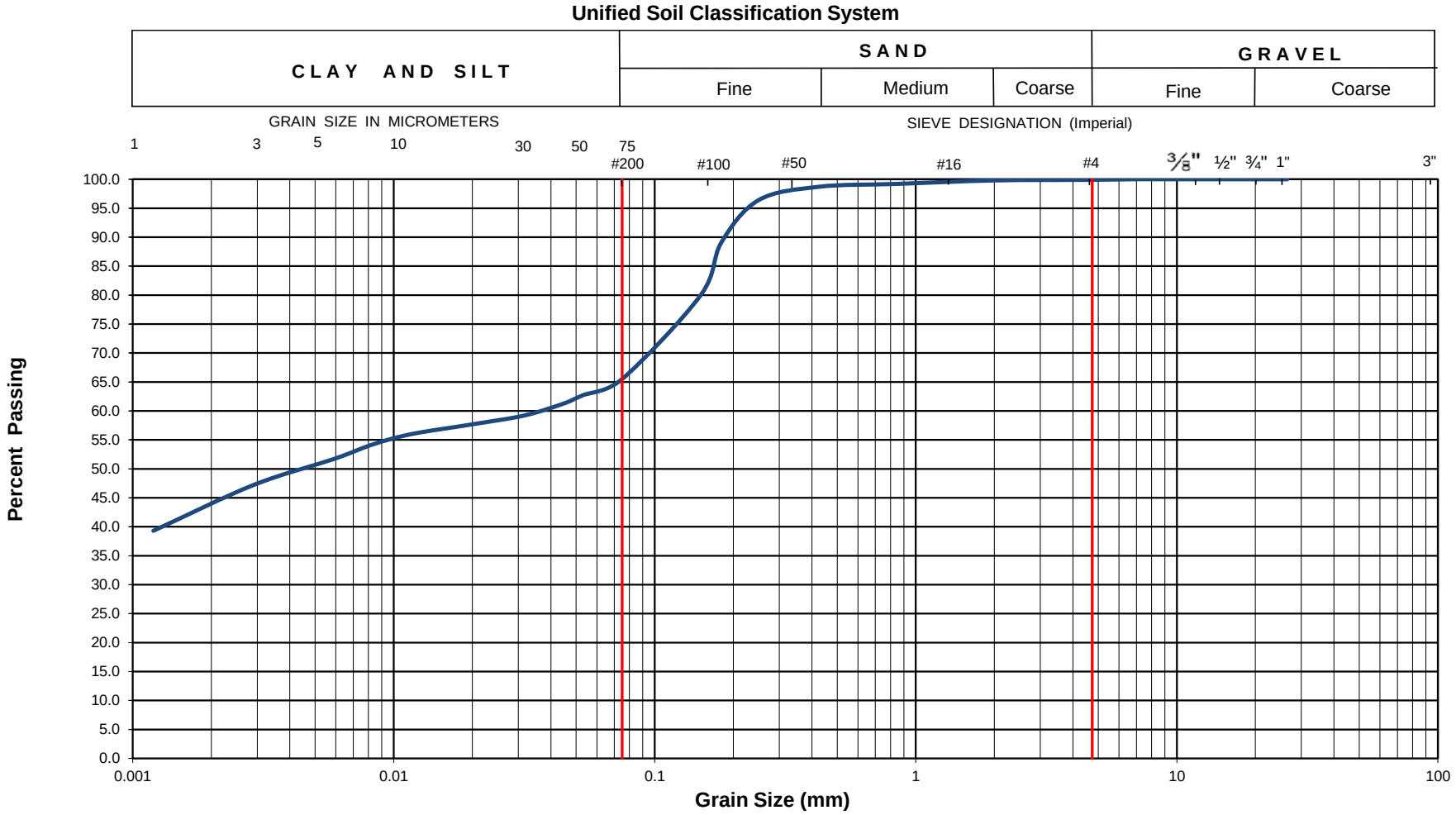
Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422



EXP Project No.:	**OTT-223012778-E0**	**Project Name :**	**Geotechinal Investigation. East Urban Centre Elementary School**						
Client :	**Ottawa Carleton District School Board**	**Project Location :**	**700 Spring Valley Drive, Ottawa, ON**						
Date Sampled :	**May 28, 2024**	**Borehole No:**	**24-01**	**Sample No.:**	**SS2**	**Depth (m) :**	**0.8 - 1.4**		
Sample Description :		**% Silt and Clay**	**82.2**	**% Sand**	**17.6**	**% Gravel**	**0.2**	**Figure :**	**29**
Sample Description :		**FILL:Silty Clay, some sand, trace gravel**							

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-223012778-E0**		**Project Name :**	**Geotechinal Investigation. East Urban Centre Elementary School**					
Client :	**Ottawa Carleton District School Board**		**Project Location :**	**700 Spring Valley Drive, Ottawa, ON**					
Date Sampled :	**May 24, 2024**		**Borehole No:**	**24-09**		**Sample No.:**	**SS2**	**Depth (m) :**	**0.8 - 1.4**
Sample Description :			**% Silt and Clay**	**65.5**	**% Sand**	**34.4**	**% Gravel**	**0.1**	**Figure :** **30**
Sample Description :			**FILL Sandy Silty Clay, Tace gravel**						

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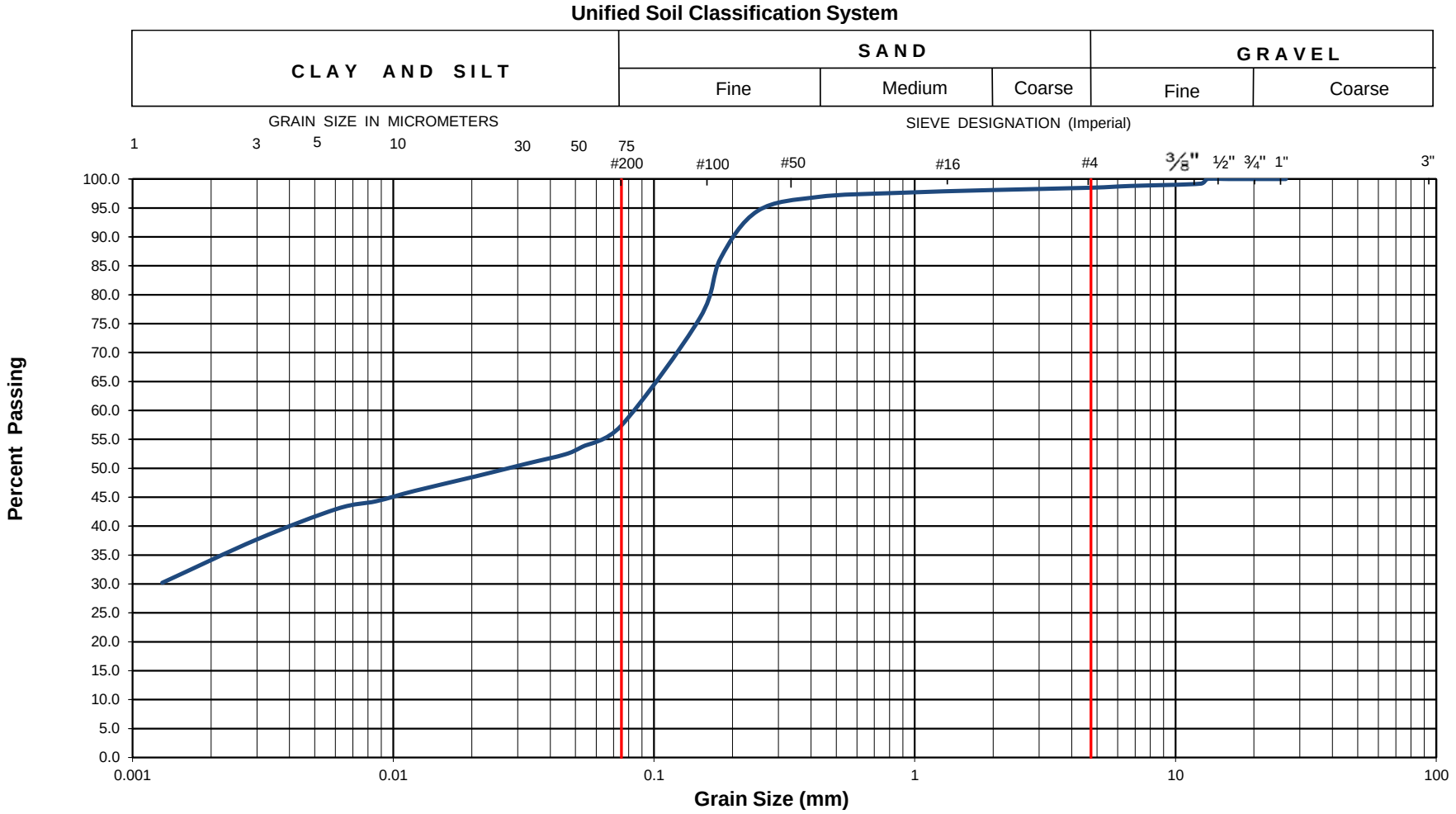
Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422



EXP Project No.:	**OTT-223012778-E0**		**Project Name :**	**Geotechinal Investigation. East Urban Centre Elementary School**					
Client :	**Ottawa Carleton District School Board**		**Project Location :**	**700 Spring Valley Drive, Ottawa, ON**					
Date Sampled :	**May 24, 2024**		**Borehole No:**	**24-09**		**Sample No.:**	**SS1**	**Depth (m) :**	**0.0 - 0.6**
Sample Description :			**% Silt and Clay**	**57.4**	**% Sand**	**41.1**	**% Gravel**	**1.5**	**Figure :** **31**
Sample Description :			**FILL: Clayey Silty Sand, Trace Gravel**						

EXP Services Inc.
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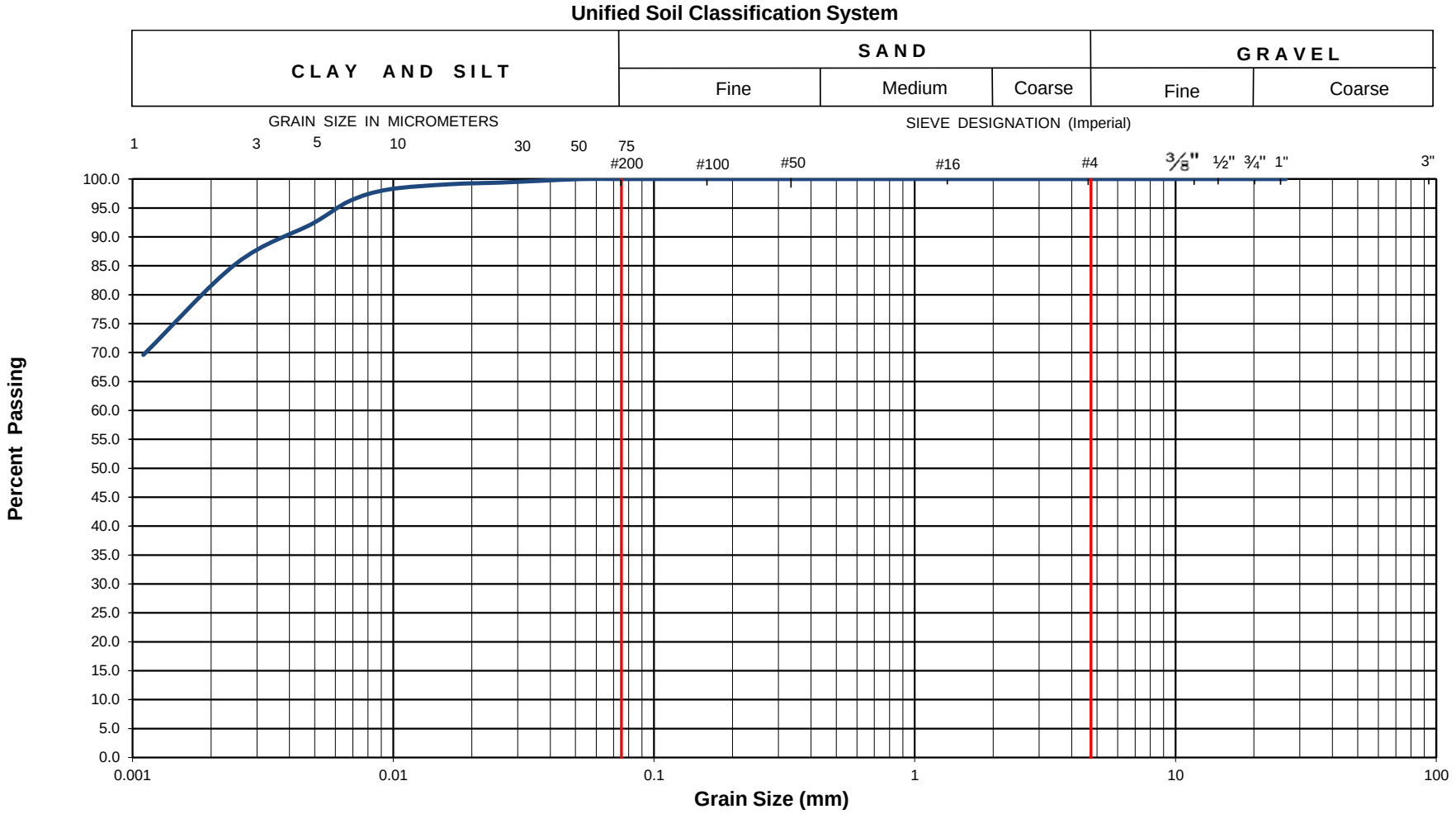
Ottawa, ON K2B 8H6

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



EXP Project No.:	**OTT-223012778-E0**	**Project Name :**	**Geotechinal Investigation. East Urban Centre Elementary School**						
Client :	**Ottawa Carleton District School Board**	**Project Location :**	**700 Spring Valley Drive, Ottawa, ON**						
Date Sampled :	**May 28, 2024**	**Borehole No:**	**24-01**	**Sample No.:**	**SS4**	**Depth (m) :**	**2.3 -2.7**		
Sample Description :		**% Silt and Clay**	**100**	**% Sand**	**0**	**% Gravel**	**0**	**Figure :**	**32**
Sample Description :		**Fat Clay (CH)**							

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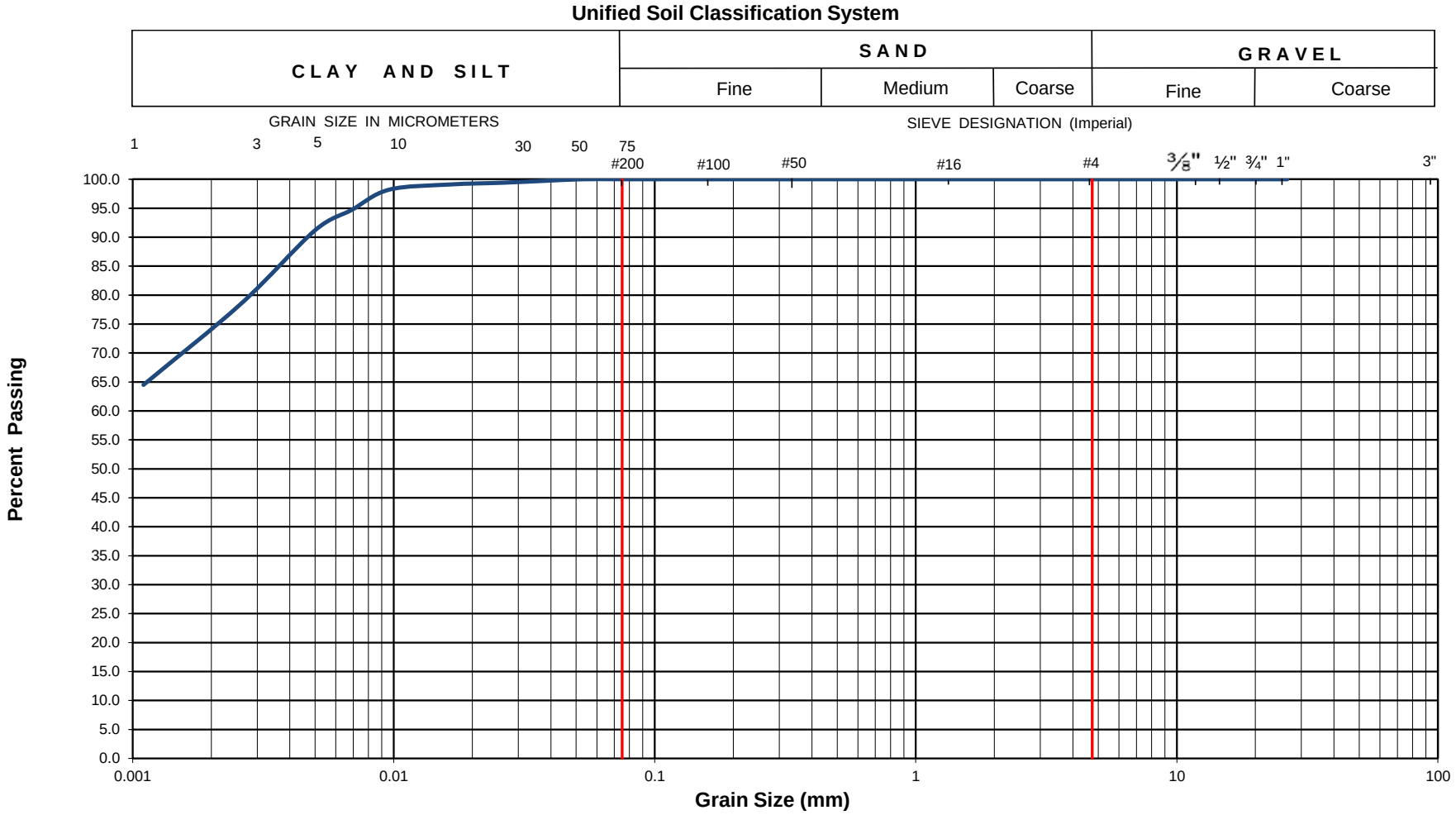
Grain-Size Distribution Curve
Method of Test For Particle Size Analysis of Soil
ASTM C-136/ASTM D422



EXP Project No.:	**OTT-223012778-E0**	**Project Name :**	**Geotechinal Investigation. East Urban Centre Elementary School**						
Client :	**Ottawa Carleton District School Board**	**Project Location :**	**700 Spring Valley Drive, Ottawa, ON**						
Date Sampled :	**May 28, 2024**	**Borehole No:**	**24-01**	**Sample No.:**	**SS9**	**Depth (m) :**	**7.6 - 8.2**		
Sample Description :		**% Silt and Clay**	**100**	**% Sand**	**0**	**% Gravel**	**0**	**Figure :**	**33**
Sample Description :		**Silty Clay (CL-ML)**							

EXP Services Inc.
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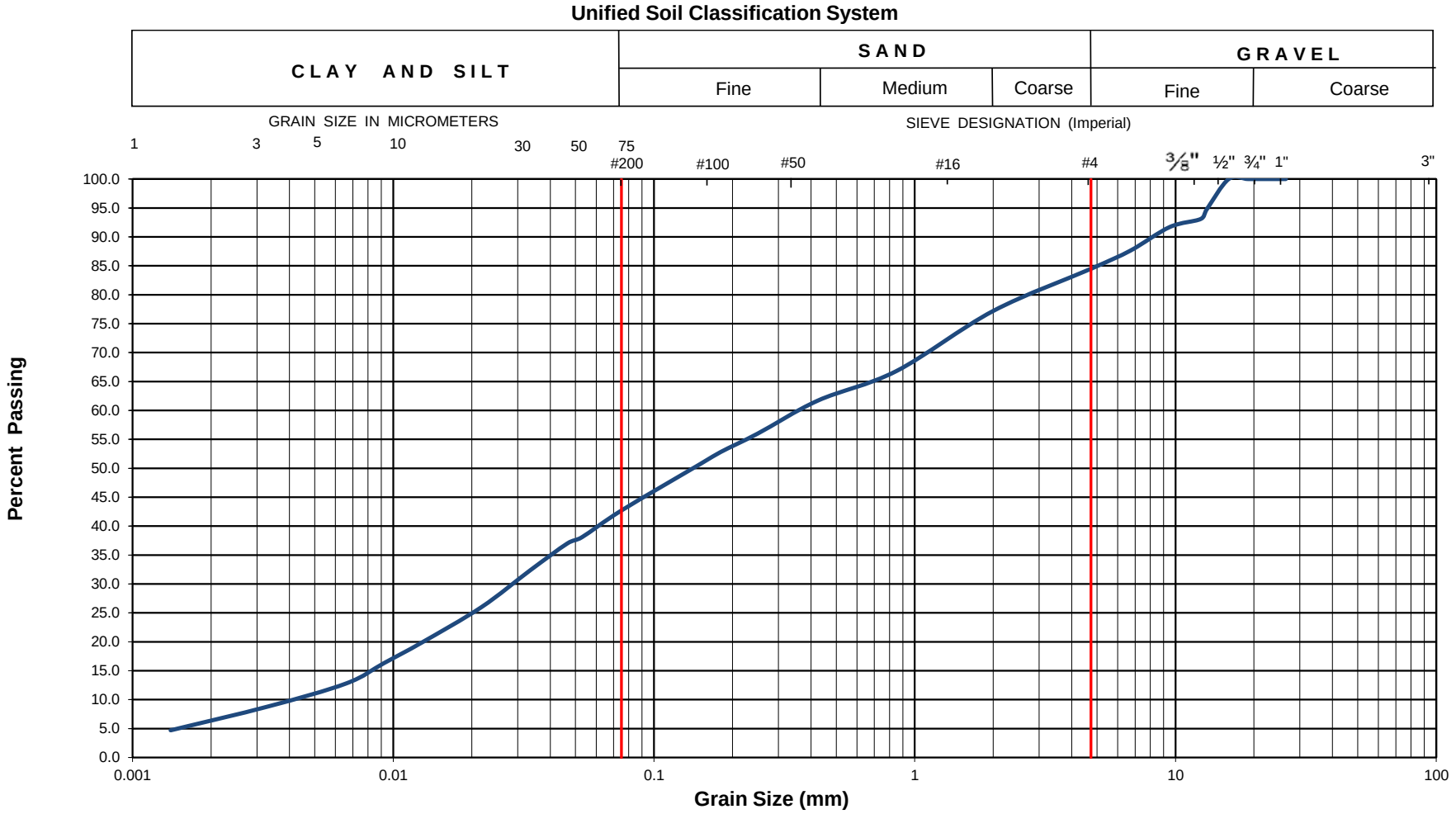
Ottawa, ON K2B 8H6

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



EXP Project No.:	**OTT-223012778-E0**		**Project Name :**	**Geotechinal Investigation. East Urban Centre Elementary School**					
Client :	**Ottawa Carleton District School Board**		**Project Location :**	**700 Spring Valley Drive, Ottawa, ON**					
Date Sampled :	**May 28, 2024**		**Borehole No:**	**24-01**		**Sample No.:**	**SS13**	**Depth (m) :**	**18.3 - 18.9**
Sample Description :			**% Silt and Clay**	**42.7**	**% Sand**	**41.8**	**% Gravel**	**15.5**	**Figure :** **34**
Sample Description :			**Silty Sand, some Gravel (SM)**						

Appendix A: Borehole Logs and Grain Size Analyses of 2019 Geotechnical Investigation

Log of Borehole BH-1

Project No: OTT-00245378-G0

Project: Preliminary Geotechnical Investigation - Proposed Spring Valley Trails Elementary

Location: School. Spring Valley Drive and Joshua Street, City of Ottawa, Ontario

Figure No. 3

Page. 1 of 1

Date Drilled: 'February 12, 2019

Drill Type: CME-55

Datum: Geodetic

Logged by: AN Checked by: SKA

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 Organic silt mixed with clayey sand and topsoil, wet (very loose)	71.9	0				
			70.4	1	3			
▼		**SILTY CLAY CRUST** Brownish grey, moist to very moist (very stiff)	69.97	2	8 ○ 144 ▲			19.5
			68.9	3	1 ○ 160 + s=4.6			
		SILTY CLAY Grey, wet (firm to stiff))		4	1 ○ 48 + s=10			
				5	HW ○ 82 + s-17			
				6	72 + s-20 Push ○			
				7	77 + s=10.7			
			63.7	8	HW ○ 82 + s=17			
		Borehole Terminated at 8.2 m Depth						

LOG OF BOREHOLE BH LOGS - 245378-E0.GPJ TROW OTTAWA.GDT 3/1/19

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. 19 mm standpipe piezometer installed upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00245378-G0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	3.0	7.6
Feb 27, 2019	1.9	

CORE DRILLING RECORD

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

Log of Borehole BH-2

Project No: OTT-00245378-G0

Project: Preliminary Geotechnical Investigation - Proposed Spring Valley Trails Elementary

Location: School. Spring Valley Drive and Joshua Street, City of Ottawa, Ontario

Figure No. 4

Page. 1 of 2

Date Drilled: 'February 12 to 14, 2019

Drill Type: CME-55

Datum: Geodetic

Logged by: AN Checked by: SKA

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		FILL Silty sand mixed with some silty clay, some roots, brownish grey, moist to very moist (loose)	72	0				
			71.21	1	4			
				2	10			
		SILTY CLAY CRUST Brown, moist (very stiff)	69.7	2	5 / 144 / 120			17.9
		SILTY CLAY Grey to dark grey, wet (stiff)	68.4	3	/HW / 67 / s=9.3			
				4	/HW / 62 / s=13			
				5	/HW / 58 / s=20			
				6	/HW / 67 / s=18.7			
				7				
			63.8	8	/HW / 72 / s=30		88	
		INFERRED SILTY CLAY Drove Dynamic Cone from 8.2 to Refusal at 22.1 m depth		9				
				10				
				11				
				12				
				13				
				14				

Continued Next Page

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. 19 mm standpipe piezometer installed upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00245378-G0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	3.0	7.6
Feb 27, 2019	0.8	

CORE DRILLING RECORD

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

LOG OF BOREHOLE BH LOGS - 245378-E0.GPJ TROW OTTAWA.GDT 3/1/19

Log of Borehole BH-2

Project No: OTT-00245378-G0

Project: Preliminary Geotechnical Investigation - Proposed Spring Valley Trails Elementary

Figure No. 4

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
		INFERRED SILTY CLAY Drove Dynamic Cone from 8.2 to Refusal at 22.1 m depth *(continued)*	58	14	20 40 60 80 50 100 150 200	250 500 750 20 40 60		
				15				
				16				
				17				
				18				
			53.1	19				
		INFERRED GLACIAL TILL		20				
				21				
			49.9	22				
		Borehole Terminated at 22.1 m Depth						

LOG OF BOREHOLE BH LOGS - 245378-E0.GPJ TROW OTTAWA.GDT 3/1/19

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. 19 mm standpipe piezometer installed upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00245378-G0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	3.0	7.6
Feb 27, 2019	0.8	

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

Log of Borehole BH-3

Project No: OTT-00245378-G0

Project: Preliminary Geotechnical Investigation - Proposed Spring Valley Trails Elementary

Location: School. Spring Valley Drive and Joshua Street, City of Ottawa, Ontario

Figure No. 5

Page. 1 of 2

Date Drilled: 'February 14, 2019

Drill Type: CME-55

Datum: Geodetic

Logged by: AN Checked by: SKA

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 Clayey silty sand with gravel, some topsoil, brown, moist to very moist (loose)	72.62	0	4			
				1	8			
		SILTY CLAY CRUST brown, moist (very stiff to stiff)	70.3	2	10	196		18.9
				3	3	96		18.5
		SILTY CLAY Grey to dark grey, very moist to wet (firm to stiff)	68.8		77 s=10.7			
					1/HW			
					48 s=20			
				5	1/HW			
					43 s=18			
				6	1/HW			
				7	67 s=28			
					1/HW			
				8	82 s=11.3			
				9	Push			
				10	67 s=9.3			
					1/HW			
				11	82			
				12	1/HW			
				13	70			
				14	1/HW			

Continued Next Page

NOTES:
1. Borehole/Test Pit 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. This Figure is to read with exp. Services Inc. report OTT-00245378-G0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	1.2	26.9

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	23.9 - 25.4	98	20
2	25.4 - 26.9	95	32

LOG OF BOREHOLE BH LOGS - 245378-E0.GPJ TROW OTTAWA.GDT 3/1/19

Log of Borehole BH-3

Project No: OTT-00245378-G0

Project: Preliminary Geotechnical Investigation - Proposed Spring Valley Trails Elementary

Figure No. 5

SOIL DESCRIPTION	Geodetic Elevation m	Depth
SILTY CLAY Grey to dark grey, very moist to wet (firm to stiff) *(continued)*	58.62	14
		15
		16
	55.8	17
SANDY GRAVEL Till Some cobbles and boulders, shale fragments, grey, moist (compact to very dense)		18
		19
		20
		21
		22
		23
		24
		25
	46.3	26
SHALE BEDROCK Billings formation (black)	45.7	
Borehole Terminated at 26.9 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

1/HW

60

1/HW

82

23

51

97/200mm

SAMPLES: Run 1, Run 2

Natural Unit Wt. kN/m³

NOTES:
1. Borehole/Test Pit 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. This Figure is to read with exp. Services Inc. report OTT-00245378-G0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	1.2	26.9

CORE DRILLING RECORD

Run No.	Depth (m)	% Rec.	RQD %
1	23.9 - 25.4	98	20
2	25.4 - 26.9	95	32

LOG OF BOREHOLE BH LOGS - 245378-E0.GPJ TROW OTTAWA.GDT 3/1/19

Log of Borehole BH-4

Project No: OTT-00245378-G0

Project: Preliminary Geotechnical Investigation - Proposed Spring Valley Trails Elementary

Location: School. Spring Valley Drive and Joshua Street, City of Ottawa, Ontario

Figure No. 6

Page. 1 of 2

Date Drilled: 'February 19, 2019

Drill Type: CME-55

Datum: Geodetic

Logged by: AN Checked by: SKA

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		FILL silty sand and silty clay mixed with topsoil, organics, etc, dark grey, moist (loose)	73.4	0
			72.34	1
			71.8	
		TOPSOIL ~200 mm	71.6	
		SILTY CLAY CRUST Brown, moist (stiff)		2
			70.4	
		SILTY CLAY Grey to dark grey, very moist to wet (firm to stiff)		3
				4
				5
				6
				7
				8
			65.2	
		INFERRED SILTY CLAY Drove Dynamic Cone from 8.2 to Refusal at 22.8 m depth		9
				10
				11
				12
				13
				14

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

6 | 7 | 192 | 7 | 120 | 1/HW | 48 +S s=10 | 1/HW | 58 +S s=24 | 1/HW | 72 +S s-15 | 1/HW | 67 +S s=14

Continued Next Page

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. 19 mm standpipe piezometer installed upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00245378-G0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	2.7	6.0
Feb 27, 2019	1.1	

CORE DRILLING RECORD

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

LOG OF BOREHOLE BH LOGS - 245378-E0.GPJ TROW OTTAWA.GDT 3/1/19

Log of Borehole BH-4

Project No: OTT-00245378-G0

Project: Preliminary Geotechnical Investigation - Proposed Spring Valley Trails Elementary

Figure No. 6

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth
		INFERRED SILTY CLAY Drove Dynamic Cone from 8.2 to Refusal at 22.8 m depth *(continued)*	59.4	14
				15
				16
				17
				18
			54.5	19
		INFERRED GLACIAL TILL		20
				21
				22
			50.6	
		Borehole Terminated at 22.8 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/m^3

LOG OF BOREHOLE BH LOGS - 245378-E0.GPJ TROW OTTAWA.GDT 3/1/19

NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
2. 19 mm standpipe piezometer installed upon completion.
3. Field work supervised by an EXP representative.
4. See Notes on Sample Descriptions
5. This Figure is to read with exp. Services Inc. report OTT-00245378-G0

WATER LEVEL RECORDS

Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	2.7	6.0
Feb 27, 2019	1.1	

CORE DRILLING RECORD

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

Log of Borehole BH-5

Project No: OTT-00245378-G0

Project: Preliminary Geotechnical Investigation - Proposed Spring Valley Trails Elementary

Location: School. Spring Valley Drive and Joshua Street, City of Ottawa, Ontario

Figure No. 7

Page. 1 of 1

Date Drilled: 'February 19, 2019

Drill Type: CME-55

Datum: Geodetic

Logged by: AN Checked by: SKA

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

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

GWL	SYMBOL	SOIL DESCRIPTION	Geodetic Elevation m	Depth	Standard Penetration Test N Value / Shear Strength kPa	Combustible Vapour Reading (ppm) / Natural Moisture Content % / Atterberg Limits (% Dry Weight)	SAMPLES	Natural Unit Wt. kN/m³
		FILL Silty sand mixed with silty clay, some organics, grey, wet (loose)	73.76	0				
				1	5			19.3
				2	5			18.6
		SILTY CLAY CRUST Brown to broewnish grey, moist to very moist (very stiff to stiff)	71.7	3	9; 192			
				4	1/HW; 82, s=8.5			
		SILTY CLAY dark grey, wet (stiff)	70.0	5	1/HW; 67, s=28			
				6	1/HW; 58, s=12; 77, s=32			
				7				
				8	1/HW; 82, s=34			
		Borehole Terminated at 8.2 m Depth	65.6					

LOG OF BOREHOLE BH LOGS - 245378-E0.GPJ TROW OTTAWA.GDT 3/1/19

NOTES:
1. Borehole/Test Pit 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. This Figure is to read with exp. Services Inc. report OTT-00245378-G0

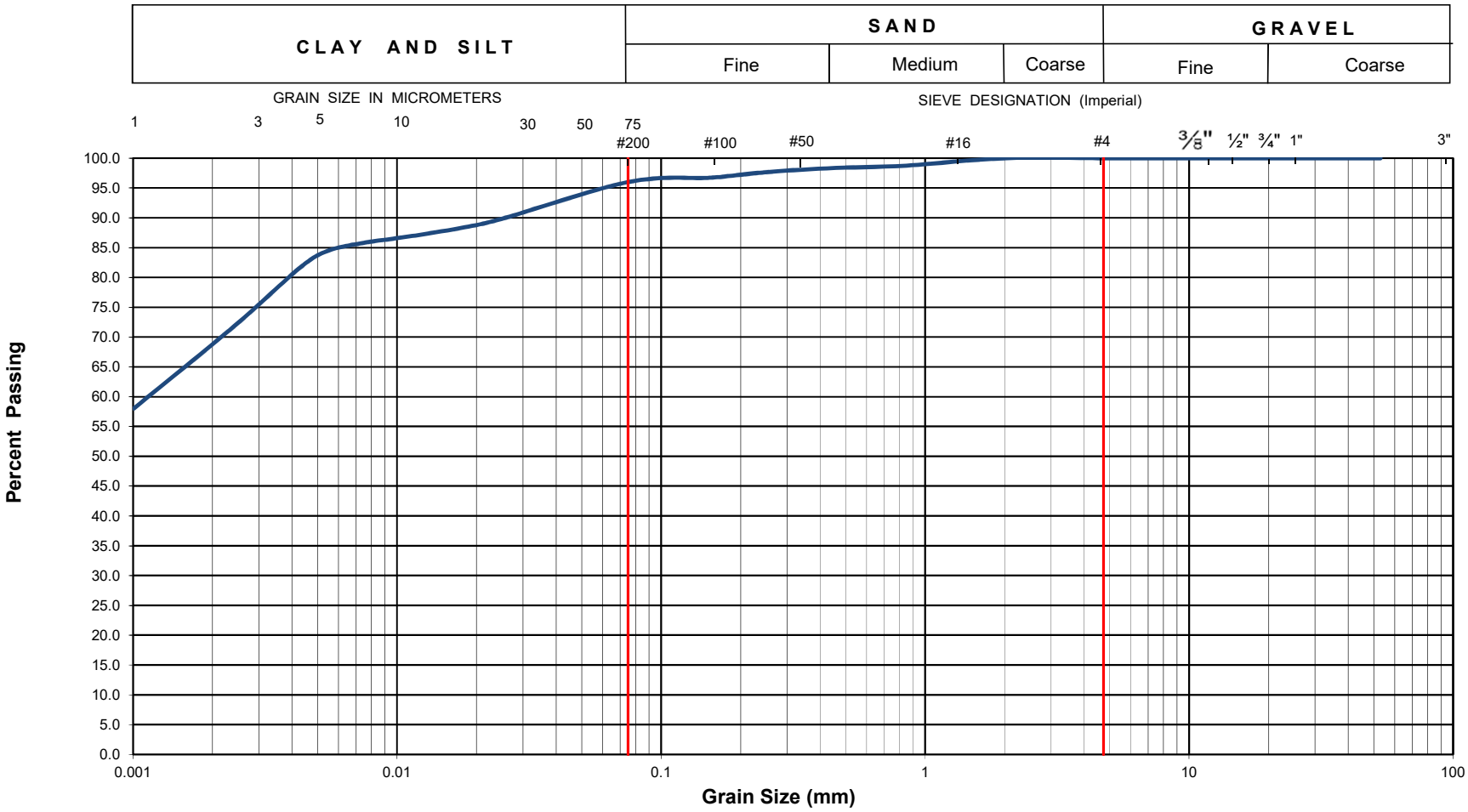
WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
Completion	2.4	7.6

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

Unified Soil Classification System

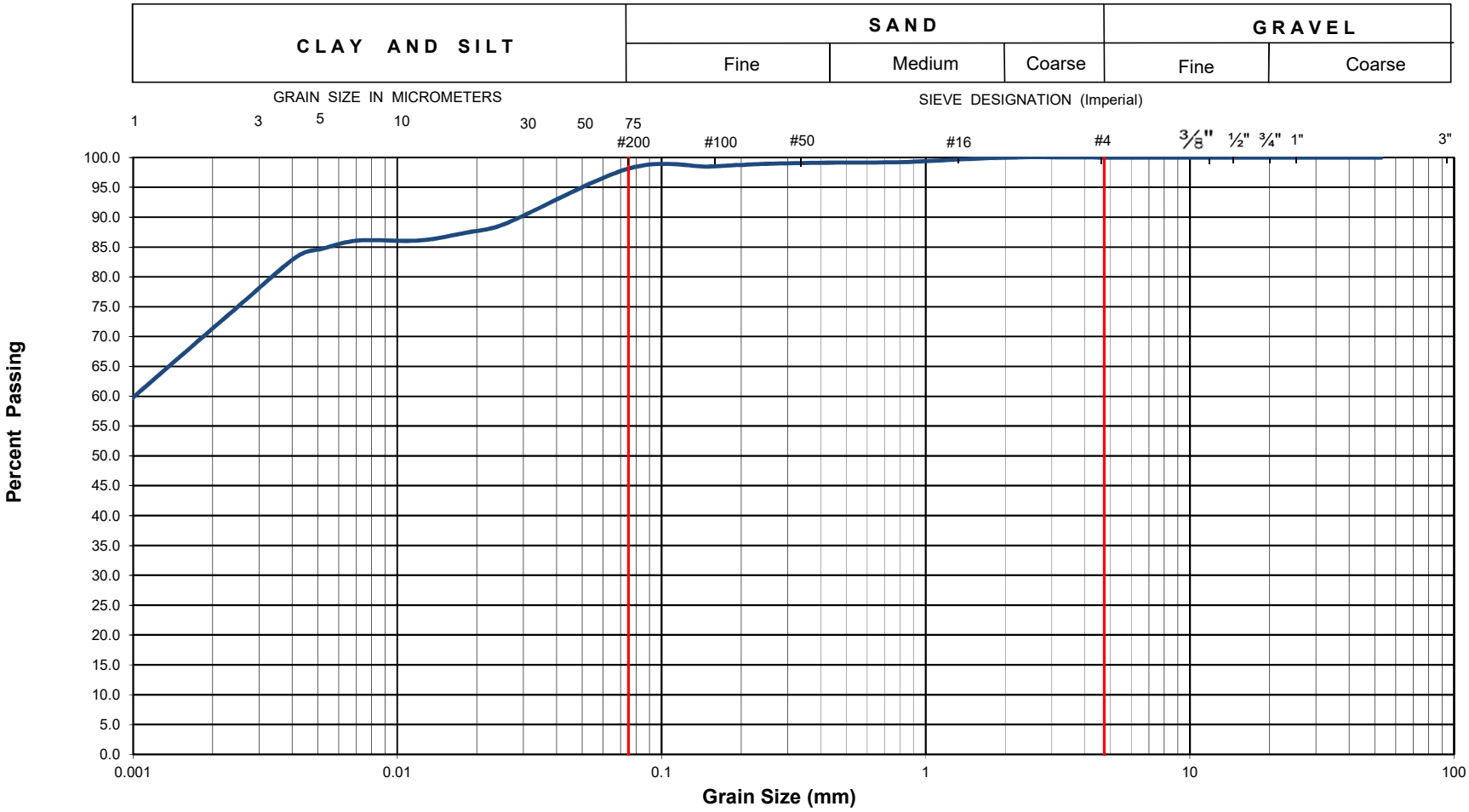


EXP Project No.:	**OTT-00245378-G0**	**Project Name :**	**Prelim. Geotech. Investigation. Spring Valley Trails Elementary School**						
Client :	**OCDSB SOA #18-007**	**Project Location :**	**Joshua Street & Spring Valley Drive, Ottawa, ON**						
Date Sampled :	**February 14, 2019**	**Borehole No:**	**3**		**Sample No.:**	**SS4**		**Depth (m) :**	**2.3 - 2.9**
Sample Description :		**% Silt and Clay**	**96**	**% Sand**	**4**	**% Gravel**	**0**	**Figure :**	**8**
Sample Description :		**Silty Clay (CH)**							

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

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

Unified Soil Classification System

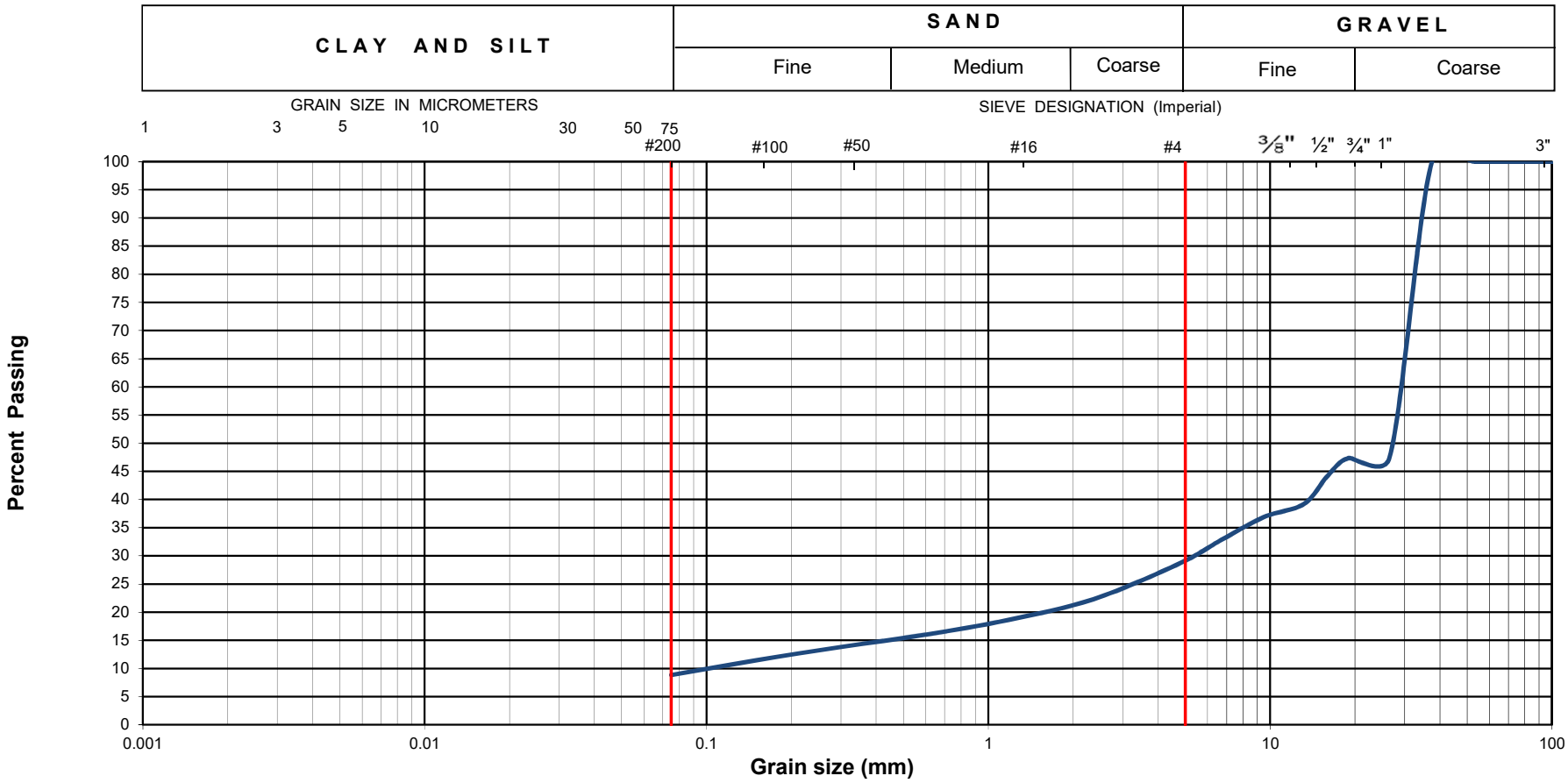


EXP Project No.:	**OTT-00245378-G0**	**Project Name :**	**Prelim. Geotech. Investigation. Spring Valley Trails Elementary School**						
Client :	**OCDSB SOA #18-007**	**Project Location :**	**Joshua Street & Spring Valley Drive, Ottawa, ON**						
Date Sampled :	**February 14, 2019**	**Borehole No:**	**3**		**Sample No.:**	**SS6**		**Depth (m) :**	**3.8-4.3**
Sample Description :		**% Silt and Clay**	**98**	**% Sand**	**2**	**% Gravel**	**0**	**Figure :**	**9**
Sample Description :		**Silty Clay (CH)**							

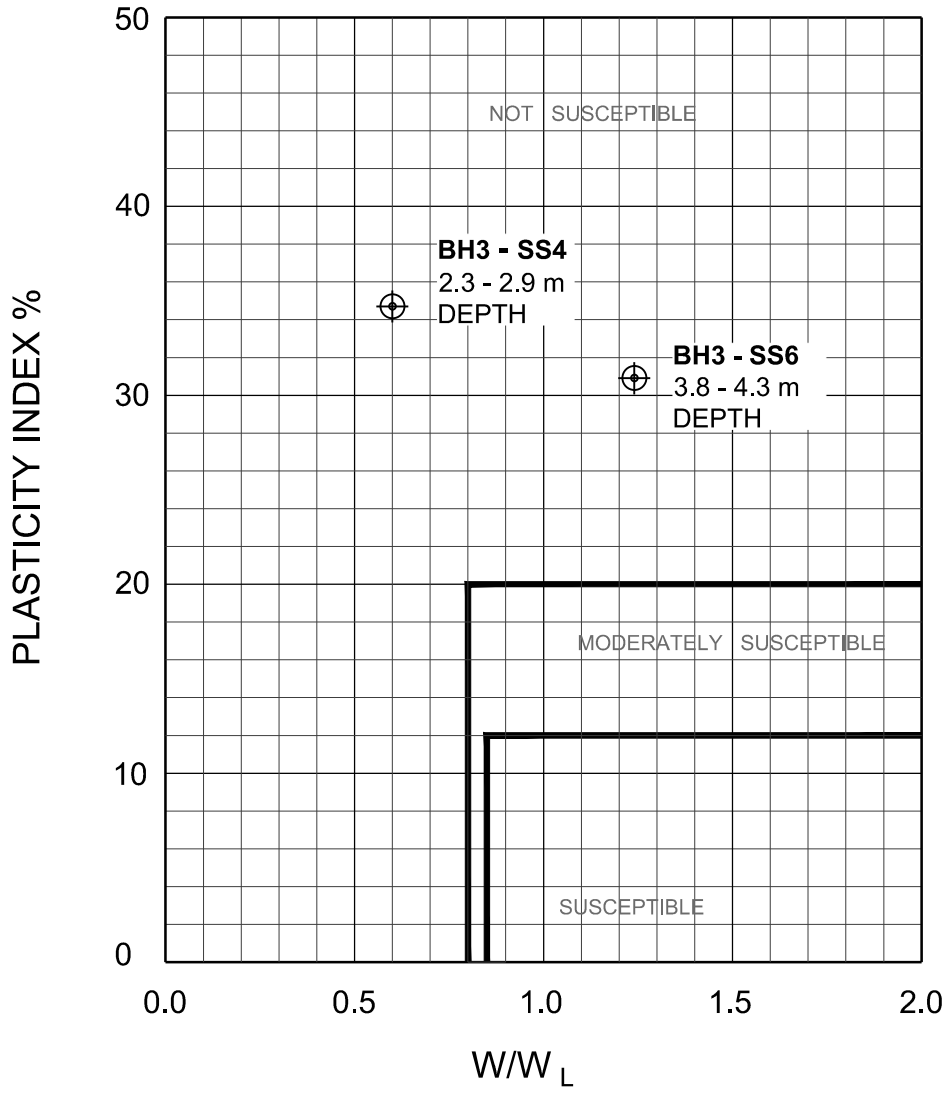
EXP Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6

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

Unified Soil Classification System



EXP Project No.:	**OTT-00245378-G0**	**Project Name :**	**Prelim. Geotech. Investigation. Spring Valley Trails Elementary School**					
Client :	**OCDSB**	**Project Location :**	**Joshua St & Spring Valley Dr**					
Date Sampled :	**February 15, 2019**	**Borehole No:**	**BH3**	**Sample:**	**SS15**		**Depth (m) :**	**17.2-17.8**
Sample Composition :		**Gravel (%)**	**71**	**Sand (%)**	**20**	**Silt & Clay (%)**	**9**	**Figure :** **10**
Sample Description :		**Poorly Graded Gravel, some Sand (GP)**						



BRAY ET AL. (2004) CRITERIA FOR LIQUEFACTION ASSESSMENT OF FINE-GRAINED SOILS

LEGEND

⊕ **BH3 - SS4**	BOREHOLE AND SAMPLE NO.
2.3 - 2.9 m	SAMPLE DEPTH (m)

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

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scale N.T.S.	CLIENT:	OCDSB	project no. OTT-00245378-G0
date FEB. 2019	TITLE:	LIQUEFACTION ASSESSMENT CHART PROPOSED SPRINGFIELD TRAILS ELEMENTARY SCHOOL	FIG 11
drawn by M.N.			

Filename: p:\projects\geotechnical\240000\245000\245378 g0 - geo investigation spring hill school osdsb\k - drawings\fig 11 liquefaction assessment.dwg
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Appendix B: One Dimensional Oedometer (Consolidation) Test Results

Stantec Consulting Ltd.
300 - 1331 Clyde Avenue, Ottawa ON K2C 3G4

June 27, 2024
File: 121624678

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: East Urban School-700 Spring Valley, Ottawa, ON. Exp Services Inc., File # OTT-0023012778-E0

This letter presents the results of one-dimensional consolidation tests carried out on three shelby tube samples in accordance with ASTM D2435/D2435M – 11(2020). The tests result is provided in the attached tables and figures.

Summary of the tested samples

Sample ID	Depth (ft)	Date sampled
BH24-3, SH5	10-12	May 27, 2024
BH24-8, SH8	20-22	May 29, 2024
BH24-8, SH10	30-32	May 29, 2024

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.

Ramin Ghassemi

Ramin Ghassemi Ph.D., P.Eng.
Geotechnical Engineer
Direct: 613 722-4420
Mobile: 437 775-7625
Ramin.ghassemi@stantec.com

CONSOLIDATION TEST SUMMARY

SAMPLE IDENTIFICATION

Borehole No. :	BH24-3	Sample No. :	SH5
		Sample Depth (ft) :	10-12

TEST CONDITIONS

Test Type :	ASTM D2435/D2435M	Date Started :	4-Jun-19
Load Duration (hr) :	24	Date Completed :	19-Jun-24

SAMPLE DIMENSIONS AND PROPERTIES _ INITIAL

Sample Height (mm) :	20.00	Unit Weight (kN/m^3) :	16.44
Sample Diameter (mm) :	50.00	Dry Unit Weight (kN/m^3) :	10.44
Area (cm^2) :	19.63	Specific Gravity : (Assumed)	2.750
Volume (cm^3) :	39.27	Solid Height (mm) :	7.75
Water Content (%) :	57.39	Volume of Solids (cm^3) :	15.21
Wet Mass (g) :	65.82	Volume of Voids (cm^3) :	24.06
Dry Mass (g) :	41.82	Degree of Saturation (%) :	99.74

TEST COMPUTATIONS

Axial Stress (kPa)	Height (H) (mm)	Corrected Deformation (ΔH) (mm)	Axial Strain (ε_a) (%)	Void Ratio e	t_{90} (min)	C_v (cm^2/s)	m_v (m^2/kN)	k (cm/s)
0	20.0000	0.0000	0.00	1.582				
5	19.9421	0.0579	0.29	1.575	2.92	4.81E-01	5.79E-04	2.73E-09
10	19.9087	0.0913	0.46	1.571	2.30	6.09E-01	3.34E-04	2.00E-09
20	19.8092	0.1908	0.95	1.558	4.06	3.43E-01	4.97E-04	1.68E-09
40	19.6510	0.3490	1.75	1.537	3.22	4.28E-01	3.96E-04	1.66E-09
80	19.3838	0.6162	3.08	1.503	2.67	5.06E-01	3.34E-04	1.66E-09
160	18.9286	1.0714	5.36	1.444	6.95	1.87E-01	2.85E-04	5.23E-10
320	17.9830	2.0170	10.09	1.322	13.09	9.28E-02	2.96E-04	2.69E-10
480	16.9540	3.0460	15.23	1.189	35.64	3.06E-02	3.22E-04	9.66E-11
160	17.1783	2.8217	14.11	1.218				
40	17.6303	2.3697	11.85	1.276				
160	17.3613	2.6387	13.19	1.242	7.03	1.54E-01	1.12E-04	1.70E-10
480	16.6752	3.3248	16.62	1.153	6.49	1.59E-01	1.07E-04	1.67E-10
720	15.8379	4.1621	20.81	1.045	31.97	2.96E-02	1.74E-04	5.07E-11
960	15.2501	4.7499	23.75	0.969	40.12	2.15E-02	1.22E-04	2.58E-11
1920	13.8244	6.1756	30.88	0.785	14.55	5.18E-02	7.43E-05	3.77E-11

SAMPLE DIMENSIONS AND PROPERTIES _ FINAL

Sample Height (mm) :	13.82	Unit Weight (kN/m^3) :	20.24
Sample Diameter (mm) :	50.00	Dry Unit Weight (kN/m^3) :	15.11
Area (cm^2) :	19.63	Specific Gravity (Assumed) :	2.750
Volume (cm^3) :	27.14	Solid Height (mm) :	7.75
Water Content (%) :	33.93	Volume of Solids (cm^3) :	15.21
Wet Mass (g) :	56.01	Volume of Voids (cm^3) :	11.94
Dry Mass (g) :	41.82		

Project No. :	121624678	Prepared By :	DB
Date :	27-Jun-24	Checked By :	RG

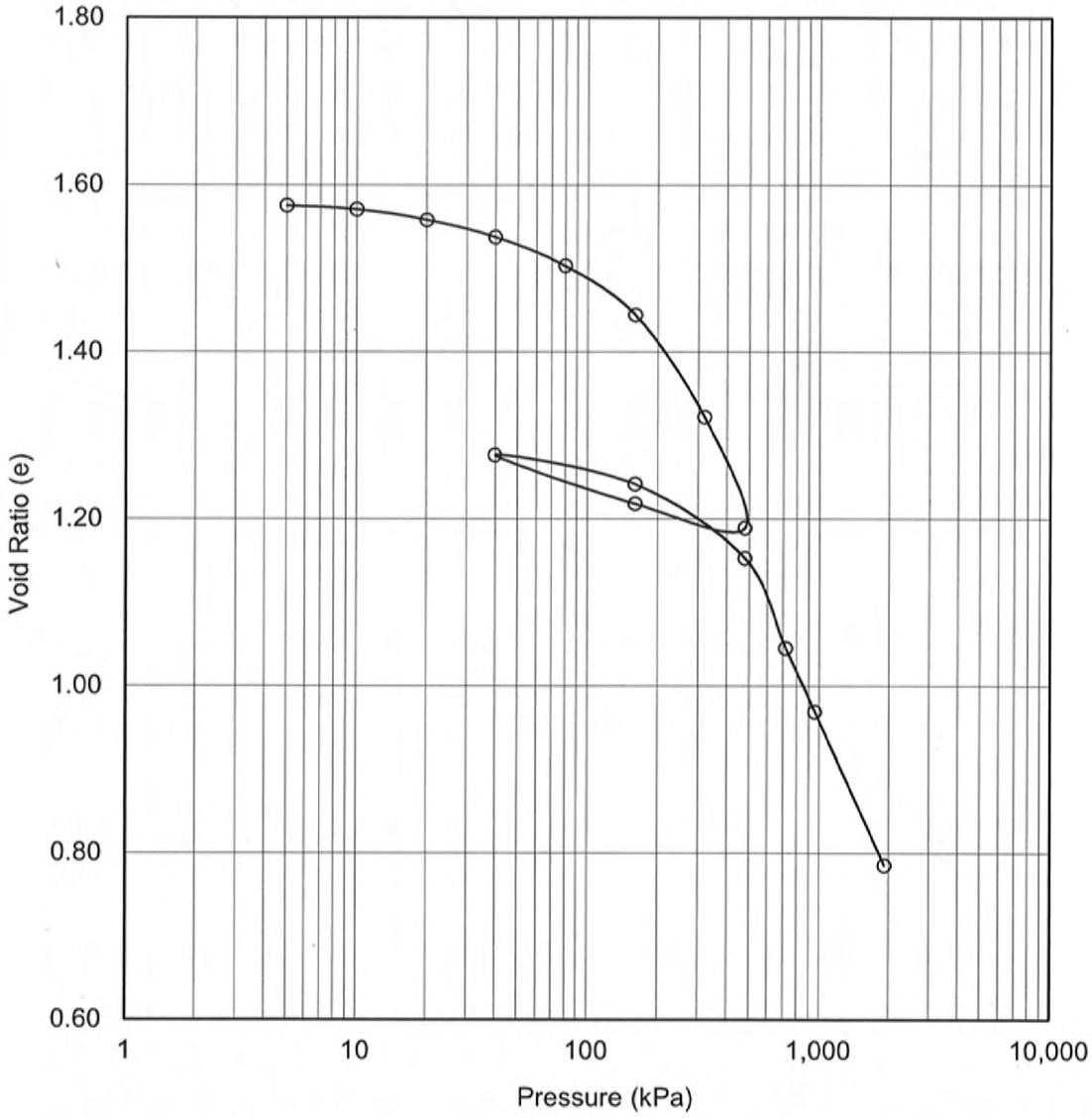
Stantec

CONSOLIDATION TEST	FIGURE 1

East Urban School, Exp File# OTT-0023012778-E0

BH 24-3, SH5

Void Ratio vs Pressure



Soil Type : *Fat clay, firm to stiff, grey, friable, wet - CH*

e_o =	1.582	w_L =	62.9%	σ_{v0}' =	kPa
w =	57.4%	w_P =	24.7%	σ_P' =	kPa
γ =	16.4 kN/m^3	PI =	38.2%		
Gs =	2.750				

Project No. : 121624678
Date : 27-Jun-24

Stantec

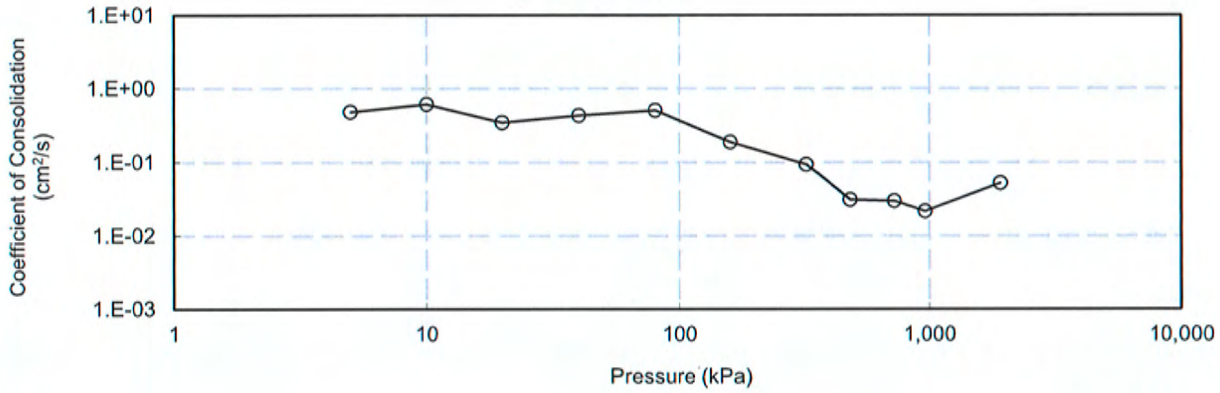
Prepared By : DB
Checked By : RG

CONSOLIDATION TEST	FIGURES 2, 3 & 4

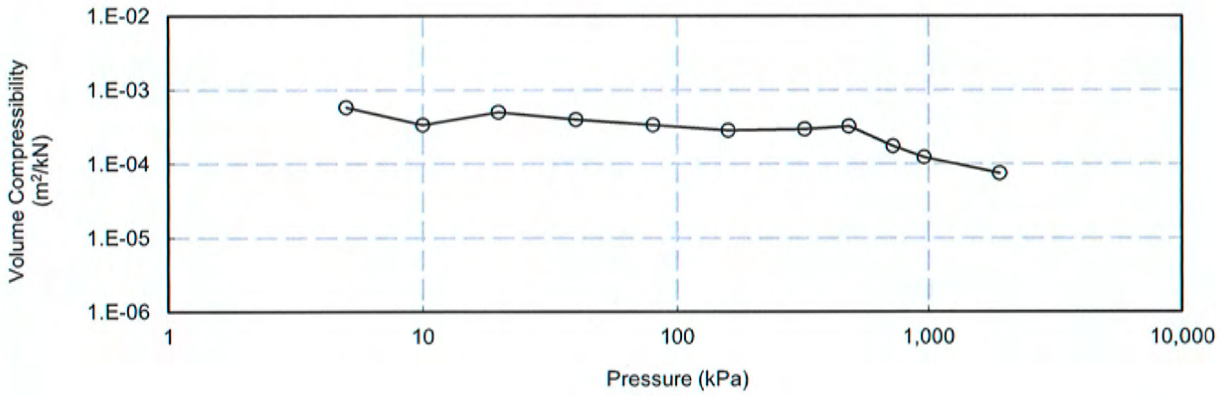
East Urban School, Exp File# OTT-0023012778-E0

BH 24-3, SH5

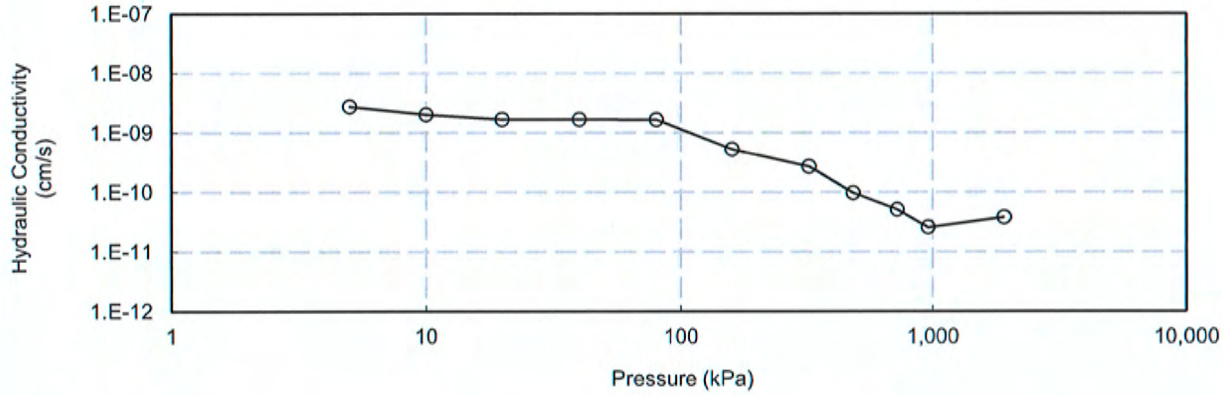
Cv vs Pressure



mv vs Pressure



k vs Pressure



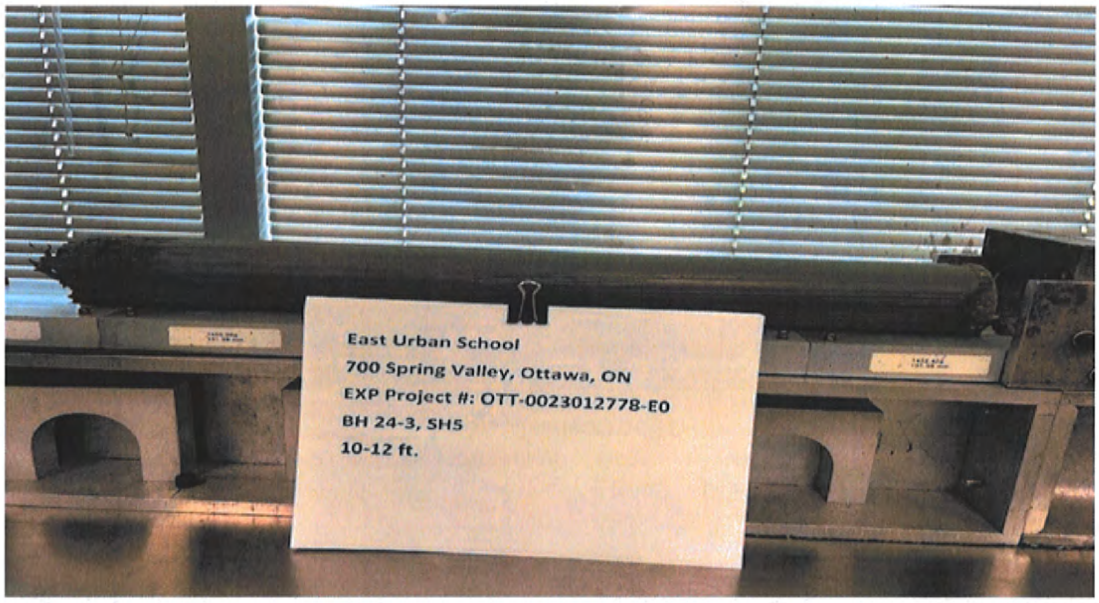
Project No. : 121624678
Date : 27-Jun-24

Stantec

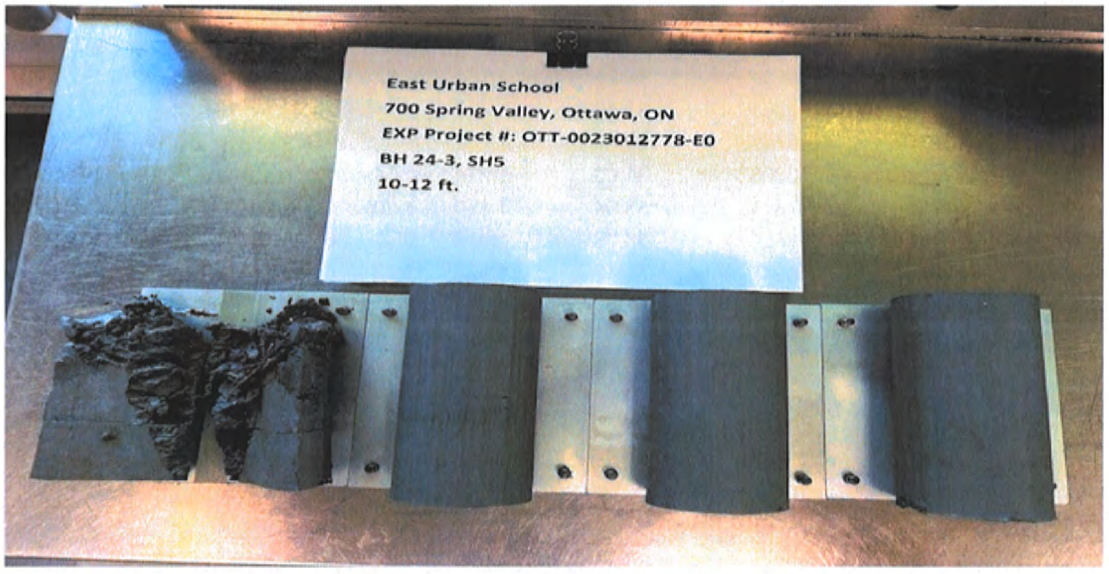
Prepared By : DB
Checked By : RG

East Urban School, Exp File# OTT-0023012778-E0

Fat clay, firm to stiff, grey, friable, wet - CH



BH 24-3, SH5



BH 24-3, SH5

CONSOLIDATION TEST SUMMARY

SAMPLE IDENTIFICATION

Borehole No. :	BH24-8	Sample No. :	SH8
		Sample Depth (ft) :	20-22

TEST CONDITIONS

Test Type :	ASTM D2435/D2435M	Date Started :	4-Jun-19
Load Duration (hr) :	24	Date Completed :	19-Jun-24

SAMPLE DIMENSIONS AND PROPERTIES _ INITIAL

Sample Height (mm) :	20.00	Unit Weight (kN/m^3) :	15.12
Sample Diameter (mm) :	50.00	Dry Unit Weight (kN/m^3) :	8.37
Area (cm^2) :	19.63	Specific Gravity : (Assumed)	2.750
Volume (cm^3) :	39.27	Solid Height (mm) :	6.20
Water Content (%) :	80.72	Volume of Solids (cm^3) :	12.18
Wet Mass (g) :	60.54	Volume of Voids (cm^3) :	27.09
Dry Mass (g) :	33.50	Degree of Saturation (%) :	99.82

TEST COMPUTATIONS

Axial Stress (kPa)	Height (H) (mm)	Corrected Deformation (ΔH) (mm)	Axial Strain (ε_a) (%)	Void Ratio e	t_{90} (min)	C_v (cm^2/s)	m_v (m^2/kN)	k (cm/s)
0	20.0000	0.0000	0.00	2.224				
5	19.8968	0.1032	0.52	2.207	1.22	1.15E+00	1.03E-03	1.16E-08
10	19.6864	0.3136	1.57	2.173	4.03	3.42E-01	2.10E-03	7.07E-09
20	19.5102	0.4898	2.45	2.145	2.19	6.19E-01	8.81E-04	5.35E-09
40	19.2759	0.7241	3.62	2.107	1.83	7.26E-01	5.86E-04	4.17E-09
80	18.9626	1.0374	5.19	2.056	2.08	6.23E-01	3.92E-04	2.40E-09
160	18.1549	1.8451	9.23	1.926	4.12	3.01E-01	5.05E-04	1.49E-09
320	14.7941	5.2059	26.03	1.385	25.15	4.04E-02	1.05E-03	4.16E-10
480	13.5499	6.4501	32.25	1.184	20.67	3.47E-02	3.89E-04	1.32E-10
160	13.6619	6.3381	31.69	1.202				
40	14.0251	5.9749	29.87	1.261				
160	13.7994	6.2006	31.00	1.224	4.54	1.51E-01	9.40E-05	1.39E-10
480	13.2121	6.7879	33.94	1.130	4.20	1.55E-01	9.18E-05	1.40E-10
720	12.6450	7.3550	36.78	1.038	9.42	6.38E-02	1.18E-04	7.40E-11
960	12.1755	7.8245	39.12	0.962	13.23	4.16E-02	9.78E-05	3.99E-11
1920	11.0681	8.9319	44.66	0.784	5.11	9.53E-02	5.77E-05	5.39E-11

SAMPLE DIMENSIONS AND PROPERTIES _ FINAL

Sample Height (mm) :	11.07	Unit Weight (kN/m^3) :	20.86
Sample Diameter (mm) :	50.00	Dry Unit Weight (kN/m^3) :	15.12
Area (cm^2) :	19.63	Specific Gravity (Assumed) :	2.750
Volume (cm^3) :	21.73	Solid Height (mm) :	6.20
Water Content (%) :	38.00	Volume of Solids (cm^3) :	12.18
Wet Mass (g) :	46.23	Volume of Voids (cm^3) :	9.55
Dry Mass (g) :	33.50		

Project No. :	121624678	Prepared By :	DB
Date :	27-Jun-24	Checked By :	RG

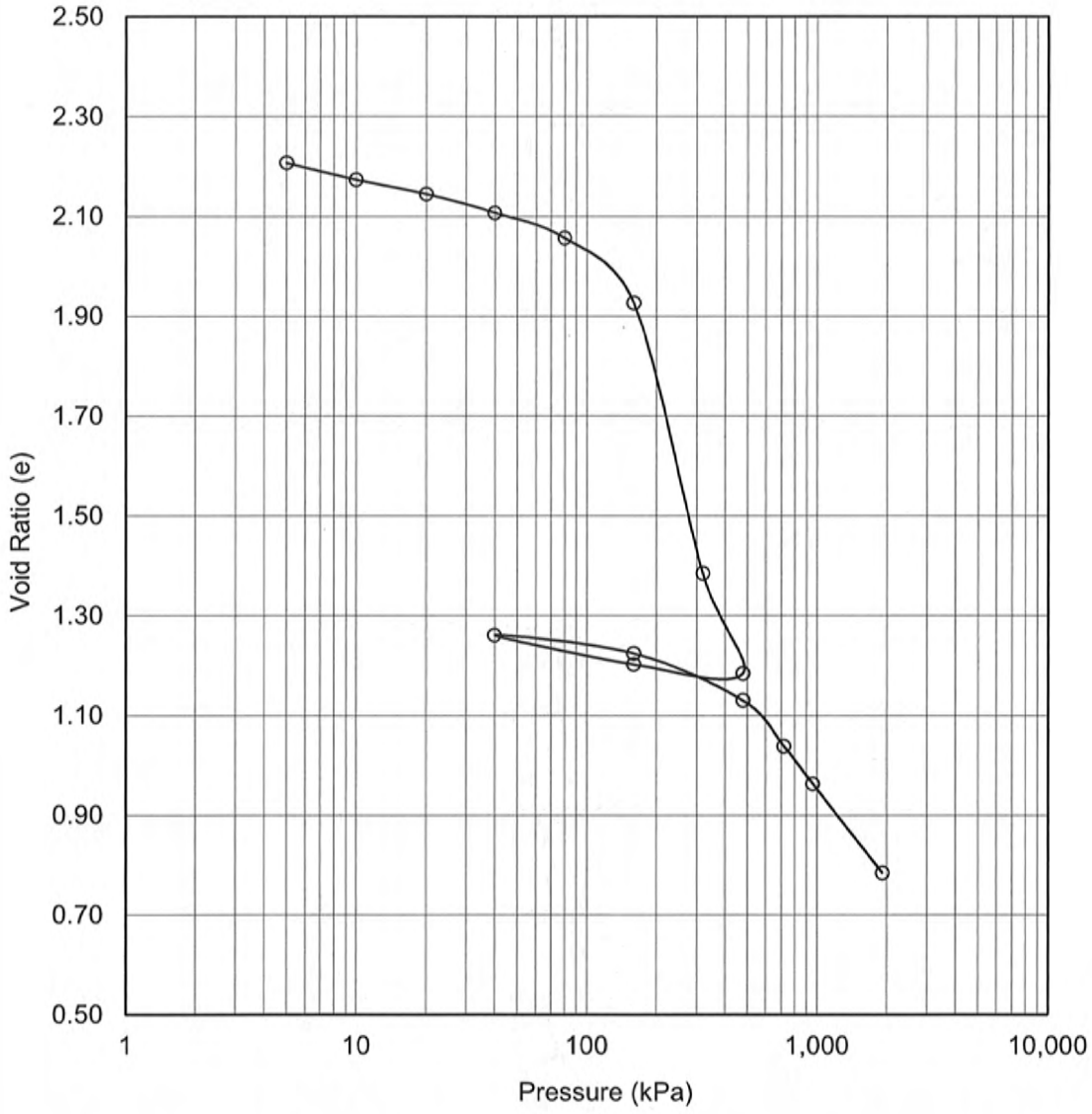
Stantec

CONSOLIDATION TEST	FIGURE 1

East Urban School, Exp File# OTT-0023012778-E0

BH 24-8, SH8

Void Ratio vs Pressure



Soil Type : *Fat clay, firm to stiff, grey, friable, wet - CH*

e_o =	2.224	w_L =	51.6%	σ_{v0}' =	kPa
w =	80.7%	w_P =	25.8%	σ_P' =	kPa
γ =	15.1 kN/m^3	PI =	25.8%		
Gs =	2.750				

Project No. : 121624678
Date : 27-Jun-24

Stantec

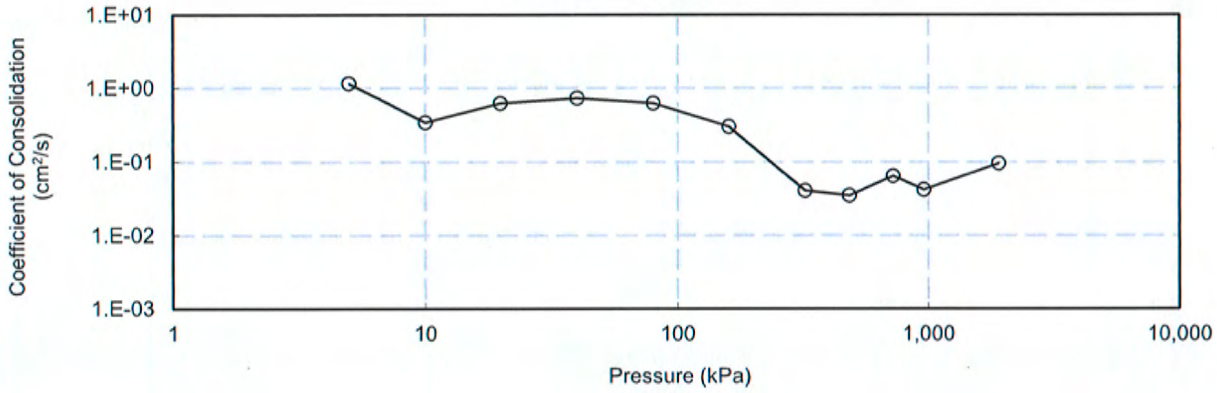
Prepared By : DB
Checked By : RG

CONSOLIDATION TEST	FIGURES 2, 3 & 4

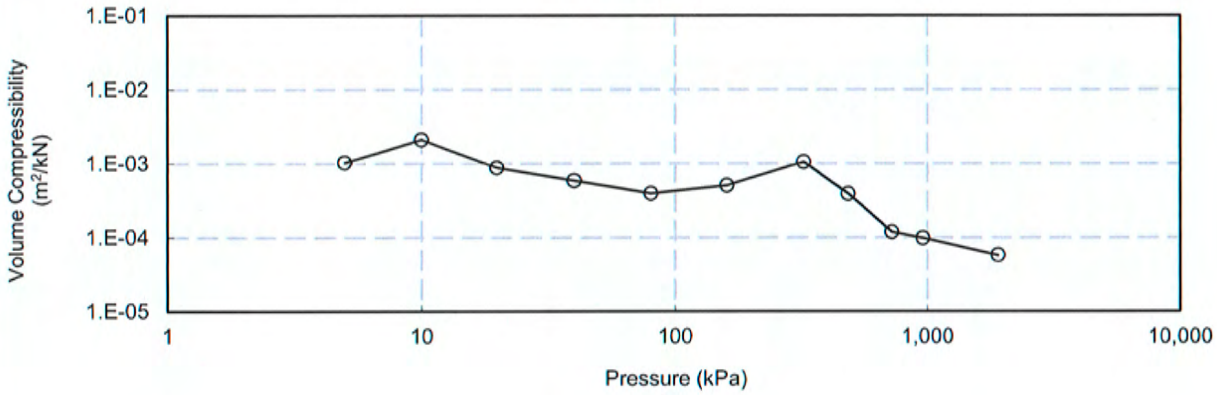
East Urban School, Exp File# OTT-0023012778-E0

BH 24-8, SH8

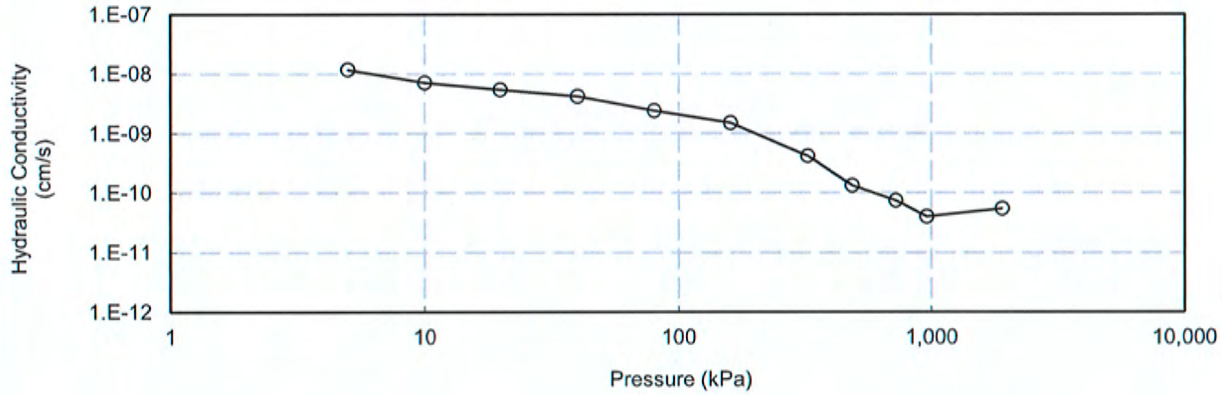
Cv vs Pressure



mv vs Pressure



k vs Pressure



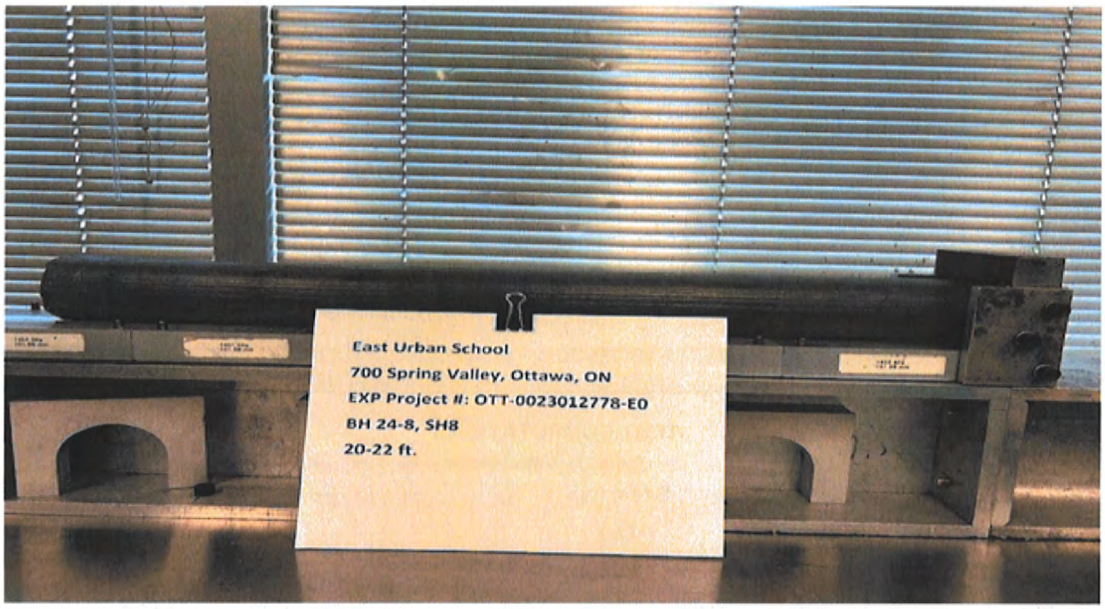
Project No. : 121624678
Date : 27-Jun-24

Stantec

Prepared By : DB
Checked By : RG

East Urban School, Exp File# OTT-0023012778-E0

Fat clay, firm to stiff, grey, friable, wet - CH



BH 24-8, SH8

CONSOLIDATION TEST SUMMARY

SAMPLE IDENTIFICATION

Borehole No. :	BH24-8	Sample No. :	SH10
		Sample Depth (ft) :	30-32

TEST CONDITIONS

Test Type :	ASTM D2435/D2435M	Date Started :	4-Jun-19
Load Duration (hr) :	24	Date Completed :	19-Jun-24

SAMPLE DIMENSIONS AND PROPERTIES _ INITIAL

Sample Height (mm) :	20.00	Unit Weight (kN/m^3) :	15.44
Sample Diameter (mm) :	50.00	Dry Unit Weight (kN/m^3) :	8.85
Area (cm^2) :	19.63	Specific Gravity : (Assumed)	2.750
Volume (cm^3) :	39.27	Solid Height (mm) :	6.56
Water Content (%) :	74.79	Volume of Solids (cm^3) :	12.88
Wet Mass (g) :	61.81	Volume of Voids (cm^3) :	26.39
Dry Mass (g) :	35.42	Degree of Saturation (%) :	100.00

TEST COMPUTATIONS

Axial Stress (kPa)	Height (H) (mm)	Corrected Deformation (ΔH) (mm)	Axial Strain (ε_a) (%)	Void Ratio e	t_{90} (min)	C_v (cm^2/s)	m_v (m^2/kN)	k (cm/s)
0	20.0000	0.0000	0.00	2.057				
5	19.9623	0.0377	0.19	2.043	3.15	4.48E-01	8.85E-04	3.89E-09
10	19.9276	0.0724	0.36	2.038	2.03	6.91E-01	3.46E-04	2.35E-09
20	19.8485	0.1515	0.76	2.026	2.59	5.41E-01	3.94E-04	2.09E-09
40	19.7368	0.2632	1.32	2.009	2.43	5.69E-01	2.79E-04	1.55E-09
80	19.5459	0.4541	2.27	1.980	1.69	8.08E-01	2.38E-04	1.89E-09
160	19.1208	0.8792	4.40	1.915	2.35	5.66E-01	2.65E-04	1.47E-09
320	16.1061	3.8939	19.47	1.455	35.17	3.27E-02	9.40E-04	3.02E-10
480	14.7888	5.2112	26.06	1.254	25.83	3.35E-02	4.11E-04	1.35E-10
160	14.9962	5.0038	25.02	1.286				
40	15.3680	4.6320	23.16	1.343				
160	15.1144	4.8856	24.43	1.304	2.88	2.86E-01	1.05E-04	2.96E-10
480	14.5047	5.4953	27.48	1.211	2.68	2.92E-01	9.50E-05	2.72E-10
720	13.7889	6.2111	31.06	1.102	10.53	6.85E-02	1.49E-04	9.99E-11
960	13.2867	6.7133	33.57	1.025	13.73	4.80E-02	1.04E-04	4.92E-11
1920	12.2158	7.7842	38.92	0.862	4.29	1.37E-01	5.56E-05	7.50E-11

SAMPLE DIMENSIONS AND PROPERTIES _ FINAL

Sample Height (mm) :	12.22	Unit Weight (kN/m^3) :	19.83
Sample Diameter (mm) :	50.00	Dry Unit Weight (kN/m^3) :	14.48
Area (cm^2) :	19.63	Specific Gravity (Assumed) :	2.750
Volume (cm^3) :	23.99	Solid Height (mm) :	6.56
Water Content (%) :	36.96	Volume of Solids (cm^3) :	12.88
Wet Mass (g) :	48.51	Volume of Voids (cm^3) :	11.11
Dry Mass (g) :	35.42		

Project No. :	121624678	Prepared By :	DB
Date :	27-Jun-24	Checked By :	RG

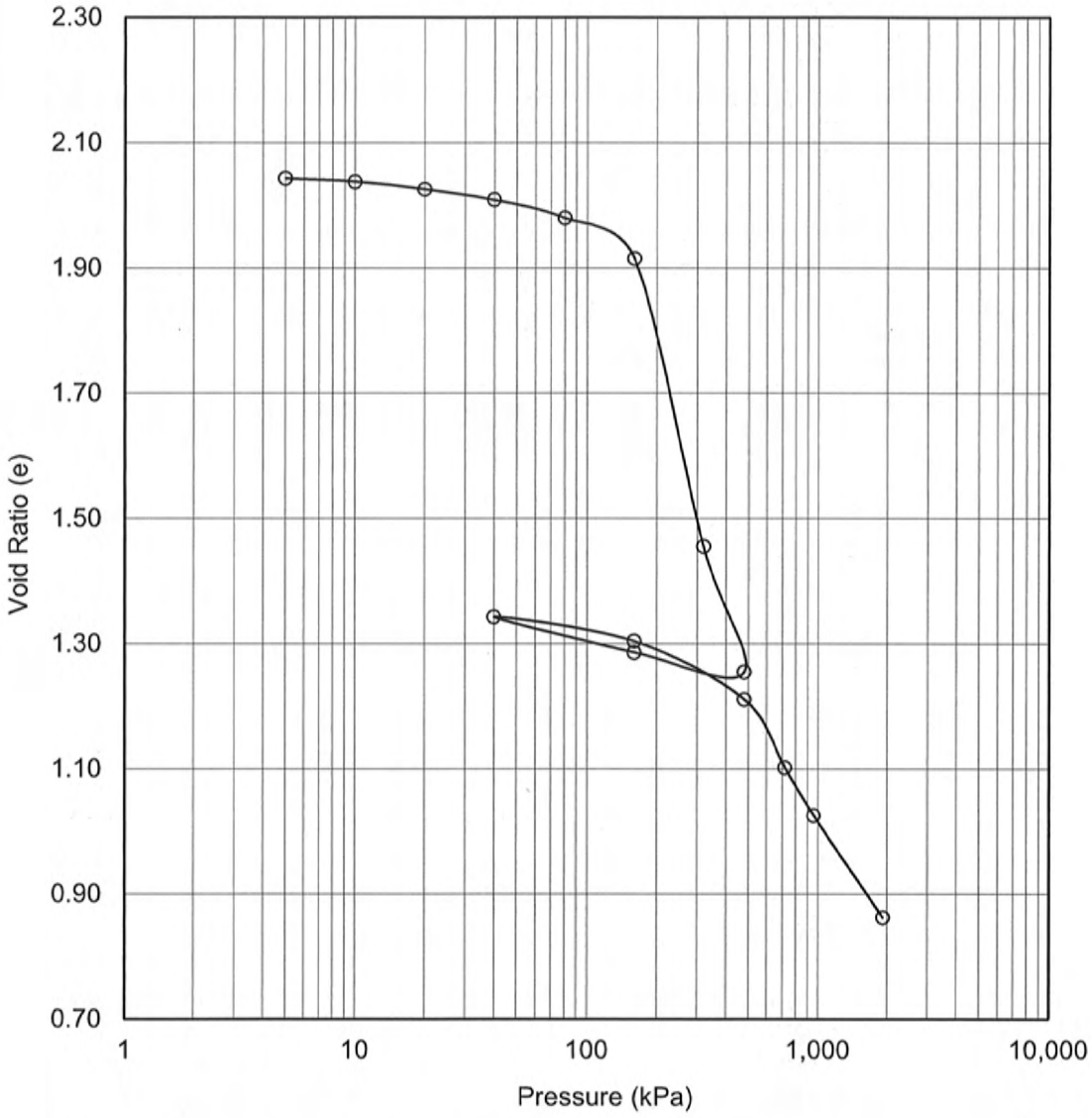
Stantec

CONSOLIDATION TEST	FIGURE 1

East Urban School, Exp File# OTT-0023012778-E0

BH 24-8, SH10

Void Ratio vs Pressure



Soil Type : *Lean clay, stiff to very stiff, grey, friable, wet - CI*

e_o =	2.057	w_L =	46.3%	σ_{v0}' =	kPa
w =	74.8%	w_P =	26.1%	σ_P' =	kPa
γ =	15.4 kN/m^3	PI =	20.2%		
Gs =	2.75				

Project No. : 121624678
Date : 27-Jun-24

Stantec

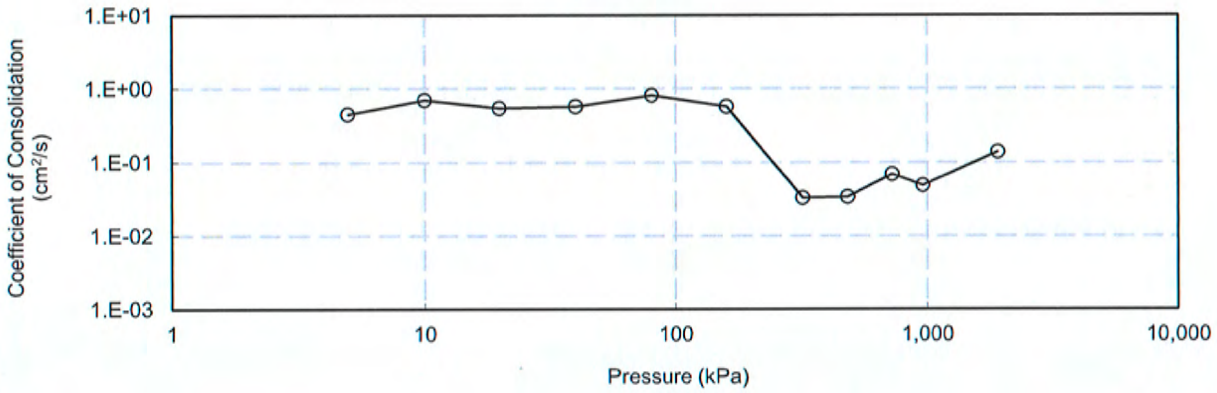
Prepared By : DB
Checked By : RG

CONSOLIDATION TEST	FIGURES 2, 3 & 4

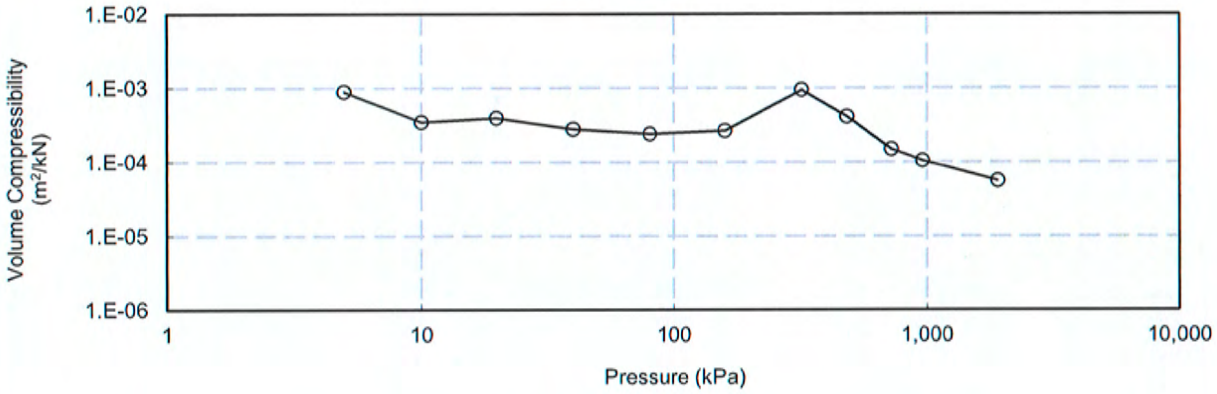
East Urban School, Exp File# OTT-0023012778-E0

BH 24-8, SH10

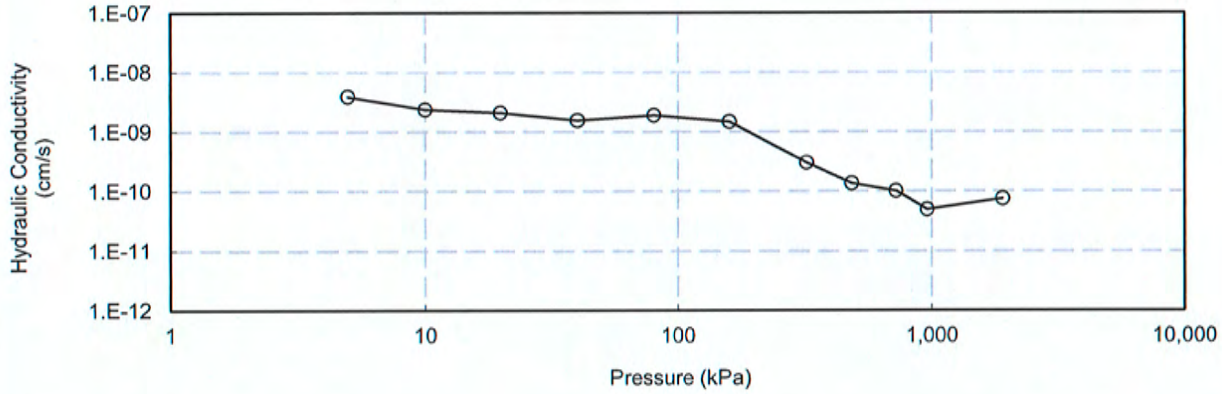
Cv vs Pressure



mv vs Pressure



k vs Pressure



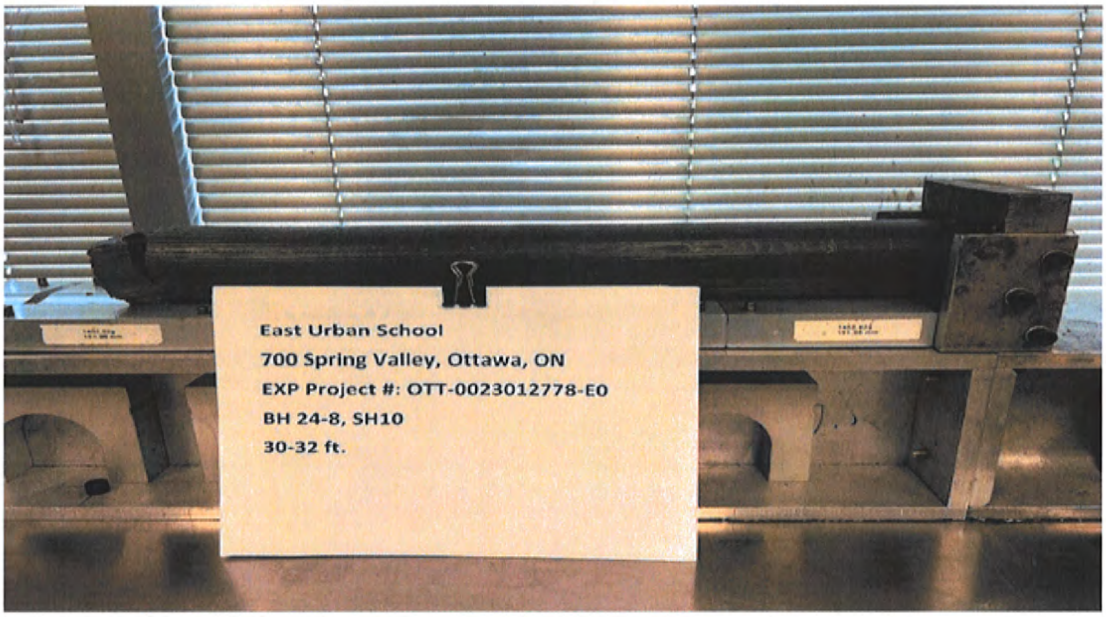
Project No. : 121624678
Date : 27-Jun-24

Stantec

Prepared By : DB
Checked By : RG

East Urban School, Exp File# OTT-0023012778-E0

Lean clay, stiff to very stiff, grey, friable, wet - CI



BH 24-8, SH10

BH 24-8, SH10

Appendix C: Seismic Shear Wave Survey Results (From 2019 Investigation)

GEOPHYSICS GPR INTERNATIONAL INC.

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

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

February 27th, 2019

Transmitted by email: ismail.taki@exp.com
Our Ref.: GPR-19-01195

Mr. Ismail M. Taki, M.Eng., P.Eng.
Project Manager, Geotechnical
exp Services inc.
100 - 2650 Queensview Drive
Ottawa (ON) K2B 8H6

Subject: **Shear Wave Velocity Sounding for Site Class Determination**
Intersection of Spring Valley Drive and Joshua Street, Orleans (ON)

[Project: OTT-00245378-K0]

Dear Sir,

Geophysics GPR International inc. has been requested by **exp** Services inc. to carry out seismic shear wave surveys on a vacant field, located north-east of the intersection of Spring Valley Drive and Joshua Street, Orléans, Ottawa (ON). The geophysical investigations used the Multi-channel Analysis of Surface Waves (MASW) and the Extended SPatial AutoCorrelation (ESPAC) methods. From the subsequent results, the seismic shear wave velocities values were calculated.

The surveys were carried out, on February 11th, by Mr. Marc Rousseau, phys. and Mr. Kenny Gardner. Figure 1 shows the regional location of the site and Figure 2 illustrates the location of the seismic spreads. Both figures are presented in the Appendix.

The following paragraphs briefly describe the survey design, the principles of the test methods, and the results in graphic and table format.

METHODS PRINCIPLES

MASW Survey

The *Multi-channel Analysis of Surface Waves* (MASW) and the *Extended SPatial AutoCorrelation* (ESPAC or MAM for *Microtremors Array Method*) are seismic methods used to evaluate the shear wave velocities of subsurface materials through the analysis of the dispersion properties of the Rayleigh surface waves ("ground roll"). The MASW is considered an "active" method, as the seismic signal is induced at known location and time in the geophones spread axis. Conversely, the ESPAC is considered a "passive" method, using the low frequency "noises" produced far away. The method can also be used with "active" seismic source records. The dispersion properties are expressed as a change of phase velocities with frequencies. Surface wave energy will decay exponentially with depth. Lower frequency surface waves will travel deeper and thus be more influenced by deeper velocity layering than the shallow higher frequency waves. The inversion of the Rayleigh wave dispersion curve yields a shear wave (V_S) velocity depth profile (sounding). Figure 3 schematically outlines the basic operating procedure for the MASW method.

Figure 4 illustrates an example of one of the MASW/ESPAC records, the corresponding spectrogram analysis and resulting 1D V_S model. The ESPAC method allows deeper Vs soundings, but generally with a lower resolution for the surface portion. Its dispersion curve can then be merged with the higher frequency one from the MASW to calculate a more complete inversion.

Seismic Refraction Survey

The method consists in measuring the propagation delays of the direct and refracted seismic waves (P and/or S) produced by an artificial source in the axis of a seismic linear spread. The seismic velocities of the materials can be directly calculated, then the refractors depths.

INTERPRETATION METHODS

MASW Surveys

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

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

Seismic Refraction surveys

The General Reciprocal Method was used, with signal sources at both ends of the seismic spreads, to consider seismic wave propagation for two opposite directions. The seismic wave's arrival times were identified for each geophone. The measurements were realised to calculate the rock depth (using P waves).

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

SURVEY DESIGN

The seismic acquisition spreads were located with a south-west - north-east direction. The geophone spacing for the main spread was of 3 metres, using 24 geophones. A shorter seismic spread, with geophone spacing of 1 metre, was dedicated to the near surface materials.

The seismic records counted 4096 data, sampled at 1000 µs for the MASW surveys, and 4096 data, sampled at 50 µs for the seismic refraction. The records included a pre-trig portion of 10 ms. A stacking procedure was also used to improve the Signal / Noise ratio for the seismic records.

Unlike the refraction method, which allows producing a result point beneath each geophone, the shear wave depth sounding can be considered as the average of the bulk area within the geophone spread, especially for its central half-length. The seismic records were made with a seismograph Terraloc MK6 (from ABEM Instrument), and the geophones were 4.5 Hz. A 10 kg sledgehammer was used as the energy source with impacts being recorded off both ends of the seismic spreads.

RESULTS

From seismic refraction, a refractor was calculated at 17 metres deep, corresponding with the possible till identified from geotechnical boreholes. The rock was calculated from seismic reflection (NMO and X^2-T^2) and seismic resonance, between 31 and 35 metres deep, dipping south-west. These results were used for the initial geophysical model, prior to the MASW inversions.

The MASW calculated velocities of the seismic shear wave (V_S) results are illustrated at Figure 5 and the numerical results are also presented at Table 1.

The $\overline{V}_{S30}$ value results from the harmonic mean of the shear wave velocities, from the surface to 30 metres deep. It is calculated by dividing the total depth of interest (30 metres) by the sum of the time spent in each velocity layer from the surface up to 30 metres. This value represents an equivalent homogeneous single layer response.

The calculated $\overline{V}_{S30}$ value is 189,0 m/s, corresponding to the Site Class "D" (cf.Table 1). However, some very low to low seismic velocities were calculated from the surface to 17 metres deep.

CONCLUSION

Geophysical surveys were carried out on a vacant field, located north-east of the intersection of Spring Valley Drive and Joshua Street, in Ottawa (ON). The seismic surveys used the MASW, ESPAC analysis methods, as well as the complementary seismic refraction, reflection and resonance methods, to calculate the $\overline{V}_{S30}$ value for the Site Class determination. The $\overline{V}_{S30}$ calculation is presented in Table 1.

The calculated $\overline{V}_{S30}$ value of the actual site is 189 m/s corresponding to the Site Class "D" ($180 < \overline{V}_{S30} \leq 360$ m/s), as determined through the MASW, ESPAC and seismic refraction, reflection and resonance methods, Table 4.1.8.4.A of the NBC, and the Building Code, O. Reg. 332/12. Some very low to low seismic velocities were calculated from the surface to 17 metres deep. Geotechnical assessment of the related materials should be produced, at least to statute on the clay degree of sensitivity and/or the potential of liquefaction.

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

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

Andrés Rincón, M.Sc., Geophys.

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

LICENSED PROFESSIONAL ENGINEER
J.-L. ARSENAULT
100148122
PROVINCE OF ONTARIO
2019-02-27

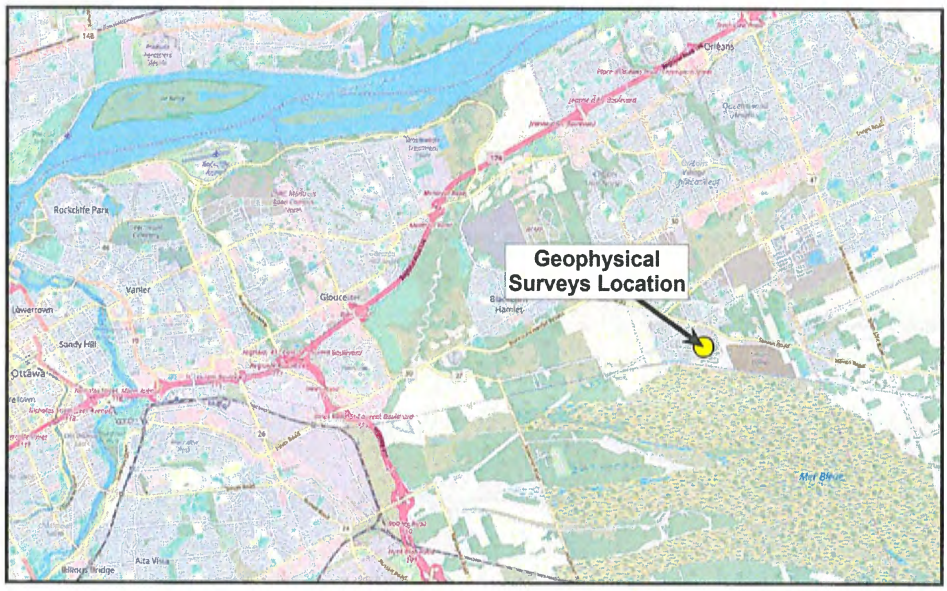


Figure 1: Regional location of the Site
(source: *OpenStreetMap™*)

Figure 2: Location of the seismic spreads
(source: *Google Earth™*)

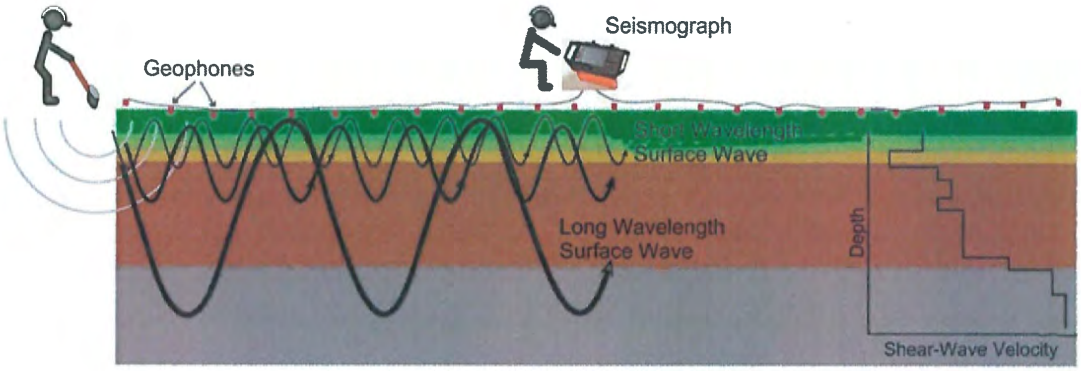


Figure 3: MASW Operating Principle

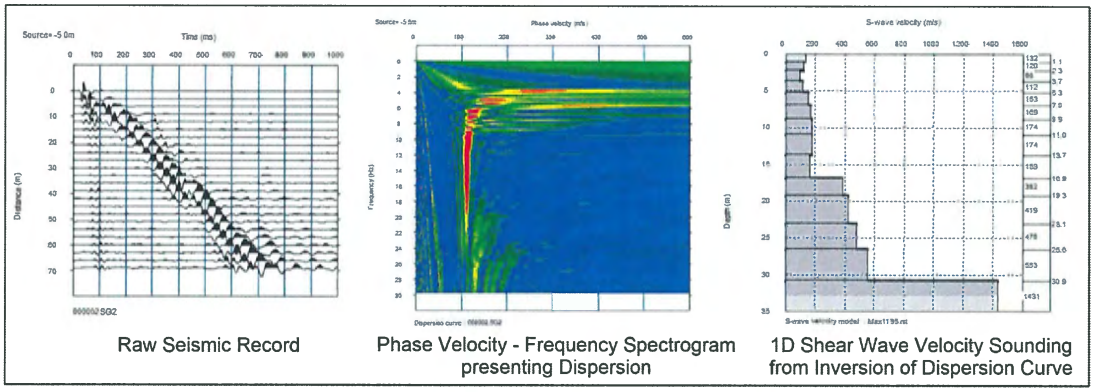


Figure 4: Example of a MASW/ESPAC record, Phase Velocity - Frequency curve and resulting 1D Shear Wave Velocity Model

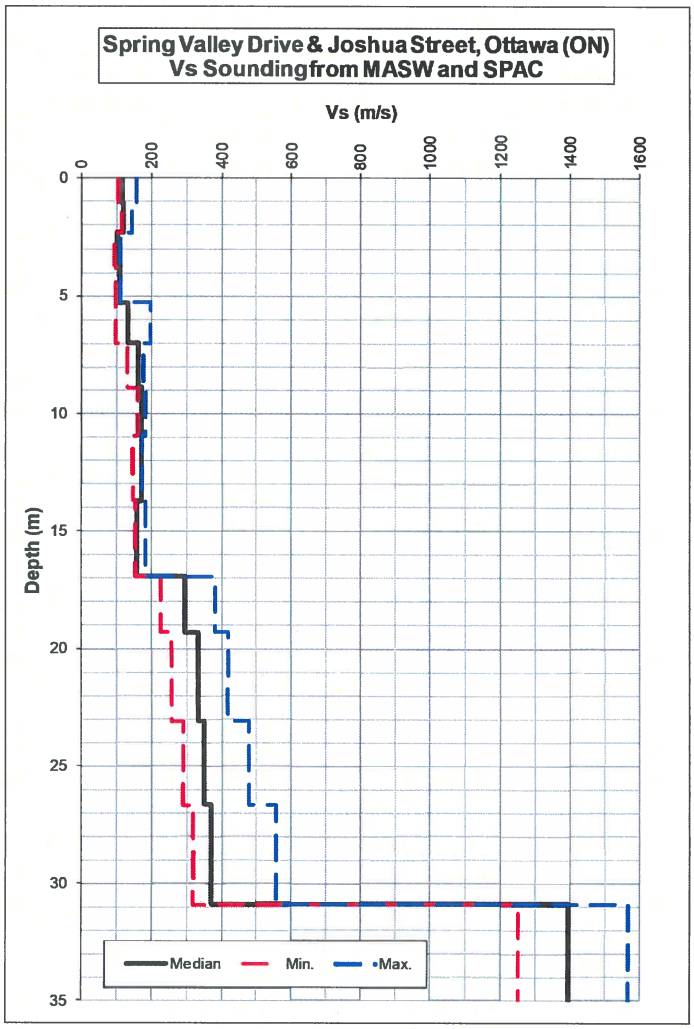


Figure 5: MASW Shear-Wave Velocities Sounding

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

Depth	Vs			Thickness	Cumul. Thickness	Delay for Vs Med.	Cumul. Delay	Avg. Vs at given depth
	Min.	Median	Max.					
(m)	(m/s)	(m/s)	(m/s)	(m)	(m)	(s)	(s)	(m/s)
0	**103.1**	**116.8**	**157.4**					
1.07	**113.2**	**120.4**	**145.0**	1.07	1.07	0.009175	0.009175	116.8
2.31	**93.1**	**102.8**	**111.9**	1.24	2.31	0.010269	0.019444	118.7
3.71	**96.9**	**108.5**	**112.6**	1.40	3.71	0.013635	0.033079	112.1
5.27	**98.8**	**134.5**	**197.6**	1.57	5.27	0.014439	0.047518	111.0
7.01	**130.0**	**162.6**	**177.9**	1.73	7.01	0.012868	0.060385	116.0
8.90	**159.9**	**173.2**	185.2	1.90	8.90	0.011661	0.072046	123.5
10.96	**147.4**	**172.7**	**174.8**	2.06	10.96	0.011899	0.083945	130.6
13.72	**153.7**	**158.2**	184.8	2.75	13.72	0.015949	0.099893	137.3
16.93	227.0	297.3	382.1	3.21	16.93	0.020307	0.120200	140.8
19.28	257.5	332.2	419.6	2.35	19.28	0.007900	0.128101	150.5
23.11	292.0	350.0	478.7	3.83	23.11	0.011542	0.139643	165.5
26.64	319.5	371.3	553.8	3.52	26.64	0.010068	0.149711	177.9
30	319.5	371.3	553.8	3.36	30.00	0.009060	0.158771	189.0

V_{S30} (m/s)	**189.0**
Site Class	**D** [1]

[1] : conditional to geotechnical assessment of the unconsolidated materials from the surface to 17 metres deep.

Appendix D: Results of Chemical Tests on Soil Samples from 2019 and 2024 Geotechnical Investigations

AGAT Laboratories

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

CLIENT NAME: EXP SERVICES INC
2650 QUEENSVIEW DRIVE, UNIT 100
OTTAWA, ON K2B8H6
(613) 688-1899

ATTENTION TO: SURINDER AGGARWAL

PROJECT: OTT-245378-G

AGAT WORK ORDER: 19Z439186

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Supervisor

DATE REPORTED: Feb 27, 2019

PAGES (INCLUDING COVER): 5

VERSION*: 1

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

*NOTES

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

Member of: Association of Professional Engineers and Geoscientists of Alberta (APEGA)
Western Enviro-Agricultural Laboratory Association (WEALA)
Environmental Services Association of Alberta (ESAA)

AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation. Measurement Uncertainty is not taken into consideration when stating conformity with a specified requirement.

Results relate only to the items tested. Results apply to samples as received.
All reportable information as specified by ISO 17025:2017 is available from AGAT Laboratories upon request

AGAT Laboratories

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

Certificate of Analysis

AGAT WORK ORDER: 19Z439186

PROJECT: OTT-245378-G

CLIENT NAME: EXP SERVICES INC

ATTENTION TO: SURINDER AGGARWAL

SAMPLING SITE:Spring Valley Trail School, Joshua St, Ottawa

SAMPLED BY:exp

Inorganic Chemistry (Soil)

DATE RECEIVED: 2019-02-20

DATE REPORTED: 2019-02-27

Parameter	Unit	G / S	RDL	SAMPLE DESCRIPTION: BH2 SS2 2. 5'-4.5' / SAMPLE TYPE: Soil / DATE SAMPLED: 2019-02-12 / 9912858	SAMPLE DESCRIPTION: BH3 SS3 5'-7' / SAMPLE TYPE: Soil / DATE SAMPLED: 2019-02-12 / 9912859	SAMPLE DESCRIPTION: BH3 SS4 7. 5'-9.5' / SAMPLE TYPE: Soil / DATE SAMPLED: 2019-02-12 / 9912860	SAMPLE DESCRIPTION: BH3 SS6 12. 5'-14' / SAMPLE TYPE: Soil / DATE SAMPLED: 2019-02-12 / 9912861	SAMPLE DESCRIPTION: BH4 SS2 2. 5'-4.5' / SAMPLE TYPE: Soil / DATE SAMPLED: 2019-02-12 / 9912862
pH (2:1)	pH Units		N/A	7.89	7.71	7.44	7.78	7.41
Electrical Conductivity (2:1)	mS/cm		0.005	0.283	0.345	0.290	0.494	0.270
Chloride (2:1)	µg/g		2	10	27	34	45	21
Sulphate (2:1)	µg/g		2	41	36	31	38	26

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

9912858-9912862 EC, pH, Chloride and Sulphate were determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil).

Certified By:

Results relate only to the items tested. Results apply to samples as received.

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Quality Assurance

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 19Z439186

PROJECT: OTT-245378-G

ATTENTION TO: SURINDER AGGARWAL

SAMPLING SITE:Spring Valley Trail School, Joshua St, Ottawa

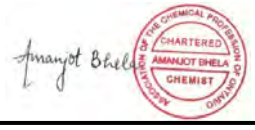
SAMPLED BY:exp

Soil Analysis

RPT Date:			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Inorganic Chemistry (Soil)															
pH (2:1)	9912858	9912858	7.89	7.95	0.8%	N/A	101%	90%	110%	NA			NA		
Electrical Conductivity (2:1)	9912858	9912858	0.283	0.298	5.2%	< 0.005	103%	90%	110%	NA			NA		
Chloride (2:1)	9912858	9912858	10	10	0.0%	< 2	102%	70%	130%	107%	70%	130%	100%	70%	130%
Sulphate (2:1)	9912858	9912858	41	35	15.8%	< 2	90%	70%	130%	95%	70%	130%	82%	70%	130%

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

Certified By:



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Results relate only to the items tested. Results apply to samples as received.

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Method Summary

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 19Z439186

PROJECT: OTT-245378-G

ATTENTION TO: SURINDER AGGARWAL

SAMPLING SITE:Spring Valley Trail School, Joshua St, Ottawa

SAMPLED BY:exp

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

Results relate only to the items tested. Results apply to samples as received.

1 Lg BK

AGAT Laboratories

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

Chain of Custody Record

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

Laboratory Use Only

Work Order #: 1924391186

Cooler Quantity: one

Arrival Temperatures: 20.1 | 20.1 | 19.8 | 2.5 | 5.0 | 3.1

Custody Seal Intact: ☐ Yes ☐ No ☐ N/A

Notes: no ice

Report Information:

Company: Exp Services
Contact: Surinder Aggarwal
Address: 2650 Queensview Dr Suite 100
Ottawa ON K2B 8H6
Phone: 613-688-1899 Fax:
Reports to be sent to:
1. Email: Surinder.Aggarwal@exp.com
2. Email:

Regulatory Requirements:

☐ No Regulatory Requirement

(Please check all applicable boxes)

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

☐ Sewer Use
☐ Sanitary ☐ Storm
Region (Indicate One)
☐ MISA

☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☐ Other
(Indicate One)

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

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

Turnaround Time (TAT) Required:

Regular TAT ☒ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

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

OR Date Required (Rush Surcharges May Apply):

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

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

Project Information:

Project: OTT-245378-G
Site Location: Spring Valley Trail School, Joshua st, Ottawa
Sampled By: exp
AGAT Quote #: PO:
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☒ No ☐

Company:
Contact:
Address:
Email:

Sample Matrix Legend

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

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI (Y/N)	O. Reg 153: Metals and Inorganics	All Metals ☐ 153 Metals (excl. Hydrides)	Hydride Metals ☐ 153 Metals (Incl. Hydrides)	ORPs: ☐ B-HWS ☐ Cl ☐ CN ☐ Cr^{6+} ☐ EC ☐ FOC ☐ Hg ☐ pH ☐ SAR	Full Metals Scan	Regulation/Custom Metals	Nutrients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3+NO_2	Volatiles: ☐ VOC ☐ BTEX ☐ THM	PHCs F1 - F4	ABNs	PAHs	PCBs: ☐ Total ☐ Aroclors	Organochlorine Pesticides	TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Sewer Use	pH	Sulphates	Chlorides	Electro Conductivity
BH 2 SS 2 2.5'-4.5'	Feb 12/19																				✓	✓	✓	✓
BH 3 SS 3 5'-7'	Feb 14/19																				✓	✓	✓	✓
BH 3 SS 4 7.5'-9.5'	Feb 14/19																				✓	✓	✓	✓
BH 3 SS 6 12.5'-14'	Feb 14/19																				✓	✓	✓	✓
BH 4 SS 2 2.5'-4.5'	Feb 19/19																				✓	✓	✓	✓

Samples Relinquished By (Print Name and Sign)	Date	Time	Samples Received By (Print Name and Sign)	Date	Time
Ryan DeGroote	Feb 20/19	4:00pm	Bernadette Gamue	19-02-20	16h00
LB/D to FedEx	19-02-21	16h00	MANOJ JOHN	FEB 22, 19	10:00
Samples Relinquished By (Print Name and Sign)	Date	Time	Samples Received By (Print Name and Sign)	Date	Time

Page 1 of 1

N°: T 078078

Document ID: DIV-78 1511 015

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

Date Revised: Sept 16, 2018

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CANADA L4Z 1Y2
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http://www.agatlabs.com

CLIENT NAME: EXP SERVICES INC
2650 QUEENSVIEW DRIVE, UNIT 100
OTTAWA, ON K2B8H6
(613) 688-1899
ATTENTION TO: Ismail M. Taki
PROJECT: OTT-23012778-E0
AGAT WORK ORDER: 24Z159829
SOIL ANALYSIS REVIEWED BY: Sukhwinder Randhawa, Inorganic Team Lead
DATE REPORTED: Jun 14, 2024
PAGES (INCLUDING COVER): 5
VERSION*: 1

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

*Notes

Disclaimer:

- *All work conducted herein has been done using accepted standard protocols, and generally accepted practices and methods. AGAT test methods may incorporate modifications from the specified reference methods to improve performance.*
- *All samples will be disposed of within 30 days after receipt unless a Long Term Storage Agreement is signed and returned. Some specialty analysis may be exempt, please contact your Client Project Manager for details.*
- *AGAT's liability in connection with any delay, performance or non-performance of these services is only to the Client and does not extend to any other third party. Unless expressly agreed otherwise in writing, AGAT's liability is limited to the actual cost of the specific analysis or analyses included in the services.*
- *This Certificate shall not be reproduced except in full, without the written approval of the laboratory.*
- *The test results reported herewith relate only to the samples as received by the laboratory.*
- *Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to, warranties of merchantability, fitness for a particular purpose, or non-infringement. AGAT assumes no responsibility for any errors or omissions in the guidelines contained in this document.*
- *All reportable information as specified by ISO/IEC 17025:2017 is available from AGAT Laboratories upon request.*
- *For environmental samples in the Province of Quebec: The analysis is performed on and results apply to samples as received. A temperature above 6°C upon receipt, as indicated in the Sample Reception Notification (SRN), could indicate the integrity of the samples has been compromised if the delay between sampling and submission to the laboratory could not be minimized.*

Member of: Association of Professional Engineers and Geoscientists of Alberta (APEGA)
Western Enviro-Agricultural Laboratory Association (WEALA)
Environmental Services Association of Alberta (ESAA)

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Certificate of Analysis

AGAT WORK ORDER: 24Z159829

PROJECT: OTT-23012778-E0

CLIENT NAME: EXP SERVICES INC

ATTENTION TO: Ismail M. Taki

SAMPLING SITE:700 Spring Valley Drive, Ottawa

SAMPLED BY:EXP

Corrosivity Package (pH, Sulphate, Chloride, EC)

DATE RECEIVED: 2024-06-07

DATE REPORTED: 2024-06-13

				BH24-3 SS6	BH24-8 SS4	BH24-8 SS9
		SAMPLE DESCRIPTION:		(12.5'-14')	(7.5'-9.0')	(25'-27')
		SAMPLE TYPE:		Soil	Soil	Soil
		DATE SAMPLED:		2024-05-27	2024-05-29	2024-05-29
Parameter	Unit	G / S	RDL	5917894	5917896	5917897
Chloride (2:1)	µg/g		2	62	35	83
Sulphate (2:1)	µg/g		2	68	51	100
pH (2:1)	pH Units		NA	9.52	8.48	9.84
Electrical Conductivity (2:1)	mS/cm		0.005	0.501	0.168	0.812
Dry/Grind Inorg				1	1	1

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

5917894-5917897 EC, pH, Chloride and Sulphate were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil). Resistivity is a calculated parameter.

Analysis performed at AGAT Toronto (unless marked by *)

Certified By:

Results relate only to the items tested. Results apply to samples as received.

AGAT Laboratories

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Quality Assurance

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 24Z159829

PROJECT: OTT-23012778-E0

ATTENTION TO: Ismail M. Taki

SAMPLING SITE:700 Spring Valley Drive, Ottawa

SAMPLED BY:EXP

Soil Analysis

RPT Date:			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Corrosivity Package (pH, Sulphate, Chloride, EC)															
Chloride (2:1)	5923393		65	65	0.0%	< 2	97%	70%	130%	107%	80%	120%	104%	70%	130%
Sulphate (2:1)	5923393		29	30	3.4%	< 2	104%	70%	130%	108%	80%	120%	100%	70%	130%
pH (2:1)	5915766		8.28	8.32	0.5%	NA	100%	80%	120%						
Electrical Conductivity (2:1)	5915766		0.163	0.178	8.3%	< 0.005	99%	80%	120%						

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

Certified By:

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Results relate only to the items tested. Results apply to samples as received.

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CANADA L4Z 1Y2
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Method Summary

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 24Z159829

PROJECT: OTT-23012778-E0

ATTENTION TO: Ismail M. Taki

SAMPLING SITE:700 Spring Valley Drive, Ottawa

SAMPLED BY:EXP

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Chloride (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	modified from SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	modified from EPA 9045D and MCKEAGUE 3.11	PH METER
Electrical Conductivity (2:1)	INOR-93-6075	modified from MSA PART 3, CH 14 and SM 2510 B	PC TITRATE
Dry/Grind Inorg	LAB-78-4026		N/A

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AGAT Laboratories

Have feedback? Scan here for a quick survey!

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Mississauga, Ontario, L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

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

Report Information:

Company: EXP Services Inc
Contact: Ismail Taki
Address: 2650 Queensview Drive, Suit 100
Ottawa,Ontario,K2B8H6
Phone: 613-688-1899 Fax:
Reports to be sent to:
1. Email: ismail.taki@exp.com
2. Email: ryan.digiuseppe@exp.com

Project Information:

Project: OTT-23012778-E0
Site Location: 700 Spring Valley Drive, Ottawa
Sampled By: EXP
AGAT Quote #: PO:
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

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

Regulatory Requirements:

(Please check all applicable boxes)

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

☐ Regulation 406
Table (Indicate One) ☐ Ind/Com ☐ Res/Park ☐ Agriculture

☐ Regulation 558
☐ CCME

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

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

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

Legal Sample ☐

Sample Matrix Legend

GW	Ground Water	**SD**	Sediment
O	Oil	**SW**	Surface Water
P	Paint	**R**	Rock/Shale
S	Soil		

Laboratory Use Only

Work Order #: 24215982 9

Cooler Quantity: One - no ice (packs
Arrival Temperatures: 23.6 | 23.5 | 23.2
Depot Temperatures: 7.3 | 7.2 | 7.5
Custody Seal Intact: ☐ Yes ☐ No ☑ N/A
Notes: bagged ice

Turnaround Time (TAT) Required:

Regular TAT ☑ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

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

OR Date Required (Rush Surcharges May Apply):

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

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

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI, DOC (Y/N)	O. Reg 153: Metals & Inorganics	O. Reg 153: Metals - ☐ CrVI, ☐ Hg, ☐ HWSB	O. Reg 153: BTEX, F1-F4 PHCs	VOC	PAHs	PCBs: Aroclors ☐	O. Reg 406: Regulation 406 Characterization Package	O. Reg 406: pH, Metals, BTEX, F1-F4	O. Reg 406: EC, SAR	O. Reg 406: Regulation 406 SPLP Rainwater Leach	O. Reg 406: mSPLP: ☐ Metals ☐ VOCs ☐ SVOCs ☐ OC	O. Reg 558: Landfill Disposal Characterization TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ BaP ☐ PCBs	Corrosivity: ☐ Moisture ☐ Sulphide	pH	Sulphates	Chloride	Electro Conductivity			Potentially Hazardous or High Concentration (Y/N)
1. BH24-3 SS6 (12.5'-14')	May 27	AM/PM	1																	☑	☑	☑	☑			
2. BH24-8 SS4 (7.5'-9.0')	May 29	AM/PM	1																	☑	☑	☑	☑			
3. BH24-8 SS9 (25'-27')	May 29	AM/PM	1																	☑	☑	☑	☑			
4.		AM/PM																								
5.		AM/PM																								
6.		AM/PM																								
7.		AM/PM																								
8.		AM/PM																								
9.		AM/PM																								
10.		AM/PM																								
11.		AM/PM																								

Samples Relinquished By (Print Name and Sign)	Date	Time	Samples Received By (Print Name and Sign)	Date	Time
			C. Gauthier	06/07/24	14h25
C to Pure	06/07/24	15h00	Andy Jin	06/08/24	11:09 am

Page ____ of ____
N°:

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Vladimir Popovic <vladimirp@n45.ca>