Proposed Leitrim Elementary School - 3955 Promenade Kelly Farm, Ottawa

February 7, 2025

Prepared for:
Conseil des écoles publiques de l'Est de l'Ontario

Cambium Reference: 21388-001 Rev.2

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1.0 Introduction

Cambium Inc. (Cambium) was retained by the Conseil des écoles publiques de l'Est de l'Ontario (CEPEO, the Client) to complete a geotechnical investigation in support of the proposed public elementary school to be located at 3955 Promenade Kelly Farm, in the neighbourhood of Findlay Creek, Ottawa, Ontario.

This report presents the methodology and findings of the geotechnical investigation at the Site and addresses constraints, requirements, and recommendations relevant to the proposed development.

1.1 Reviewed Documents

The following project documents were received and reviewed during the drafting of this report:

[1] Requirements for Geotechnical Investigation CA0040067.4396 CEPEO – New Public Elementary School – Leitrim District 3955 Promenade Kelly Farm, Ottawa, ON Architecture 49 Inc.: Prepared by WSP, dated August 27, 2024.

[2] Project CEPEO LEITRIM Drawings No. A1.1, A1.2, A2.0, and A2.1: Prepared by Architecture 49 Inc., dated October 19, 2023.

[3] Technical Memorandum Geotechnical Review Proposed New School Development, Findlay North Property Ottawa, Ontario: Prepared by Golder Associates, dated February 9, 2021.

[4] Concept Plan, Project ECOLE ELEMNENTAIRE LEITRIM 3955 Promenade Kelly Darm, Ottawa, Sheet No. L100: Prepared by Architecture 49 Inc., dated October 18, 2023.

1.2 Standards and Guidelines

Applicable standards, guidelines and other normative documents utilized in preparing geotechnical engineering recommendations for this report are provided below.

[5] Canadian Foundation Engineering Manual – 4th and 5th Edition; Canadian Geotechnical Society; 2006, 2023.

[6] Ontario Provincial Standard Drawing (Nov 2010, Rev 1): OPSD 3090.101- Foundation Frost Penetration Depths for Southern Ontario

[7] Reference Guide Note: Geotechnical Solutions (2024 v2) – EBS Geostructural Inc.(www.ebsgeo.com)

2.0 Site Description

2.1 Site Description

The Site is located in the neighbourhood of Findlay Creek within the City of Ottawa. The Site is at the southeast corner of Promenade Kelly Farm and Promenade Barret Farm, or approximately 250 m south of Route Leitrim. The location is shown in Figure 1. The site is bounded by Promenade Kelly Farm and Promenade Barret Farm to the west and north, respectively. To the east are single-family dwellings. Along the east half of the south property line is Rue Lavatera, and town homes constructed adjacent to the west half of the south property line.

The neighbourhood of Findlay creek began development in the early 2000's and between 2017 and 2018, the neighbourhood development extended towards the Site. Based on available public satellite imagery, the Site was used as farmland in 2017. In 2019, the satellite imagery shows the community under development. It is understood that the roads, services, and stormwater management pond were excavated between 2017 and 2019, and the excess soils were used to backfill portions of the neighbourhood, including the Site. The site is currently relatively flat in the northwest quarter, but slightly uneven throughout the rest of the Site due to historic dumping of excess materials.

Publicly available geological maps show the area as near the transition of coarse-textured glaciomarine deposits and glacial till terrain. The underlying bedrock is mapped as dolostone and sandstone of the March Formation.

2.2 Project Description

It is Cambium's understanding that the proposed development will consist of an approximately two-storey elementary school building which will include at grade parking, exterior play areas, and location for portable classrooms. The preliminary development plans also include an area of potential future expansion of the building.

The geotechnical investigation was required to confirm the existing subsurface conditions, groundwater conditions, and soil parameters as input into the design and construction of the proposed developments. Analysis from the geotechnical investigation, recommendations for

the proposed developments, and relevant supporting documents are provided in the following sections and/or appended to this report.

2.3 Previous Investigation by Others

A copy of the previously completed soil investigation technical memorandum [3] for the site was provided as part of the initial request for the work. Based on this previous letter, the soil conditions in the area consist of topsoil over native deposits of silty clay and clayey silt underlain by glacial till 1 to 2 mbgs. Practical refusal was encountered at depths ranging from 4.0 to 5.2 meters below grade.

3.0 Methodology

3.1 Borehole Investigation

A borehole investigation was conducted at the Site between September 23 and 25, 2024 to assess subsurface conditions. A total of twelve (12) boreholes were advanced across the site. Three of the boreholes were completed as monitoring wells and are designated BH110-24 through BH112-24. Ten of the boreholes, BH101-24 to BH107-24 and BH110-24 to BH112-24 were located within the proposed building footprint. BH108-24 and BH109-24 were located within proposed pavement structures. All boreholes were terminated between 6.0 and 6.7 m depth. The elevation of each borehole was determined relative to a site benchmark, the top nut of the fire hydrant located on the south side of Barrett Farm Drive, on the north side of the site, which was assigned a relative elevation of 200 metres. The locations of the boreholes and benchmark relative to existing site conditions are shown on Figure 2.

Drilling and sampling was completed using a track-mounted drill rig operating under the supervision of a Cambium technician. The boreholes were advanced to the sampling depths by means of continuous flight hollow or solid stem augers and sampled with 50 mm O.D. split spoon samplers. Standard Penetration Test (SPT) N values were recorded for the sampled intervals as the number of blows required to drive a split spoon sampler 305 mm into the soil, using a 63.5 kg drop hammer falling 750 mm, as per ASTM D1586 procedures. The SPT N values are used in this report to assess consistency of cohesive soils and relative density of non-cohesive materials. Field vane shear tests were completed within soft cohesive deposits as per ASTM D2573 procedures to confirm consistency and sensitivity of these deposits.

Soil samples were collected at approximately 0.75 m intervals. The encountered soil units were logged in the field using visual and tactile methods, and samples were placed in labelled plastic bags for transport, future reference, possible laboratory testing, and storage. Open boreholes were checked for groundwater and general stability prior to backfilling. The boreholes and monitoring wells were backfilled in accordance with O.Reg. 903, as amended.

The prepared borehole logs are provided in Appendix A. Site soil and groundwater conditions and our geotechnical recommendations are presented in the following sections of this report.

3.2 Laboratory Testing

Laboratory soil testing included seven Particle Size Distribution Analyses (LS-702, 705), five Atterberg Limit Analyses (LS-703, 704) and Natural Moisture Content Analyses (LS-701) was completed on all soil samples. Results are presented in Appendix B and are summarized on the borehole logs and described in the subsequent sections of this report.

3.3 Multi-channel Analysis of Surface Waves

As part of this investigation, Multi-channel Analysis of Surface Waves (MASW) survey was completed on the site in order to evaluate the shear wave velocities of the subsurface materials and determine the seismic site class. The survey was completed on September 27th, 2024, by Frontwave Geophysics Inc. A total of twenty-four (24) geophones in 1 m spacing were placed at the site in order to acquire shear wave velocities and complete the testing. A report summarizing the testing was provided by Frontwave Geophysics Inc. and included as Appendix C in this report.

3.4 Chemical Testing for Excess Soils

Cambium is providing commentary on observable contamination encountered within the boreholes advanced as part of this investigation. The commentary will include discussion on needs for additional testing for excess soils management and is provided as a separate letter.

4.0 Subsurface Conditions

The detailed soil profiles encountered in the boreholes are shown on the attached borehole logs in Appendix A. Conditions indicated on the borehole logs are for specific locations only and can vary between and beyond the borehole locations. 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 and should not be interpreted as exact planes of geological change. In addition, the descriptions provided on the borehole logs are inferred from a variety of factors, including visual observations of the soil samples retrieved, laboratory testing, measurements prior to and after drilling, and the drilling process itself (such as drilling speed and shaking/grinding of the augers).

Based on the results of the borehole investigation, subsurface conditions at the Site generally consist of sand and silt fill material overlying cohesive deposits of silt and clay to clayey silt, over loose deposits of silt. Glacial till was encountered underlying the upper deposits across the majority of the site with practical refusal on probable bedrock also encountered at some locations.

The subsurface soil and groundwater conditions encountered in the boreholes drilled at the site are described in the following sections.

4.1 Fill Material

Fill material was encountered from the surface of all borehole locations. The composition of the fill materials varies partially between borehole locations but is predominantly brown silt and sand or silty sand, gravelly to some gravel. Cobbles and boulders were noted within the fill material in boreholes BH103-24, BH104-24, and BH108-24. Organics were observed within the fill material in boreholes BH101-24, BH102-24, BH104-24, BH107-24, BH108-24, BH109-24, and BH112-24., Isolated clayey pockets were also observed at three borehole locations. As noted in Section 2.1, the fill material from the site is likely sourced from the adjacent developments.

Thickness of the fill materials range from 0.8 to 2.3 m.

SPT N-values measured in the fill material range from 3 to 49, indicative of a variable very loose to dense relative density. On average the relative density of the fill material is loose to

compact, higher values are due to the increase in gravel in the material, and lower values are due to the presence of clay and/or organics.

Laboratory particle size distribution analysis was completed for one sample of the fill material. The analysis results, based on a modified Unified Soil Classification System (USCS) scale, are summarized in Table 1 with full results provided in Appendix B.

Table 1 Particle Size Distribution Analysis – Fill Material

Sample	Depth (mbgs)	Soil	Gravel (%)	Sand (%)	Silt and Clay (%)
BH103-24, SS02	0.8 – 1.4	Gravelly sand and silt	26	39	35

4.2 Cohesive Deposits

Cohesive deposits were encountered underlying the fill material at all boreholes locations. The cohesive deposits predominantly consist of silt and clay and transition to clayey silt with depth. The silt and clay in the upper portions are grey-brown to grey in colour, with trace sand and trace gravel. The thickness of the silt and clay ranges from 0.8 to 3.1 m and extends to a depth ranging from 2.3 to 3.8 mbgs. This deposit transitions clayey silt in boreholes BH103-24, BH104-24, BH105-24, BH107-24, BH108-24, BH111-24, and BH112-24 at depths ranging from 2.3 to 3.8 mbgs. Borehole BH110-24 the deposit transition from clayey silt to silt and clay. Sand lenses were noted within the cohesive deposits at varying depths throughout the entire deposit.

The SPT'N' values range from static weight of hammer to 7. The undrained shear strength was measured within the cohesive deposits during the fieldwork with a field shear vane, and ranges from 48 to 52 kPa (natural shear strength), indicative of a firm to stiff consistency. The respective remoulded shear strengths ranged from 19 to 23 kPa, indicative of low sensitivity.

Laboratory particle size distribution analyses and Atterberg Limits testing were completed for samples of the silt and clay/clayey silt. The analysis results, based on a modified Unified Soil Classification System (USCS) scale, are summarized in Table 2 and Table 3 with full results provided in Appendix B.

Table 2 Particle Size Distribution Analysis – Cohesive Deposits

Sample	Depth (mbgs)	Soil	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH101-24, SS03	1.5 – 2.1	Silt and clay, trace sand, trace gravel	2	6	48	42
BH101-24, SS04	2.3 – 2.9	Silt and clay, some sand, trace gravel	3	17	44	36
BH104-24, SS05	3.1 – 3.7	Clayey silt, trace sand, trace gravel	1	5	74	20

Table 3 Atterberg Limits Testing – Cohesive Deposits

Sample	Depth (mbgs)	Soil	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Classification	Moisture Content (%)
BH101-24, SS03	1.5 – 2.1	Silt and clay, trace sand, trace gravel	38.5	19.1	19.4	CL	30.1
BH101-24, SS04	2.3 – 2.9	Silt and clay, some sand, trace gravel	34.8	15.5	19.3	CL	38.3
BH104-24, SS05	3.1 – 3.7	Clayey silt, trace sand, trace gravel	22.7	18.2	4.4	CL-ML	29.3

The Atterberg testing indicates that the upper portions of the cohesive deposits are considered plastic and have moisture contents above the plastic limits and at some locations above the liquid limit. The lower clayey silt deposits can be considered slightly plastic.

4.3 Silt

Native, cohesionless deposits of silt were encountered underlying the cohesive deposits in all borehole locations with the exception of borehole BH101-24. The deposits are composed of grey silt, trace to some sand, trace gravel. Lenses of cohesive clay was noted throughout the deposit at varying depths. The silt deposit was encountered at depths ranging from 2.3 to 4.6 mbgs and extends to depths ranging from 3.8 to 6.7 mbgs. Borehole BH110-24 terminated within the silt deposit upon reaching target depth at 6.7 mbgs. The remaining boreholes had a measured thickness from 0.8 to 2.3 m. Boreholes BH103-24 and BH105-24 terminated within the silt due to practical auger refusal. Further discussion on auger refusal is provided in Section 4.5.

The SPT'N' values range from static weight of hammer to 19, indicative of a very loose to compact relative density. The undrained shear strength was measured within the silt deposits

during the fieldwork with a field shear vane at four borehole locations: BH102-24, BH104-24, BH108-24, and BH110-24. The results of the testing are shown on the respective logs, however the material is considered non-cohesive based on the results of our testing. Any readings are due to cohesive clay lenses within the silt deposits.

Laboratory particle size distribution analyses and Atterberg Limits testing were completed for samples of the silt and clay/clayey silt. The analysis results, based on a modified USCS scale, are summarized in Table 4 and Table 5 with full results provided in Appendix B.

Table 4 Particle Size Distribution Analysis – Silt

Sample	Depth (mbgs)	Soil	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
BH107-24, SS06	4.6 – 5.2	Silt, trace sand, trace gravel	1	2	90	7

Table 5 Atterberg Limits Testing – Silt

Sample	Depth (mbgs)	Soil	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Classification	Moisture Content (%)
BH107-24, SS06	4.6 – 5.2	Silt, trace sand, trace gravel	-			Non-Plastic	27.1

The Atterberg testing indicates that the silt is non plastic.

4.4 Glacial Till

Native deposit of glacial till was encountered underlying the fill materials, silts, and clay deposits in 9 borehole locations: BH101-24, BH102-24, BH104-24, BH106-24 through BH109-24, BH111-24, and BH112-24.

Glacial till is a mass deposit and is a heterogenous mix of all grain sizes. The till deposit encountered at this site generally consists of grey sandy silty gravel or gravelly silty sand. Cobbles and boulders should be expected within this deposit.

The glacial till was encountered at depths ranging from 3.1 to 6.1 mbgs and extend to depths ranging between 6.0 and 6.7 mbgs. Boreholes BH106-24, BH107-24, BH108-24, and BH110-24 terminated within the glacial till due to reaching target depths. Where glacial till was

encountered at the remaining locations, boreholes terminated within the glacial till due to practical refusal.

The SPT'N' values range from 12 to over 50, indicating compact to very dense relative density.

Laboratory particle size distribution analysis was completed for two samples of the glacial till deposit. The analysis results, based on a modified Unified Soil Classification System (USCS) scale, are summarized in Table 6 with full results provided in Appendix B.

Table 6 Particle Size Distribution Analysis – Glacial till Deposit

Sample	Depth (mbgs)	Soil	Gravel (%)	Sand (%)	Silt and Clay (%)
BH101-24, SS06	4.6 – 5.2	Silty gravelly sand	25	47	28
BH111-24 SS07	6.1 – 6.6	Sandy silty gravel	42	29	29

Atterberg Limits testing was completed on one sample of the glacial till. The results are summarized in the table below.

Table 7 Atterberg Limits Testing – Glacial Till

Sample	Depth (mbgs)	Soil	Liquid Limit (%)	Plastic Limit (%)	Plastic Index (%)	Classification	Moisture Content (%)
BH101-24, SS06	4.6 – 5.2	Silty gravelly sand	-			Non-Plastic	8.5

4.5 Auger Refusal

Eight of the boreholes terminated due to practical refusal. The depths to the refusal at each borehole location are summarized on Table 8 below.

Table 8 Practical Refusal Summary

Location	Depth/Elevation(mbgs)
BH101-24	6.1
BH102-24	6.0
BH103-24	6.1
BH104-24	6.4
BH105-24	6.1
BH109-24	6.2
BH111-24	6.6
BH112-24	6.6

Refusal depths are generally consistent across the site, where encountered, at depths of around 6 mbgs. It is anticipated that where refusal was not encountered refusal will likely be within 1 to 2 m from termination depths. It should be noted that practical refusal can also be encountered on boulders within glacial till deposits, and refusal depths may not indicate bedrock.

There is typically a weathered zone at the contact between the top of the bedrock and the overlying overburden material. Bedrock will transition with depth from fully weathered (soil-like and indistinguishable from glacial till), to partially weathered (angular stones with soils matrix), to sound bedrock (regular fissuring). Bedrock was not cored as part of this investigation.

The bedrock beneath the site is of the March Formation, which is a deposit comprised predominantly of dolostone and sandstone.

4.6 Groundwater

Groundwater level was measured in monitoring wells installed by Cambium on October 3, 2024. In addition to the Cambium wells, 3 other wells were observed on site installed previously by Others. The origin and construction of these other wells are unknown to us, however groundwater readings were also taken in these wells. The results are summarized in the Table 9 below. The groundwater level was measured in the installed wells with an electronic water level tape.

Table 9 Summary of Groundwater Measurements

Borehole	Depth of well (mbgs)	Groundwater Level (mbgs)
		October 3, 2024
BH110-24	6.1	3.1
BH111-24a	6.1	3.3
BH112-24b	6.0	3.1
Monitoring Well A	4.0	2.8
Monitoring Well B	3.8	2.9
Monitoring Well B	3.6	2.9

Groundwater levels at the Site are anticipated to vary between and beyond the borehole locations and to fluctuate on a seasonal basis and in response to significant precipitation or snowmelt events.

4.7 Chemical Analysis

One soil sample was submitted to Paracel Laboratories Ltd for chemical corrosivity analysis. The laboratory results are presented in Appendix D. The sample was analysed for chloride, sulphate, pH, resistivity, sulphide concentration, and redox potential. The submitted sample, taken from BH104-24, was taken from a depth of 1.5 to 2.1 mbgs.

To determine the potential for corrosion, the laboratory results were compared to the ANSI/AWWA corrosivity rating system, and the total points were less than 10. Based on the total points scored, corrosive protective measures on unprotected steel are not considered necessary.

Please note that there may be other overriding factors in the assessment of corrosion potential, such as redox potential, the nature of effluent conveyed, the application of de-icing salts on any access roads and subsequent leaching into the subsoils and stray currents.

The laboratory test results also indicate that the soluble sulphate concentration of the tested sample is less than 0.1%. Based on this concentration, there is a negligible potential for sulphate attack on concrete. Accordingly, normal Type 10 Portland cement can be used.

5.0 Geotechnical Design Considerations

This section of the report provides engineering information and recommendations for the geotechnical design aspects of the project based on our interpretation of the borehole information, the laboratory test data and on our understanding of the project requirements. The following recommendations are provided to assist designers. It is possible that subsurface conditions beyond the borehole locations may vary from those observed. Recommendations should not be construed as providing instructions to contractors, who should form their own opinions about site conditions. Contractors bidding on or undertaking any work at the Site should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction and make their own interpretation of the factual data as it affects their proposed construction techniques, schedule, equipment capabilities, costs, sequencing, and the like. If significant variations are found before or during construction, Cambium should be contacted so that we can reassess our findings, if necessary.

Cambium will not assume any responsibility for construction-related decisions made by contractors on the basis of this report.

As previously stated in Section 2.2, it is Cambium's understanding that the proposed development includes a two-storey elementary school building which will include at grade parking, exterior play areas, and location for portable classrooms. With the exception of boreholes BH107-24 through BH109-24, all other boreholes were advanced within the anticipated footprint of the building.

5.1 Frost Penetration

Based on OPSD 3090.101 [6], frost penetration depth at the site is estimated at 1.8 m. Foundation footings for both heated and unheated structures should be situated at or below this depth for frost protection. If foundations cannot extend to the required depth, equivalent insulation should be provided. Frost protection could be provided with rigid polystyrene insulation (such as DOWN Styrofoam HI40, or equivalent). Insulation should be provided based on the depth of required frost cover, with 25 mm of insulation equivalent to 300 mm of soil cover. An insulation detail can be provided upon request.

5.2 Grade Raise Restrictions

The site is underlain by a deposit of cohesive deposits which are sensitive to secondary settlement. The cohesive soils have a limited capacity to support loads imposed by grade raise fill material in combination with the loads from structures.

The settlement response of the cohesive deposits to the increase in loading is influenced by variables such as the existing effective overburden pressure, the past preconsolidation pressure of the material, the compressibility characteristics of the deposit, and the presence or absence of drainage paths within the deposit. The settlement response can be significant when the stress increase is at or near the difference between the preconsolidation pressure and the existing overburden stress.

Based on our analysis of the cohesive deposits, any grade raise to the site should be limited to at most 1.2 m unless the grade raise is completed well in advance of construction.

Grade raise restrictions can be limited to the area surrounding the building and other structural elements. Any grade raises should be limited to the above indicated height within 3 m of any settlement sensitive structures such as the building and associated underground site services, hardscapes like exterior concrete slabs, play structures, retaining walls, etc. Beyond 3 m from settlement sensitive structures, the grade raise restriction may be increased to 4.0 m.

For an additional cost Cambium can be retained to review site grading plans to confirm that the grade raise restrictions have been appropriately followed.

5.3 Temporary Excavation and Support

Temporary excavations must be carried out in accordance with the latest edition of the Occupational Health and Safety Act (OHSA) and Ontario Health and Safety Regulations for Construction Projects (O. Reg 213). It is anticipated that temporary excavations into the cohesive deposits, and cohesionless silts at this site can be classified as Type 4 soils and a maximum side slope inclination of 3H:1V would be required for OHSA compliance, or appropriately shored. Excavations advanced through the overlying fill may be classified as Type 3 soils and a maximum side slope inclination of 1H:1V can be applied. For excavations progressing through different soil types, the greater type will govern slope requirements.

Care should be taken to direct surface runoff away from the open excavations. Stockpiles of excavated materials should be kept at least at the same distance as the excavation depth from the top edge of the excavation to prevent slope instability.

The underlying clays are noted to measure natural water contents at or above the liquid limit. As a result, excavating into these materials may result in difficulty in stockpiling. Additionally, backfilling or re-use of the materials following excavation will require an allocation of time to allow for the material to dry prior to re-use.

5.4 Temporary Groundwater Control

Groundwater was measured on October 3, 2024. The measurements indicate that the static groundwater level at around 3 mbgs. Additionally, natural moisture contents within the silt deposits are significant. Therefore, it is anticipated that the excavations extending into these underlying silts will encounter significant groundwater inflow. Moisture contents of the glacial till measured relatively low, indicting groundwater flow is likely perched on the overlying silts and clayey deposits.

Water takings in excess of 50 m^3/day are regulated by the (Ministry of the Environment, Conservation and Parks (MECP). Certain takings of groundwater and storm water for construction site dewatering purposes with a combined total less than 400 m^3/day qualify for self-registration on the MECP's Environmental Activity and Sector Registry ("EASR"). A Category 3 PTTW is required where the proposed water taking is greater than 400 m^3/day. At a minimum, an EASR is likely required for this site. An EASR posting should be obtained in advance of construction to avoid possible delays.

It is recommended that further hydrogeological studies are completed to confirm the anticipate dewatering quantities based on excavation requirements.

Any excavation work advancing deeper than the prevailing groundwater table will require positive dewatering prior to excavation. Static groundwater level should be maintained at least 1.0 m below the base of the excavations.

5.5 Foundation Design

5.5.1 Shallow Spread Footings

Conventional shallow spread footings placed directly on the upper firm cohesive deposits should be sized using a net reaction at **SLS** of **75 kPa**, and a factored geotechnical resistance at **ULS** of **125 kPa**. Foundations must bear on the upper firm silt and clay or clayey silt, situated at most 1.8 m below current site grades. Where subexcavation is required to due fill material or unsuitable bearing surfaces, the grade may be raised using engineered fill.

Engineered fill must be placed directly on the undisturbed native deposits and the pad of engineered fill should conform to Ontario Provincial Standards Specification (OPSS.MUNI) 1010 Granular B Type II. The imported engineered fill should be placed in maximum 200 mm thick lifts to at least 98 % of the standard proctor maximum dry density (SPMDD) value. To allow for adequate spread of the loading below and beyond the footings, the engineered fill should extend a horizontal distance of at least 300 mm beyond the edge of the footings and then down and away from the edges at an angle of 1H:1V, or flatter. Excavations should be sized to accommodate fill placement.

Bearing capacity values assume a strip footing width of 1.2 m and spread footing dimensions of 3 m x 3 m. Cambium should be contacted to review actual site grading/footing drawings, when available, to confirm bearing capacity estimates and/or revise if necessary.

The quality of the subgrade should be inspected by Cambium during construction, prior to constructing the footings, to confirm bearing capacity estimates. If loose or deleterious material is encountered, the material should be subexcavated and replaced with approved engineered fill placed in maximum 200 mm thick lifts and compacted to at least 98 % SPMDD value. Soft or disturbed clayey soils should not be considered suitable for support of the foundations and should be subexcavated to underlying competent material.

5.5.2 Options for Greater Bearing Capacity

The site is underlain by very loose deposits of silt which have limited capacities to support foundation loads. The following foundations options may be considered for the proposed buildings:

1. Option 1 – helical piles, extending to competent underlying materials
2. Option 2 – non-conventional ground improvement/foundation options such as Grouted Rammed Aggregate Piers (RAP), Concrete Modulus Columns or Geopiers, or ground improvement options including rapid impact compaction
3. Option 3 – Micropiles embedded in the underlying bedrock

5.5.3 Option 1 –Helical Piles

Helical piles extended to the underlying glacial till or bedrock may be considered to support the proposed buildings.

Square shaft helical piles with a diameter of 38-mm may be considered. Bearing capacities for helical piles will be dependant on contractor materials and installation. A conservative capacity estimate of **200 kN SLS** and **270 kN ULS** is likely achievable and may be considered for design purposes.

The helical piles would be designed by the specialist supplier. Actual capacities of the piles will vary.

5.5.4 Option 2 – Ground Improvement

Rammed Aggregate Pier (RAP) soil reinforcing elements are installed by ramming an open-graded aggregate into the ground to form a very stiff, high-density aggregate pier. Ramming takes place with a vertical vibration hammer and crowd pressure with a tamper base that both densifies the aggregate and forces the aggregate laterally into the surrounding native soil. This action increases the lateral stress in the surrounding soil and increases the composite density of the soil mass. RAP can be constructed using the following two methodologies:

Geopier method: This method involves pre-drilling a hole in the soil with an auger and placing crushed rock at the bottom of the hole. The crushed rock is then rammed by a hydraulic hammer and then layers of well graded crushed rock are rammed on top of it (averaging a 12-inch compacted lift thickness). This ramming effect creates a very dense, stiff rock pier that expands the drilled shaft and reinforces the soil.

Impact method: This method includes driving a hollow mandrel into the ground, ¾ inch stone is then delivered through the hollow mandrel. The mandrel is raised and then lowered to compact thin lifts of the aggregate.

The method, spacing/layout and bearing capacity of the piers would be provided by the specialist contractor based on the proposed design details. The specialist contractor will have to be retained by the client.

5.5.5 Option 3 – Micropiles

Micropiles that are socketed into bedrock could also be utilized to support foundation loads at this Site. Bedrock was not cored as part of this investigation. The upper zone of the bedrock may be partially weathered and thus have a limited capacity relative to sound bedrock. It is estimated that the weathered zone at this site may range from 0.3 to 1 m in length. It is recommended that rock coring is completed to confirm the bedrock type and condition.

Micropiles are small diameter steel shafts with a centralized rigid element (generally threaded steel bar) that are advanced to a suitable bearing stratum via methods that can penetrate some obstructions (e.g. cobbles, boulders, some deleterious materials) and subsequently filled with grout. A working adhesion between the grout and bedrock at ULS of 250 kPa may be used for this site. As each micropile system is slightly different, a specialist contractor would be required to determine the final number of piles based on the specific capacities of their systems.

5.6 Rock Anchors

The bedrock was not cored as part of this investigation, however practical refusal was encountered at consistent depths across the site, indicating the depth to bedrock is estimated to be 6.0 to 6.6 m below existing grades. Bedrock underlying the site is mapped as sandstone and/or dolostone of the March Formation.

As indicated, the underlying bedrock was not cored as part of this investigation, therefore anchors made into the bedrock may be designed using a ULS working adhesion of 250 kPa. The unconfined compressive strength of the grout used should be at least 30 times the design working adhesion. The installation of the anchors should be tested to at least 133 % of the design load. Embedment depth of the rock anchors will depend on required loads however a

minimum of 1.8 m is recommended for this site. Depending on the extent of weathering of the underlying rock, greater embedment depths may be required. Minimal distance between 2 anchors should be at least 4 times the diameter of the anchor hole to negate group effects. Two adjacent rock anchors will have to be tested simultaneously to observe group effect conditions.

It is recommended that rock coring is completed at this site to assess the quality of the underlying bedrock and refine the above design recommendations.

5.7 Seismic Site Classification

The Ontario Building Code (2024) stipulates the methodology for earthquake design analysis, as set out in Subsection 4.1.8. The determination of the type of analysis is predicated on the importance of the structure, the spectral response acceleration, and the site classification.

An MASW survey has been completed at this site to measure the average V_s of the upper 30 m of the site stratigraphy. The results of this survey indicate an average V_s of 724 m/s for the equivalent single layer response between the surface and 30 m in depth. If all foundations, including interior foundations, are placed below 1.8 mbgs the V_s may be increased to 850 m/s. It assumed the foundations for the proposed building will be placed on the silty clay deposits, the designation of the seismic analysis can be taken as **Site Class C.**

Once final site grades are foundation elevations are provided, the seismic site class should be confirmed. If foundations are deepened to be supported on underlying bedrock, it should be possible to improve the seismic site class.

5.8 Backfill For Foundation Elements

The existing sand and silt fills across the site may be useable as backfill against foundation elements, provided they are free of organics or deleterious materials. The material should be stockpiled, inspected, and approved by Cambium personnel prior to reuse.

The native soils at this site, such as the silts and clays, should not be used as backfill against exterior or unheated foundation elements or below settlement sensitive structures. All material containing organics should not be used as backfill against the foundation walls.

To avoid frost adhesion and possible heaving, all foundation walls are to be backfilled with non-frost susceptible granular material such as imported material meeting OPSS Granular B Type I or II.

Backfill adjacent to the structural elements (i.e., foundation walls) should be placed evenly in lifts not exceeding 200 mm loose thickness and should be compacted to at least 95% of SPMDD taking care not to damage the adjacent structures. Light compaction equipment such as small vibratory or hand operated ram equipment should be used immediately adjacent to the wall; otherwise, compaction stresses on the wall may be greater than that imposed by the backfill material.

5.9 Soil Friction

The frictional resistance of soil can be expressed, unfactored, as **tan φ**. Factored soil friction resistance between two different soil types, should be taken as $\mathbf{0.6}\ tan\varphi$, where **φ** is the lower friction angle between the two soil types. Friction angles for the soils encountered at the site are provided in the table below.

Table 10 Friction Angles

Soil	Internal Friction Angle Φ' (°)	Coefficient of Friction
Compacted Imported Engineered Fill (Granular A or B)	35	0.42
Existing Earth Fill	30	0.35
Native Silt and Clay	28	0.32
Native Silt	25	0.28
Glacial Till	32	0.37

5.10 Slab-on-Grade Construction

It is anticipated that the floor slabs can be designed as a concrete slab-on-grade.

The slab may be supported on compacted engineered fill such as material meeting OPSS.MUNI 1010 Granular A or B Type II placed directly on the underlying native deposits.

The exposed subgrade should be inspected by Cambium. Remedial work should be carried out on any softened, disturbed, wet or poorly performing zones as directed by Cambium. Any

low areas may then be brought up to within at least 200 mm of the underside of the floor slabs, as required, using OPSS Granular B, Type I material or other approved material, placed in maximum 200 mm loose lifts and uniformly compacted to at least 98% of SPMDD.

The final lift of granular fill beneath floor slabs should consist of a minimum thickness of 200 mm of OPSS Granular A material, uniformly compacted, acting as a moisture barrier. Any filling operations should be inspected and tested by Cambium. Additional Granular A material may be needed to provide adequate pipe bedding and cover, depending on the requirements for an under-slab drainage system.

The floor slabs should be structurally separate from the foundation walls and columns. Sawcut control joints should be provided at regular intervals and along column lines to minimize shrinkage cracking and to allow for any differential settlement of the floor slabs.

For initial analyses, the moduli of subgrade reaction appropriate for slab on grade design on the soils at the site are as follows:

- Engineered Fill: 22 MPa/m

The above capacities may be improved using ground improvement as outlined in Section 5.5.2 Alternative, the floor slabs can be designed as a structural concrete slab-on-grade, supported by the deep foundations.

5.11 Lateral Earth Pressure

The design of the foundation walls, if required, should consider the horizontal soil loads, as well as surcharge loads that may occur during or after construction. The backfill materials should consist of imported free-draining granular soils (e.g. OPSS Granular B, Type I or Granular A and Granular B Type II) as approved by a Geotechnical Engineer. The backfill materials should be placed in lifts not exceeding 200 mm thick. The layers should be compacted to at least 95% of SPMDD. Lateral earth pressure coefficients (K) are shown in Table 11.

Table 11 Lateral Earth Pressure Coefficients

Soil	Bulk Unit Weight γ (kN/m3)	Internal Friction Angle Φ' (°)	Active earth pressure coefficient Ka (Rankine)	Passive earth pressure coefficient Kp (Rankine)	At-rest earth pressure coefficient Ko (Rankine)
Compacted Imported Engineered Fill (Granular A or B)	22	35	0.27	3.69	0.43
Existing Earth Fill	21	30	0.33	3.0	0.50

**Values derived from empirical relationships based on soil types and SPT N-values*

The earth pressure coefficient adopted will depend on whether the retaining structure is restrained, or some movement can occur such that the active state of earth pressure can develop. The use of vibratory compaction equipment immediately behind the retaining walls should be restricted in size.

The coefficients provided in Table 11 assume that the surface of the granular backfill or native material is horizontal against any proposed wall, and the wall is vertical and smooth. Cambium should be contacted to provide updated lateral earth pressure coefficients should the assumptions differ to those noted.

The following formula may be used to calculate active lateral thrust (Pa) on yielding retaining structures.

$$P_a = (\mathrm{H}/2)(\mathrm{K_a})(\gamma\mathrm{H}+2\mathrm{q})$$

where,

H = Height of retaining structure (m)

γ = unit weight of retained soil (kN/m³)

q = surcharge (kPa)

Unit weights found in Table 11 should be used for compacted loadings of the appropriate material.

Where traffic loads are expected within 3 meters of the foundation walls, a vehicle surcharge pressure of at least 3 and up to 6 kPa should be applied; the actual surcharge pressure should depend on the type of traffic.

5.12 Perimeter Drainage

Perimeter drainage is not considered necessary for slab on grade structures at this site, provided that floor slabs are situated at least 300 mm above exterior grades but can be provided as a redundancy. A perimeter foundation drainage system should consist of geotextile wrapped perforated 100 mm diameter pipes surrounded by a trench of 19 mm clear stone around the foundations. Any drainage system should outlet to a suitable discharge point under gravity flow away from the structures, or to a sump pit and pumped out. The design of the system must conform to applicable plumbing code requirements.

5.13 Buried Utilities

5.13.1 Frost Protection for Underground Services

It is recommended to place water services at a minimum depth of 300 mm below the frost penetration depth with the top of the pipe located at 1.8 mbgs or lower as dictated by municipal service requirements. If a minimum of 1.8 m of soil cover cannot be provided, then the pipe should be insulated with a rigid polystyrene insulation (DOW Styrofoam HI40, or equivalent) or a pre-insulated pipe be installed.

5.13.2 Subgrade Preparation

Any underground services proposed as part of the construction may be founded directly on the upper portions (firm) of the underlying cohesive deposits. Excavation and dewatering recommendations are provided in the section below. The subgrades will consist mainly of soft silty clay. Care should be taken to reduce construction traffic directly on the silty clay. Geotextile and pipe bedding should be placed immediately following excavation.

5.13.3 Excavation and Dewatering

Excavation and dewatering for trenches should adhere to the recommendations provided in Sections 5.3 and 5.4, respectively. Provided that trench excavation do not extend into

underlying loose silt deposits, and that trenches are limited in length and kept open for only a limited time, groundwater control within the silty clay should be manageable with sump pumps.

5.13.4 Pipe Bedding and Cover Materials

Bedding and cover material for any services should conform to Ontario Provincial Standard Drawings (OPSD) 802.010 and 802.013 (flexible pipes) and OPSD 802.031 to 802.033 (rigid pipes). The pipe bedding should consist of 200 mm of OPSS.MUNI 1010 Granular A wrapped by a geotextile (Terrafix 270R or similar). The bedding and cover material shall be placed in maximum 200 mm thick lifts and should be compacted to at least 95% SPMDD. The cover material shall extend a minimum of 300 mm above the top of the pipe and be compacted to a minimum of 95% of SPMDD, taking care not to damage the utility pipes during compaction. The use of clear stone should not be permitted.

5.13.5 Pipe Backfill

Above the pipe cover material, the pipe can be backfilled by using imported granular fill material such as OPSS.MUNI 1010 Granular B, Type I. An alternative select subgrade material (SSM) may be used as well, provided that the material is approved by Cambium prior to use. The re-using of excavated organic free native soils is likely not feasible due to the high moisture content and composition of the material. The cohesionless fill materials located from the surface of the site may be re-useable. The soils should be placed in maximum 300 mm thick lifts compacted to 95% SPMDD.

5.14 Pavement Design

5.14.1 Subgrade Preparation

The performance of the pavement is dependent upon proper subgrade preparation. All organic materials should be removed and backfilled with approved engineered fill, compacted to 98% SPMDD. The subgrade should be inspected by a Geotechnical Engineer. The most severe loading conditions on pavement subgrades will likely occur during construction, and subgrades may become disturbed due to construction operations, particular with construction traffic driving over unpaved granular subbase or base roadways.

Depending on the construction traffic and the effect on the pavement materials, increasing the thickness of the subbase and/or base materials may become necessary. The requirements for increase can be assessed by geotechnical personnel as needed.

5.14.2 Pavement Structure

The recommended minimum pavement structure design has been developed for two traffic loading scenarios, light duty and heavy duty. The heavy-duty design is appropriate for school bus lanes and emergency vehicle routes, while the light duty design is appropriate for areas where no heavy traffic is anticipated. The recommended minimum pavement structure is provided in Table 12.

Table 12 Pavement Structure

Pavement Layer	Light Duty	Heavy Duty
Surface Course Asphalt	40 mm SP12.5	40 mm SP12.5
Binder Course Asphalt	60 mm SP19	120 mm SP19 (2 lifts of 60 mm)
Granular Base	150 mm OPSS1010 Granular A	200 mm OPSS1010 Granular A
Granular Subbase	300 mm OPSS1010 Granular B Type II	450 mm OPSS1010 Granular B Type II

Material and thickness substitutions must be approved by the Design Engineer. Compaction of the subgrade should be verified by the Engineer prior to placing the granular base. Granular layers should be placed in 150 mm maximum loose lifts and compacted to at least 98 % of the SPMDD value. The granular materials should conform to OPSS standards, as confirmed by appropriate materials testing.

5.14.3 Asphaltic Cement Type

Performance grade PG 58-34 asphaltic cement, Traffic Level C, should be specified for Superpave asphaltic concrete mixes.

5.14.4 Pavement Drainage

Adequate drainage of the pavement granular materials and subgrade is important for the long-term performance of the pavement at this site. The subgrade surface should be crowned and shaped to drain to ditches and/or catch basins to promote drainage of the granular material.

6.0 Limitations and Use of Report

This geotechnical engineering report intended for planning and design purposes only. This investigation has been carried out using investigation techniques and engineering analysis methods consistent with those ordinarily exercised by engineering practitioners. The discussion and recommendations that have been presented are based on factual data obtained from this investigation.

6.1 Additional Investigation Work

As noted, it is recommended that further studies are conducted to confirm the anticipated dewatering requirements depending on the foundation design. Rock coring is recommended to confirm rock anchor recommendations.

6.2 Design Review and Inspections

It is recommended that Cambium be contacted to review and approve design drawings, prior to tendering or commencing construction, to ensure that all pertinent geotechnical-related factors have been addressed. It is important that onsite geotechnical supervision be provided at this site for excavation and backfill procedures, deleterious soil removal, subgrade inspections and compaction testing.

6.3 Changes in Site and Project Scope

Subsurface conditions can be altered by the passage of sufficient time, natural occurrences, and human intervention. In particular, consideration should be given to contractual responsibilities as they relate to control of groundwater seepage, disturbance of soils, and frost protection.

The design parameters provided, and the engineering advice offered in this report are intended for use by the owner and its retained design consultants. If there are changes to the project scope and development features, these interpretations made of the subsurface information, for geotechnical design parameters, advice, and comments relating to constructability issues and quality control may not be complete for the project. Cambium should be retained to conduct further review to interpret the implications of such changes with respect to this report.

7.0 Closing

Please note that this work program and report are governed by the attached Qualifications and Limitations. If you have questions or comments regarding this document, please do not hesitate to contact the undersigned at (705) 742-7900.

Respectfully submitted,

Cambium Inc.

DocuSigned by:
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Stuart Baird
Director of Technical Operations, Services

DS

LICENSED PROFESSIONAL ENGINEER
B. VIJAYABASKARAN
100216716
PROVINCE OF ONTARIO
2025-02-07

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6439A79ECBB1496...

Blasco Vijayabaskaran
Project Manager

BV/SB

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8.0 Standard Limitations

Limited Warranty

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Site Assessments

A site assessment is created using data and information collected during the investigation of a site and based on conditions encountered at the time and particular locations at which fieldwork is conducted. The information, sample results and data collected represent the conditions only at the specific times at which and at those specific locations from which the information, samples and data were obtained and the information, sample results and data may vary at other locations and times. To the extent that Cambium's work or report considers any locations or times other than those from which information, sample results and data was specifically received, the work or report is based on a reasonable extrapolation from such information, sample results and data but the actual conditions encountered may vary from those extrapolations.

Only conditions at the site and locations chosen for study by the client are evaluated; no adjacent or other properties are evaluated unless specifically requested by the client. Any physical or other aspects of the site chosen for study by the client, or any other matter not specifically addressed in a report prepared by Cambium, are beyond the scope of the work performed by Cambium and such matters have not been investigated or addressed.

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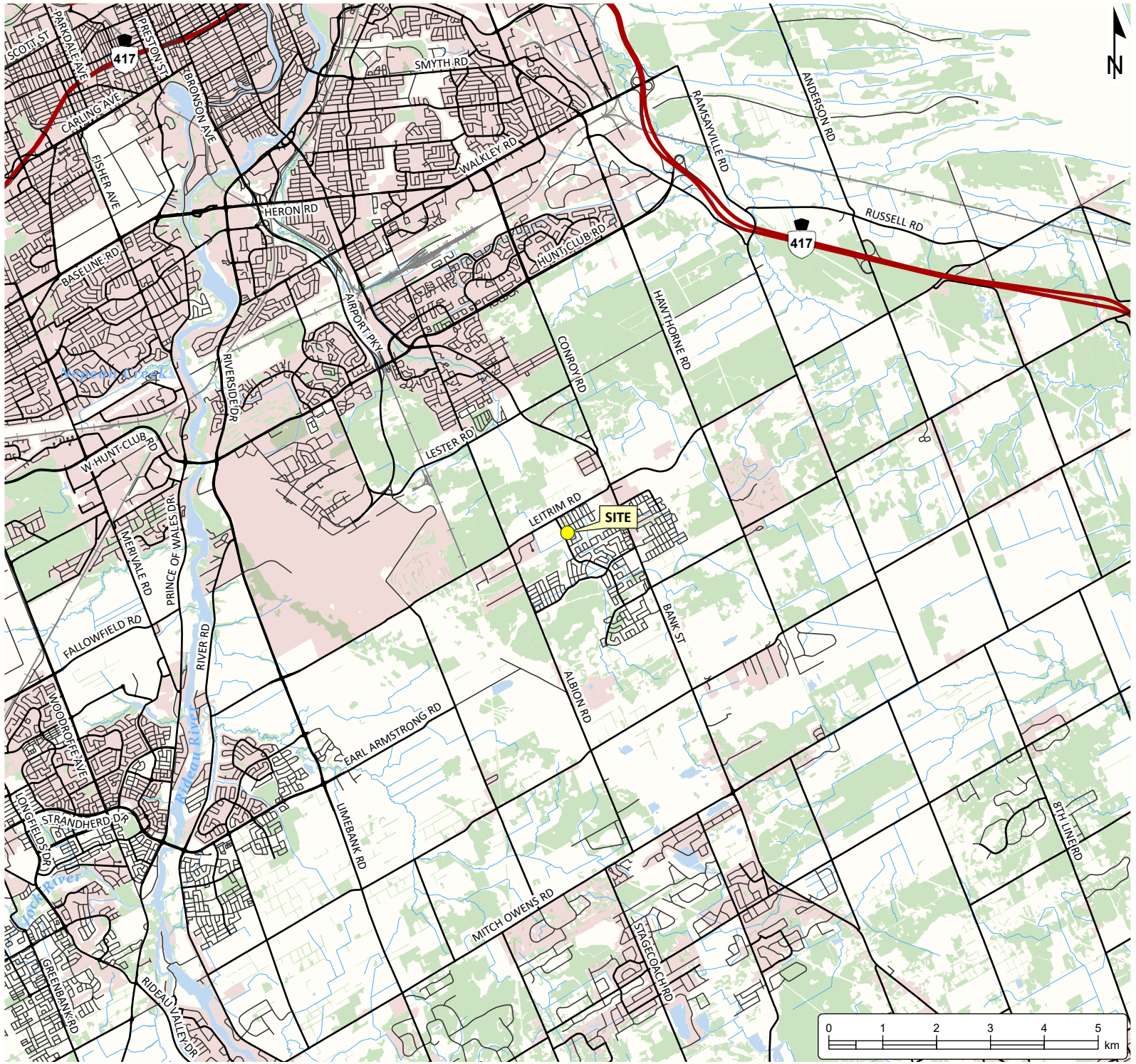
Appended Figures



GEOTECHNICAL INVESTIGATION

CONSEIL DES ÉCOLES PUBLIQUES DE L'EST DE L'ONTARIO
3955 Promenade Kelly Farm
Ottawa, Ontario

LEGEND

- Highway
- Major Road
- Minor Road
- Railway
- Watercourse
- Water Area
- Wooded Area
- Built Up Area

Notes:
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SITE LOCATION PLAN

Project No.: 21388-001		Date: October 2024	Rev.:
Scale: 1:100,000		Projection: NAD 1983 UTM Zone 18N	
Created by: LD	Checked by: BV	Figure: 1	

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GEOTECHNICAL INVESTIGATION

CONSEIL DES ÉCOLES PUBLIQUES DE L'EST DE L'ONTARIO
3955 Promenade Kelly Farm
Ottawa, Ontario

LEGEND

- Benchmark
- Borehole
- Site (approximate)

Notes:
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BOREHOLE LOCATION PLAN

Project No.: 21388-001		Date: October 2024	Rev.:
Scale: 1:1,500		Projection: NAD 1983 UTM Zone 18N	
Created by: LD	Checked by: BV	Figure: 2	

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Appendix A
Borehole Logs

Client:	Conseil des ecoles publiques de l'Est de l'Ontario	**Project Name:**	Proposed School Prom. Kelly Farm Ottawa	**Log of Borehole:**	BH101-24
Contractor:	Canadian Environmental Drilling	**Method:**	Track Mounted Solid Stem Auger	Page:	1 of 1
Project No.:	21388-001	**Elevation:**	198.77 mREL	**Date Completed:**	2024-09-24
Location:	3955 Promenade Kelly Farm, Ottawa ON	**UTM:**	18T **N:** 5019087 **E:** 452193.5		

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) 25 50 75 / % Moisture 25 50 75	Shear Strength Cu, kPa (nat V., rem V.) 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
198.8	0	**FILL:** (SM) gravelly SILTY SAND: brown, moist, loose, with organics		01	SS	54	5	15.1%	5		
198.3	0.5										
197.8	1			02	SS	50	6	10.8%	6		
197.3	1.5		197.25 / 1.52								
		(ML) SILT and CLAY: grey-brown, w~PL, firm, trace sand, trace gravel		03	SS	100	5	30.1%	5		
196.8	2										
		grey, some sand									
196.3	2.5			04	SS	100	1	38.3%	1		
195.8	3		195.72 / 3.05								
		(SM) gravelly SILTY SAND: grey, wet, compact [GLACIAL TILL]		05	SS	100	12	9.4%	12		
195.3	3.5										
194.8	4										
194.3	4.5										
				06	SS	67	21	8.5%	21		
193.8	5										
193.3	5.5										
192.8	6		192.67 / 6.10								Borehole did not cave-in upon removal of augers. Standing water observed at 5.2 mbgs.
		Borehole terminated @ 6.1 mbgs due to practical auger refusal encountered.									
192.3	6.5										
191.8	7										
191.3											

GRAINSIZE DISTRIBUTION

SAMPLE	GRAVEL	SAND	SILT	CLAY
SS3	2	8	48	42
SS4	3	17	44	36
SS6	25	47	26	2

Logged By: RR **Input By:** JS

Client:	Conseil des ecoles publiques de l'Est de l'Ontario	**Project Name:**	Proposed School Prom. Kelly Farm Ottawa	**Log of Borehole:**	BH102-24
Contractor:	Canadian Environmental Drilling	**Method:**	Track Mounted Hollow Stem Auger	Page:	1 of 1
Project No.:	21388-001	**Elevation:**	198.36 mREL	**Date Completed:**	2024-09-24
Location:	3955 Promenade Kelly Farm, Ottawa ON	**UTM:**	18T **N:** 5019068 **E:** 452195		

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI (25 50 75) / % Moisture (25 50 75)	Shear Strength Cu, kPa nat V. rem V. (20 40 60 80) / SPT (N) (20 40 60 80)	Well Installation	Log Notes
198.4	0	**FILL:** (SM) gravelly SAND and SILT: brown, moist, loose, with organics and wood debris	197.60 / 0.76	01	SS	50	4	15.2%	4		
197.9	0.5										
197.4	1	**(ML) SILT and CLAY:** brown, w~PL, firm		02	SS	50	6	16%	6		
196.9	1.5			03	SS	100	4	37.2%	4		
196.4	2		196.07 / 2.29								
195.9	2.5	**(ML) SILT:** grey, wet, very loose, trace sand, trace gravel		04	SS	100	1	32.2%	1		
195.4	3			05					22 44		
194.9	3.5			06					44		
194.4	4		194.40 / 3.96								4m: Material change on augers presumed transition to till.
193.9	4.5	**(SM) gravelly SILTY SAND:** grey, wet, compact [GLACIAL TILL]									
193.4	5			07	SS	100	24	9.5%	24		
192.9	5.5										0.15 m of flowing material inside augers after reaching refusal at 6.0 mbgs
192.4	6		192.34 / 6.02								Borehole caving observed 3.4 mbgs. Standing water observed at 2.6 mbgs.
191.9	6.5	Borehole terminated @ 6 mbgs due to practical auger refusal encountered.									
191.4	7										
190.9											

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

Logged By: RR **Input By:** JS

Peterborough, Barrie, Whitby, Kingston, Ottawa

Client:	Conseil des ecoles publiques de l'Est de l'Ontario	**Project Name:**	Proposed School Prom. Kelly Farm Ottawa	**Log of Borehole:**	BH103-24
Contractor:	Canadian Environmental Drilling	**Method:**	Track Mounted Solid Stem Auger	Page:	1 of 1
Project No.:	21388-001	**Elevation:**	198.81 mREL	**Date Completed:**	2024-09-23
Location:	3955 Promenade Kelly Farm, Ottawa ON	**UTM:**	18T **N:** 5019067 **E:** 452136.3		

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) 25 50 75 / % Moisture 25 50 75	Shear Strength Cu, kPa (nat V., rem V.) 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
198.8	0	**FILL:** (SM) gravelly SAND and SILT: brown to blackish-brown, wet, very dense to dense, with cobbles and boulders		01	SS	75	49	7.3%	49		
198.3	0.5										
197.8	1			02	SS	73	30	8.6%	30		hydrocarbon odor
197.3	1.5	becomes loose		03	SS	29	7	11.1%	7		
196.8	2		196.52 / 2.29								
196.3	2.5	**(ML) SILT and CLAY:** grey, w~PL, soft, trace sand sand lenses throughout		04	SS	96	3	31.6%	3		
195.8	3		195.76 / 3.05								
195.3	3.5	**(ML) CLAYEY SILT:** grey, w>pl, firm, trace sand, trace gravel		05	SS	100	6	24.7%	6		
194.8	4	clayey seems throughout		06	SS	79	2	24.1%	2		
194.3	4.5		194.24 / 4.57								
193.8	5	**(ML) SILT:** grey, wet, very loose, trace sand, trace gravel		07	SS	100	0	23.4%			
193.3	5.5	becomes very dense		08	SS	100	>50	27.5%			
192.8	6		192.76 / 6.05								Borehole caving observed 5.6 mbgs. Standing water observed at 4.3 mbgs.
192.3	6.5	Borehole terminated @ 6 mbgs due to practical auger refusal encountered.									
191.8	7										
191.3											

GRAINSIZE DISTRIBUTION	SAMPLE	GRAVEL	SAND	SILT	CLAY
	SS2	26	39	35	

Logged By: RR **Input By:** JS

Peterborough, Barrie, Whitby, Kingston, Ottawa

Client:	Conseil des ecoles publiques de l'Est de l'Ontario	**Project Name:**	Proposed School Prom. Kelly Farm Ottawa	**Log of Borehole:**	BH104-24
Contractor:	Canadian Environmental Drilling	**Method:**	Track Mounted Hollow Stem Auger	Page:	1 of 1
Project No.:	21388-001	**Elevation:**	198.89 mREL	**Date Completed:**	2024-09-23
Location:	3955 Promenade Kelly Farm, Ottawa ON	**UTM:**	18T **N:** 5019044 **E:** 452157.1		

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) 25 50 75 / % Moisture 25 50 75	Shear Strength Cu, kPa 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
198.9	0	**FILL:** (SM) gravelly SAND and SILT: brown, moist, compact, with cobbles and boulders	197.37	01	SS	42	10	7.3%	10		
198.4	0.5										
197.9	1			02	SS	58	9	11.5%	9		
197.4	1.5	**(ML) SILT and CLAY:** grey, w~PL, firm, trace sand	1.52 / 196.60	03	SS	50	7	18.8%	7		
196.9	2										
196.4	2.5	**(ML) CLAYEY SILT:** grey, moist, loose, trace sand, trace gravel	2.29	04	SS	100	4	36.5%	4		Sand seams occur between 2.1 mbgs and 5.18 mbgs.
195.9	3	sand lenses every 100 to 150 mm.		05	SS	100	3	29.3%	3		
195.4	3.5		195.08								
194.9	4	**(ML) SILT:** grey, wet, very loose, trace sand, trace gravel	3.81	06	SS	100	0	26%			
194.4	4.5			07					1 2		
193.9	5		193.56	08					22 33		
193.4	5.5	**(SM) gravelly SILTY SAND:** grey, wet, dense [GLACIAL TILL]	5.33	09	SS	13	36	14.2%	36		
192.9	6		192.49	10	SS	100	>50	9.8%			Borehole caving observed 5.5 mbgs. Standing water not observed in open hole.
192.4	6.5	Borehole terminated @ 6.4 mbgs due to practical auger and SPT refusal encountered.	6.40								
191.9	7										
191.4											

GRAINSIZE DISTRIBUTION	SAMPLE	GRAVEL	SAND	SILT	CLAY
	SS5	1	5	74	20

Logged By: RR **Input By:** JS

Peterborough, Barrie, Whitby, Kingston, Ottawa

Client:	Conseil des ecoles publiques de l'Est de l'Ontario	**Project Name:**	Proposed School Prom. Kelly Farm Ottawa	**Log of Borehole:**	BH105-24
Contractor:	Canadian Environmental Drilling	**Method:**	Track Mounted Solid Stem Auger	Page:	1 of 1
Project No.:	21388-001	**Elevation:**	198.89 mREL	**Date Completed:**	2024-09-25
Location:	3955 Promenade Kelly Farm, Ottawa ON	**UTM:**	18T **N:** 5019030 **E:** 452176.1		

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI — 25 50 75 / % Moisture 25 50 75	Shear Strength Cu, kPa (nat V., rem V.) 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
198.9	0	**FILL:** (SM) gravelly SILTY SAND: brown, moist, loose		01	SS	54	8	11.3%	8		
198.4	0.5										
197.9	1		197.87	02A	SS			12.2%			
		(ML) SILT and CLAY: brown-grey, w~PL, firm, trace sand, trace gravel	1.02	02B	SS	33	3	21.9%	3		
197.4	1.5	sand lenses throughout		03	SS	92	4	23.4%	4		
196.9	2										
196.4	2.5			04	SS	100	3	29.4%	3		
195.9	3		195.84								
		(ML) CLAYEY SILT: grey, w > pl, firm, trace sand, trace gravel	3.05	05	SS	50	5	23.2%	5		
195.4	3.5										
194.9	4										
194.4	4.5		194.32								
		(ML) SILT: grey, very loose, trace sand, trace gravel	4.57	06	SS	50	1	29.2%	1		
193.9	5										
193.4	5.5										
192.9	6		192.77	07	SS	0	>50				
192.4	6.5	Borehole terminated @ 6.1 mbgs due to practical auger refusal encountered.	6.12								Borehole caving observed 3.7 mbgs. Standing water observed at 0.9 mbgs, possibly due to rainfall.
191.9	7										
191.4											

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

Logged By: RR **Input By:** JS

Peterborough, Barrie, Whitby, Kingston, Ottawa

Client:	Conseil des ecoles publiques de l'Est de l'Ontario	**Project Name:**	Proposed School Prom. Kelly Farm Ottawa	**Log of Borehole:**	BH106-24
Contractor:	Canadian Environmental Drilling	**Method:**	Track Mounted Solid Stem Auger	Page:	1 of 1
Project No.:	21388-001	**Elevation:**	198.89 mREL	**Date Completed:**	2024-09-25
Location:	3955 Promenade Kelly Farm, Ottawa ON	**UTM:**	18T **N:** 5019012 **E:** 452146.2		

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) 25 50 75 / % Moisture 25 50 75	Shear Strength Cu, kPa 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
198.9	0	**FILL:** (SM) gravelly SILTY SAND: brown, moist, compact		01	SS	54	25	9.4%	25		
198.4	0.5										
197.9	1			02	SS	50	7	12.3%	7		
197.4	1.5		197.37								
		(ML) SILT and CLAY: brown-grey, w~PL, firm, trace gravel	1.52	03	SS	63	5	22.5%	5		
196.9	2										
196.4	2.5	sand lenses throughout		04	SS	67	4	20.8%	4		
195.9	3										
195.4	3.5			05	SS	100	6	31.9%	6		
			195.08								
		(ML) SILT: grey, wet, very loose, trace sand, trace gravel	3.81	06	SS	83	2	30.3%	2		
194.9	4										
194.4	4.5			07	SS	100	2	27.1%	2		
193.9	5										
193.4	5.5										
192.9	6		192.79								
		(SM) gravelly SILTY SAND: grey, wet, compact [GLACIAL TILL]	6.10	08	SS	8	12	10%	12		
192.4	6.5		192.18								Borehole caving observed at 4.3 mbgs. Standing water not observed.
		Borehole terminated @ 6.7 mbgs due to target depth achieved.	6.71								
191.9	7										
191.4											

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

Logged By: RR **Input By:** JS

Peterborough, Barrie, Whitby, Kingston, Ottawa

Client:	Conseil des ecoles publiques de l'Est de l'Ontario	**Project Name:**	Proposed School Prom. Kelly Farm Ottawa	**Log of Borehole:**	BH107-24
Contractor:	Canadian Environmental Drilling	**Method:**	Track Mounted Solid Stem Auger	Page:	1 of 1
Project No.:	21388-001	**Elevation:**	198.72 mREL	**Date Completed:**	2024-09-25
Location:	3955 Promenade Kelly Farm, Ottawa ON	**UTM:**	18T **N:** 5018980 **E:** 452163.8		

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) 25 50 75 / % Moisture 25 50 75	Shear Strength Cu, kPa 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
198.7	0	**FILL:** (SM) SILTY SAND and GRAVEL: brown to grey, moist, loose to compact, with organics		01	SS	33	6	20.3%	6		
198.2	0.5										
197.7	1			02	SS	50	10	16.9%	10		
197.2	1.5	some clay		03A	SS	33	14	16.5%			
				03B	SS			5.7%	14		
196.7	2		196.43								
196.2	2.5	**(ML) SILT and CLAY:** brown-grey, w~PL, firm, some sand sand lenses throughout	2.29	04	SS	100	4	31.8%	4		
195.7	3		195.37	05A	SS	100	6	27.6%	6		
195.2	3.5	**(ML) CLAYEY SILT:** grey, wet, firm, trace sand, trace gravel	3.35	05B	SS			24.4%			
194.7	4										
194.2	4.5		194.15								
		(ML) SILT: grey, wet, very loose, trace sand, trace gravel	4.57	06	SS	83	1	27.1%	1		
193.7	5										
193.2	5.5										
192.7	6		192.62								
		(GM) sandy SILTY GRAVEL: grey, wet, compact [GLACIAL TILL]	6.10	07	SS	50	13	7.8%	13		
192.2	6.5		192.01								Borehole cave-in observed at 4.9 mbgs. Standing water observed at 4.6 mbgs.
		Borehole terminated @ 6.7 mbgs due to target depth achieved.	6.71								
191.7	7										
191.2											

GRAINSIZE DISTRIBUTION	SAMPLE	GRAVEL	SAND	SILT	CLAY
	SS6	1	2	90	7

Logged By: RR **Input By:** JS

Peterborough, Barrie, Whitby, Kingston, Ottawa

Client:	Conseil des ecoles publiques de l'Est de l'Ontario	**Project Name:**	Proposed School Prom. Kelly Farm Ottawa	**Log of Borehole:**	BH108-24
Contractor:	Canadian Environmental Drilling	**Method:**	Track Mounted Solid Stem Auger	Page:	1 of 1
Project No.:	21388-001	**Elevation:**	198.66 mREL	**Date Completed:**	2024-09-24
Location:	3955 Promenade Kelly Farm, Ottawa ON	**UTM:**	18T **N:** 5019036 **E:** 452213.7		

Elevation (m)	Depth	Lithology	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI — 25 50 75 / % Moisture 25 50 75	Shear Strength Cu, kPa (nat V., rem V.) 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
198.7	0		**FILL:** (SM) gravelly SILTY SAND: brown, moist, compact, with cobbles, boulders, and organics	197.90	01	SS	67	15	8.9%	15		
198.2	0.5			0.76								
197.7	1		**(ML) SILT and CLAY:** brown-grey, w~PL, firm, trace sand		02	SS	83	7	18.3%	7		
197.2	1.5		some sand		03	SS	83	2	27%	2		
196.7	2											
196.2	2.5				04	SS	100	1	38.7%	1		
195.7	3				05					19.2 48		
195.2	3.5			194.85	06					23 51.8		
194.7	4		**(ML) CLAYEY SILT:** grey, w > pl, firm, trace sand, trace gravel	3.81	07	SS	100	1	29.5%	1		
194.2	4.5			194.09								
193.7	5		**(ML) SILT:** grey, wet, very loose, trace sand, trace gravel	4.57	08	SS	100	0	29.8%			
193.2	5.5				09					9.6		
192.7	6			192.56	10					9.6		
192.2	6.5		**(GM) sandy SILTY GRAVEL:** grey, wet, dense [GLACIAL TILL]	6.10 / 191.95	11	SS	100	36	7.6%	36		Borehole caving observed 5.6 mbgs. Standing water observed at 4.3 mbgs..
191.7	7		Borehole terminated @ 6.7 mbgs due to target depth achieved.	6.71								
191.2												

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

Logged By: JS **Input By:** RR

Peterborough, Barrie, Whitby, Kingston, Ottawa

CAMBIUM

Client: Conseil des ecoles publiques de l'Est de l'Ontario
Project Name: Proposed School Prom. Kelly Farm Ottawa
Log of Borehole: BH109-24

Contractor: Canadian Environmental Drilling
Method: Track Mounted Solid Stem Auger
Page: 1 of 1

Project No.: 21388-001
Elevation: 198.71 mREL
Date Completed: 2024-09-24

Location: 3955 Promenade Kelly Farm, Ottawa ON
UTM: 18T **N:** 5019086 **E:** 452216.1

Elevation (m)	Depth	Lithology	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI — 25 50 75 / % Moisture 25 50 75	Shear Strength Cu, kPa (nat V., rem V.) — 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
198.7	0		**FILL:** (SM) SILTY SAND: brown, moist, loose, trace gravel, with organics		01	SS	50	5	13.7%	5		
198.2	0.5											
197.7	1		becomes soft, increase in clay		02	SS	32	3	22.2%	3		
197.2	1.5			197.06	03A	SS			13.7%			
			(ML) SILT and CLAY: grey, w< pl, firm to very soft, trace sand, trace gravel	1.65	03B	SS	100	4	27.6%	4		
196.7	2											
196.2	2.5		sand lenses throughout		04	SS	100	0	44%			
195.7	3			195.66								
			(ML) SILT: grey, wet, very loose, trace sand, trace gravel	3.05	05	SS	100	1	28.4%	1		
195.2	3.5		clay seems throughout									
				194.90								
194.7	4		**(GM) sandy SILTY GRAVEL:** grey, wet, very dense to compact [GLACIAL TILL]	3.81	06	SS	38	70	9.6%	70		
194.2	4.5											
193.7	5				07	SS	33	12	7.3%	12		
193.2	5.5											
192.7	6			192.51	08	SS	100	>50	5.4%			Borehole caving observed 5.2 mbgs. Standing water observed at 4.6 mbgs.
			Borehole terminated @ 6.2 mbgs due to practical auger and SPT refusal encountered.	6.20								
192.2	6.5											
191.7	7											
191.2												

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

Logged By: RR **Input By:** JS

Peterborough, Barrie, Whitby, Kingston, Ottawa

Client:	Conseil des ecoles publiques de l'Est de l'Ontario	**Project Name:**	Proposed School Prom. Kelly Farm Ottawa	**Log of Borehole:**	BH110-24
Contractor:	Canadian Environmental Drilling	**Method:**	Track Mounted Solid Stem Auger	Page:	1 of 1
Project No.:	21388-001	**Elevation:**	198.59 mREL	**Date Completed:**	2024-09-24
Location:	3955 Promenade Kelly Farm, Ottawa ON	**UTM:**	18T **N:** 5019007 **E:** 452167.6		

SUBSURFACE PROFILE				SAMPLE							
Elevation (m)	Depth	Lithology	Description	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) 25 50 75 / % Moisture 25 50 75	Shear Strength Cu, kPa 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
198.6	0		**FILL:** (SM) gravelly SILTY SAND: brown, moist, compact, trace silt	01	SS	33	14	9.1%	14	Cap	
198.1	0.5		becomes firm, increase in clay content	02	SS	42	4	16.3%	4		
197.6	1										
197.1	1.5		197.07 / 1.52 **(ML) CLAYEY SILT:** grey-brown, w < pl, firm, trace sand, trace gravel	03	SS	54	5	18.1%	5	Bentonite Plug / Riser	
196.6	2		196.30								
196.1	2.5		2.29 **(ML) SILT:** grey brown, w~PL, soft, trace sand; sand lenses throughout	04	SS	100	3	36%	3		
195.6	3		195.54 / 3.05 **(ML) SILT:** grey, wet, compact, trace sand, trace gravel	05	SS	67	19	17.8%	19		
195.1	3.5										
194.6	4		clay lenses throughout								
194.1	4.5		becomes very loose	06	SS	67	0	31.2%		Sand Pack / PVC Screen	
193.6	5										
193.1	5.5			07							
192.6	6			08					22 33 / 22 33		
192.1	6.5		becomes loose	09	SS	67	3	32.3%	3	Cap	
191.6	7		191.88 / 6.71 Borehole terminated @ 6.7 mbgs due to target depth achieved.								Borehole cave-in observed 5.6 mbgs. Standing water observed at 5.4 mbgs.
191.1											

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

Logged By: RR **Input By:** JS

Peterborough, Barrie, Whitby, Kingston, Ottawa

Client:	Conseil des ecoles publiques de l'Est de l'Ontario	**Project Name:**	Proposed School Prom. Kelly Farm Ottawa	**Log of Borehole:**	BH111-24
Contractor:	Canadian Environmental Drilling	**Method:**	Track Mounted Solid Stem Auger	Page:	1 of 1
Project No.:	21388-001	**Elevation:**	198.80 mREL	**Date Completed:**	2024-09-23
Location:	3955 Promenade Kelly Farm, Ottawa ON	**UTM:**	18T **N:** 5019035 **E:** 452143.8		

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) LL PL PI — 25 50 75 / % Moisture 25 50 75	Shear Strength Cu, kPa nat V. rem V. — 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
198.8	0	**FILL:** (SM) gravelly SAND and SILT: brown, moist, loose	198.04	01	SS	25	8	3.9%	8	Cap	
198.3	0.5										
		(ML) SILT and CLAY: brown-grey, w~PL, firm, trace sand	0.76	02	SS	46	4	19.9%	4	Bentonite Plug	
197.8	1										
197.3	1.5	becomes stiff, sand lenses throughout		03	SS	73	8	21.9%	8	Riser	
196.8	2										
196.3	2.5	becomes firm		04	SS	100	4	37.2%	4		
195.8	3		195.75								
		(ML) CLAYEY SILT: grey, w > pl, soft, trace sand, trace gravel	3.05	05	SS	71	3	25.2%	3		
195.3	3.5										
194.8	4									Sand Pack	
194.3	4.5		194.23								
		(ML) SILT: grey, wet, very loose, trace sand, trace gravel	4.57	06	SS	100	0	28.4%		PVC Screen	
193.8	5										
193.3	5.5										
192.8	6		192.70							Cap	
		(GM) SILTY GRAVEL: grey, wet, compact [GLACIAL TILL]	6.10	07	SS	100	20	6.9%	20		Borehole caving observed 5.2 mbgs. Standing water not observed.
192.3	6.5		192.22								
		Borehole terminated @ 6.6 mbgs due to practical auger refusal encountered.	6.58								
191.8	7										
191.3											

GRAINSIZE DISTRIBUTION	SAMPLE	GRAVEL	SAND	SILT	CLAY
	SS7	42	29	25	4

Logged By: RR **Input By:** JS

Peterborough, Barrie, Whitby, Kingston, Ottawa

Client:	Conseil des ecoles publiques de l'Est de l'Ontario	**Project Name:**	Proposed School Prom. Kelly Farm Ottawa	**Log of Borehole:**	BH112-24
Contractor:	Canadian Environmental Drilling	**Method:**	Track Mounted Solid Stem Auger	Page:	1 of 1
Project No.:	21388-001	**Elevation:**	198.67 mREL	**Date Completed:**	2024-09-24
Location:	3955 Promenade Kelly Farm, Ottawa ON	**UTM:**	18T **N:** 5019080 **E:** 452167.7		

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	Atterberg Limits (%) 25 50 75 / % Moisture 25 50 75	Shear Strength Cu, kPa 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
198.7	0	**FILL:** (SM) gravelly SILTY SAND: brown, moist, compact, with organics		01	SS	54	10	12.6%	10	Cap	
198.2	0.5										
197.7	1			02	SS	46	6	16.7%	6	Bentonite Plug	
197.2	1.5		197.15							Riser	
		(ML) SILT and CLAY: brown, w~PL, soft, trace sand	1.52	03	SS	100	3	31.3%	3		
196.7	2										
196.2	2.5	sand seems every 100-150 mm.		04	SS	58	4	31%	4		
195.7	3		195.62								
		(ML) SILT: grey, wet, trace sand, trace gravel	3.05	05A	SS	100	5	31.2%	5		
195.2	3.5		195.27								
		(GM) sandy SILTY GRAVEL: grey, wet, compact [GLACIAL TILL]	3.40	05B	SS			9.2%			
194.7	4									Sand Pack	
194.2	4.5									PVC Screen	
		becomes compact		06	SS	67	16	8.7%	16		
193.7	5										
193.2	5.5										
192.7	6		192.70							Cap	
		Borehole terminated @ 6 mbgs due to practical auger refusal encountered.	5.97								Borehole caving observed 5.2 mbgs. Standing water not observed.
192.2	6.5										
191.7	7										
191.2											

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

Logged By: RR **Input By:** JS

Peterborough, Barrie, Whitby, Kingston, Ottawa

Appendix B

Soil Laboratory Testing Results

Grain Size Distribution Chart

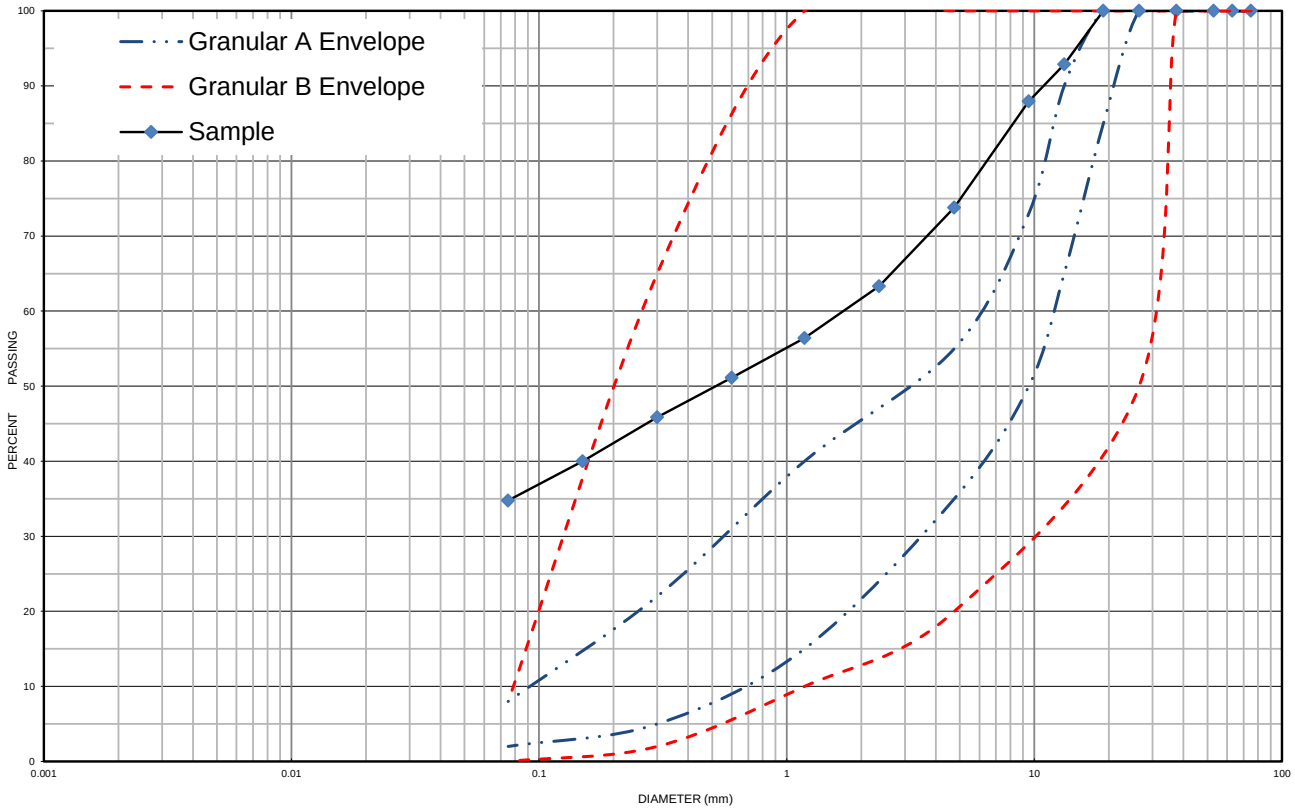
Project Number: *21388-001* **Client:** *Conseil des ecoles publiques de l'Est de l'Ontario*

Project Name: *Proposed School Promenade Kelly Farm Ottawa*

Sample Date: *August 28, 2024* **Sampled By:** *Rory Ryan - Cambium Inc.*

Location: *BH 103-24 SS 2* **Depth:** *0.8 m to 1.4 m* **Lab Sample No:** *S-24-1776*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 103-24	SS 2	0.8 m to 1.4 m	26	39	35		8.6

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Gravelly Sand and Silt	SM	1.650	-	-	-	-

Additional information available upon request

Issued By: _____ *Date Issued:* *October 9, 2024*

(Senior Project Manager)

Cambium Inc. (Laboratory)
866.217.7900 | cambium-inc.com
194 Sophia St. | Peterborough | ON | K9H 1E5

Grain Size Distribution Chart

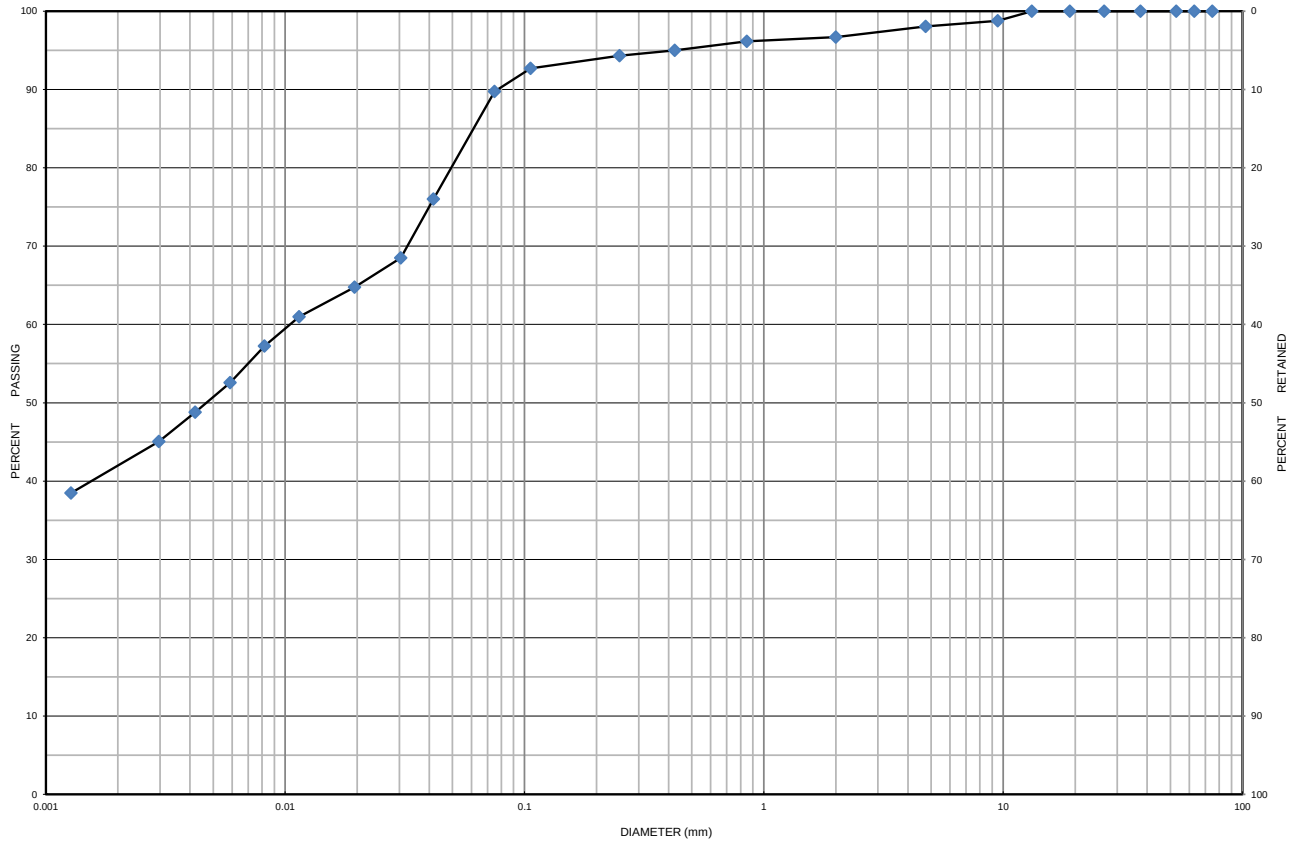
Project Number: *21388-001* **Client:** *Conseil des ecoles publiques de l'Est de l'Ontario*

Project Name: *Proposed School Promenade Kelly Farm Ottawa*

Sample Date: *August 28, 2024* **Sampled By:** *Rory Ryan - Cambium Inc.*

Location: *BH 101-24 SS 3* **Depth:** *1.5 m to 2.1 m* **Lab Sample No:** *S-24-1770*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 101-24	SS 3	1.5 m to 2.1 m	2	8	48	42	30.1

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silt and Clay trace Sand trace Gravel	ML	0.011	-	-	-	-

Additional information available upon request

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(Senior Project Manager)

Cambium Inc. (Laboratory)
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194 Sophia St. | Peterborough | ON | K9H 1E5

Grain Size Distribution Chart

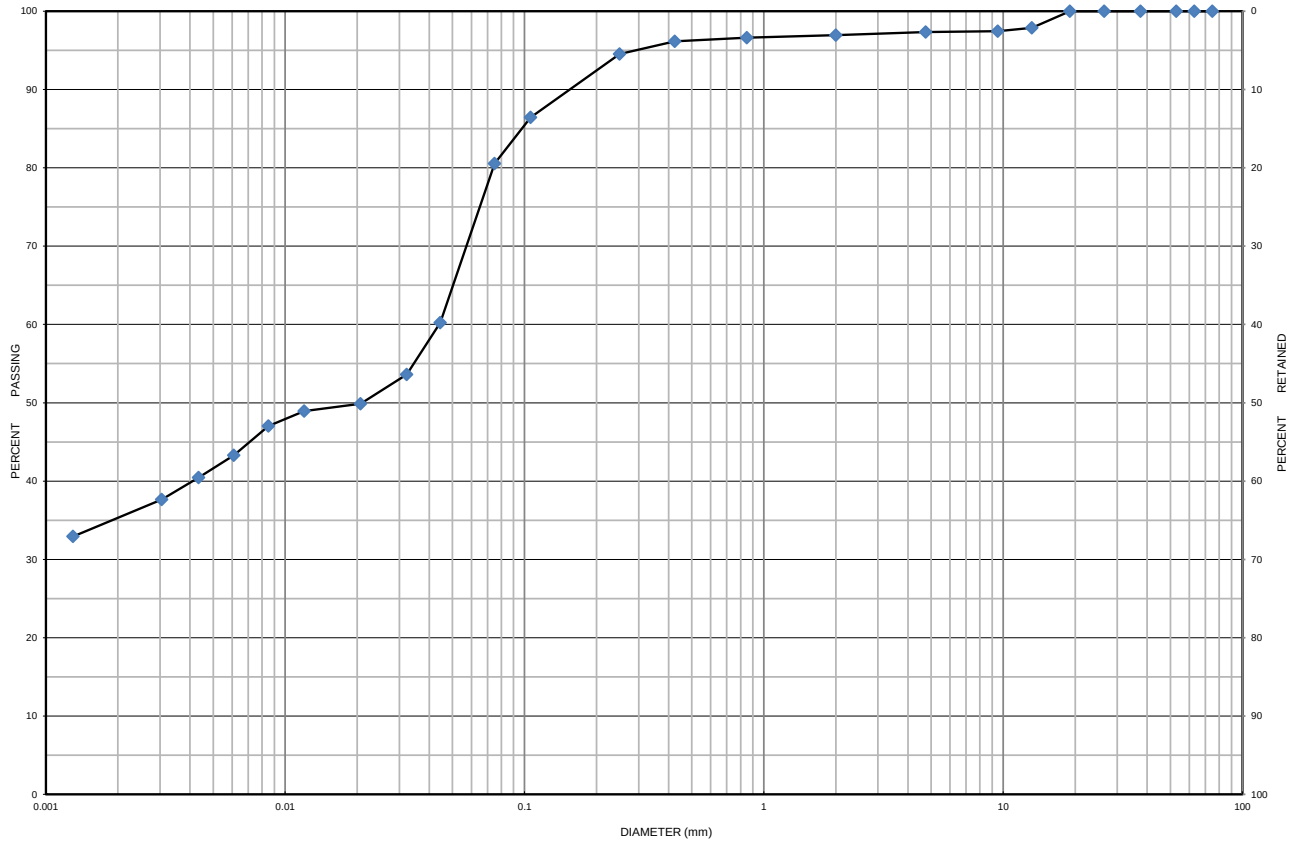
Project Number: *21388-001* **Client:** *Conseil des ecoles publiques de l'Est de l'Ontario*

Project Name: *Proposed School Promenade Kelly Farm Ottawa*

Sample Date: *August 28, 2024* **Sampled By:** *Rory Ryan - Cambium Inc.*

Location: *BH 101-24 SS 4* **Depth:** *2.3 m to 2.9 m* **Lab Sample No:** *S-24-1771*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 101-24	SS 4	2.3 m to 2.9 m	3	17	44	36	38.3

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silt and Clay some Sand trace Gravel	ML	0.044	-	-	-	-

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Grain Size Distribution Chart

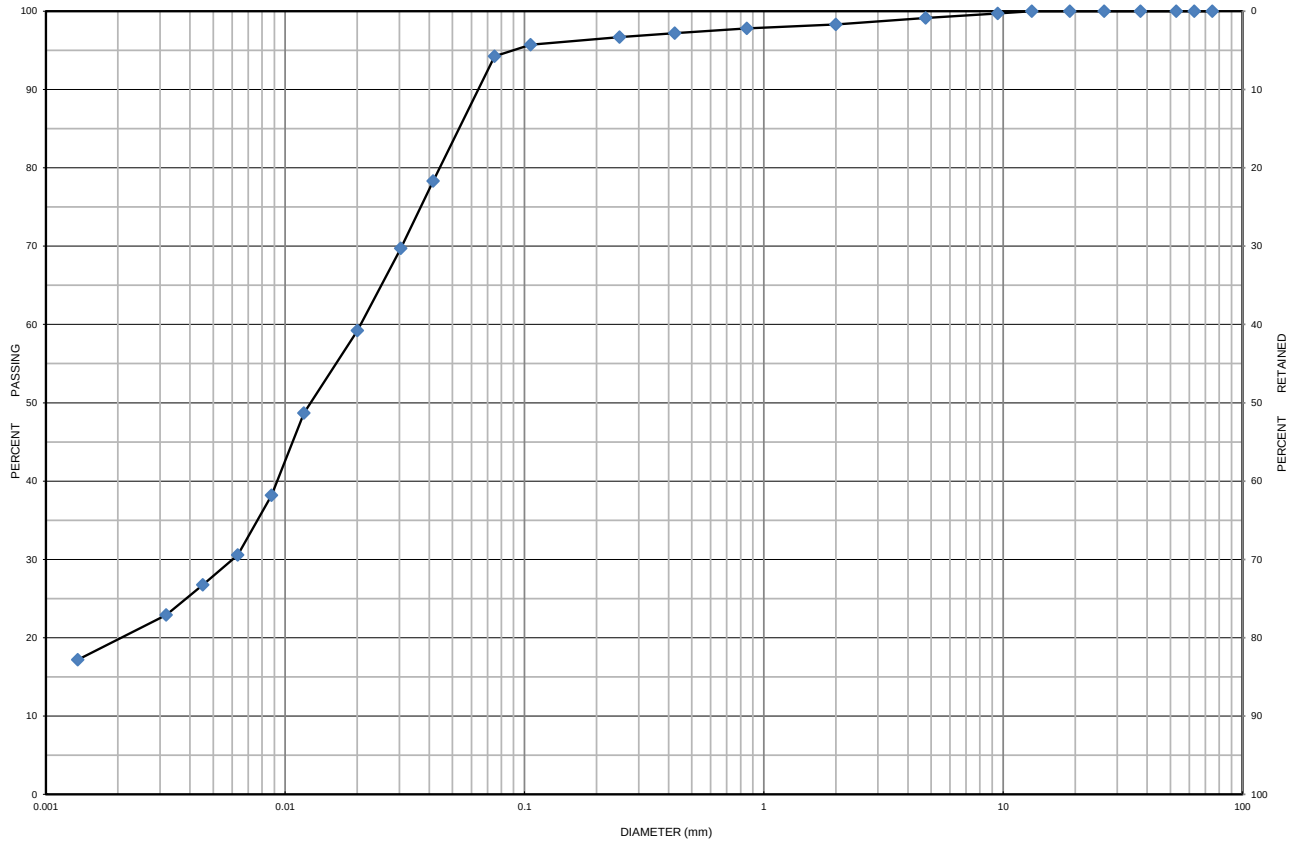
Project Number: *21388-001* **Client:** *Conseil des ecoles publiques de l'Est de l'Ontario*

Project Name: *Proposed School Promenade Kelly Farm Ottawa*

Sample Date: *August 28, 2024* **Sampled By:** *Rory Ryan - Cambium Inc.*

Location: *BH 104-24 SS 5* **Depth:** *3 m to 3.7 m* **Lab Sample No:** *S-24-1773*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 104-24	SS 5	3 m to 3.7 m	1	5	74	20	29.3

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Clayey Silt trace Sand trace Gravel	ML	0.021	0.006	-	-	-

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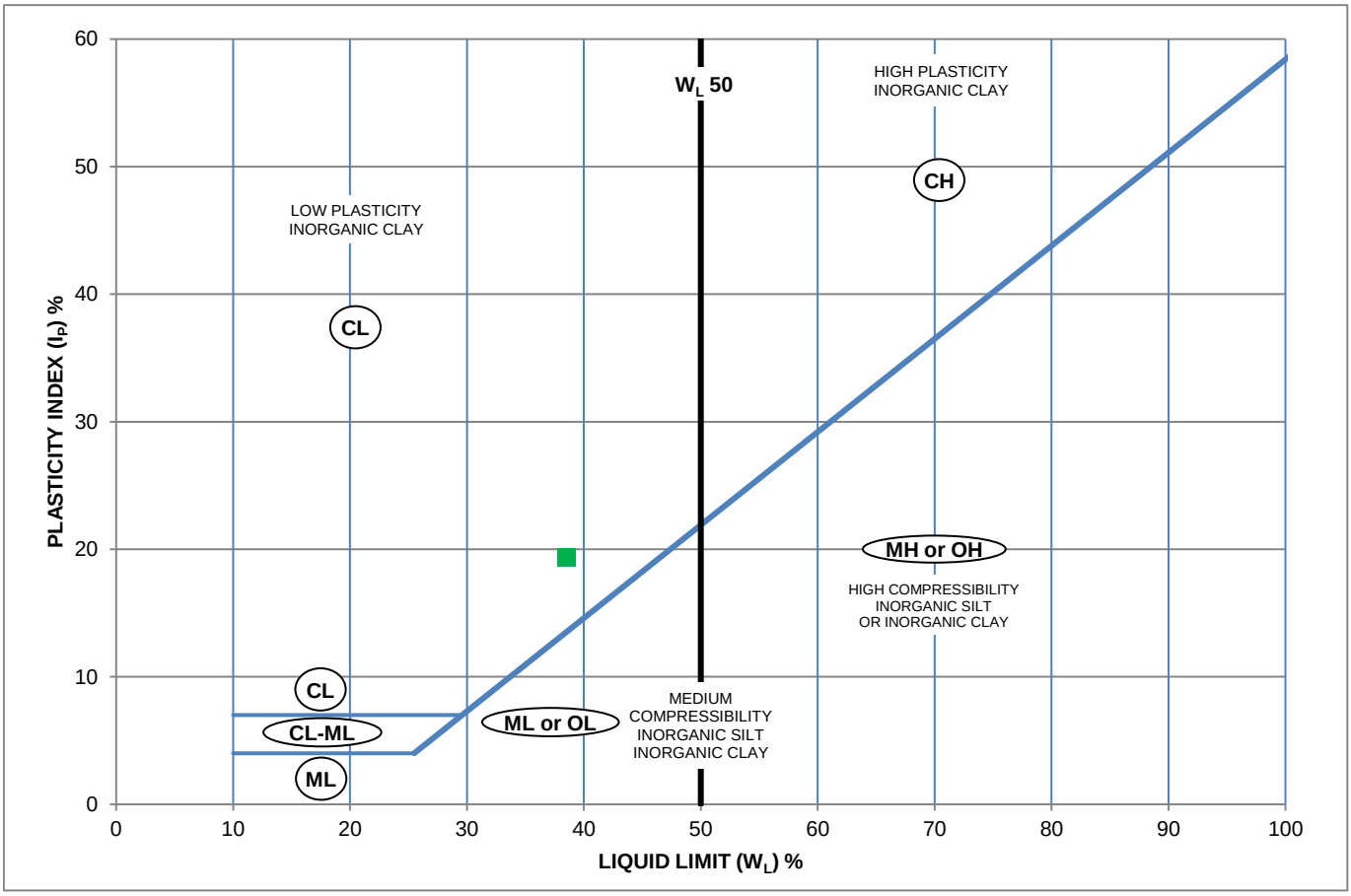
Plasticity Chart

Project Number: *21388-001* **Client:** *Conseil des ecoles publiques de l'Est de l'O*

Project Name: *Proposed School Promenade Kelly Farm Ottawa*

Sampled By: *Rory Ryan - Cambium Inc.* **Sample Date:** *August 28, 2024*

Hole No.: *BH 101-24 SS 3* **Depth:** *1.5 m to 2.1 m* **Lab Sample No:** *S-24-1770*



Symbol	Borehole	Sample	Depth	Description
■	BH 101-24	SS 3	1.5 m to 2.1 m	Low Plasticity Clay

Liquid Limit (%)	Plastic Limit	Plasticity Index (%)
38.5	***19.1***	***19.4***

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Plasticity Chart

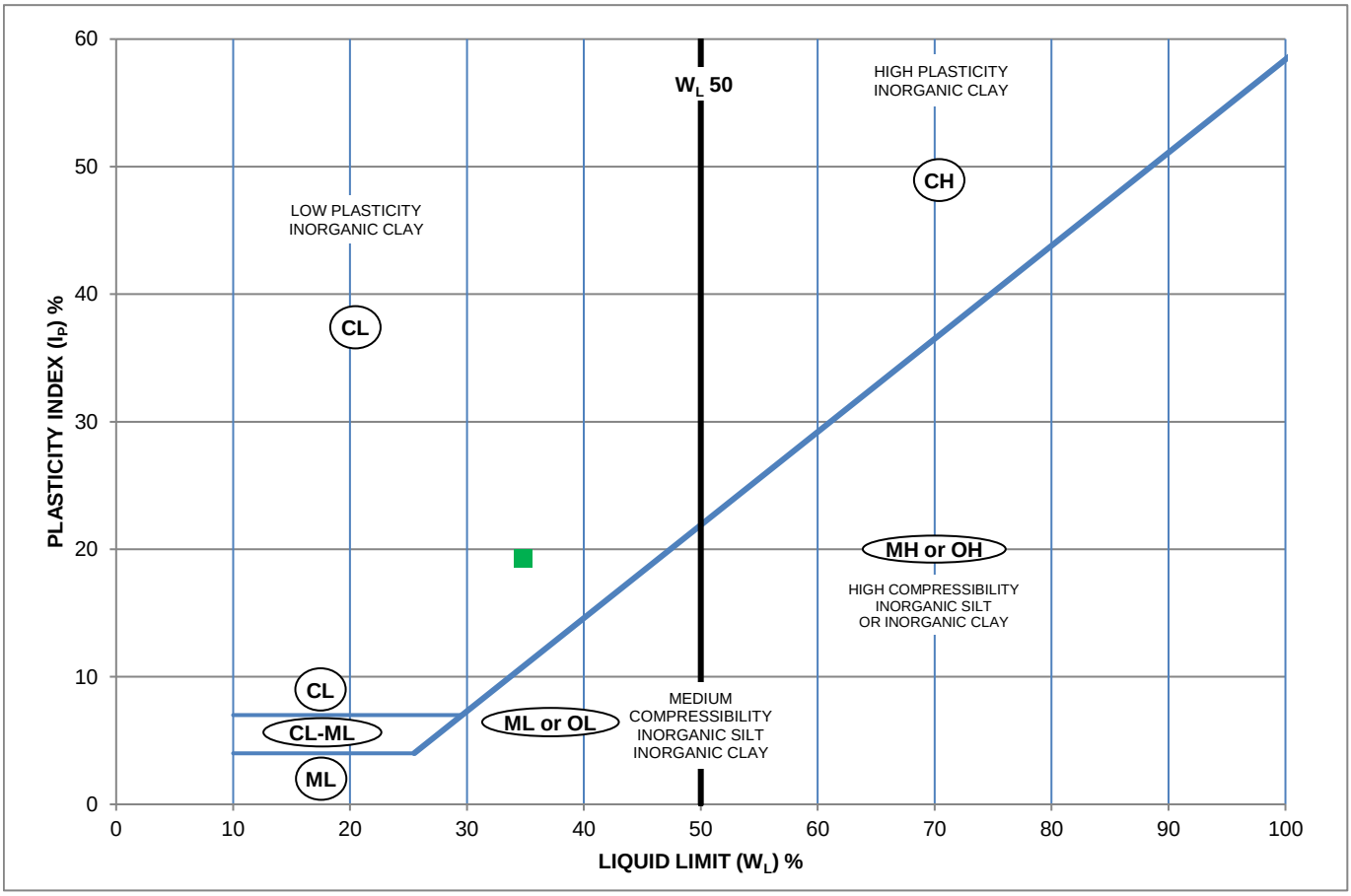
Project Number: *21388-001* **Client:** *Conseil des ecoles publiques de l'Est de l'O*

Project Name: *Proposed School Promenade Kelly Farm Ottawa*

Sampled By: *Rory Ryan - Cambium Inc.* **Sample Date:** *August 28, 2024*

Hole No.: *BH 101-24 SS 4* **Depth:** *2.3 m to 2.9 m* **Lab Sample No:** *S-24-1771*

Low Plasticity	High Plasticity



Symbol	Borehole	Sample	Depth	Description
■	BH 101-24	SS 4	2.3 m to 2.9 m	Low Plasticity Clay

Liquid Limit (%)	Plastic Limit	Plasticity Index (%)
34.8	***15.5***	***19.3***

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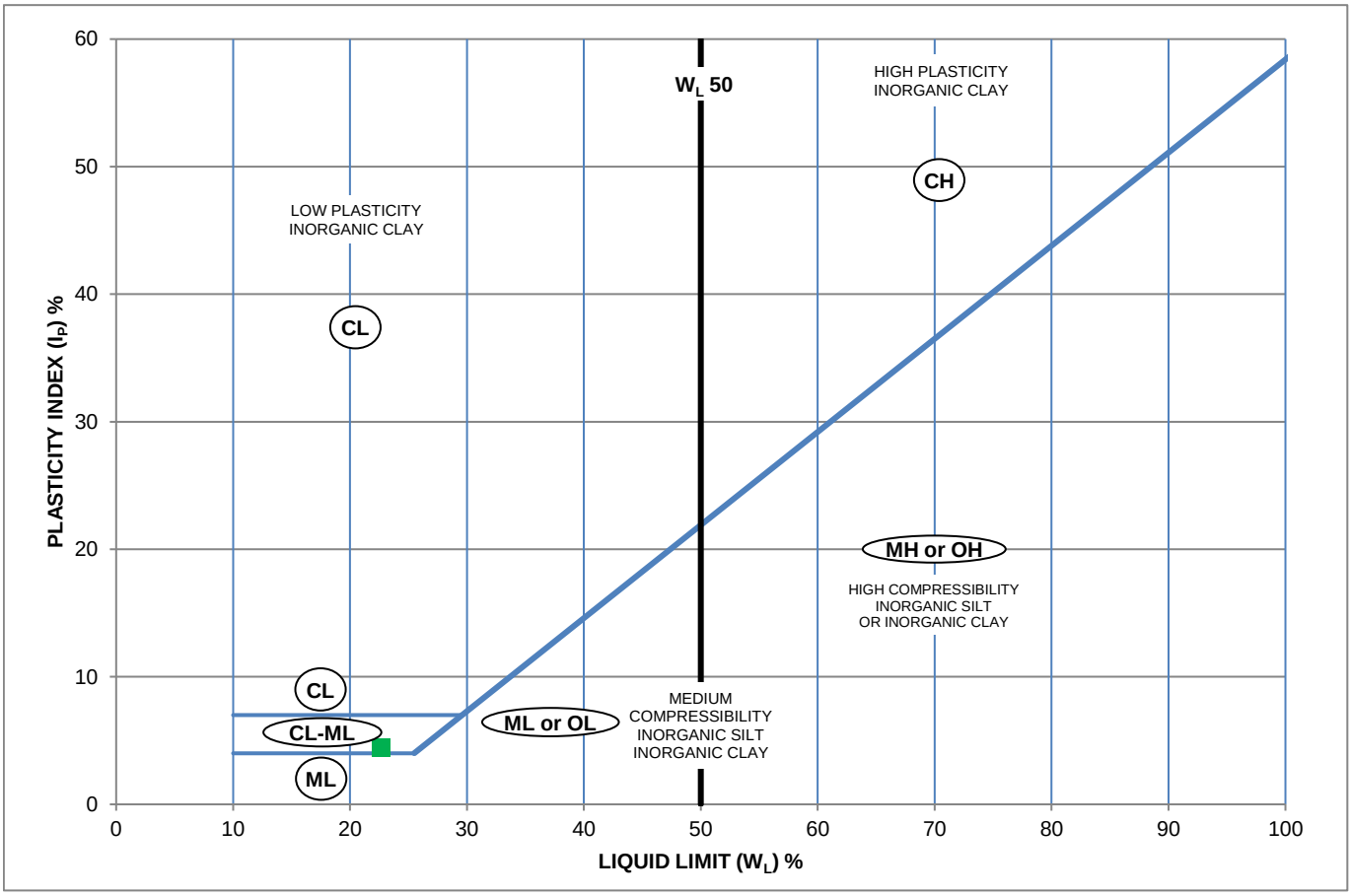
Plasticity Chart

Project Number: *21388-001* **Client:** *Conseil des ecoles publiques de l'Est de l'O*

Project Name: *Proposed School Promenade Kelly Farm Ottawa*

Sampled By: *Rory Ryan - Cambium Inc.* **Sample Date:** *August 28, 2024*

Hole No.: *BH 104-24 SS 5* **Depth:** *3 m to 3.7 m* **Lab Sample No:** *S-24-1773*



Symbol	Borehole	Sample	Depth	Description
■	BH 104-24	SS 5	3 m to 3.7 m	ML-CL

Liquid Limit (%)	Plastic Limit	Plasticity Index (%)
22.7	***18.2***	***4.4***

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Grain Size Distribution Chart

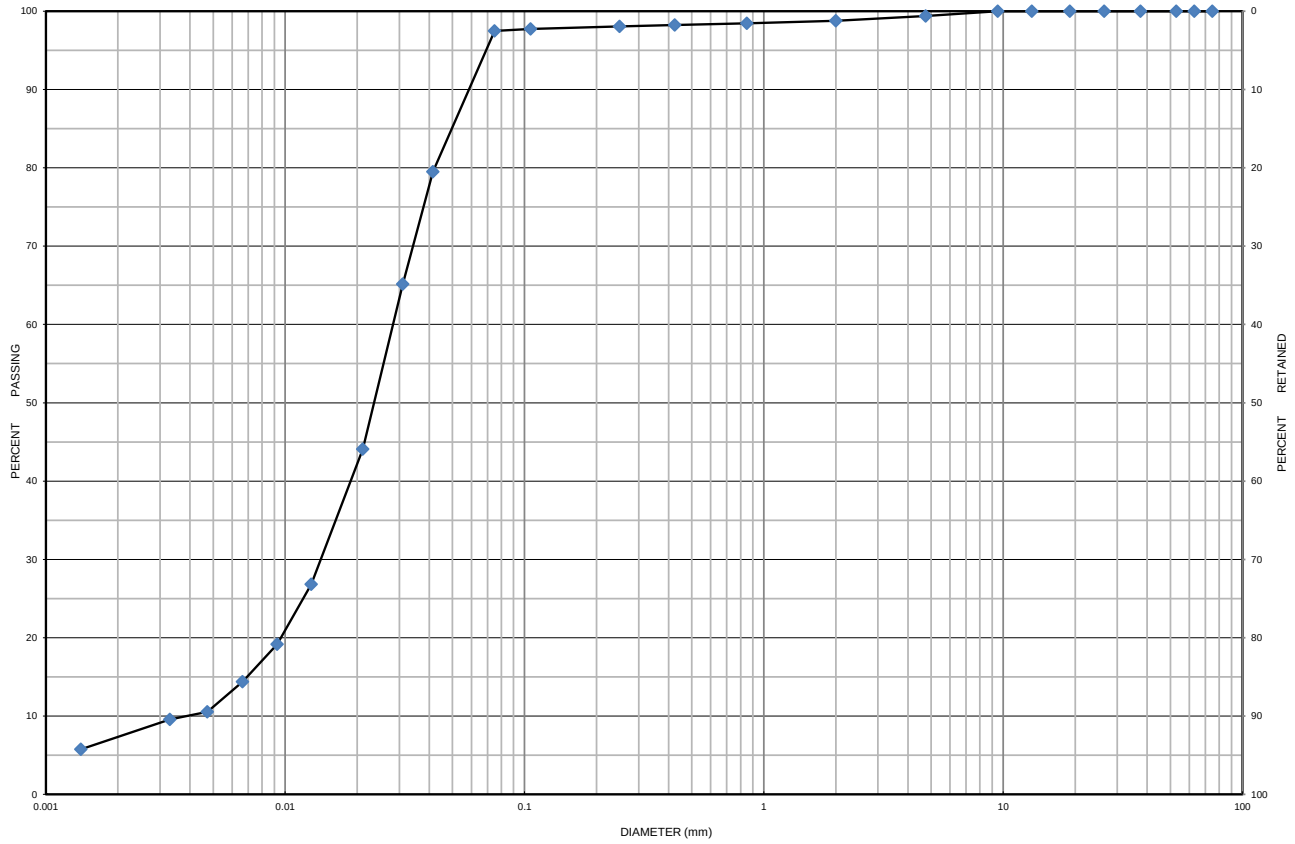
Project Number: *21388-001* **Client:** *Conseil des ecoles publiques de l'Est de l'Ontario*

Project Name: *Proposed School Promenade Kelly Farm Ottawa*

Sample Date: *August 28, 2024* **Sampled By:** *Rory Ryan - Cambium Inc.*

Location: *BH 107-24 SS 6* **Depth:** *4.6 m to 5.2 m* **Lab Sample No:** *S-24-1774*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 107-24	SS 6	4.6 m to 5.2 m	1	2	90	7	27.1

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silt trace Clay trace Sand trace Gravel	ML	0.0280	0.0140	0.0035	8.00	2.00

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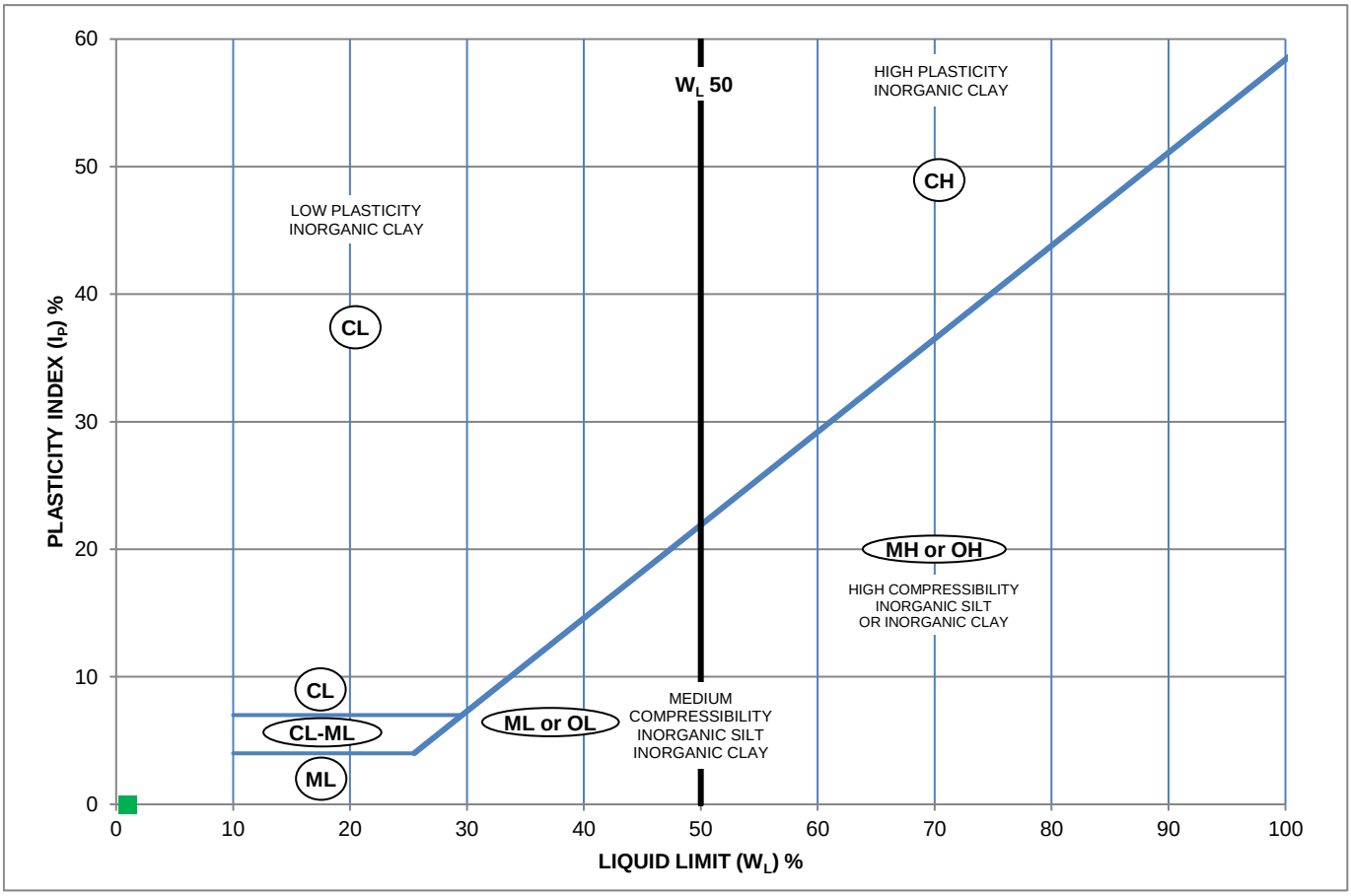
Plasticity Chart

Project Number: *21388-001* **Client:** *Conseil des ecoles publiques de l'Est de l'O*

Project Name: *Proposed School Promenade Kelly Farm Ottawa*

Sampled By: *Rory Ryan - Cambium Inc.* **Sample Date:** *August 28, 2024*

Hole No.: *BH 107-24 SS 6* **Depth:** *4.6 m to 5.2 m* **Lab Sample No:** *S-24-1774*



Symbol	Borehole	Sample	Depth	Description
■	BH 107-24	SS 6	4.6 m to 5.2 m	Material not plastic

Liquid Limit (%)	Plastic Limit	Plasticity Index (%)
Unable to complete	***Unable to complete***	***Unable to complete***

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Grain Size Distribution Chart

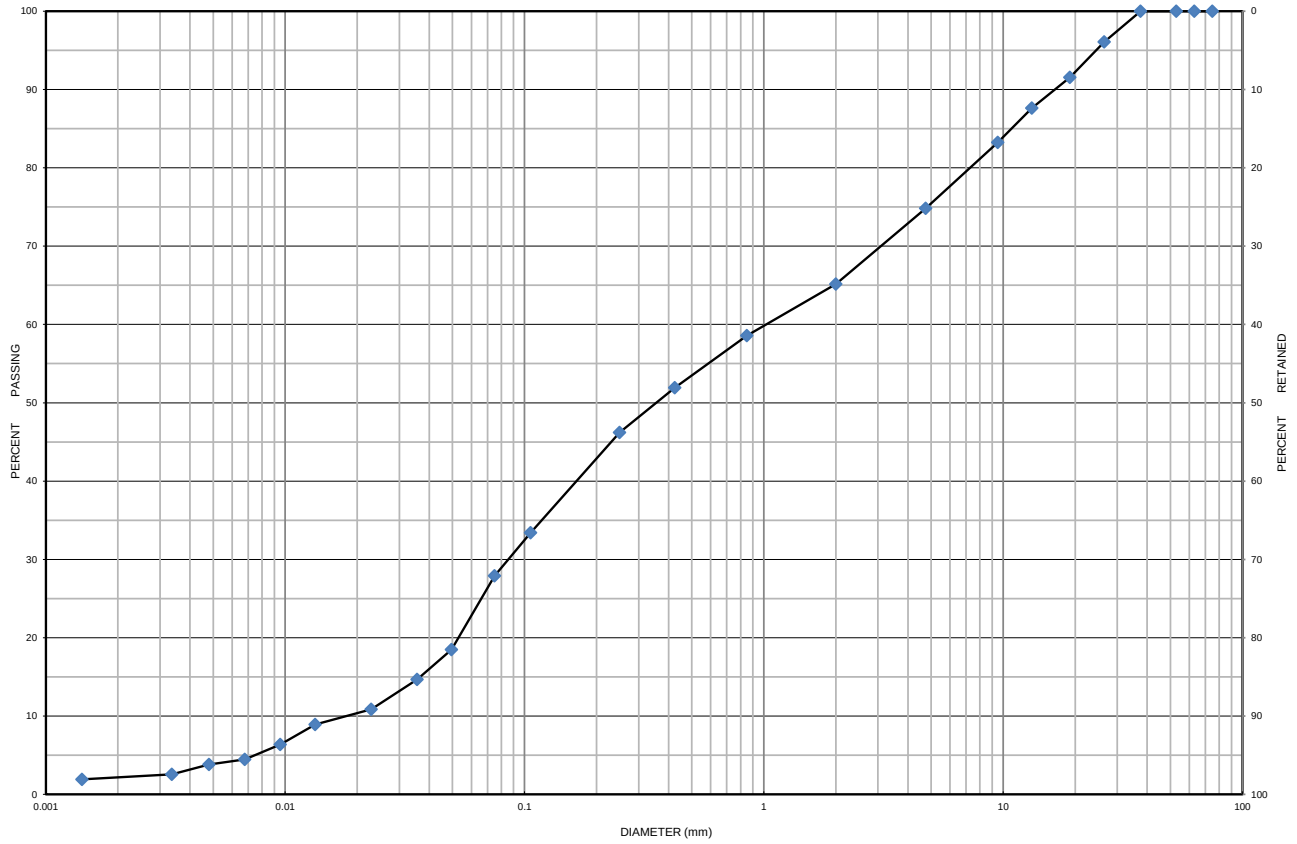
Project Number: *21388-001* **Client:** *Conseil des ecoles publiques de l'Est de l'Ontario*

Project Name: *Proposed School Promenade Kelly Farm Ottawa*

Sample Date: *August 28, 2024* **Sampled By:** *Rory Ryan - Cambium Inc.*

Location: *BH 101-24 SS 6* **Depth:** *4.6 m to 5.2 m* **Lab Sample No:** *S-24-1772*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 101-24	SS 6	4.6 m to 5.2 m	25	47	26	2	8.5

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silty Gravelly Sand trace Clay	SM	1.100	0.085	0.017	64.71	0.39

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Grain Size Distribution Chart

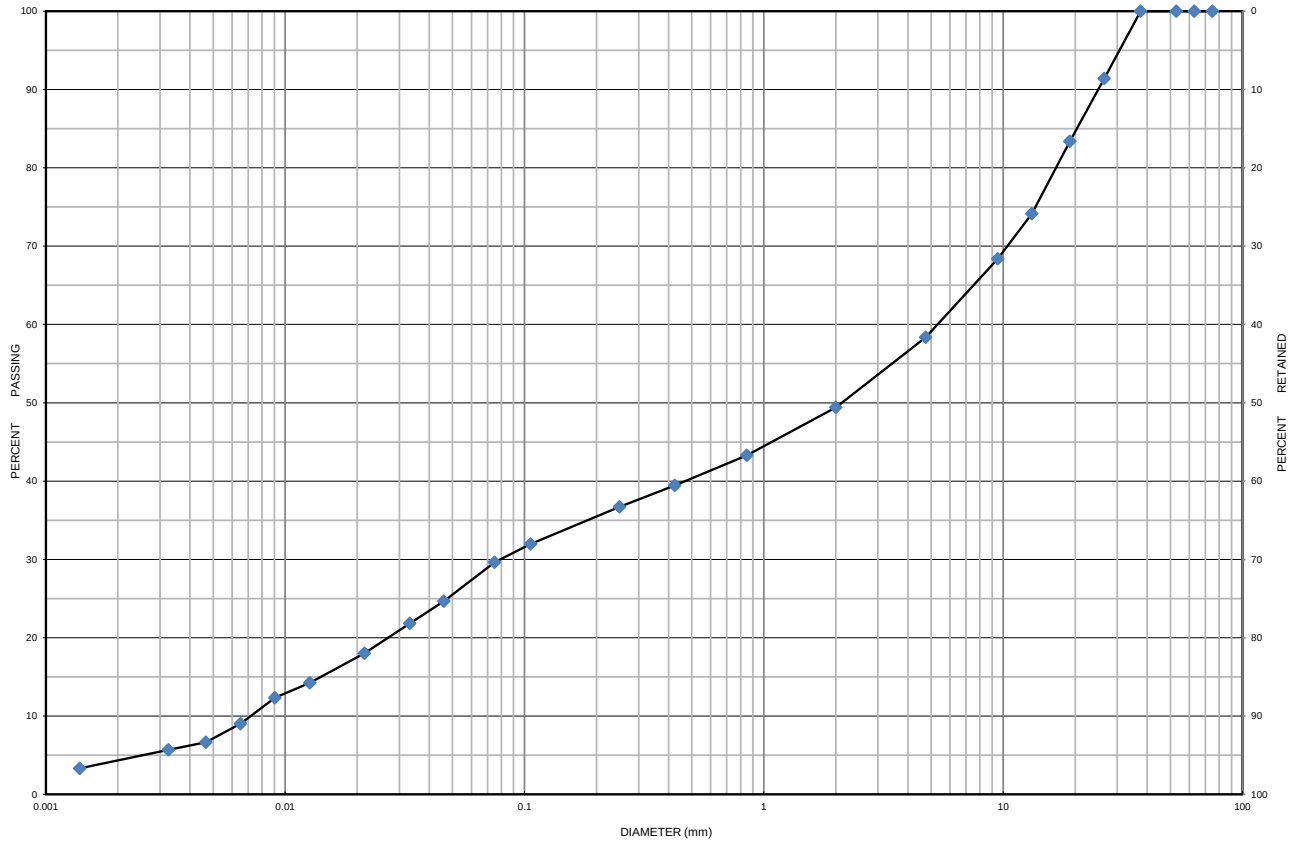
Project Number: *21388-001* **Client:** *Conseil des ecoles publiques de l'Est de l'Ontario*

Project Name: *Proposed School Promenade Kelly Farm Ottawa*

Sample Date: *August 28, 2024* **Sampled By:** *Rory Ryan - Cambium Inc.*

Location: *BH 111-24 SS 7* **Depth:** *6.1 m to 6.6 m* **Lab Sample No:** *S-24-1775*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 111-24	SS 7	6.1 m to 6.6 m	42	29	25	4	6.9

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sandy Silty Gravel trace Clay	SM	5.400	0.079	0.007	771.43	0.17

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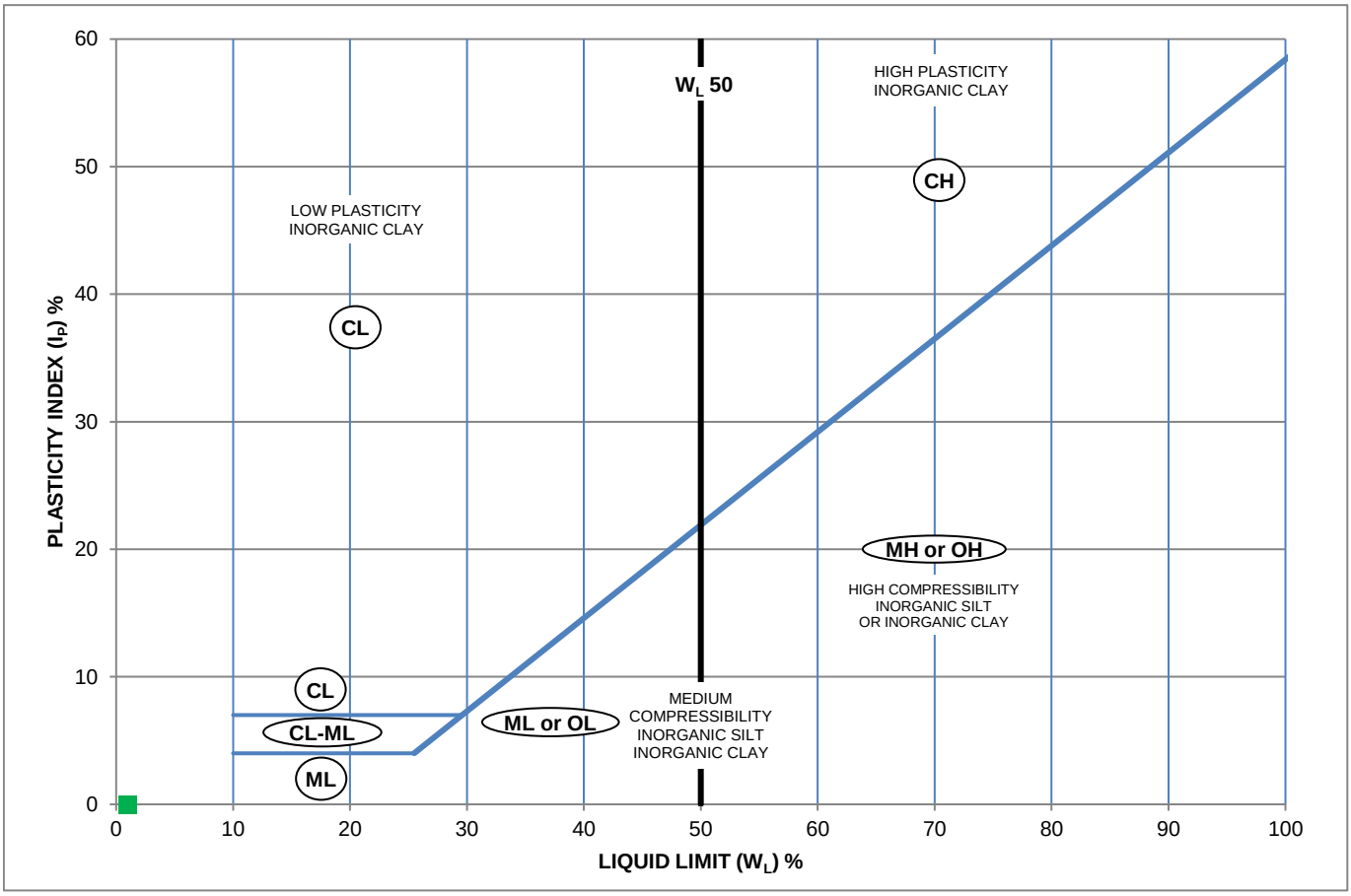
Plasticity Chart

Project Number: *21388-001* **Client:** *Conseil des ecoles publiques de l'Est de l'O*

Project Name: *Proposed School Promenade Kelly Farm Ottawa*

Sampled By: *Rory Ryan - Cambium Inc.* **Sample Date:** *August 28, 2024*

Hole No.: *BH 101-24 SS 6* **Depth:** *4.6 m to 5.2 m* **Lab Sample No:** *S-24-1772*



Symbol	Borehole	Sample	Depth	Description
■	BH 101-24	SS 6	4.6 m to 5.2 m	Material not plastic

Liquid Limit (%)	Plastic Limit	Plasticity Index (%)
Unable to complete	***Unable to complete***	***Unable to complete***

Additional information available upon request

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Appendix C

Shear Wave Velocity Sounding for Site Class Determination

Frontwave Geophysics Inc.

FRONTWAVE
GEOPHYSICS

SHEAR WAVE VELOCITY TESTING
FOR SEISMIC SITE CLASSIFICATION
3955 PROMENADE KELLY FARM, OTTAWA, ONTARIO

Submitted to:

Cambium Inc.
31 Hyperion Court, Suite 102
Kingston, Ontario K7K 7G3

Attention:

Mr. Blasco Vijayabaskaran, P.Eng. Email: Blasco.Vijayabaskaran@cambium-inc.com

File No. F-24234

October 2, 2024

Frontwave Geophysics Inc.
Brampton, ON
(647) 514-4724
www.frontwave.ca

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1 INTRODUCTION

Frontwave Geophysics Inc. was retained by Cambium Inc. to carry out a geophysical investigation for a proposed new school at 3955 Promenade Kelly Farm in Ottawa, Ontario.

The objective of the survey was to determine site class (designation) for seismic site response based on the average shear wave velocity value measured over the upper 30 m (V_S30). The multi-channel analysis of surface waves (MASW) and seismic refraction methods were employed for this investigation. The MASW aimed to obtain shear wave velocity depth profiles in the overburden; the purpose of the seismic refraction survey was to obtain shear wave velocity values for the top of bedrock.

The fieldwork was conducted on September 27, 2024. The location of the seismic survey line is shown in Figure 1.

This report describes the basic principles of the seismic refraction and MASW methods, survey design, interpretation method, and presents the results of the investigation in the chart and table format.

2 INVESTIGATION METHODOLOGY

2.1 Multichannel Analysis of Surface Waves (MASW)

Overview

The Multi-channel Analysis of Surface Waves (MASW) is a seismic method widely applied to produce shear wave velocity (V_S) profiles. It is based on the dispersive nature of Rayleigh or Love surface waves in layered media. Surface waves with longer wavelengths propagate deeper in the subsurface, hence, their phase velocity is more influenced by the elastic properties of deeper layers. The velocity of surface waves depends mainly on the shear wave velocity of the medium. The distribution of surface waves phase velocities as a function of wavelength (or frequency) can be visualized as a dispersion curve. The inverse problem is then solved by modelling the experimental data with a theoretical dispersion curve; the model parameters are typically limited to layer thickness and shear wave velocity with an assumption of horizontally layered strata. As a result of the inversion, a shear wave velocity depth profile is obtained. Figure 2 illustrates the overall procedure of the MASW method.

Survey Design

The acquisition layout consisted of 24 receivers in a linear array (spread), connected with a multicore cable to P.A.S.I. Gea-24 seismograph. 4.5 Hz natural frequency vertical geophones were used for this survey. The measurements were conducted with a spread length of 23 m (1 m spacing between geophones).

An 8-kg sledgehammer was used as an energy source. Shots were executed at five locations per spread: one shot in the middle of the spread, two shots close to the ends of the spread, and two shots with an offset of 12 m from the ends of the spread. The record length was set to 1500 ms with a 0.05 ms sampling interval.

Legend

Location of 23 m, 24-geophone MASW spread

Location of 46 m, 24-geophone seismic refraction spread

Image: Google Earth 2022

Date:	2024-10-02
File No:	F-24234
Title:	Survey location plan
Location:	3955 Promenade Kelly Farm Ottawa, ON

FRONTWAVE GEOPHYSICS

Figure: **1**

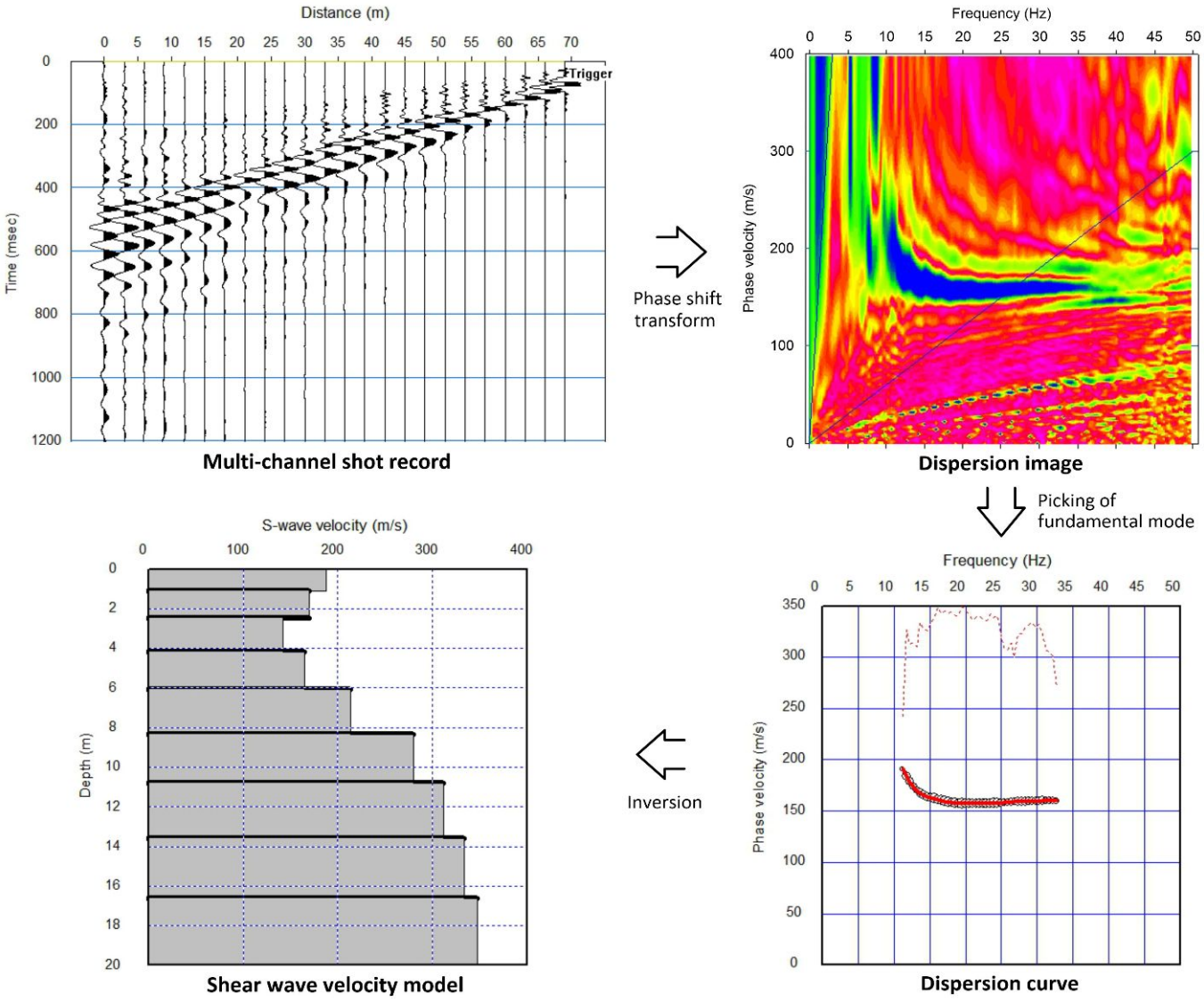

Figure 2 *The procedure of MASW data processing using the SeisImager SW software package.*

Interpretation

A dispersion curve is obtained from each field record by converting the shot gather into a dispersion image and then identifying and picking the fundamental mode. A shear wave velocity profile is obtained through inversion of the dispersion curve by modelling the subsurface as a horizontally layered medium with the model parameters limited to the number of layers, their thickness and shear-wave velocity.

Seisimager SW software package was used for processing, picking and inversion of the MASW data.

Accuracy of the results

The accuracy of MASW generally depends on the complexity of the subsurface and specific site conditions (noise levels, topography, etc.). Lateral velocity variations and steeper bedrock topography increase the dispersion uncertainty. The presence of high-velocity contrast layers such as bedrock will require the use of a-priory information to optimize model parameters for more accurate results. Hence, if the a-priory information is not available (e.g. when the data are overly noisy to carry out refraction analysis), the accuracy decreases.

At bedrock sites and sites with very shallow overburden overlying bedrock, the MASW method performs poorly. Very strong velocity contrast between layers at shallow depths often results in a superposition of fundamental and higher Rayleigh wave modes which, when superimposed, cannot be distinguished. At sites where the thickness of the overburden is sufficient to obtain a coherent dispersion, the inversion would significantly underestimate the S-wave velocity within the rock. For this reason, it is preferred to supplement the MASW with shear wave refraction data which provide accurate shear wave velocity values for bedrock.

2.2 Seismic Refraction

Overview

The seismic refraction method is based on the measurement of arrival times of seismic waves refracted at interfaces between geological layers. The method is used to obtain velocity depth models and to map interfaces between layers with significant velocity contrast such as water table and bedrock surface. Compressional (P) wave or shear (S) wave refracted arrivals can be recorded using vertically or horizontally oriented sensors and sources, respectively. Figure 3 is a schematic of a simplified seismic model showing the basic principle of the refraction method.

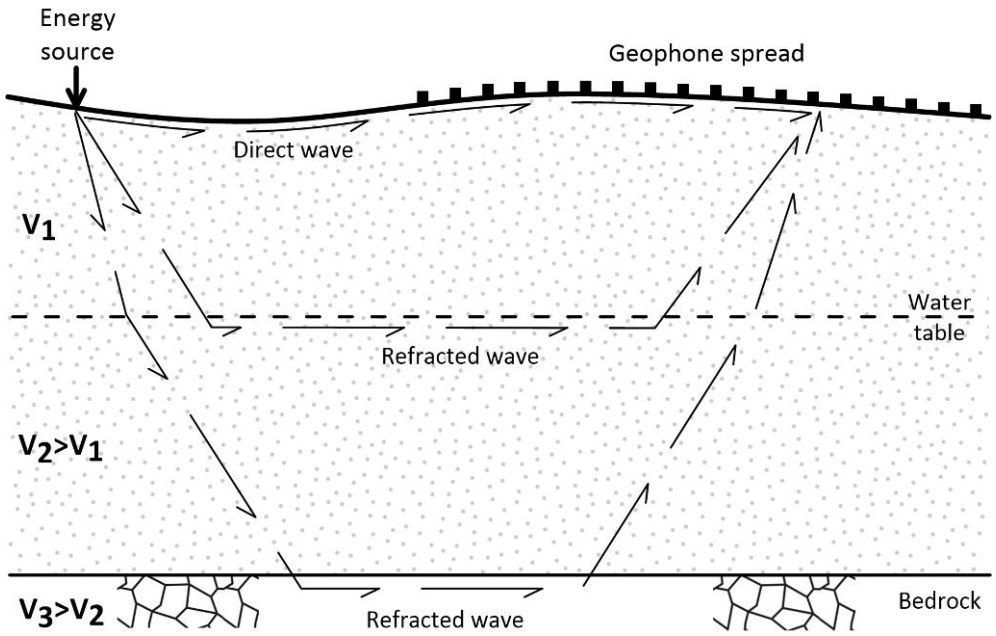

Figure 3 *Seismic model showing the basic principle of refraction method.*

Survey Design

The acquisition layout consisted of 24 receivers in a linear array (spread), connected with a multicore cable to P.A.S.I. Gea-24 seismograph. 10 Hz natural frequency horizontal geophones were used for this survey. The measurements were conducted with a spread length of 46 m (2 m spacing between geophones).

An 8-kg sledgehammer was used as an energy source. Shots were executed at four locations per spread: two shots at the ends of the spread and two shots with an offset of 8 m from the ends of the spread. Preferential S-wave energy was generated by horizontally striking a metal bar in a direction perpendicular to the survey line. Shots in two opposite directions were recorded at each shot location to record S-wave arrivals of opposite polarity. The record length was set to 500 ms with a 0.1 ms sampling interval.

Interpretation

The reciprocal (plus-minus) method was used for the interpretation of the seismic refraction data. The method assumes the subsurface as a series of discrete layers (refractors) with simple velocity distributions. It allows calculating the depth and velocity of a continuous undulating refractor, providing the target layer is of sufficient thickness and the dip angles are moderate.

ZondST2D software package was used for processing of the refraction data. The processing involved stacking of shot records obtained with opposite source directions, identification and picking of S-wave first arrivals.

Accuracy of the results

The accuracy of bedrock velocity determination at this site was estimated to be within 10%.

3 RESULTS

The quality of seismic shot records was good; first arrivals of refracted waves and MASW dispersion curves were well defined. Example S-wave refraction shot record and an MASW dispersion image obtained at this site are presented in Figure 4.

The results of the interpretation of S-wave refraction data are presented in Figure 5 in the form of a bedrock profile. The interpreted depth to bedrock ranged from 5.9 to 6.7 m below the ground surface. The shear wave velocity in the bedrock measured using the refraction method was 3246 ± 10% m/s.

Refraction data were used for parameterization of the initial MASW inversion model. The measured shear wave velocity for the bedrock is representative of the top of the rock. According to Commentary J (Paragraph 96) of the National Building Code of Canada 2015 (NBC), the measured value may be extrapolated if the rock conditions are known to be continuous to a depth of 30 m.

The resulting shear wave velocity depth profile is presented in Figure 6. The average S-wave velocity is plotted in the chart as a solid line. The dashed lines represent the upper and lower bound S-wave velocity profiles.

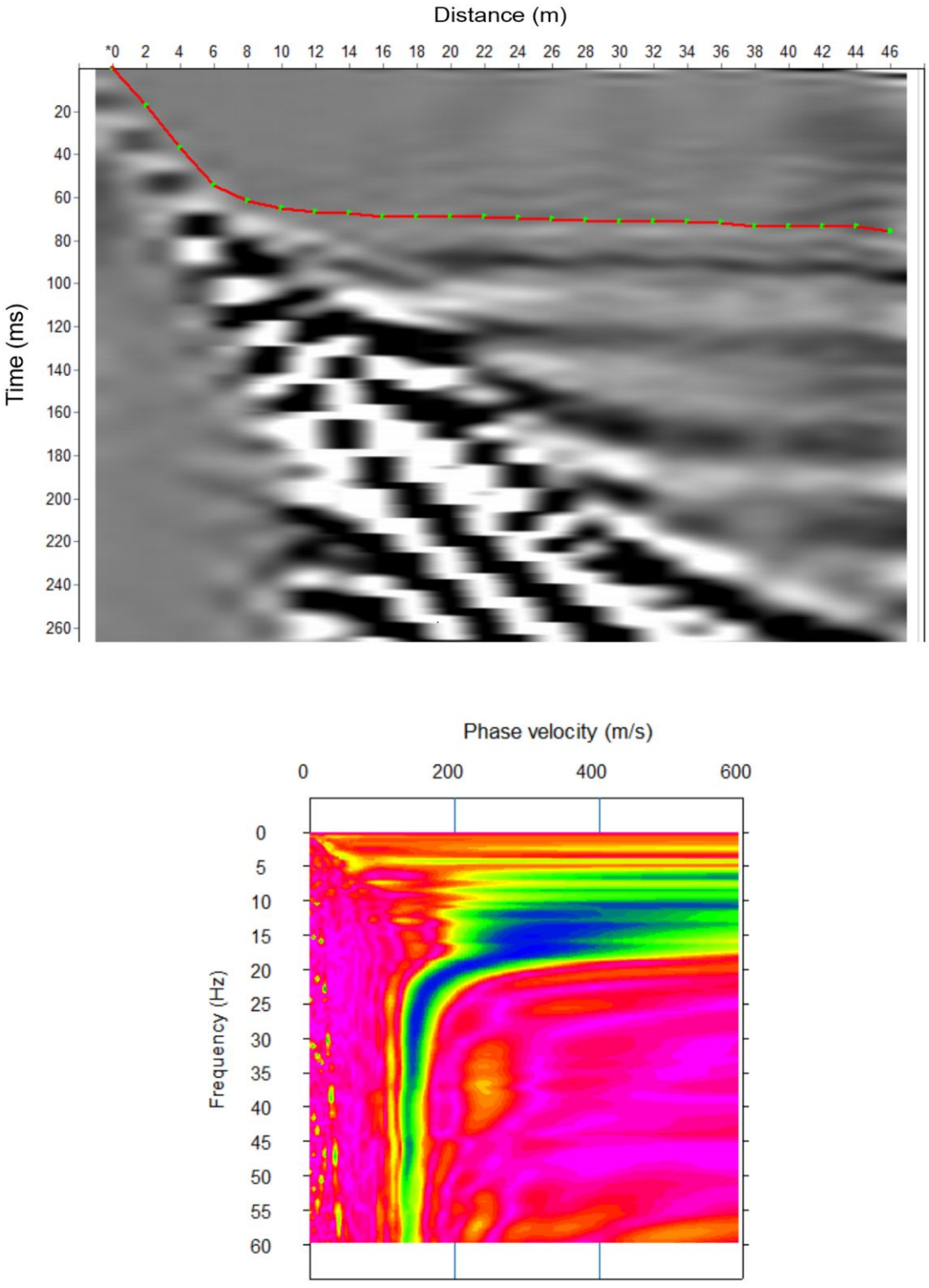

Figure 4 *Data examples displaying a stacked S-wave refraction shot record with S-wave first arrivals indicated (top) and MASW dispersion image (bottom).*

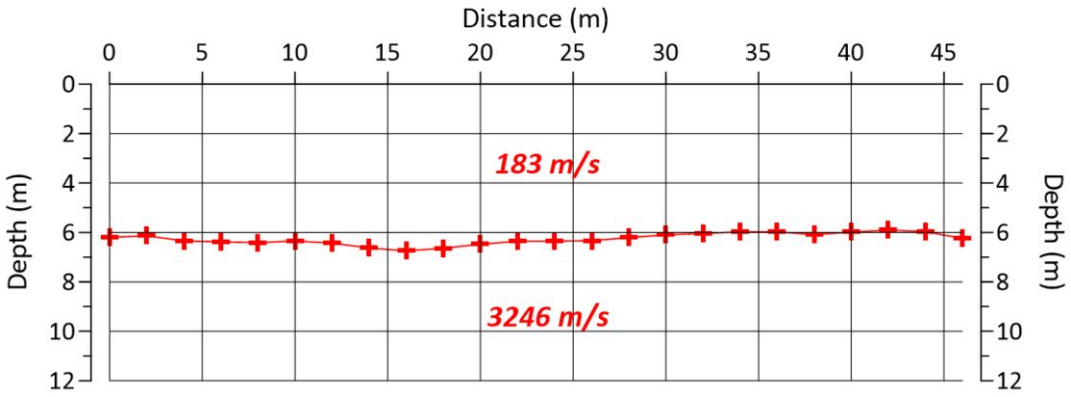

Figure 5 *Interpreted bedrock profile from S-wave refraction.*

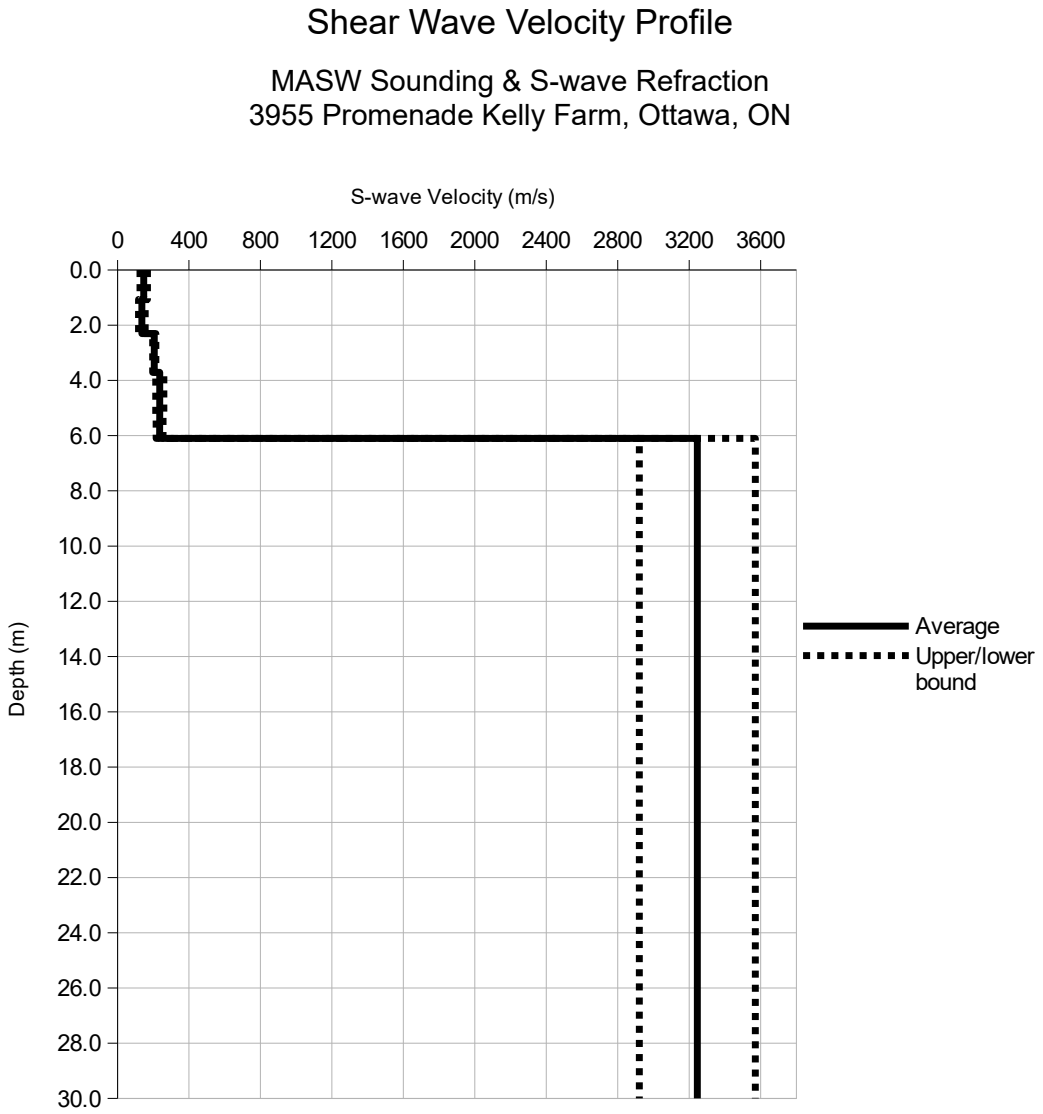

Figure 6 *Shear wave velocity profile from MASW sounding and S-wave refraction.*

The tabulated shear wave velocity model is presented in Table 1.

Table 1 *Shear wave velocities from MASW sounding and S-wave refraction.*

Depth Interval (m)		S-wave Velocity (m/s)
From	To	
0.0	1.1	147
1.1	2.3	136
2.3	3.7	206
3.7	5.3	237
5.3	6.3	235
6.3	30.0	3246

The average shear wave velocity within the upper 30 meters (V_S30) is defined as the travel-time weighted average velocity from surface to a depth of 30 m and calculated using the following formula:

$$V_S30 = 30 / \Sigma (d/V_S),$$

where d is the thickness of any layer and V_S is the layer S-wave velocity. In other words, V_S30 is calculated as 30 m divided by the sum of the S-wave travel times for each layer within the topmost 30 m.

The calculated V_S30 values are presented in Table 2.

Table 2 *V_S30 values from MASW sounding.*

Depth Range (m)	Minimum V_S30 (m/s)	Average V_S30 (m/s)	Maximum V_S30 (m/s)	NBC 2015 Site Class	NBC 2020 Site Designation
0 to 30	648	**724**	798	**C**	**X_{724}**

The V_S30 values obtained from the MASW sounding varied from 648 m/s to 798 m/s with an average of 724 m/s.

Based on the Site Classification for Seismic Site Response (Table 4.1.8.4.-A) of the National Building Code of Canada 2015 (NBC 2015), the investigated area is in **Site Class C** ($360 < V_S30 \leq 760$ m/s).

Based on the Sentence 4.1.8.4.(2b) of the National Building Code of Canada 2020 (NBC 2020), the **Site Designation** is **X_{724}**.

4 CLOSURE

Shear wave velocity testing involving the multi-channel analysis of surface waves (MASW) and seismic refraction methods was carried out for a proposed new school at 3955 Promenade Kelly Farm in Ottawa, Ontario.

The average shear wave velocity (V_S30) value calculated from in situ shear wave velocity measurements was **724 m/s**. Based on the Site Classification for Seismic Site Response (Table 4.1.8.4.-A) of the National Building Code of Canada 2015 (NBC 2015), the investigated area is in **Site Class C** ($360 < V_S30 \leq 760$ m/s). Based on the Sentence 4.1.8.4.(2b) of the National Building Code of Canada 2020 (NBC 2020), the **Site Designation** is $\mathbf{X_{724}}$.

We hope you find this report satisfactory. Should you have any questions or require additional information, please do not hesitate to contact the undersigned.

Frontwave Geophysics Inc.

Ilia Gusakov, P.Geo.
Geophysicist
(647) 514-4724
ilia.gusakov@frontwave.ca

PROFESSIONAL GEOSCIENTIST
ILIA GUSAKOV
PRACTISING MEMBER
3161
ONTARIO

Appendix D

Laboratory Certificates of Analysis

PARACEL LABORATORIES LTD.

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300 - 2319 St. Laurent Blvd
Ottawa, ON, K1G 4J8
1-800-749-1947
www.paracellabs.com

Certificate of Analysis

Cambium Inc. (Ottawa)
343 Preston St, 11th Floor
Ottawa, ON K7K 7G3
Attn: Blasco Vijayabaskaran

Client PO:
Project: 21388-001
Custody: 70545

Report Date: 27-Sep-2024
Order Date: 23-Sep-2024

Order #: 2439135

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
2439135-01	BH104_1.5-2.1

Approved By:

Mark Foto

Mark Foto, M.Sc.
Lab Supervisor

PARACEL LABORATORIES LTD.

Order #: 2439135

Certificate of Analysis

Report Date: 27-Sep-2024

Client: **Cambium Inc. (Ottawa)**

Order Date: 23-Sep-2024

Client PO:

Project Description: 21388-001

Analysis Summary Table

Analysis	Method Reference/Description	Extraction Date	Analysis Date
Anions	EPA 300.1 - IC, water extraction	26-Sep-24	26-Sep-24
pH, soil	EPA 150.1 - pH probe @ 25 °C, CaCl buffered ext.	25-Sep-24	25-Sep-24
Resistivity	EPA 120.1 - probe, water extraction	26-Sep-24	26-Sep-24
Solids, %	CWS Tier 1 - Gravimetric	24-Sep-24	25-Sep-24

PARACEL LABORATORIES LTD.

Order #: 2439135

Certificate of Analysis

Report Date: 27-Sep-2024

Client: **Cambium Inc. (Ottawa)**

Order Date: 23-Sep-2024

Client PO:

Project Description: 21388-001

	Client ID:	BH104_1.5-2.1	-	-	-		
	Sample Date:	23-Sep-24 10:00	-	-	-	-	-
	Sample ID:	2439135-01	-	-	-		
	Matrix:	Soil	-	-	-		
	MDL/Units						
Physical Characteristics							
% Solids	0.1 % by Wt.	83.7	-	-	-	-	-
General Inorganics							
pH	0.05 pH Units	7.31	-	-	-	-	-
Resistivity	0.1 Ohm.m	22.7	-	-	-	-	-
Anions							
Chloride	10 ug/g	18	-	-	-	-	-
Sulphate	10 ug/g	227	-	-	-	-	-

PARACEL LABORATORIES LTD.

Order #: 2439135

Certificate of Analysis

Report Date: 27-Sep-2024

Client: **Cambium Inc. (Ottawa)**

Order Date: 23-Sep-2024

Client PO:

Project Description: 21388-001

Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions								
Chloride	ND	10	ug/g					
Sulphate	ND	10	ug/g					
General Inorganics								
Resistivity	ND	0.1	Ohm.m					

PARACEL LABORATORIES LTD.

Order #: 2439135

Certificate of Analysis

Report Date: 27-Sep-2024

Client: **Cambium Inc. (Ottawa)**

Order Date: 23-Sep-2024

Client PO:

Project Description: 21388-001

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	18.4	10	ug/g	18.0			2.0	35	
Sulphate	241	10	ug/g	227			6.2	35	
General Inorganics									
pH	7.95	0.05	pH Units	7.91			0.5	2.3	
Resistivity	22.4	0.1	Ohm.m	22.7			1.1	20	
Physical Characteristics									
% Solids	93.6	0.1	% by Wt.	93.3			0.4	25	

PARACEL LABORATORIES LTD.

Order #: 2439135

Certificate of Analysis

Report Date: 27-Sep-2024

Client: **Cambium Inc. (Ottawa)**

Order Date: 23-Sep-2024

Client PO:

Project Description: 21388-001

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	112	10	ug/g	18.0	94.4	82-118			
Sulphate	312	10	ug/g	227	85.8	80-120			

PARACEL LABORATORIES LTD.

Order #: 2439135

Certificate of Analysis

Report Date: 27-Sep-2024

Client: **Cambium Inc. (Ottawa)**

Order Date: 23-Sep-2024

Client PO:

Project Description: 21388-001

Qualifier Notes:

Sample Data Revisions:

None

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable

ND: Not Detected

MDL: Method Detection Limit

Source Result: Data used as source for matrix and duplicate samples

%REC: Percent recovery.

RPD: Relative percent difference.

NC: Not Calculated

Soil results are reported on a dry weight basis unlesss otherwise noted.

Where %Solids is reported, moisture loss includes the loss of volatile hydrocarbons.

PARACEL LABORATORIES LTD

Paracel ID: 2439135

Paracel Order Number (Lab Use Only)	Chain Of Custody (Lab Use Only)
2439135	№ 70545

Client Name: Cambium Inc
Contact Name: Blasco Vijayabaskaran
Address: 343 Preston St, 11th Floor, Ottawa ON
Telephone: 613-929-1507

Project Ref: 21388-001
Quote #:
PO #:
E-mail: blasco.vijayabaskaran@cambium-inc.com
rory.ryan@cambium-inc.com

Page 1 of 1

Turnaround Time
☐ 1 day ☐ 3 day
☐ 2 day ☑ Regular
Date Required:

☐ REG 153/04 ☐ REG 406/19

Other Regulation
☐ Table 1 ☐ Res/Park ☐ Med/Fine
☐ Table 2 ☐ Ind/Comm ☐ Coarse
☐ Table 3 ☐ Agri/Other
☐ Table
For RSC: ☐ Yes ☐ No
☐ REG 558 ☐ PWQO
☐ CCME ☐ MISA
☐ SU - Sani ☐ SU - Storm
Mun:
☐ Other:

Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

Required Analysis

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken Date	Sample Taken Time	Corrosivity	Sulphides	Redox
1	BH104_1.5-2.1	S		3	Sept. 23/24	10:00 AM	X	X	X
2									
3									
4									
5									
6									
7									
8									
9									
10									

Comments:

Method of Delivery: Walkin

Relinquished By (Sign): R. Ryan	Received By Driver/Depot:	Received at Lab: D. Popov	Verified By:
Relinquished By (Print): Rory Ryan	Date/Time:	Date/Time: Sept 23,24 5:02	Date/Time: Sep. 24 11:00
Date/Time: Sept. 23/24 5:02 PM	Temperature: °C	Temperature: 14.2 °C	pH Verified: ☐ By: NA

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Kingston, ON, K7P 2R9
1-800-749-1947
www.paracellabs.com

Subcontracted Analysis

Cambium Inc. (Ottawa)
343 Preston St, 11th Floor
Ottawa, ON K7K 7G3
Attn: Blasco Vijayabaskaran

Paracel Report No.	**2439135**
Client Project(s):	**21388-001**
Client PO:	
Reference:	**Standing Offer - ENV**
CoC Number:	**70545**

Order Date:	23-Sep-24
Report Date:	27-Sep-24

Sample(s) from this project were subcontracted for the listed parameters. A copy of the subcontractor's report is attached

Paracel ID	Client ID	Analysis
2439135-01	BH104_1.5-2.1	Redox potential, soil Sulphide, solid

TESTMARK Laboratories Ltd.
Committed to Quality and Service

CERTIFICATE OF ANALYSIS

Client:	Dale Robertson	Work Order Number:	551535
Company:	Paracel Laboratories Ltd. - Ottawa	PO #:	
Address:	300-2319 St. Laurent Blvd. Ottawa, ON, K1G 4J8	Regulation: Project #:	Information not provided 2439135
Phone/Fax:	(613) 731-9577 / (613) 731-9064	DWS #:	
Email:	drobertson@paracellabs.com	Sampled By:	
Date Order Received:	9/26/2024	Analysis Started:	10/2/2024
Arrival Temperature:	24.3 C	Analysis Completed:	10/2/2024

WORK ORDER SUMMARY

ANALYSES WERE PERFORMED ON THE FOLLOWING SAMPLES. THE RESULTS RELATE ONLY TO THE ITEMS TESTED.

Sample Description	Lab ID	Matrix	Type	Comments	Date Collected	Time Collected
BH104_1.5-2.1	2060571	Soil	None		9/23/2024	10:00 AM

METHODS AND INSTRUMENTATION

THE FOLLOWING METHODS WERE USED FOR YOUR SAMPLE(S):

Method	Lab	Description	Reference
RedOx - Soil (T06)	Mississauga	Determination of RedOx Potential of Soil	Modified from APHA-2580B

REPORT COMMENTS

Non-Testmark container received 09/26/24 JP
Sample for Redox received past hold time, proceed with analysis as per client note 09/26/24 JP

This report has been approved by:

Marc Creighton
Laboratory Director

6820 Kitimat Road Unit 4, Mississauga, ON, L5N 5M3
Phone: (905) 821-1112 Fax: (905) 821-2095 Web: www.testmark.ca

TESTMARK Laboratories Ltd.
Committed to Quality and Service

CERTIFICATE OF ANALYSIS

Paracel Laboratories Ltd. - Ottawa

Work Order Number: 551535

WORK ORDER RESULTS

Sample Description	BH104 _ 1.5 - 2.1		
Sample Date	9/23/2024 10:00 AM		
Lab ID	2060571		
General Chemistry	Result	MDL	Units
RedOx (vs. S.H.E.)	314 [313]	N/A	mV

LEGEND

Dates: Dates are formatted as mm/dd/year throughout this report.

MDL: Method detection limit or minimum reporting limit.

[ ]: Results for laboratory replicates are shown in square brackets immediately below the associated sample result for ease of comparison.

Organic Soil Analysis: Data reported for organic analysis in soils samples are corrected for moisture content.

Quality Control: All associated Quality Control data is available on request.

Field Data: Reports containing Field Parameters represent data that has been collected and provided by the client. Testmark is not responsible for the validity of this data which may be used in subsequent calculations.

Sample Condition Deviations: A noted sample condition deviation may affect the validity of the result. Results apply to the sample(s) as received.

Reproduction of Report: Report shall not be reproduced, except in full, without the approval of Testmark Laboratories Ltd.

ICPMS Dustfall Insoluble: The ICPMS Dustfall Insoluble Portion method analyzes only the particulate matter from the Dustfall Sampler which is retained on the analysis filter during the Dustfall method.

Regulation Comparisons: Disclaimer: Please note that regulation criteria are provided for comparative purposes, however the onus on ensuring the validity of this comparison rests with the client.

6820 Kitimat Road Unit 4, Mississauga, ON, L5N 5M3
Phone: (905) 821-1112 Fax: (905) 821-2095 Web: www.testmark.ca

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

02-October-2024

Paracel Laboratories
Attn : Dale Robertson

300-2319 St.Laurent Blvd.
Ottawa, ON
K1G 4K6, Canada

Phone: 613-731-9577
Fax:613-731-9064

Date Rec. : 25 September 2024
LR Report: **CA13735-SEP24**
Reference: Project#: 2439135

Copy: #1

CERTIFICATE OF ANALYSIS
Final Report

Sample ID	Sample Date & Time	Sulphide (Na2CO3) %
1: Analysis Start Date		01-Oct-24
2: Analysis Start Time		11:19
3: Analysis Completed Date		01-Oct-24
4: Analysis Completed Time		11:27
5: RL		0.01
6: BH104_1.5-2.1	23-Sep-24 10:00	0.04

RL - SGS Reporting Limit

Kimberley Didsbury
Project Specialist,
Environment, Health & Safety

OnLine LIMS

0003876778

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

LR Report : **CA13735-SEP24**

Quality Control Report

Inorganic Analysis														
Parameter	Reporting Limit	Unit	Method Blank	Duplicate				LCS / Spike Blank			Matrix Spike / Reference Material			
				Result 1	Result 2	RPD	Acceptance Criteria	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)		
							%		Low	High		Low	High	
Carbon/Sulphur - QCBatchID: ECS0003-OCT24														
Sulphide (Na2CO3)	0.01	%	< 0.01											

PARACEL LABORATORIES LT

Paracel ID: 2439135

Paracel Order Number (Lab Use Only)	Chain Of Custody (Lab Use Only)
2439135	№ 70545

Client Name: Cambium Inc
Contact Name: Blasco Vijayabaskaran
Address: 343 Preston St, 11th Floor, Ottawa ON
Telephone: 613-929-1507

Project Ref: 21388-001
Quote #:
PO #:
E-mail: blasco.vijayabaskaran@cambium-inc.com
rory.ryan@cambium-inc.com

Page 1 of 1

Turnaround Time
☐ 1 day ☐ 3 day
☐ 2 day ☒ Regular
Date Required:

☐ REG 153/04 ☐ REG 406/19

Table 1 ☐ Res/Park ☐ Med/Fine
Table 2 ☐ Ind/Comm ☐ Coarse
Table 3 ☐ Agri/Other
Table ___
For RSC: ☐ Yes ☐ No

Other Regulation
☐ REG 558 ☐ PWQO
☐ CCME ☐ MISA
☐ SU - Sani ☐ SU - Storm
Mun:
☐ Other:

Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

Required Analysis

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Sample Taken: Date	Sample Taken: Time	Corrosivity	Sulphides	Redox
1	BH104_1.5-2.1	S		3	Sept.23/24	10:00 AM	X	X	X
2									
3									
4									
5									
6									
7									
8									
9									
10									

Comments:

Method of Delivery: Walkin

Relinquished By (Sign):	Received By Driver/Depot:	Received at Lab:	Verified By:
Relinquished By (Print): Rory Ryan	Date/Time:	Date/Time: Sept 23,24 5:02	Date/Time: Sep.24 11:00
Date/Time: Sept.23/24 5:02 PM	Temperature: °C	Temperature: 14.2 °C	pH Verified: ☐ By: NA