Geotechnical Investigation Report - 245 Church Street, Penetanguishene, Ontario

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Prepared for:
Koenig Developments Ltd.

Cambium Reference: 13237-001

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1.0 Introduction

Cambium Inc. (Cambium) was retained by Koenig Developments Ltd. (Client) to complete a geotechnical investigation in support of a proposed development located at 245 Church Street in Penetanguishene, Ontario (Site).

The geotechnical investigation was required to confirm subsurface conditions at the Site and to provide geotechnical parameters and recommendations for supporting the design and construction of the proposed development.

This report presents and summarizes the methodology and findings of the geotechnical investigation conducted by Cambium at the Site. Based on the results of the investigation, geotechnical engineering recommendations relevant to the proposed development are provided.

1.1 Reviewed Documents

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

[1] EcoVue Consulting Services Inc. – Peterborough, Ontario
Concept Plan CP1 – Koening Developments Ltd. – 245 Church Street, Town of Penetanguishene, ON; August 12, 2021.

[2] RS Surveying Limited– Stouffville, Ontario
Part 1: Plan of Survey Showing Topographic Detail of Part of Lots 142 and 143 East Side of Church Street Registered Plan 70, Town of Penetanguishene, County of Simcoe; October 7, 2022.

1.2 Standards and Guidelines

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

[3] Canadian Foundation Engineering Manual – 4th Edition; Canadian Geotechnical Society; 2006.

2.0 Site and Project Description

2.1 Site Description

The Site is located on the east side of Church Street in Penetanguishene (Township of Essa), Ontario, and covers an area of roughly 5.5 acres. It is bordered to the east by Church Street and to the south, west and east by developed residential properties. The property is currently vacant with a mixture of vegetation at the eastern extents of the property.

The existing ground elevation at the property slopes upward from west the east property limit to approximately the east property limit of 243 Church Street. Afterwards, the site slopes downward to the treed area where it becomes relatively flat. The elevations range is approximately from 228.0 m above sea level (mASL) and 222.0 mASL [2].

2.2 Project Description

The proposed development will consist of constructing twenty-seven single detached house lots, four townhouse lots, and one double duplex containing four units. It will also consist of a cul-de-sac, extending from Oxley Drive.

3.0 Methodology

3.1 Borehole Investigation

Four boreholes were advanced at the Site on July 21, 2021, at predetermined locations confirmed with the Client. The boreholes were designated as BH101-21 to BH104-21 and were terminated at a depth of 6.6 m below ground surface (mbgs).

BH102-21, BH103-21 and BH104-21 were outfitted with monitoring wells following completion of drilling, to allow for subsequent groundwater level monitoring at the Site.

Borehole drilling and sampling were completed using a track-mounted drill rig operating under the supervision of a Cambium geotechnical analyst. The boreholes were advanced to the sampling depths by means of continuous flight hollow stem augers 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 the consistency of cohesive soils and relative density of non-cohesive materials. Soil samples were collected at approximately 0.75 m intervals in the upper 3.0 mbgs and at 1.5 m intervals below that depth.

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, laboratory testing, and storage. Borehole logs are provided in Appendix A. A Borehole Location Plan is appended as Figure 1 of this report.

3.2 Site Survey

The UTM coordinates of all boreholes were obtained using a Garmin handheld GPS immediately after the completion of drilling. The elevations of the boreholes and monitoring wells were obtained from the Client provided topographic survey, conducted by RS Surveying Limited on October 7, 2022.

3.3 Physical Laboratory Testing

Physical laboratory testing, including five grain size analyses (LS-702, 705), was completed on selected soil samples to confirm textural classification and to assess geotechnical parameters. Natural moisture content testing (LS-701) was completed on all retrieved soil samples. Results of the grain size testing are presented in Appendix B and are discussed in Section 4.0.

4.0 Subsurface Conditions

The stratigraphy encountered in the boreholes is indicated on the attached borehole logs in Appendix A. It is noted that the 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 in 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 (drilling speed, shaking/grinding of the augers, etc.).

In general, the subsurface conditions consist of surficial topsoil underlain by presumably native sands, with varying silt contents and trace amounts of clay.

4.1 Regional Geology

Ontario Geological Survey (OGS) mapping indicates that the quaternary geology at the Site is projected to be characterized by predominantly granular glaciomarine deposits (sand, gravelly sand and gravel nearshore and beach deposits).

Physiographic mapping (Chapman, L.J. & Putnam, D.F., 2007) shows the Site within sand plain formations.

4.2 Topsoil

A layer of black sandy topsoil was observed at the surface of each of the boreholes advanced throughout the Site. The thickness of the topsoil ranged from 100 mm and 400 mm. The topsoil layer was noted as moist at the time of the investigation, with a natural moisture content ranging from 9.7% to 20.3% based on laboratory testing. The thickness of the topsoil layer encountered at each of the borehole locations may be found on the borehole logs within Appendix A.

Assessment of organic matter content or other common topsoil quality tests were beyond the scope of this study.

4.3 Sand

A layer of sand soils containing varying amounts of gravel, silt, and clay was encountered immediately beneath the surficial topsoil layer in boreholes BH101-21, BH102-21 and BH104-21. The sand soils were brown to grey in colour and extended to depths of 1.5 mbgs in BH101-21, 4.6 mbgs in BH102-21 and the termination depth of 6.6 mbgs in BH104-21. The SPT N values recorded within the sand layer ranged from 4 to greater than 50 blows for 180 mm of penetration, indicating a very loose to very dense relative density. The natural moisture content of this sand layer ranged from 8.8% to 21.2% based on laboratory testing. The sand was noted as moist within boreholes BH101-21 and BH102-21, with the layer being noted as moist to saturated within borehole BH104-21 at the time of the investigation.

Laboratory particle size distribution analyses were completed for two samples of the sand soils in order to assess the soil composition. The testing results are provided in Appendix B and are summarized in Table 1 based on the Unified Soils Classification System (USCS).

Table 1 Particle Size Distribution – Sand

Borehole	Depth (mbgs)	Description	% Gravel	% Sand	% Silt	% Clay	% Moisture content
BH102-21 SS2	0.6-1.2	Sand some Silt trace Clay trace Gravel	1	80	15	4	10.7
BH104-21 SS4	2.3-2.7	Sand trace Silt trace Gravel	4	87	9		8.8

4.4 Silty Sand

A layer of silty sand soils were encountered immediately beneath the upper sand deposit within boreholes BH101-21 and BH102-21, the silty sand soils extended to the borehole termination depths of 6.6 mbgs within the boreholes. The soils were noted as grey in colour and contained varying amounts of gravel and clay. The SPT N values recorded within the silty sand ranged from 20 to 50 blows for 100 mm of penetration, indicating a compact to very

dense relative density. The natural moisture content of the silty sand layer ranged from 5.1% to 10.4% based on laboratory testing and was noted as moist at the time of the investigation.

Laboratory particle size distribution analyses was completed for two samples of the silty sand soils to assess the soil composition. The testing results are provided in Appendix B and are summarized in Table 2 based on the USCS.

Table 2 Particle Size Distribution – Silty Sand

Borehole	Depth (mbgs)	Description	% Gravel	% Sand	% Silt	% Clay	% Moisture content
BH101-21 SS3	1.5-2.0	Silty Sand trace Gravel	7	68	25		9.5
BH102-21 SS6	4.6-5.0	Silty Sand some Gravel trace Clay	11	62	24	3	7.2

4.5 Sand and Silt

A layer of silt and sand soils were encountered beneath the surficial topsoil layer within borehole BH103-21, the sand and silt soils extended to the borehole termination depth of 6.6 mbgs. The sand and silt soils were noted as brown to grey in colour and contained trace amounts of gravel. The SPT N values recorded within the silt and sand layer ranged from 3 to 50 blows for 280 mm of penetration, indicating a very loose to very dense relative density. The natural moisture content of the sand and silt soils ranged from 4.0% to 21.2% based on laboratory testing and was noted as moist to wet during the investigation.

Laboratory particle size distribution analysis was completed for one sample of the sand and silt soils in order to assess the soil composition. The testing results are provided in Appendix B and are summarized in Table 3 based on the USCS.

Table 3 Particle Size Distribution – Sand and Silt

Borehole	Depth (mbgs)	Description	% Gravel	% Sand	% Silt	% Clay	% Moisture content
BH103-21 SS2	0.6-1.2	Sand and Silt trace Gravel	3	62	35		16.7

4.6 Bedrock

Bedrock was not encountered within any of the boreholes advanced by Cambium at the Site. Each of the boreholes were terminated at a depth of 6.6 mbgs, corresponding to elevations between 216.1 mASL and 221.6 mASL.

4.7 Groundwater

The encountered soils were generally noted as wet at the time of investigation below depths of approximately 6.2 mbgs and 1.2 mbgs, within boreholes BH103-21 and BH104-21, respectively. The soils encountered within boreholes BH101-21 and BH102-21 were noted as moist at the time of the investigation. The presence of groundwater (free water) and caving (sloughing) of the borehole wall was not noted within any of the boreholes advanced as part of the investigation.

A total of three monitoring wells were installed during the investigation. The monitoring wells were installed within BH102-21 through BH104-21 and were utilized as part of the hydrogeological assessment undertaken by Cambium and reported under a separate cover. The monitoring wells allow for subsequent monitoring of the stabilized groundwater table within the Site. Groundwater level measurements were taken over a period of twelve months from August, 2021 to July, 2022. A summary of the groundwater levels recorded within the monitoring wells throughout the site, following the borehole investigation, is summarized in Table 4.

Table 4 Groundwater Observations in the Monitoring Well

Date	Borehole	Ground Elevation (mASL)	Water Level Depth (mbgs)	Water Level Elevation (mASL)
August 3, 2021	BH102-21	224.67	6.0	218.67
	BH103-21	223.86	5.91	217.95
	BH104-21	222.65	6.13	216.52
September 20, 2021	BH102-21	224.67	Dry	-
	BH103-21	223.86	5.93	217.93
	BH104-21	222.65	6.13	216.52
October 26, 2021	BH102-21	224.67	Dry	-

Date	Borehole	Ground Elevation (mASL)	Water Level Depth (mbgs)	Water Level Elevation (mASL)
	BH103-21	223.86	5.93	2
	BH104-21	222.65	6.13	216.52
November 22, 2021	BH102-21	224.67	Dry	-
	BH103-21	223.86	5.94	217.92
	BH104-21	222.65	6.16	216.49
December 21, 2021	BH102-21	224.67	Dry	-
	BH103-21	223.86	5.94	217.92
	BH104-21	222.65	**5.92**	**216.73**
January 28, 2022	BH102-21	224.67	Dry	-
	BH103-21	223.86	5.93	217.93
	BH104-21	222.65	6.15	216.50
February 22, 2022	BH102-21	224.67	Dry	-
	BH103-21	223.86	5.92	217.93
	BH104-21	222.65	6.14	216.51
March 23, 2022	BH102-21	224.67	5.96	218.71
	BH103-21	223.86	5.95	217.91
	BH104-21	222.65	6.18	216.47
April 25, 2022	BH102-21	224.67	Dry	-
	BH103-21	223.86	5.92	217.94
	BH104-21	222.65	6.08	216.57
May 20, 2022	BH102-21	224.67	**5.75**	**218.92**
	BH103-21	223.86	5.91	217.95
	BH104-21	222.65	6.13	216.52
June 15, 2022	BH102-21	224.67	5.97	218.70
	BH103-21	223.86	**5.90**	**217.96**
	BH104-21	222.65	6.17	216.48
July 6, 2022	BH102-21	224.67	5.95	218.72
	BH103-21	223.86	5.92	217.94
	BH104-21	222.65	6.14	216.51

***Bold** text denotes the highest groundwater elevations observed during the monitoring events in each respective monitoring well.*

Groundwater levels at the Site are anticipated to vary between and beyond the borehole locations and to fluctuate with seasonal variations in precipitation and snowmelt.

5.0 Geotechnical Considerations

This section of the report provides engineering information on, and recommendations for, the geotechnical design aspects of the project based on our interpretation of the borehole information, the laboratory test data, and our understanding of the project requirements. The information in this portion of the report is provided for planning and design purposes for the guidance of the design engineers and architects. Where comments are made on construction, they are provided only to highlight aspects of construction which could affect the design of the project. 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 independent interpretation of the factual data as it affects their proposed construction techniques, schedule, equipment capabilities, costs, sequencing and the like. Cambium will not assume any responsibility for construction-related decisions made by contractors on the basis of this report.

5.1 Site Preparation

Existing topsoil and organic material, any loose reworked/disturbed native materials and any deleterious material (i.e., construction debris, fibrous material, asphalt, brick fragments, etc.) encountered should be excavated and removed beneath proposed development areas prior to construction. Additionally, this material should be excavated and removed to a minimum distance of 3 m around the building footprint. Any topsoil and materials with significant quantities of organics and deleterious materials are not appropriate for use as fill.

The exposed subgrade should be proof-rolled and inspected by a qualified geotechnical engineer prior to placement of any granular fill or foundations. Any loose/soft soils identified at the time of the proof-rolling that are unable to uniformly be compacted should be sub-excavated and removed.

The excavations created through the removal of these materials should be backfilled with approved engineered fill consistent with the recommendations provided below.

The near surface soils can become unstable if wet or saturated. Such conditions are common in the spring and late fall. Under these conditions, temporary use of granular fill, and possible separating/reinforcing geotextiles, may be required to prevent severe rutting on construction access routes.

5.2 Frost Penetration

Based on climate data and design charts, the maximum frost penetration depth below the surface at the Site is estimated at 1.6 mbgs. Exterior footings for the proposed structures should be situated at or below this depth for frost penetration or should be appropriately protected. Any services should be located below this depth or be appropriately insulated.

5.3 Excavations

For the purposes of this report, it is assumed that the recommendations given are based on basements are being constructed as part of the residential development. Therefore, it is assumed that excavations are not extending more than 3.5 m below the existing ground surface. Should deeper excavations be proposed for any reason and following completion of the grading plan, the following comments and recommendations should be reviewed and revised, as necessary.

In the areas of the Site where unsupported excavations to the required depths are deemed feasible, the excavations must be carried out in accordance with the latest edition of OHSA and Ontario Regulation 213/91 (as amended). For practical purposes, the overburden soils at the Site above the groundwater table and within continually dewatered depths can be considered Type 3 soils, as such, excavation side slopes should be no steeper than 1H:1V.

Soils below the groundwater table should be treated as Type 4 soils and therefore excavation unsupported side slopes should be decreased to 3H:1V in these areas.

Excavation slopes should be protected during construction from precipitation, runoff, or snow/ice melt and should be inspected regularly for signs of instability.

If localized instability is noted during excavation or if wet conditions are encountered, the side slopes should be flattened as required to maintain safe working conditions or the excavation sidewalls must be fully supported (shored).

5.4 Groundwater Control and Dewatering

Based on the results of the groundwater monitoring program, conducted between August 2021 and July 2022, the minimum depths of groundwater observed within the monitoring wells were recorded between 5.8 mbgs and 5.9 mbgs, or at elevations from 216.7 mASL and 219 mASL.

Based on the provided concept plan it is presumed that each of the proposed residential dwellings will be constructed with a basement. It is estimated that the subgrade elevations for residential basement floor slabs may be as low as 220 mASL within the eastern portion of the Site, and as low as 223 mASL within the western portion of the Site. Based on the results of the 12-month groundwater monitoring program, summarized in Table 4, groundwater seepage at the subgrade elevation is not anticipated. These excavations, and any sub-excavations required to replace incompetent soil materials encountered below proposed foundations/floor slabs, are not expected to intersect the local groundwater table.

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"). Registry on the EASR replaces the need to obtain a PTTW and a Section 53 approval. A Category 3 PTTW is required where the proposed water taking is greater than 400 m^3/day.

If groundwater seepage is encountered during the excavation works, it should be manageable using filtered sumps and pumps. Based on the anticipated depth and size of the excavations, a PPTW or registry on the EASR will likely not be required. The dewatering system is the Contractor's responsibility and the rate and volume required for dewatering is dependent on the construction methods and staging chosen by the contractor. Further, the contractor will be responsible for obtaining any required discharge approvals. The hydrogeological assessment will be submitted separately.

It is noted that the elevation of the groundwater table will vary due to seasonal conditions and in response to heavy precipitation events and should be expected to be notably higher in the spring (i.e., March to May). To minimize predictable water issues and costs, it is recommended that the excavation and in ground construction be performed in drier seasons.

5.5 Foundation Design

5.5.1 Conventional Footings

Design and construction recommendations for potential foundation systems are outlined below. It is assumed that the proposed development will consist of twenty-seven single detached house lots, four townhouse lots, and one double duplex containing four units (with basements). Foundations for such structures at this site may consist of shallow spread footings founded directly on native, undisturbed soils. It is understood that the Site may be regraded, and our foundation recommendations may change depending upon the final grades. Cambium should be contacted to review the final grading plan and provide any necessary changes to the foundation recommendations outlined below.

From a geotechnical perspective, the proposed structures can be supported on standard strip and/or spread footings founded on competent native soils (sand dominant, compact to dense relative density). Table 5 gives allowable bearing capacities based on geotechnical principles outlined in Section [3] for shallow foundations bearing on native soils.

The provided values are applicable for strip foundations with a minimum width of 0.5 m and for spread foundations with minimum dimensions of 1 m x 1 m.

Table 5 Bearing Capacities for Foundations on Native Soils

Borehole	Soil Description	Depth (mbgs)	Elevation (mASL)	Maximum Geotechnical Reaction SLS (kPa)	Maximum Geotechnical Reaction ULS (kPa)
BH101-21	Sand some Silt trace Gravel trace Clay; loose	0.1 – 1.5	228.0 – 226.7	50	75
	Silty Sand trace Gravel; compact to very dense	Below 1.5	Below 226.7	150	200
BH102-21	Sand some Silt trace Clay; loose	0.3 – 3.0	224.4 – 221.7	50	75
	Sand some Silt trace Clay; compact	Below 3.0	Below 221.7	150	200
BH103-21	Sand and Silt trace Gravel; loose	1.5 – 2.3	222.4 – 221.6	50	75
	Sand and Silt trace Gravel; compact to very dense	Below 2.3	Below 221.6	150	200
BH104-21	Sand trace Gravel trace Silt; loose	0.6 – 2.3	222.0 – 220.4	50	75
	Sand trace Gravel trace Silt trace Clay; compact to very dense	Below 2.3	Below 220.4	150	200

Note: assumes all foundations provided with at least 1.6 m of adjacent earth cover. For BH102-21, assumes compact native soils below a depth of 3.0 mbgs; if loose/incompetent materials are encountered at footing elevations, these are required to be sub-excavated and replaced according to the provided recommendations.

Alternatively, in areas where the proposed founding levels are above the level of competent native soil, or where sub excavation is required, footings made to bear directly on a pad of engineered fill constructed per the recommendations in Section 5.6. From a preliminary perspective, footings placed on approved engineered fill and appropriately protected from frost may be designed for an allowable bearing capacity of 75 kPa at SLS and 100 kPa at ULS. Cambium should be retained to review the final grading plan, as the preliminary engineered fill bearing capacity values will change depending on engineered fill thickness, material and the native subgrade soil the engineered fill pad is constructed on.

Settlement potential at the above-noted SLS loadings is less than 25 mm and differential settlement is expected to be less than 20 mm.

The quality of the subgrade should be inspected by Cambium during construction, prior to constructing the footings, to confirm bearing capacity estimates.

5.5.2 Floor Slabs

To create a stable working surface, to distribute loadings, and for drainage purposes, an allowance should be made to provide at least 200 mm of OPSS.MUNI 1010 Granular A compacted to 98% of Standard Proctor Maximum Dry Density (SPMDD) beneath all floor slabs. It is recommended that all floor slabs are situated at least 500 mm above the seasonal high groundwater elevation.

If any interior areas are not to be continuously heated throughout the winter there is potential for damage to the floor slab due to frost action depending upon the composition of the subgrade soils. The floor slab within any area expected to be exposed to freezing temperatures should be adequately insulated to prevent frost penetration within the subgrade.

Any basement floor slabs should be underlain by a 300 mm thick layer of 19 mm diameter crushed clear stone wrapped in a geotextile (Terrafix 270R or equivalent) and hydraulically connected to perimeter subdrains.

The clear stone material should be nominally compacted to a dense state.

5.6 Backfill and Compaction

All existing vegetation, topsoil, organic and non-organic fills, and any loose soils shall be removed down to a competent base. Backfill areas must be approved by a qualified geotechnical engineer prior to placement of any new fill, to ensure the suitability of subgrade conditions.

Some moisture content adjustments of fill material may be required prior to placement and compaction, depending upon seasonal conditions. Geotechnical inspections and testing of engineered fill are required to confirm acceptable quality.

Foundation wall and any buried utility backfill material should consist of free-draining imported granular material. Typically, backfill should be placed in maximum 300 mm thick lifts and should be compacted to a minimum of 98% of SPMDD. Backfill adjacent to the structural elements (i.e., foundation walls) should be compacted to 95% of SPMDD taking care not to

damage the adjacent structures. The backfill material in the upper 300 mm below the pavement subgrade elevation should be compacted to 100% of SPMDD in all areas.

5.6.1 Engineered Fill

Where the fill material is treated as an engineered fill to support structural elements such as foundations and/or floor slabs the following is recommended:

I. Remove any and all existing vegetation, surficial topsoil / organics, organic fills or fills and any loose/disturbed soils to a competent subgrade for a suitable envelope.

II. The area of the engineered fill should extend horizontally 1 m beyond the outside edge of the foundations then extend downward at an imaginary 1H:1V slope to the competent approved native soil. The exposed edges of the engineered fill should be sloped at a maximum of 3H:1V to avoid weakening of the engineered fill edges due to slope movement. If fill is required adjacent to sloped banks (i.e., slope steeper than 3H:1V), the fill shall be placed in stepped planes to avoid a plane weakness.

III. The subgrade or base of the engineered fill area must be approved by Cambium prior to placement of any new fill, to ensure that suitability of subgrade condition.

IV. Place approved OPSS 1010.MUNI SSM or Granular ‘B’ Type I material at a moisture content at or near optimum moisture in suitable maximum 200 mm thick lifts, compacted to 100% of SPMDD. If native soils from the site are not used as engineered fill, imported material for engineered fill should consist of clean, non-organic soils, free of chemical contamination or deleterious material. Any frost penetration into the fill material must be removed prior to placement of subsequent lifts of fill and reviewed by Cambium.

V. The engineered fill should be placed at least 600 mm above the elevation of the proposed underside of footing.

VI. Due to the potential negative effects of differential settlement between the engineered fill and the native soils, in any block where footings are to be placed partly on engineered fill and partly on native soils, reinforcing steel bars should be included and placed within the footings and the top of the foundation walls. All tie reinforcing steel

bars should be included and placed within the top of the foundation walls. All tie reinforcing steel bars should have at least 600 mm of overlap. The actual steel reinforcement design should be confirmed / designed by the project structural engineer.

VII. Full time testing and inspection of the engineered fill will be required for it to be used as a founding material, as outlined in Section 4.2.2.2 of the Ontario Building Code.

5.7 Subdrainage

The exterior grade around any buildings should be sloped from the walls to direct surface runoff away from the building. To deal with seasonal perched water and/or the water table, perimeter subdrains consisting of geotextile wrapped perforated pipe subdrains set in a trench of clear stone and connected to a sump or other frost-free positive outlet are recommended.

Subsurface walls should be adequately damp proofed above the water table and waterproofed below the water table.

5.8 Lateral Earth Pressure

Lateral earth pressure coefficients (K) are shown in Table 6 and may be used for the preliminary design of temporary and permanent structures at the Site. It is assumed that potential lateral loads will result from cohesion less, frictional materials, such as granular backfill and the encountered near surface native sand.

Table 6 Lateral Earth Pressure Coefficients

Stratum/Parameter	γ / γ ‘ [kN/m^3]	Φ [°]	c [kN/m^2]	K_o [-]	K_a [-]	K_p [-]
Sand Materials very loose to loose	19 / 10	27.5	0	0.54	0.37	2.72
Sand Materials compact to dense	20 / 11	32	0	0.47	0.31	3.26
Engineered Fill (per recommendations provided above)	20.5 / 11.5	32.5	0	0.46	0.30	3.32

Where:

γ	=	bulk unit weight of soil (kN/m^3)
γ'	=	submerged (effective) unit weight of soil (kN/m^3)
φ	=	internal angle of friction (degrees)
c	=	soil cohesion (kN/m^2)
K_a	=	Rankine active earth pressure coefficient (dimensionless)
K_o	=	Rankine at-rest earth pressure coefficient (dimensionless)
K_p	=	Rankine passive earth pressure coefficient (dimensionless)

The coefficients provided in Table 6 assume that the surface of the granular backfill is horizontal against any proposed retaining 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.

5.9 Buried Utilities

Trench excavations above the groundwater table should generally consider Type 3 soil conditions, which require side slopes no steeper than 1H:1V, otherwise shoring would be required. Any excavations below the water table should generally consider Type 4 soil conditions which require side slopes of 3H:1V or flatter. All utilities should be placed at a minimum depth of 1.6 mbgs to prevent damage due to frost action or be adequately insulated.

Bedding and cover material for any services should consist of OPSS 1010 Granular A or B Type II, placed in accordance with pertinent Ontario Provincial Standard Drawings (OPSD 802.013). The bedding and cover material shall be placed in maximum 200 mm thick lifts and should be compacted to at least 98% of SPMDD. The cover material shall be a minimum of 300 mm over the top of the pipe and compacted to 98% of SPMDD, taking care not to damage the utility pipes during compaction. If bedding is being placed in wet conditions consideration should be given to using 19 mm crushed clear stone underlain by a geotextile (Terrafix 270R or similar).

5.10 Seismic Site Classification

The Ontario Building Code (OBC) specifies that the structures should be designed to withstand forces due to earthquakes. For the purpose of earthquake design, geotechnical information shall be used to determine the “Site Class”.

The parameters for determination of Site Classification for Seismic Site Response are set out in Table 4.1.8.4A of the OBC (2012). The classification is based on the determination of the average shear wave velocity in the top 30 metres of the Site stratigraphy, where shear wave velocity (V_s) measurements have been taken. Alternatively, the classification is estimated based on rational analysis of undrained shear strength (S_u) or penetration resistances (N_{60} values).

The soils at the Site were investigated up to a maximum depth of 6.6 mbgs. Therefore, the recommended site classification would be based on the available information as well as our interpretation of conditions below the borehole termination depths based on our knowledge of the soil conditions in the area. It is assumed that the soils encountered in the samples retrieved remain continuous to a minimum depth of 30 m below the bottom of any foundations. Based on the explored soil properties and in accordance with Table 4.1.8.4.A, it is recommended that **Site Class “D” (stiff soil)** be applied for structural design at the Site.

Peak ground acceleration and spectral acceleration (period of 0.2 seconds) for the Site are calculated to be 0.058g and 0.101g respectively using the 2015 National Building Code Seismic Hazard Calculation. A detailed report of the calculation and its results can be found in Appendix C.

Consideration could be given to carrying out shear wave velocity testing (Multichannel Analysis of Surface Waves, “MASW”) to evaluate whether an improved seismic site class can be obtained. Further details regarding shear wave velocity testing could be provided upon request.

5.11 Pavement Design

The performance of the pavement is dependent upon proper subgrade preparation. All topsoil and organic materials should be removed from the site and backfilled with approved engineered fill or native material, compacted to 100% of SPMDD. The subgrade should be proof rolled and inspected by a Geotechnical Engineer. Any areas where boulders, rutting, or appreciable deflection is noted should be sub excavated and replaced with suitable fill. The fill should be compacted to at least 100% of SPMDD.

The recommended pavement structure should meet the Town of Penetanguishene standards for parking and driving areas and should, as a minimum, consist of the pavement layers identified in Table 7. The light duty pavement structure is intended for private roads, parking areas, driveways which will not see frequent heavy traffic from trucks, buses, etc. while the heavy-duty pavement structure is appropriate for private roads where heavy loads such as trucks, buses are anticipated or for designated fire routes.

Table 7 Recommended Minimum Pavement Structure

Pavement Layer	Light Duty	Heavy-Duty
Surface Course Asphalt	40 mm HL3 or HL4	40 mm HL3 or HL4
Binder Course Asphalt	50 mm HL8	70 mm HL8
Granular Base	150 mm OPSS 1010 Granular A	150 mm OPSS 1010 Granular A
Granular Subbase	300 mm OPSS 1010 Granular B	400 mm OPSS 1010 Granular B

Material and thickness substitutions must be approved by the Design Engineer.

The thickness of the subbase layer could be increased at the discretion of the Engineer, to accommodate site conditions at the time of construction, including soft or weak subgrade soil replacement. Asphalt materials should be rolled and compacted as per OPSS 310.

Compaction of the subgrade should be verified by the Engineer prior to placing the granular fill. Granular layers should be placed in 150 mm thick maximum loose lifts and compacted to at least 100% of SPMDD.

The granular materials specified should conform to OPSS standards, as confirmed by appropriate materials testing.

The final asphalt surface should be sloped at a minimum of 2% to shed runoff. Abutting pavements should be saw cut to provide clean vertical joints with new pavement areas.

The design of a storm water management system is beyond the scope of this investigation; however, it is recommended that the subgrade, subbase, base, and asphalt surfaces should be shaped and crown to promote drainage of the pavement structure.

6.0 Report Limitations

6.1 Design Review and Inspections

Cambium should 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.

6.2 Changes in Site and Project Scope

This geotechnical engineering report is intended for planning and design purposes only.

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

We trust that the information contained in this report meets your current requirements. If you have questions or comments regarding this document, please do not hesitate to contact the undersigned at (705) 719-0700.

Respectfully submitted,

Cambium Inc.

Chris Malliaros, B.A.Sc., EIT.
Project Coordinator - Geotechnical

Rob Gethin, P.Eng.
Group Manager - Geotechnical

RG/cm

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8.0 Standard Limitations

Limited Warranty

In performing work on behalf of a client, Cambium relies on its client to provide instructions on the scope of its retainer, and, on that basis, Cambium determines the precise nature of the work to be performed. Cambium undertakes all work in accordance with applicable accepted industry practices and standards. Unless required under local laws, other than as expressly stated herein, no other warranties or conditions, either expressed or implied, are made regarding the services, work or reports provided.

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The findings and results presented in reports prepared by Cambium are based on the materials and information provided by the client to Cambium and on the facts, conditions and circumstances encountered by Cambium during the performance of the work requested by the client. In formulating its findings and results into a report, Cambium assumes that the information and materials provided by the client or obtained by Cambium from the client or otherwise are factual, accurate and represent a true depiction of the circumstances that exist. Cambium relies on its client to inform Cambium if there are changes to any such information and materials. Cambium does not review, analyze, or attempt to verify the accuracy or completeness of the information or materials provided, or circumstances encountered, other than in accordance with applicable accepted industry practice. Cambium will not be responsible for matters arising from incomplete, incorrect, or misleading information or from facts or circumstances that are not fully disclosed to or that are concealed from Cambium during the provision of services, work or reports.

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When preparing reports, Cambium considers applicable legislation, regulations, governmental guidelines, and policies to the extent they are within its knowledge, but Cambium is not qualified to advise with respect to legal matters. The presentation of information regarding applicable legislation, regulations, governmental guidelines, and policies is for information only and is not intended to and should not be interpreted as constituting a legal opinion concerning the work completed or conditions outlined in a report. All legal matters should be reviewed and considered by an appropriately qualified legal practitioner.

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.

Reliance

Cambium's services, work and reports may be relied on by the client and its corporate directors and officers, employees, and professional advisors. Cambium is not responsible for the use of its work or reports by any other party, or for the reliance on, or for any decision which is made by any party using the services or work performed by or a report prepared by Cambium without Cambium's express written consent. Any party that relies on services or work performed by Cambium or a report prepared by Cambium without Cambium's express written consent, does so at its own risk. No report of Cambium may be disclosed or referred to in any public document without Cambium's express prior written consent. Cambium specifically disclaims any liability or responsibility to any such party for any loss, damage, expense, fine, penalty or other such thing which may arise or result from the use of any information, recommendation or other matter arising from the services, work or reports provided by Cambium.

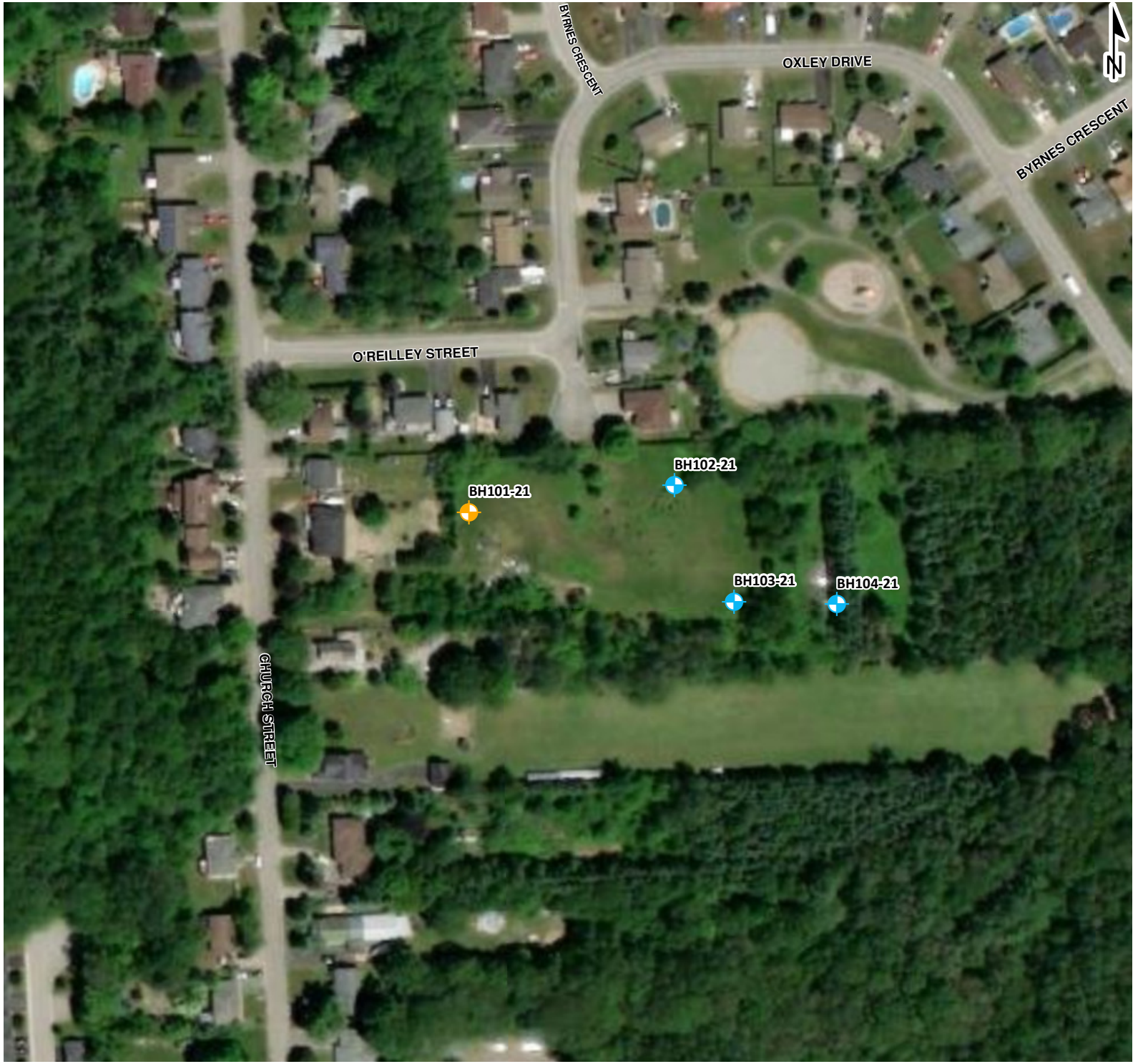
Limitation of Liability

Potential liability to the client arising out of the report is limited to the amount of Cambium's professional liability insurance coverage. Cambium shall only be liable for direct damages to the extent caused by Cambium's negligence and/or breach of contract. Cambium shall not be liable for consequential damages.

Personal Liability

The client expressly agrees that Cambium employees shall have no personal liability to the client with respect to a claim, whether in contract, tort and/or other cause of action in law. Furthermore, the client agrees that it will bring no proceedings nor take any action in any court of law against Cambium employees in their personal capacity.

Appended Figures



HYDROGEOLOGICAL ASSESSMENT

ECOVUE CONSULTING SERVICES INC.
245 Church Street
Penetanguishene, Ontario

LEGEND

- Borehole
- Monitoring Well

Notes:
- Base mapping features are © Queen's Printer of Ontario, 2019 (this does not constitute an endorsement by the Ministry of Natural Resources or the Ontario Government).
- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
- Cambium Inc. makes every effort to ensure this map is free from errors but cannot be held responsible for any damages due to error or omissions. This map should not be used for navigation or legal purposes. It is intended for general reference use only.

CAMBIUM
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Peterborough, Ontario, K9H 1E5
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BOREHOLE LOCATION PLAN

Project No.:	13237-001	Date:	July 2021
		Rev.:	
Scale:	1:2,000	Projection:	NAD 1983 UTM Zone 17N
Created by:	ACS	Checked by:	RG
Figure:	1		

O:\GIS\MXDs\13200-13299\13237-001 Schuren Sriskandarajah - Water Balance and Hydrogeological Assessment - 245 Church St\2021-07-23 FIG 1 - Borehole Location Plan.mxd

Appendix A

Borehole Logs

Peterborough
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Oshawa
Kingston
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Log of Borehole: BH101-21

Client:	EcoVue Consulting Services Inc.	**Project Name:**	245 Church Street, Penetanguishene, ON	**Project No.:**	13237-001
Contractor:	Walker Drilling	**Method:**	Hollow Stem Auger	**Date Completed:**	July 21, 2021
Location:	245 Church Street, Penetanguishene, ON	**UTM:**	17T, 4960179 m N, 584981 m E	**Elevation:**	228.16 mASL

SUBSURFACE PROFILE			SAMPLE							
Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N) / DCPT	% Moisture (25 50 75)	SPT (N) / DCPT (10 20 30 40)	Well Installation	Remarks
228 / 0		TOPSOIL: Black sand, some silt, with organics, loose, moist [TOPSOIL]	1A							
		SAND: Brown sand, some silt, trace clay trace gravel, loose, moist	1B	SS	60	6				
227 / 1			2	SS	90	5				
		SILTY SAND: Grey silty sand, trace gravel, compact, moist	3	SS	80	20				GSA SS3: 7% Gravel 68% Sand 25% Silt and Clay
226 / 2		-trace cobbles, very dense	4	SS	70	50/ 280 mm				
225 / 3			5	SS	80	50/ 230 mm				
224 / 4										
223 / 5			6	SS	10	50/ 150 mm				
222 / 6			7	SS	50	50/ 125 mm				
221 / 7		Borehole terminated at 6.6 mbgs due to target depth achieved.								Borehole open and dry upon completion of drilling

Logged By: BW **Input By:** BW

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Log of Borehole: BH102-21

Client:	EcoVue Consulting Services Inc.	**Project Name:**	245 Church Street, Penetanguishene, ON	**Project No.:**	13237-001
Contractor:	Walker Drilling	**Method:**	Hollow Stem Auger	**Date Completed:**	July 21, 2021
Location:	245 Church Street, Penetanguishene, ON	**UTM:**	17T, 4960189 m No, 585057 m East	**Elevation:**	224.67 mASL

Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N) / DCPT	% Moisture (25 50 75)	SPT (N) / DCPT (10 20 30 40)	Well Installation	Remarks
224 / 0		TOPSOIL: Black sand, some silt, with organics, loose, moist [TOPSOIL]	1A	SS	90	6			Monument	Top of Pipe (TOP) elevation: 225.46 mASL. Groundwater measured at 5.95 mbgs (218.72 m Rel. El.) on July 6, 2022
			1B						Cap	
		SAND: Brown sand, some silt, trace clay, trace gravel, loose, moist								
223 / 1		-less silt content	2	SS	80	7				
									Bentonite Plug	
			3	SS	70	6			PVC Standpipe	GSA SS2: 1% Gravel 80% Sand 15% Silt 4% Clay
222 / 2										
			4	SS	70	9				
221 / 3		-compact								
			5	SS	70	21				
220 / 4		SILTY SAND: Grey silty sand, some gravel, trace clay, very dense, moist	6	SS	70	50			Sand Pack	
									PVC Screen	GSA SS6: 11% Gravel 62% Sand 24% Silt 3% Clay
219 / 5										
218 / 6			7	SS	0	50/ 100 mm			Cap	
7		Borehole terminated at 6.6 mbgs due to target depth achieved.								

Logged By: BW **Input By:** BW

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Log of Borehole: BH103-21

Client:	EcoVue Consulting Services Inc.	**Project Name:**	245 Church Street, Penetanguishene, ON	**Project No.:**	13237-001
Contractor:	Walker Drilling	**Method:**	Hollow Stem Auger	**Date Completed:**	July 21, 2021
Location:	245 Church Street, Penetanguishene, ON	**UTM:**	17T, 4960146 m N, 585079 m E	**Elevation:**	223.86 mASL

Elevation (m)	Depth	Lithology	Description	Number	Type	% Recovery	SPT (N) / DCPT	% Moisture (25 50 75)	SPT (N) / DCPT (10 20 30 40)	Well Installation	Remarks
223	0		TOPSOIL: Black sand, some silt, with organics, loose, moist [TOPSOIL]	1A	SS	60	3			Monument Cap	Top of Pipe (TOP) elevation: 224.70 mASL. Groundwater measured at 5.92 mbgs (217.94 m Rel. El.) on July 6, 2022
			SAND and SILT: Brown sand and silt, trace gravel, loose, moist	1B							
	1		-trace cobbles	2	SS	100	3				
										Bentonite Plug	
			-grey, no cobbles	3	SS	50	7			PVC Standpipe	GSA SS2: 3% Gravel 62% Sand 35% Silt and Clay
222	2		-compact	4	SS	60	21				
221	3			5	SS	0	20				
220	4									Sand Pack	
			-dense	6	SS	90	39			PVC Screen	
219	5										
218	6		-very dense, wet	7	SS	90	50/ 280 mm			Cap	
217	7		Borehole terminated at 6.6 mbgs due to target depth achieved.								

Logged By: BW **Input By:** BW

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Log of Borehole: BH104-21

Client:	EcoVue Consulting Services Inc.	**Project Name:**	245 Church Street, Penetanguishene, ON	**Project No.:**	13237-001
Contractor:	Walker Drilling	**Method:**	Hollow Stem Auger	**Date Completed:**	July 21, 2021
Location:	245 Church Street, Penetanguishene, ON	**UTM:**	17T, 4960145 m N, 585117 m E	**Elevation:**	222.65 mASL

SUBSURFACE PROFILE			SAMPLE								
Elevation (m) / Depth	Lithology	Description	Number	Type	% Recovery	SPT (N) / DCPT	% Moisture (25 50 75)	SPT (N) / DCPT (10 20 30 40)	Well Installation	Remarks
0 / 222		TOPSOIL: Black sand, some silt, with organics, loose, moist [TOPSOIL]	1A	SS	90	4			*Monument*	Top of Pipe (TOP) elevation: 223.49 mASL. Groundwater measured at 6.14 mbgs (216.51 m Rel. El.) on July 6, 2022
			1B						*Cap*	
1		SAND: Brown sand, trace gravel, trace silt, loose, moist								
		-trace cobbles, wet	2	SS	80	8				
									Bentonite Plug	
221 / 2			3	SS	60	6			*PVC Standpipe*	
		-trace clay, compact	4	SS	70	16				GSA SS4: 4% Gravel 87% Sand 9% Silt and Clay
220 / 3			5	SS	80	21				
219 / 4									*Sand Pack*	
									PVC Screen	
218 / 5		-very dense	6	SS	0	50/ 205 mm				
217 / 6		-saturated	7	SS	60	50/ 180 mm			*Cap*	
216 / 7		Borehole terminated at 6.6 mbgs due to target depth achieved.								

Logged By: BW **Input By:** BW

Appendix B

Physical Laboratory Testing Results

Grain Size Distribution Chart

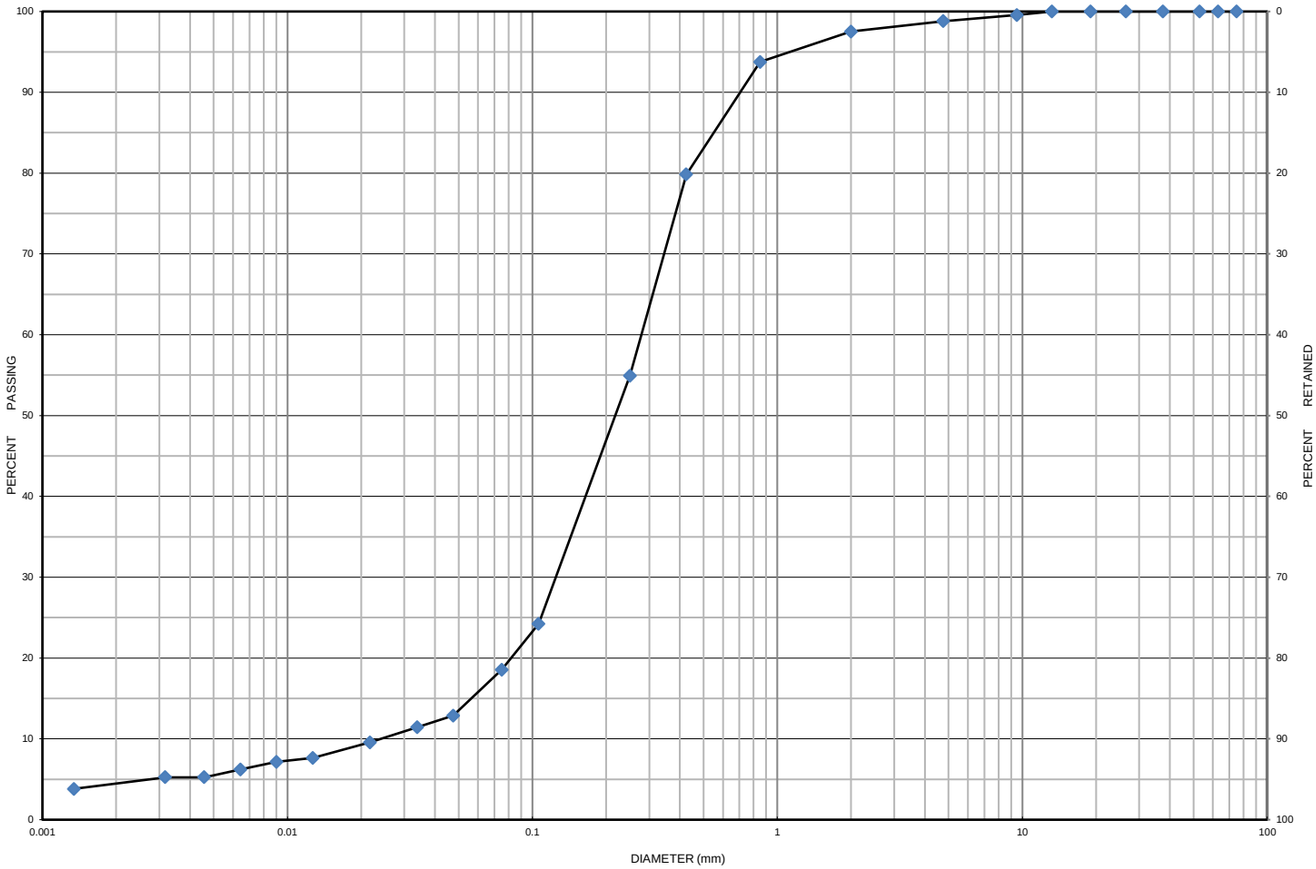
Project Number: *13237-001* **Client:** *Schuren Sriskandarajah*

Project Name: *Water Balance and Hydrogeological Assessment - 245 Church St*

Sample Date: *Juy 21, 2021* **Sampled By:** *Ben White - Cambium Inc.*

Location: *BH 102-21 SS 2* **Depth:** *0.6 m to 1.2 m* **Lab Sample No:** *S-21-0879*

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 102-21	SS 2	0.6 m to 1.2 m	1	80	15	4	10.7

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sand some Silt trace Clay trace Gravel	SM	0.275	0.130	0.025	11.00	2.46

Additional information available upon request

Issued By: _____ *Date Issued:* *August 2, 2021*

(Senior Project Manager)

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Grain Size Distribution Chart

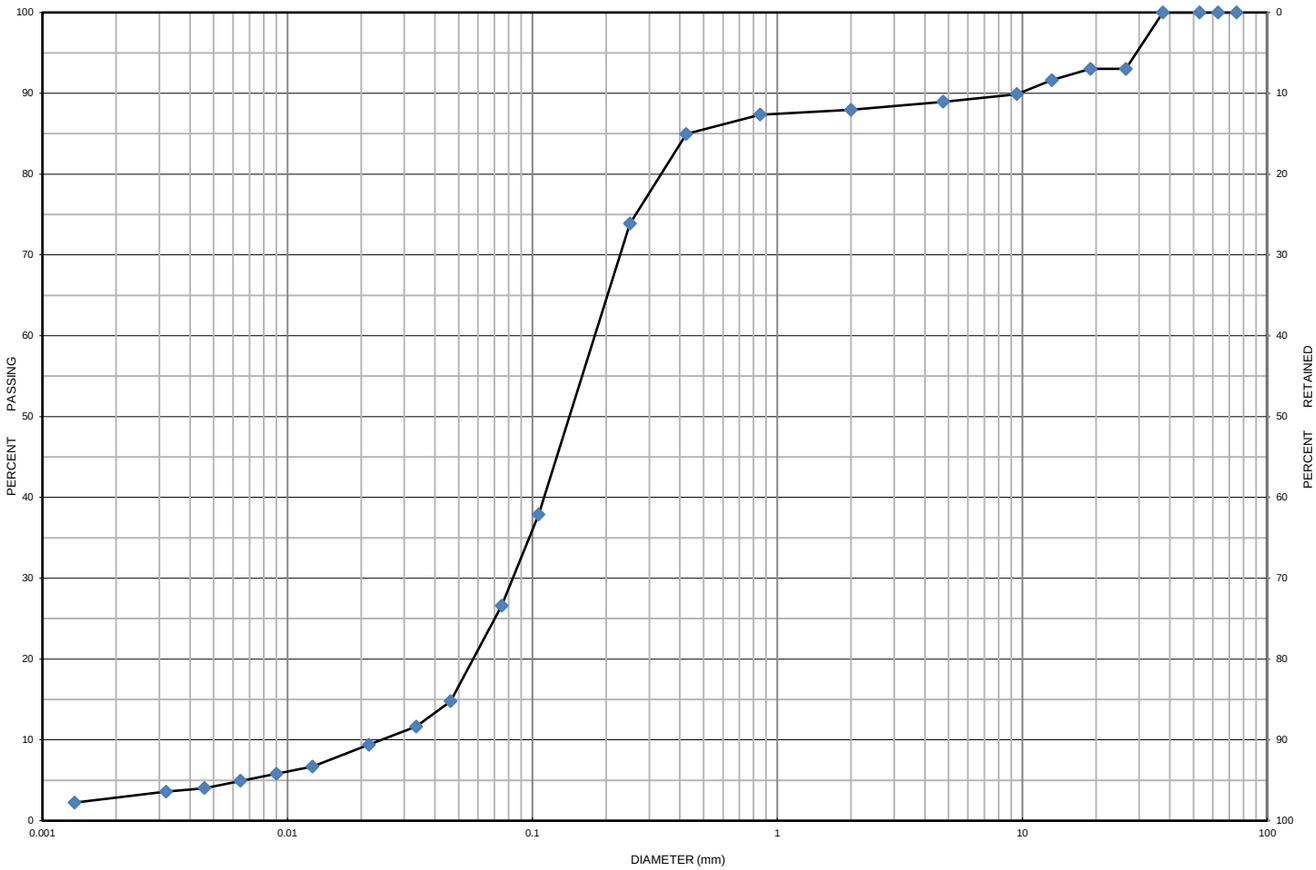
Project Number: *13237-001* **Client:** *Schuren Sriskandarajah*

Project Name: *Water Balance and Hydrogeological Assessment - 245 Church St*

Sample Date: *July 21, 2021* **Sampled By:** *Ben White - Cambium Inc.*

Location: *BH 102-21 SS 6* **Depth:** *4.6 m to 5 m* **Lab Sample No:** *S-21-0880*

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 102-21	SS 6	4.6 m to 5 m	11	62	24	3	7.2

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silty Sand some Gravel trace Clay	SM	0.180	0.083	0.025	7.20	1.53

Additional information available upon request

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Grain Size Distribution Chart

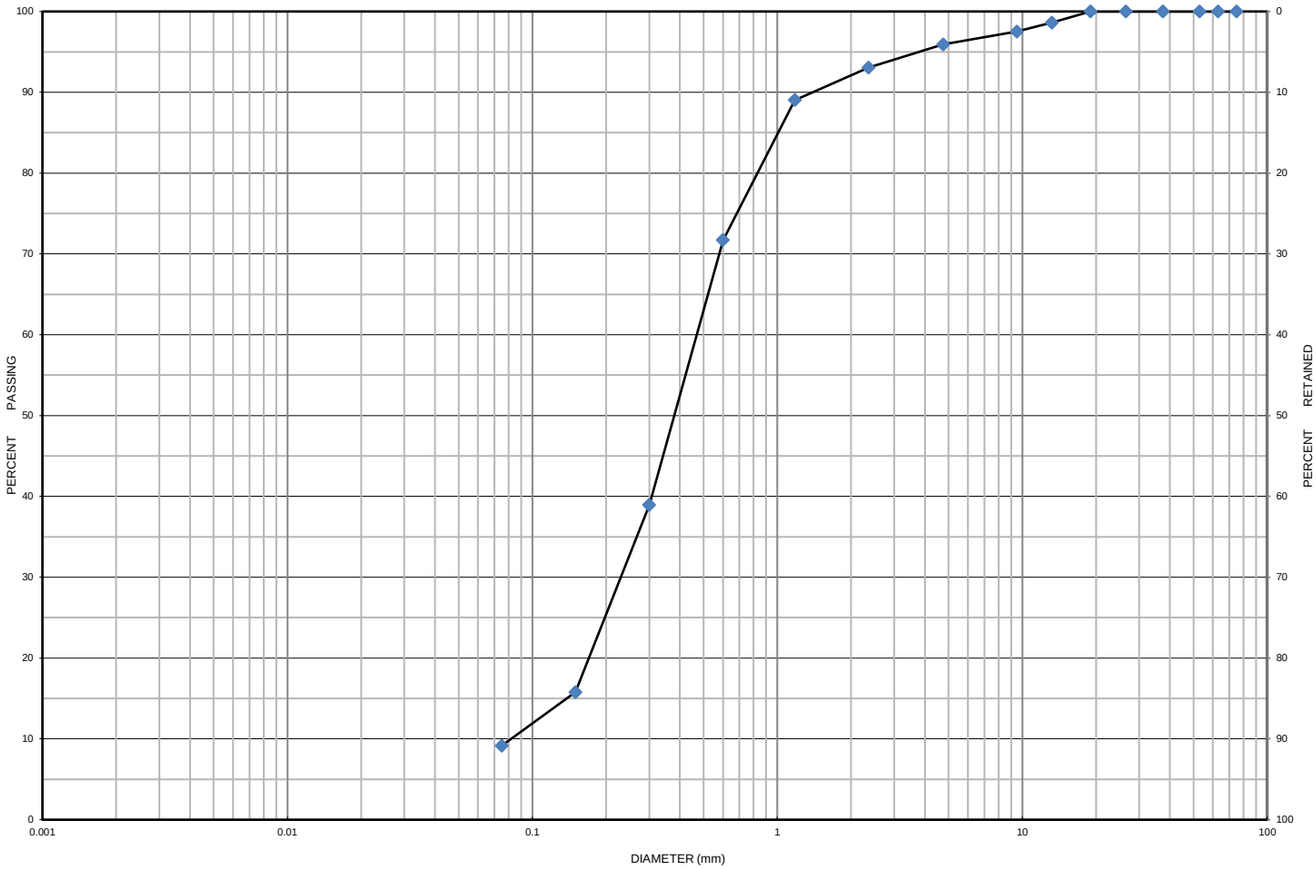
Project Number: *13237-001* **Client:** *Schuren Sriskandarajah*

Project Name: *Water Balance and Hydrogeological Assessment - 245 Church St*

Sample Date: *July 21, 2021* **Sampled By:** *Ben White - Cambium Inc.*

Location: *BH 104-21 SS 4* **Depth:** *2.3 m to 2.7 m* **Lab Sample No:** *S-21-0881*

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 104-21	SS 4	2.3 m to 2.7 m	4	87	9		8.8

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sand trace Silt trace Gravel	SP	0.460	0.135	0.080	5.75	0.50

Additional information available upon request

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(Senior Project Manager)

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Grain Size Distribution Chart

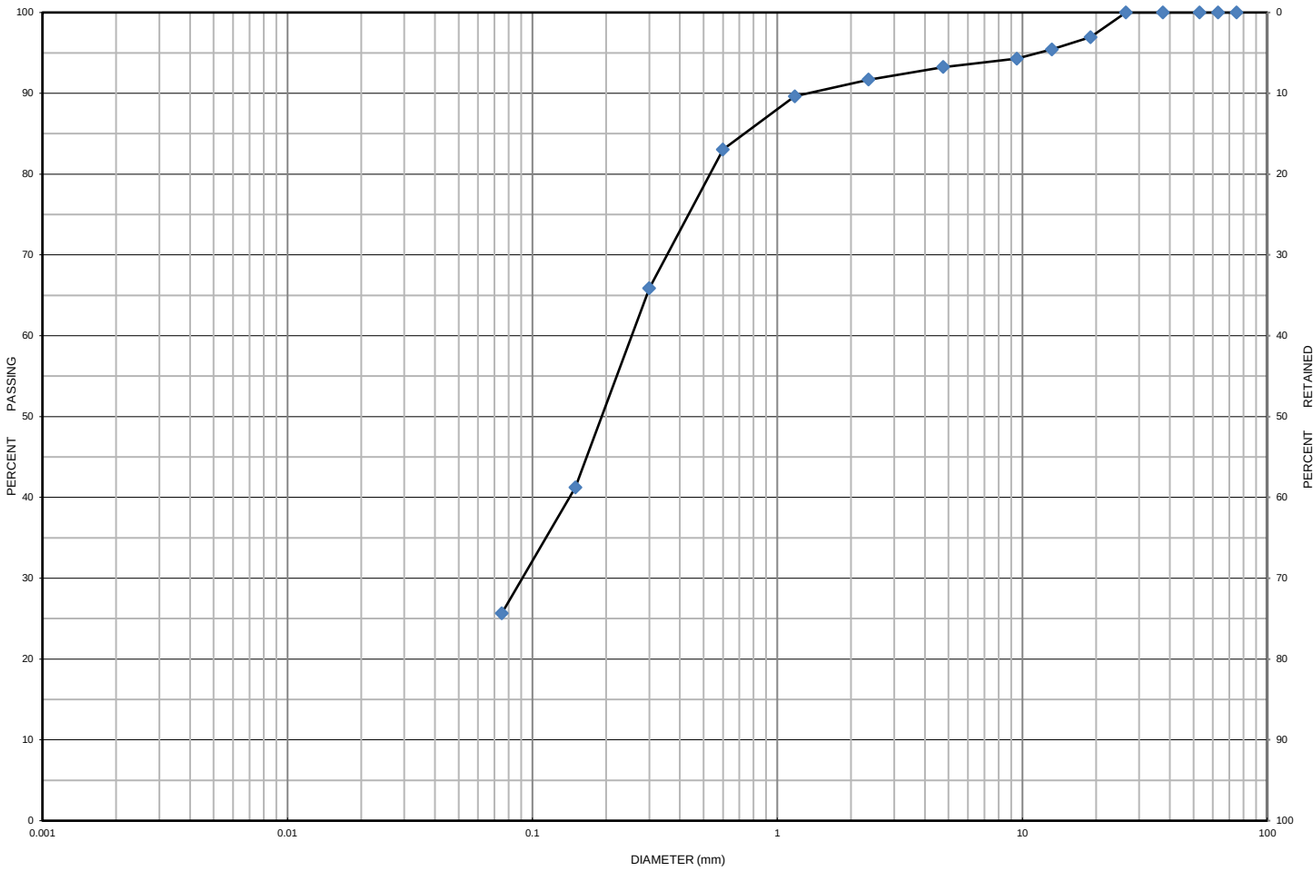
Project Number: *13237-001* **Client:** *Schuren Sriskandarajah*

Project Name: *Water Balance and Hydrogeological Assessment - 245 Church St*

Sample Date: *July 21, 2021* **Sampled By:** *Ben White - Cambium Inc.*

Location: *BH 101-21 SS 3* **Depth:** *1.5 m to 2 m* **Lab Sample No:** *S-21-0882*

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 101-21	SS 3	1.5 m to 2 m	7	68	25		9.5

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silty Sand trace Gravel	SM	0.255	0.090	0.000	-	-

Additional information available upon request

Issued By: _____ *Date Issued:* *August 2, 2021*

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Grain Size Distribution Chart

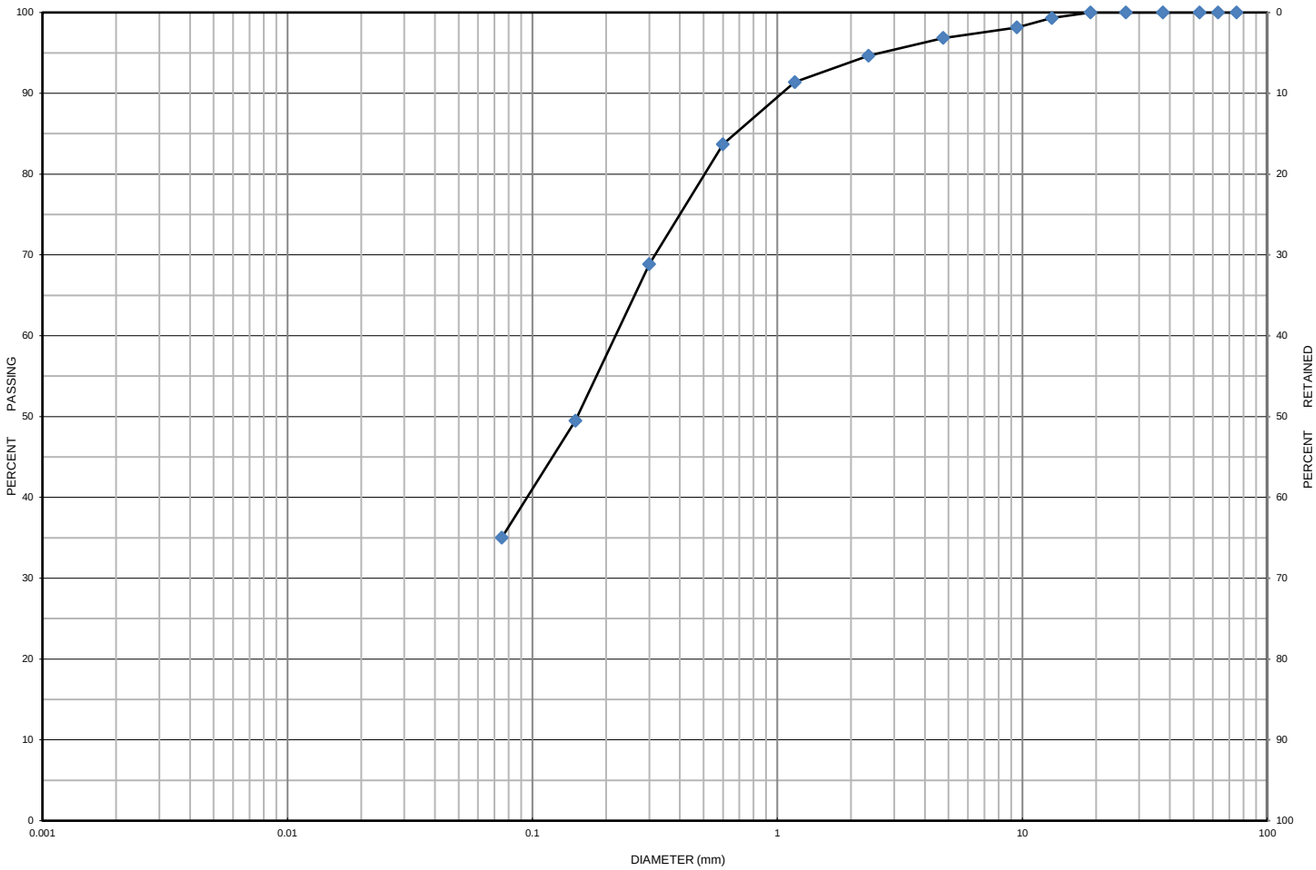
Project Number: *13237-001* **Client:** *Schuren Sriskandarajah*

Project Name: *Water Balance and Hydrogeological Assessment - 245 Church St*

Sample Date: *July 21, 2021* **Sampled By:** *Ben White - Cambium Inc.*

Location: *BH 103-21 SS 2* **Depth:** *0.6 m to 1.2 m* **Lab Sample No:** *S-21-0883*

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 103-21	SS 2	0.6 m to 1.2 m	3	62	35		16.7

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sand and Silt trace Gravel	SM	0.220	0.000	0.000	-	-

Additional information available upon request

Issued By: _____ *Date Issued:* *August 2, 2021*

(Senior Project Manager)

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Moisture Content

Project Number: 13237-001
Project Name: Water Balance and Hydrogeological Assessment - 245 Church St
Client: Schuren Sriskandarajah
Date Taken: 2021-07-21

Lab Number: S-21-0878
Date Tested: 2021-07-27
Tested By: A. McLean / D. Rock

Borehole Number	Sample Number	Sample Depth (m)	Water Weight (g)	Water Content (%)	Additional Observations
101	1A	0.00-0.13	26.4	13.7	NR,1
101	1B	0.13-0.61	19.8	10.2	
101	2	0.61-1.22	31.9	14.0	1
101	3	1.52-1.98	64.6	9.5	NR
101	4	2.29-2.71	18.9	6.1	
101	5	3.05-3.43	19.6	7.7	
101	6	4.57-4.70	9.7	5.1	NR
101	7	6.10-6.37	26.1	7.3	
102	1A	0.00-0.30	27.3	9.7	NR
102	1B	0.30-0.61	26.4	12.5	1
102	2	0.61-1.22	85.3	10.7	NR
102	3	1.52-1.98	28.0	10.8	
102	4	2.29-2.74	24.1	9.3	1
102	5	3.05-3.51	25.6	10.4	
102	6	4.57-5.03	51.2	7.2	NR
103	1A	0.00-0.23	43.4	17.5	NR,1
103	1B	0.23-0.61	26.4	14.7	1
103	2	0.61-1.22	131.4	16.7	NR
103	3	1.52-1.98	51.1	21.2	
103	4	2.29-2.74	24.0	8.9	
103	6	4.57-5.03	20.1	9.0	
103	7	6.10-6.52	9.3	4.0	
104	1A	0.00-0.38	47.4	20.3	
104	1B	0.38-0.61	46.1	18.8	NR,1
104	2	0.61-1.22	60.8	16.1	
104	3	1.52-1.98	23.5	10.5	

1 – Contains organics
2 – Contains rubble
3 – Hydrocarbon Odour
4 – Unknown Chemical Odour
5 – Saturated – free water visible
6 – Very moist – near optimum moisture content
7 – Moist – below optimum moisture
8 – Dry – dry texture – powdery
9 – Very small – caution may not be representative
10 – Hold sample for gradation analysis

Moisture Content

Project Number: 13237-001
Project Name: Water Balance and Hydrogeological Assessment - 245 Church St
Client: Schuren Sriskandarajah
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Lab Number: S-21-0878
Date Tested: 2021-07-27
Tested By: A. McLean / D. Rock

Borehole Number	Sample Number	Sample Depth (m)	Water Weight (g)	Water Content (%)	Additional Observations
104	4	2.29-2.74	65.3	8.8	NR
104	5	3.05-3.51	36.3	10.8	
104	7	6.10-6.43	26.0	12.8	

1 – Contains organics
2 – Contains rubble
3 – Hydrocarbon Odour
4 – Unknown Chemical Odour
5 – Saturated – free water visible
6 – Very moist – near optimum moisture content
7 – Moist – below optimum moisture
8 – Dry – dry texture – powdery
9 – Very small – caution may not be representative
10 – Hold sample for gradation analysis

Appendix C

2015 National Building Code Seismic Hazard Values

2015 National Building Code Seismic Hazard Calculation

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

Site: 44.790N 79.925W **User File Reference:** 245 Church Street, Penetanguishene, ON 2022-10-31 19:34 UT

Requested by: Cambium Inc.

Probability of exceedance per annum	0.000404	0.001	0.0021	0.01
Probability of exceedance in 50 years	2 %	5 %	10 %	40 %
Sa (0.05)	0.071	0.045	0.029	0.010
Sa (0.1)	0.100	0.065	0.044	0.016
Sa (0.2)	0.101	0.068	0.047	0.018
Sa (0.3)	0.088	0.060	0.042	0.016
Sa (0.5)	0.075	0.050	0.035	0.013
Sa (1.0)	0.046	0.031	0.021	0.006
Sa (2.0)	0.024	0.016	0.010	0.003
Sa (5.0)	0.006	0.004	0.002	0.001
Sa (10.0)	0.003	0.002	0.001	0.000
PGA (g)	0.058	0.038	0.025	0.009
PGV (m/s)	0.062	0.039	0.025	0.008

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

References

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

Structural Commentaries (User's Guide - NBC 2015: Part 4 of Division B)
Commentary J: Design for Seismic Effects

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

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