

# **Preliminary Geotechnical Investigation Report - 140 Lockhart Road, Barrie**



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Prepared for:  
2640085 Ontario Inc.

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## 1.0 Introduction

Cambium Inc. (Cambium) was retained by Innovative Planning Solutions, representing 2640085 Ontario Inc. (the Client) to complete a preliminary geotechnical investigation in support of the design and construction of the proposed industrial subdivision development located at 140 Lockhart Road in Barrie, Ontario. The Site is bounded to the east, north, and west by industrial developments and to the south by Lockhart Road. A Site Plan, including borehole locations, is included as Figure 1 of this report.

Preliminary site plans indicate that the proposed development is to include approximately 38 lots zoned for light industrial, industrial use, stormwater management pond, environmental protection and internal roadways.

This report presents the methodology and findings of a preliminary geotechnical investigation of the subject site to determine the subsurface soil and groundwater conditions and provide preliminary design recommendations. Based on the results of this investigation, the report provides preliminary geotechnical engineering recommendations pertaining to the proposed development. It is assumed that all the proposed lots will be developed with slab on grade single storey structures and municipally serviced. A detailed geotechnical investigation, including additional boreholes across the site is required once the details of the individual structures are known.

## 2.0 Investigation Methodology

### 2.1 Field Work

The field investigation involved advancing a total of seven boreholes (numbered BH101-20 through BH107-20) across the site from September 3<sup>rd</sup> to 4<sup>th</sup>, 2020. The boreholes were advanced from grade to depths ranging from 2.6 to 8.0 meters below ground surface (mbgs). The location of the boreholes relative to existing site conditions are provided on the attached Figure 1.

Drilling and sampling was 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 solid stem augers and 50 mm O.D. split spoon samplers. Standard Penetration Test (SPT) results (N-values) were recorded for the sampled intervals as the number of blows required to drive a split spoon sampler 305 mm in to 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 soils.

Borehole and monitoring well samples were inspected and logged in the field using visual and tactile methods. Soil samples were placed in labelled plastic containers for transport, review, potential laboratory testing, and temporary storage. Open boreholes were checked for groundwater and stability prior to backfilling and were backfilled in accordance with O.Reg. 903, as amended. One groundwater monitoring well was installed in Borehole BH106-20 to measure stabilized groundwater readings.

GPS coordinates of each borehole were obtained using a handheld GPS device. Boreholes were surveyed using real-time kinematic (RTK) surveying equipment systems, the boreholes are referenced based on geodetic elevations UTM zone 17T.

Records of the individual Borehole Logs are provided in Appendix A.



## **2.2 Physical Laboratory Testing**

Physical laboratory testing was completed on select soil samples to confirm textural classification and to assess geotechnical parameters. The results are summarized in the respective soil stratigraphy sections in Section 3.0 and included in detail in Appendix B.

## **3.0 Subsurface Conditions**

The subsurface soil and groundwater conditions encountered in the boreholes are presented on the attached Borehole Logs in Appendix A. The stratigraphic boundaries indicated on the logs are inferred from non-continuous samples and observations of drilling resistance and typically represent a transition from one soil type to another, sometime gradually. The boundaries should not be interpreted to represent exact planes of geologic change. The subsurface conditions have been confirmed in a series of widely spaced boreholes, and will vary between and beyond the borehole locations.

### **3.1 Stratigraphy**

The following stratigraphy is based on the borehole findings, as well as the geotechnical laboratory testing conducted on representative soil samples.

#### **3.1.1 Topsoil**

Topsoil was encountered from the surface at all borehole locations. The topsoil ranges in thickness from 0.1 to 1.1 m. Assessments of organic matter content or other topsoil quality tests were beyond the scope of this study. Proper delineation of the average topsoil thickness at the site would require many additional test holes on a grid pattern.

#### **3.1.2 Earth Fill**

A layer of fill material was encountered underlying the topsoil in BH102-20. The earth fill was composed of grey silty sand, with rootlets, and extended to a depth of 0.8 mbgs and was approximately 0.7 m thick.

#### **3.1.3 Sand/Silty Sand**

Native deposits of sand and silty sand were encountered underlying the fill material in BH102-20 and underlying the topsoil in BH103-20 and BH106-20. The sand deposit in BH102-20 is composed of a brown sand, trace silt. The silty sand deposit encountered in BH103-20 and

BH106-20 is composed of brown silty sand, with trace clay and trace gravel encountered in BH103-20.

The sand deposits were encountered at depths ranging from 0.8 to 1.1 mbgs and extend to depths ranging from 1.1 to 2.3 mbgs. The measured thicknesses of the deposits range from 0.4 to 2.1 m.

SPT N-values measured in the sand deposits range from 25 to 38 blows per 305 mm of penetration, reflective of a compact to dense relative density.

#### **3.1.4 Clayey Silt**

A native deposit of cohesive clayey silt was encountered underlying the silty sand in BH103-20 and BH106-20. The deposits are composed of grey or grey brown clayey silt with trace sand.

The clayey silt deposit was encountered at depths ranging between 1.9 and 2.3 mbgs and extended to depths between 3.0 and 4.6 mbgs. The thickness of the deposit measured 2.3 and 1.1 m at BH103-20 and BH106-20, respectively.

SPT N-values measured in the clayey silt deposits range from 7 to 15, indicative of a firm to very stiff consistency.

#### **3.1.5 Glacial Till**

Glacial till was encountered at all borehole locations underlying the clayey silty and/or topsoil and/or sand deposits at all borehole locations. Glacial till is typically a heterogeneous mixture of all grain sizes. At this site the glacial till is predominantly composed of grey or grey brown silty sand to silt and sand with trace clay and trace gravel. Based on drilling observations there is likely the presence cobbles and boulders within the glacial till, typically found in glacial till deposits.

The glacial till was encountered at depths ranging from 0.1 to 4.5 mbgs. It should be noted that the upper portions of the glacial till in BH101-20, BH104-20, BH105-20, and BH107-20 have been disturbed. Where observed, the disturbed material extends to an approximate depth of 1.5 mbgs. All boreholes were terminated within the glacial till deposit at variable depths ranging from

2.6 to 8.0 mbgs. It should be noted that BH102-20, BH104-20, and BH105-20 terminated due to auger refusal at depths ranging from 2.6 to 4.6 mbgs. Auger refusal can sometimes be encountered on cobbles and boulders within the glacial till.

SPT N-values measured within the glacial till range from 11 to over 50, reflective of a compact to very dense relative density.

Grain size analysis was completed on five (5) samples of the glacial till and the results are summarized in Table 1. Detailed results are provided in Appendix B.

**Table 1 Particle Size Distribution Results**

| Borehole     | Depth (m)  | Soil          | % Gravel | % Sand | % Silt | % Clay |
|--------------|------------|---------------|----------|--------|--------|--------|
| BH101-20 SS2 | 0.6 to 1.2 | Sand and Silt | 3        | 43     | 41     | 13     |
| BH102-20 SS3 | 1.5 to 2.0 | Silty Sand    | 10       | 42     | 33     | 15     |
| BH104-20 SS5 | 3.0 to 3.5 | Silty Sand    | 15       | 49     | 27     | 9      |
| BH105-20 SS3 | 1.5 to 2.0 | Silty Sand    | 18       | 46     | 27     | 9      |
| BH107-20 SS7 | 6.1 to 6.6 | Silty Sand    | 3        | 61     | 31     | 5      |

### 3.2 Groundwater

The depth of groundwater was measured in each borehole immediately following drilling field work. One (1) groundwater monitoring well was installed in BH106-20 in order to measure stabilized groundwater conditions. The groundwater and caving (sloughing) observations are shown on the respective Borehole Logs and summarized in Table 2.

**Table 2 Groundwater Observations**

| Borehole No. | Depth of Borehole (mbgs) | Groundwater / Wet Soils Depth Encountered During Drilling (mbgs) | Caving Depth (mbgs) | Groundwater Level (mbgs)<br>22/09/2020 |
|--------------|--------------------------|------------------------------------------------------------------|---------------------|----------------------------------------|
| BH101-20     | 5.0                      | Dry                                                              | -                   | -                                      |
| BH102-20     | 2.6                      | 1.5                                                              | 2.3                 | -                                      |
| BH103-20     | 8.0                      | Dry                                                              | -                   | -                                      |
| BH104-20     | 4.6                      | Dry                                                              | -                   | -                                      |
| BH105-20     | 3.1                      | Dry                                                              | -                   | -                                      |
| BH106-20     | 5.0                      | 2.3                                                              | -                   | 3.7                                    |
| BH107-20     | 7.7                      | Dry                                                              | -                   | -                                      |

Based on the groundwater levels measured in BH106-20 on September 22, 2020, the preliminary design groundwater table is estimated at  $\pm 273.5$  metres above sea level (mASL). Further groundwater readings from multiple monitoring wells across the site will be required at the detailed design stage. Perched water should also be anticipated in the overlying earth fill and disturbed material.

Groundwater levels may fluctuate with time, and seasonally, depending on the amount of precipitation and surface runoff.

## **4.0 Preliminary Geotechnical Recommendations**

The following preliminary discussion and recommendations are based on the factual data obtained from this investigation and are intended for use by the owner and the design engineer. Contractors bidding or providing services on this project should review the factual data and determine their own conclusions regarding the construction methods and scheduling.

This report is based on the assumption that the design features relevant to the geotechnical analysis will be completed in accordance with applicable codes, standards, and guidelines of practice. If there are changes to the site development features, or there is any significant variations in the subsurface conditions that are found before or during construction, Cambium should be retained to review the implications of these changes with respect to the contents of this report.

It is assumed that all the proposed lots will be developed with slab on grade single storey structures and municipally serviced. A detailed geotechnical investigation, including additional boreholes across the site is required once more design details are provided.

Based on site observations the existing elevations of the surrounding roadways and boreholes, significant grade raise is not anticipated at this site. Site grading recommendations can be provided depending on need and upon request.

### **4.1 Excavations**

Temporary excavations must be carried out in accordance with the latest edition of the Occupational Health and Safety Act (OHSA), Ontario Regulation 213/91 (as amended). For practical purposes, the overburden soils at the site above the water table can be considered to be Type 3 soils, as such excavation side slopes should be no steeper than 1H:1V. Below the water table soils at the site would be considered as Type 4 soils and would require side slopes of no steeper than 3H:1V. Minimum support system requirements (shoring) for steeper excavations are stipulated in Sections 235 through 238 of the Occupational Health and Safety Act (OHSA), Construction Projects, Part III.

Excavation side slopes should be protected from exposure to precipitation and associated ground surface runoff 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).

Larger size particles, such as cobbles and boulders) will be encountered within the glacial till deposit. The size and distribution of such obstructions cannot be predicted with boreholes, as the sampler size is insufficient to secure representative particles of this size. Provisions should be made in excavation contracts to allocate risks associated with the time spent and the equipment utilized to remove or penetration such obstructions, when encountered.

#### **4.2 Groundwater Control**

No groundwater was observed in the boreholes immediately following drilling field work in September, 2020. Stabilized groundwater levels measured in the BH106-20 monitoring well in September, 2020 indicate a groundwater level at a depth of 3.7 mbgs ( $\pm 273.5$  mASL). Perched water should also be anticipated within the subsurface deposits, such as fill, sand, and disturbed glacial till.

Further hydrogeological data will be required in order to provide accurate groundwater control measures and determine Ministry of the Environment, Conservation, and Parks (MECP) requirements.

Agricultural drainage pipes may be encountered during the excavation of the proposed structures. Any drainage pipes could be a source of significant volumes of water, which could impact construction work and subgrades. It is recommended that any drainage pipe encountered during the excavation be removed a horizontal distance of 2 m from the edge of the excavation and appropriately sealed.

#### **4.3 Earth Pressure Design Parameters**

The appropriate values for use in the design of structures subject to unbalanced earth pressures at this site are tabulated as follows in Table 3:

**Table 3 Earth Pressure Design Values**

| Stratum/Parameter                      | $\gamma$ | $\phi$ | $K_a$ | $K_o$ | $K_p$ |
|----------------------------------------|----------|--------|-------|-------|-------|
| Earth Fill                             | 19       | 30     | 0.33  | 0.50  | 3.00  |
| Native Undisturbed Sands, Glacial Till | 21       | 34     | 0.28  | 0.44  | 3.54  |
| Native Undisturbed Clayey Silt         | 19       | 30     | 0.33  | 0.50  | 3.00  |
| Granular Backfill                      | 22       | 35     | 0.27  | 0.42  | 3.70  |

Where:

- $\gamma$  = bulk unit weight of soil (kN/m<sup>3</sup>)
- $\phi$  = internal angle of friction (degrees)
- $K_a$  = Rankine active earth pressure coefficient (dimensionless)
- $K_o$  = Rankine at-rest earth pressure coefficient (dimensionless)
- $K_p$  = Rankine passive earth pressure coefficient (dimensionless)

The above earth pressure parameters pertain to a horizontal grade condition behind a retaining structure. Values of earth pressure parameters for an inclined retained grade condition will vary.

Walls subject to unbalanced earth pressures must be designed to resist a pressure that can be calculated based on the following equation:

$$P = K[\gamma(h - h_w) + \gamma' h_w + q] + \gamma_w h_w$$

Where,

- P = the horizontal pressure at depth, h (m)
- K = the earth pressure coefficient
- h<sub>w</sub> = the depth below the ground water level (m)
- $\gamma$  = the bulk unit weight of soil, (kN/m<sup>3</sup>)
- $\gamma'$  = the submerged unit weight of the exterior soil, ( $\gamma - 9.8$  kN/m<sup>3</sup>)
- q = the complete surcharge loading (kPa)

The wall backfill must be drained effectively to eliminate hydrostatic pressures on the wall that would otherwise act in conjunction with the earth pressure. In this case, the above equation is simplified to:

$$P = K[\gamma h + q]$$

The factored geotechnical resistance to sliding of foundation elements is developed by friction between the base of the footing and the soil. This friction (**R**) depends on the normal load at the soil contact (**N**) and the frictional resistance of the soil (**tan φ**) expressed as  $R_f = N \tan \phi$ , which is the unfactored resistance. The factored geotechnical resistance at ULS is  $R_f = 0.8 N \tan \phi$ .

#### 4.4 Preliminary Foundation Design

As previously indicated, it is assumed that the proposed development will consist predominantly of single storey structures of slab on grade design (i.e. no basement). Foundations for such structures at this site may consist of shallow spread footings founded directly on native, undisturbed deposits of sand, clayey silt, or silty sand glacial till.

Foundations constructed on undisturbed, compact sands, or firm clayey silts, can be designed using a net geotechnical reaction at Serviceability Limit State (SLS) of 175 kPa for an estimated total settlement of 25 mm or less. The maximum factored geotechnical resistance at Ultimate Limit State (ULS) for foundations constructed on the undisturbed soil is 250 kPa. The settlement at SLS will occur as the load is applied, and is linear and non-recoverable. Differential settlement is a function of spacing, loading, and foundation size.

Alternatively, in areas where the proposed founding levels are above the level of competent native soil, or where subexcavation is required, footings can be made to bear directly on a pad of Engineered Fill such as that conforming to Ontario Provincial Standards Specification (OPSS) 1010.MUNI Granular B Type II. Any engineered fill placed below proposed foundations should be placed directly on undisturbed native sands or clayey silt. 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 1 horizontal to 1 vertical, or flatter. Excavations should be sized to accommodate fill placement. Foundations made on top of adequately compacted engineered fill should be sized using a net reaction at SLS of 150 kPa, and factored geotechnical resistance at ULS of 225 kPa.

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

To reduce cracking in the footings, foundation walls, and concrete slab on grades where footings change between different subgrade materials, suitable transition zones should be created and the footings suitably reinforced.

#### **4.5 Frost Penetration of Foundations**

All exterior footings of the proposed building should be provided with at least 1.5 m of earth cover for frost protection purposes. If the required depth of earth cover is not practicable, a combination of earth cover and polystyrene insulation could be considered. An insulation detail could be provided upon request.

#### **4.6 Earthquake Design Parameters**

The Ontario Building Code (2012) stipulates the methodology for earthquake design analysis, as set out in Subsection 4.1.8.7. The determination of the type of analysis is predicated on the importance of the structure, the spectral response acceleration and the site classification.

The parameters for determination of Site Classification for Seismic Site Response are set out in Table 4.1.8.4A of the Ontario Building Code (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 on the basis of rational analysis of undrained shear strength ( $s_u$ ) or penetration resistance (N-values).

$$v_{s-avg} = \frac{\sum_{i=1}^n d_i}{\sum_{i=1}^n \frac{d_i}{v_{si}}}$$

Shear wave velocity

$$S_{u-avg} = \frac{\sum_{i=1}^n d_i}{\sum_{i=1}^n \frac{d_i}{S_{ui}}}$$

Undrained shear strength

$$N_{avg} = \frac{\sum_{i=1}^n d_i}{\sum_{i=1}^n \frac{d_i}{N_i}}$$

SPT N-values

Beneath the foundations for this site, there will exist compact to very dense sands and/or firm to hard clayey silts. Boreholes were advanced to a maximum depth of 8.0 m and bedrock was not proven. It is therefore recommended that the site designation for seismic analysis is conservatively Class D as per Table 4.1.8.4.A of the Ontario Building Code (2012). Tables 4.1.8.4.B and 4.1.8.4.C. of the same code provide the applicable acceleration (Table 4) and velocity (Table 5) based site coefficients.

**Table 4 Acceleration Based Seismic Coefficients**

| Site Class | Values of $F_a$      |                   |                   |                   |                      |
|------------|----------------------|-------------------|-------------------|-------------------|----------------------|
|            | $S_a(0.2) \leq 0.25$ | $S_a(0.2) = 0.50$ | $S_a(0.2) = 0.75$ | $S_a(0.2) = 1.00$ | $S_a(0.2) \geq 1.25$ |
| D          | 1.3                  | 1.2               | 1.1               | 1.1               | 1.0                  |

**Table 5 Velocity Based Seismic Coefficients**

| Site Class | Values of $F_v$     |                  |                  |                  |                     |
|------------|---------------------|------------------|------------------|------------------|---------------------|
|            | $S_a(1.0) \leq 0.1$ | $S_a(1.0) = 0.2$ | $S_a(1.0) = 0.3$ | $S_a(1.0) = 0.4$ | $S_a(1.0) \geq 0.5$ |
| D          | 1.4                 | 1.3              | 1.2              | 1.1              | 1.1                 |

Consideration could be given to carrying out shear wave velocity testing ("MASW") to evaluate whether an improved seismic site class can be obtained. Additionally, deeper boreholes may also provide more accurate results. Further details regarding shear wave velocity testing could be provided upon request.

## 4.7 Foundation Wall Backfill

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

It is possible to reuse some of the existing cohesionless material as backfill such as in areas underlying landscaped areas and those not sensitive to excess settlement. The reused material should be tested by Cambium to determine if the level of frost susceptibility is within adequate tolerance.

Where backfill will support areas of hard surfacing (pavements, walkways, etc.) the backfill should be placed in maximum 200 mm thick lifts and compacted to at least 95% of the SPMDD value.

## 4.8 Slab on Grade Design Parameters

All organic material and deleterious material must be removed prior to constructing the slab on grade. These materials do not constitute an adequate subgrade for support of a slab on grade. Compacted earth fill, engineered fill, the native sands, clayey silts, or glacial tills are suitable for the support of a conventional slab on grade provided they are approved by Cambium.

The moduli of subgrade reaction appropriate for slab on grade design on the soils at the site are as follows:

- Compacted earth fill: 16,000 kPa/m
- Engineered Fill: 22,000 kPa/m
- Native, undisturbed soils: 30,000 kPa/m

The subgrade for the slab must be cut-neat, proof rolled, and inspected by Cambium, prior to the placement of an aggregate base. The subgrade should be proof rolled using a static smooth drum roller. If any soft or weak subgrade areas are identified, or if there are areas containing excessive amounts of deleterious/organic material or moisture, they must be locally sub-

excavated and backfilled with approved clean earth fill or Engineered Fill such as OPSS Granular B (Type I or II) and compacted to a minimum of 98% Standard Proctor Maximum Dry Density (SPMDD).

It is necessary that the slab be provided with a capillary moisture barrier and drainage layer. This is made by placing the slab on a minimum 200 mm layer of clear stone and nominally compacted by vibration to a dense state. The upper 50 mm of clear stone may be replaced with 50 mm of OPSS Granular A to create a working surface.

#### **4.9 Perimeter Drainage**

Perimeter foundation drainage is not considered necessary for slab-on-grade structures provided that the finished floor slab elevation is set above the exterior surface grades.

#### **4.10 Site Servicing**

##### **4.10.1 Excavation**

Excavations for proposed site services should adhere to the recommendations provided in Section 4.1.

##### **4.10.2 Bedding**

The existing native soils and glacial till will provide adequate support for buried services on conventional well graded granular base material. Where disturbance to the trench base has occurred, such as due to groundwater inflow or construction activities, the disturbed materials should be sub-excavated and replaced with suitably compacted granular fill.

Granular bedding material should consist of a conventional Class 'B' bedding, such as OPSS.MUNI 1010 Granular A. The use of 19 mm clear stone (OPSS.MUNI 1004) as bedding is also acceptable provided that the bedding is wrapped in suitable geotextile filter (Terrafix 360R or equivalent). The bedding materials should be compacted to a minimum 95% of SPMDD. Clear stone bedding material should be nominally compacted to a dense state.

### **4.10.3 Trench Backfill**

In general, excavated soils encountered on site may be re-used as backfill, provided the moisture content of these materials is within 2% of optimum to ensure adequate compaction, the trenches are wide enough to accommodate large compaction equipment, and the soil is free of any organic material. Soils with elevated moisture could be put aside to dry, tilled to reduce the moisture content so that they can be effectively compacted, or could be mixed with dryer material. Alternatively, materials of higher moisture content could be wasted and replaced with imported material which can be readily compacted.

The backfill should consist of clean earth fill and should be placed in lifts of 150 mm thickness or less and compacted to a minimum 95% of SPMMD (in settlement sensitive areas) and 90% of SPMDD (in non-settlement sensitive areas) at a water content within 2% of optimum. Existing earth fill and native soils will be difficult to place and compact successfully in narrow trench excavations, where large compaction equipment could not operate. For narrow trench excavations, it is recommended that free draining granular material, such as OPSS 1010 Granular 'B' be used in order to allow for adequate compaction using vibratory equipment. The placement and inspection of any earth fill as backfill must be conducted under the full time observation of Cambium.

## **4.11 Pavement Design Consideration**

### **4.11.1 Subgrade Preparation**

The performance of the pavement is dependent upon proper subgrade preparation. All topsoil and organic materials should be removed. The subgrade should be proof rolled and inspected by Cambium personnel. Any areas where rutting or appreciable deflection is noted should be sub-excavated and replaced with suitable earth fill. The fill should be compacted to at least 98% of SPMDD.

#### 4.11.2 Typical Flexible Pavement Structure

The performance of the pavement is dependent upon proper subgrade preparation and drainage. All fill materials should be removed down to native material and backfilled with approved engineered fill or native material, compacted to 98% of SPMDD. The subgrade should be proof rolled and inspected by a Geotechnical Engineer prior to placing the granular fill. Any areas where rutting or appreciable deflection is noted should be subexcavated and replaced with suitable fill. The fill should be compacted to at least 98% of SPMDD.

The recommended minimum pavement structure design has been developed for two traffic loading scenarios; light duty and heavy duty. The light duty design is appropriate for areas where no truck traffic is anticipated. The heavy duty design should meet the City of Barrie Transportation Design Manual (2020) requirements and as a minimum, consist of the pavement layers identified in Table 6. The heavy duty pavement structure recommended below assumes that the annual average daily traffic (AADT) is less than 2,500, and is appropriate for areas where heavy traffic or heavy loads are anticipated. If the predicted AADT is higher than that assumed, Cambium should be contacted to reassess this recommendation.

It is noted that the minimum pavement structure may be reassessed following further geotechnical investigations.

**Table 6 Recommended Minimum Pavement Structure**

| Pavement Layer         | Light Duty (Light Vehicle Parking) | Heavy Duty (City of Barrie Designated Routes or Fire Truck Routes) |
|------------------------|------------------------------------|--------------------------------------------------------------------|
| Surface Course Asphalt | 40 mm HL3 or HL4                   | 40 mm HL3 or SP 12.5                                               |
| Binder Course Asphalt  | 50 mm HL8                          | 70 mm HL8 or SP 19                                                 |
| Granular Base          | 150 mm OPSS 1010 Granular A        | 150 mm OPSS 1010 Granular A                                        |
| Granular Subbase       | 300 mm OPSS 1010 Granular B        | 450 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.



Granular layers should be placed in no more than 300 mm thick lifts and compacted to at least 98% of SPMDD (ASTM D698) standard. 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 sawcut to provide clean vertical joints with new pavement areas.

## **5.0 Limitations**

### **5.1 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.

### **5.2 Changes in Site and Project Scope**

This is a preliminary geotechnical engineering report intended for planning and preliminary design purposes only. Additional boreholes and a detailed geotechnical engineering report are required for detailed designs.

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 preliminary design parameters provided and the preliminary engineering advice offered in this report are intended for use by the owner and its retained design consultants. These interpretations made of the subsurface information, for preliminary geotechnical design parameters, advice, and comments relating to constructability issues and quality control are not complete for the project. Cambium should be retained to conduct further investigation at the site for detailed designs.



## 6.0 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 reviewer at (705) 719-0700.

Respectfully submitted,

### CAMBIUM INC.

Prepared By:

Blasco Vijayabaskaran, P.Eng.  
Geotechnical Engineer/Project Manager

SEB/RG/bv

Reviewed By:

Rob Gethin, P.Eng.  
Group Manager – Geotechnical Services





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## Appended Figures

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## GEOTECHNICAL INVESTIGATION

2640085 ONTARIO LTD.  
140 Lockhart Road,  
Barrie, Ontario

### LEGEND

-  Borehole Location
-  Site (approximate)

**Notes:**  
- Site is approximate and was obtained from the County of Simcoe online GIS.  
- 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.



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## BOREHOLE LOCATION PLAN

|              |           |             |                       |
|--------------|-----------|-------------|-----------------------|
| Project No.: | 10957-002 | Date:       | September 2020        |
| Scale:       | 1:5,000   | Rev.:       |                       |
| Created by:  | TLC       | Projection: | NAD 1983 UTM Zone 17N |
| Checked by:  | RG        | Figure:     | 1                     |



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## **Appendix A**

## **Borehole Logs**

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**Client:** 2640085 Ontario Inc.

**Project Name:** Geotech Investigation - 140 Lockhart Road

**Project No.:** 10957-002

**Contractor:** Walker Drilling Ltd.

**Method:** Hollow Stem Augers

**Date Completed:** September 3, 2020

**Location:** 140 Lockhart Raod, Barrie

**UTM:** 17T: 606098m E, 4909398m N

**Elevation:** 280.5

| SUBSURFACE PROFILE |       |           |                                                                              | SAMPLE |      |            |                |            |    |    |                |    |    |    |                   |         |
|--------------------|-------|-----------|------------------------------------------------------------------------------|--------|------|------------|----------------|------------|----|----|----------------|----|----|----|-------------------|---------|
| Elevation<br>(m)   | Depth | Lithology | Description                                                                  | Number | Type | % Recovery | SPT (N) / DCPT | % Moisture |    |    | SPT (N) / DCPT |    |    |    | Well Installation | Remarks |
|                    |       |           |                                                                              |        |      |            |                | 25         | 50 | 75 | 10             | 20 | 30 | 40 |                   |         |
| 0                  |       |           | Topsoil: Dark brown silty sand, with organics, moist                         | 1A     |      |            |                |            |    |    |                |    |    |    |                   |         |
| 280                |       |           | Till: Weathered/disturbed                                                    | 1B     | SS   | 50         | 4              |            |    |    |                |    |    |    |                   |         |
|                    |       |           | Grey below                                                                   | 2      | SS   | 100        | 9              |            |    |    |                |    |    |    |                   |         |
| 279                |       |           | Till: Grey silt and sand, some clay, some gravel, dense to very dense, moist | 3      | SS   | 0          | 40             |            |    |    |                |    |    |    |                   |         |
|                    |       |           |                                                                              | 4      | SS   | 100        | 50/280 mm      |            |    |    |                |    |    |    |                   |         |
| 278                |       |           |                                                                              | 5      | SS   | 70         | 50             |            |    |    |                |    |    |    |                   |         |
| 277                |       |           |                                                                              |        |      |            |                |            |    |    |                |    |    |    |                   |         |
| 276                |       |           |                                                                              | 6      | SS   | 70         | 35             |            |    |    |                |    |    |    |                   |         |
| 275                |       |           | Borehole terminated at 5.0 mbgs.                                             |        |      |            |                |            |    |    |                |    |    |    |                   |         |
| 274                |       |           |                                                                              |        |      |            |                |            |    |    |                |    |    |    |                   |         |
| 273                |       |           |                                                                              |        |      |            |                |            |    |    |                |    |    |    |                   |         |

GSA SS2:  
Gravel 3%  
Sand 43%  
Silt 41%  
Clay 13%

Borehole open and dry upon completion.

**Logged By:** BW

**Input By:** BW



Client: 2640085 Ontario Inc.

Project Name: Geotech Investigation - 140 Lockhart Road

Project No.: 10957-002

Contractor: Walker Drilling Ltd.

Method: Hollow Stem Augers

Date Completed: September 3, 2020

Location: 140 Lockhart Road, Barrie

UTM: 17T: 605925m E, 4909558m N

Elevation: 287.6

| SUBSURFACE PROFILE |       |           |                                                                            | SAMPLE |      |            |                  |            |    |    |                |    |    |                   |         |
|--------------------|-------|-----------|----------------------------------------------------------------------------|--------|------|------------|------------------|------------|----|----|----------------|----|----|-------------------|---------|
| Elevation<br>(m)   | Depth | Lithology | Description                                                                | Number | Type | % Recovery | SPT (N) / DCPT   | % Moisture |    |    | SPT (N) / DCPT |    |    | Well Installation | Remarks |
|                    |       |           |                                                                            |        |      |            |                  | 25         | 50 | 75 | 10             | 20 | 30 | 40                |         |
| 0                  |       |           | Topsoil: Dark brown silty sand, with organics, moist                       | 1A     | SS   | 90         | 12               |            |    |    |                |    |    |                   |         |
| 287                |       |           | Fill: Grey silty sand, with rootlets, compact, moist                       | 1B     |      |            |                  |            |    |    |                |    |    |                   |         |
| 1                  |       |           | Sand: Brown sand, trace silt, compact, moist                               | 2A     | SS   | 90         | 28               |            |    |    |                |    |    |                   |         |
|                    |       |           | Till: Grey silty sand, some clay, trace gravel, dense to very dense, moist | 2B     |      |            |                  |            |    |    |                |    |    |                   |         |
| 286                |       |           |                                                                            | 2C     |      |            |                  |            |    |    |                |    |    |                   |         |
| 2                  |       |           |                                                                            | 3      | SS   | 100        | 44               |            |    |    |                |    |    |                   |         |
|                    |       |           |                                                                            |        |      |            |                  |            |    |    |                |    |    |                   |         |
| 285                |       |           |                                                                            | 4      | SS   | 20         | 50/<br>125<br>mm |            |    |    |                |    |    |                   |         |
| 3                  |       |           | Borehole terminated at 2.6 mbgs due to auger refusal.                      |        |      |            |                  |            |    |    |                |    |    |                   |         |
| 284                |       |           |                                                                            |        |      |            |                  |            |    |    |                |    |    |                   |         |
| 4                  |       |           |                                                                            |        |      |            |                  |            |    |    |                |    |    |                   |         |
| 283                |       |           |                                                                            |        |      |            |                  |            |    |    |                |    |    |                   |         |
| 5                  |       |           |                                                                            |        |      |            |                  |            |    |    |                |    |    |                   |         |
| 282                |       |           |                                                                            |        |      |            |                  |            |    |    |                |    |    |                   |         |
| 6                  |       |           |                                                                            |        |      |            |                  |            |    |    |                |    |    |                   |         |
| 281                |       |           |                                                                            |        |      |            |                  |            |    |    |                |    |    |                   |         |
| 7                  |       |           |                                                                            |        |      |            |                  |            |    |    |                |    |    |                   |         |
| 280                |       |           |                                                                            |        |      |            |                  |            |    |    |                |    |    |                   |         |
| 8                  |       |           |                                                                            |        |      |            |                  |            |    |    |                |    |    |                   |         |

GSA SS3:  
Gravel 10%  
Sand 42%  
Silt 33%  
Clay 15%

Cobbles noted in cuttings at 2.3 mbgs.

Wet soils measured at 1.5 mbgs, caving at 2.3 mbgs.



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# Log of Borehole:

BH103-20

Page 1 of 1

**Client:** 2640085 Ontario Inc.

**Project Name:** Geotech Investigation - 140 Lockhart Road

**Project No.:** 10957-002

**Contractor:** Walker Drilling Ltd.

**Method:** Hollow Stem Augers

**Date Completed:** September 3, 2020

**Location:** 140 Lockhart Raod, Barrie

**UTM:** 17T: 605786m E, 4909107m N

**Elevation:** 276.0

| SUBSURFACE PROFILE |       |           |                                                                                   | SAMPLE |      |            |                  |            |    |    |                |    |    |                   |                                        |
|--------------------|-------|-----------|-----------------------------------------------------------------------------------|--------|------|------------|------------------|------------|----|----|----------------|----|----|-------------------|----------------------------------------|
| Elevation<br>(m)   | Depth | Lithology | Description                                                                       | Number | Type | % Recovery | SPT (N) / DCPT   | % Moisture |    |    | SPT (N) / DCPT |    |    | Well Installation | Remarks                                |
|                    |       |           |                                                                                   |        |      |            |                  | 25         | 50 | 75 | 10             | 20 | 30 | 40                |                                        |
| 0                  |       |           | Topsoil: Dark brown silty sand, some gravel, with organics, moist                 | 1A     |      |            |                  |            |    |    |                |    |    |                   |                                        |
|                    |       |           | Silty Sand: Brown silty sand, some gravel, trace clay, compact to dense, moist    | 1B     | SS   | 80         | 31               |            |    |    |                |    |    |                   |                                        |
| 274                | 1     |           |                                                                                   | 2      | SS   | 30         | 38               |            |    |    |                |    |    |                   |                                        |
|                    |       |           |                                                                                   |        |      |            |                  |            |    |    |                |    |    |                   |                                        |
| 273                | 2     |           |                                                                                   | 3      | SS   | 80         | 25               |            |    |    |                |    |    |                   |                                        |
|                    |       |           | Clayey Silt: Grey brown clayey silt, trace sand, firm to stiff, moist             | 4      | SS   | 80         | 7                |            |    |    |                |    |    |                   |                                        |
| 272                | 3     |           |                                                                                   |        |      |            |                  |            |    |    |                |    |    |                   |                                        |
|                    |       |           |                                                                                   | 5      | SS   | 90         | 9                |            |    |    |                |    |    |                   |                                        |
| 271                | 4     |           |                                                                                   |        |      |            |                  |            |    |    |                |    |    |                   |                                        |
|                    |       |           | Till: Brown to grey brown silty sand, trace clay, trace gravel, very dense, moist | 6      | SS   | 80         | 50/<br>125<br>mm |            |    |    |                |    |    |                   |                                        |
| 270                | 5     |           |                                                                                   |        |      |            |                  |            |    |    |                |    |    |                   |                                        |
|                    |       |           |                                                                                   |        |      |            |                  |            |    |    |                |    |    |                   |                                        |
| 269                | 6     |           |                                                                                   |        |      |            |                  |            |    |    |                |    |    |                   |                                        |
|                    |       |           |                                                                                   | 7      | SS   | 100        | 50/<br>255<br>mm |            |    |    |                |    |    |                   |                                        |
| 268                | 7     |           |                                                                                   |        |      |            |                  |            |    |    |                |    |    |                   |                                        |
|                    |       |           |                                                                                   |        |      |            |                  |            |    |    |                |    |    |                   |                                        |
| 267                | 8     |           |                                                                                   | 8      | SS   | 100        | 50/<br>230<br>mm |            |    |    |                |    |    |                   |                                        |
|                    |       |           | Borehole terminated at 8.0 mbgs.                                                  |        |      |            |                  |            |    |    |                |    |    |                   |                                        |
|                    |       |           |                                                                                   |        |      |            |                  |            |    |    |                |    |    |                   | Borehole open and dry upon completion. |

**Logged By:** BW

**Input By:** BW



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# Log of Borehole:

BH104-20

Page 1 of 1

**Client:** 2640085 Ontario Inc.

**Project Name:** Geotech Investigation - 140 Lockhart Road

**Project No.:** 10957-002

**Contractor:** Walker Drilling Ltd.

**Method:** Hollow Stem Augers

**Date Completed:** September 3, 2020

**Location:** 140 Lockhart Raod, Barrie

**UTM:** 17T: 605785m E, 4909107m N

**Elevation:** 277.1

| SUBSURFACE PROFILE |       |                                                                                    |                                                                   | SAMPLE |      |            |                  |            |    |    |                |    |    |    |                   |                                        |
|--------------------|-------|------------------------------------------------------------------------------------|-------------------------------------------------------------------|--------|------|------------|------------------|------------|----|----|----------------|----|----|----|-------------------|----------------------------------------|
| Elevation<br>(m)   | Depth | Lithology                                                                          | Description                                                       | Number | Type | % Recovery | SPT (N) / DCPT   | % Moisture |    |    | SPT (N) / DCPT |    |    |    | Well Installation | Remarks                                |
|                    |       |                                                                                    |                                                                   |        |      |            |                  | 25         | 50 | 75 | 10             | 20 | 30 | 40 |                   |                                        |
| 0                  |       |   | Topsoil: Dark brown, silty sand, with organics, moist             | 1      | SS   | 60         | 5                |            |    |    |                |    |    |    |                   |                                        |
|                    |       |                                                                                    |                                                                   | 2A     |      |            |                  |            |    |    |                |    |    |    |                   |                                        |
| 275                | 1     |  | Till: Weathered/disturbed                                         | 2B     | SS   | 80         | 36               |            |    |    |                |    |    |    |                   |                                        |
|                    |       |                                                                                    |                                                                   |        |      |            |                  |            |    |    |                |    |    |    |                   |                                        |
|                    |       |                                                                                    | Till: Grey silty sand, some gravel, trace clay, very dense, moist | 3      | SS   | 70         | 50/<br>255<br>mm |            |    |    |                |    |    |    |                   |                                        |
| 274                | 2     |                                                                                    |                                                                   |        |      |            | 50/<br>75m<br>m  |            |    |    |                |    |    |    |                   |                                        |
|                    |       |                                                                                    |                                                                   | 4      | SS   | 60         |                  |            |    |    |                |    |    |    |                   |                                        |
|                    |       |                                                                                    |                                                                   |        |      |            |                  |            |    |    |                |    |    |    |                   |                                        |
| 273                | 3     |                                                                                    |                                                                   | 5      | SS   | 80         | 50/<br>230<br>mm |            |    |    |                |    |    |    |                   |                                        |
|                    |       |                                                                                    |                                                                   |        |      |            |                  |            |    |    |                |    |    |    |                   |                                        |
| 272                | 4     |                                                                                    |                                                                   |        |      |            | 50/<br>50m<br>m  |            |    |    |                |    |    |    |                   |                                        |
|                    |       |                                                                                    |                                                                   | 6      | SS   | 0          |                  |            |    |    |                |    |    |    |                   |                                        |
| 271                | 5     |                                                                                    | Borehole terminated at 4.6 mbgs due to auger refusal.             |        |      |            |                  |            |    |    |                |    |    |    |                   | Borehole open and dry upon completion. |

GSA SS5:  
Gravel 15%  
Sand 49%  
Silt 27%  
Clay 9%

Borehole open and dry upon completion.

**Logged By:** BW

**Input By:** BW



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# Log of Borehole:

BH105-20

Page 1 of 1

**Client:** 2640085 Ontario Inc.

**Project Name:** Geotech Investigation - 140 Lockhart Road

**Project No.:** 10957-002

**Contractor:** Walker Drilling Ltd.

**Method:** Hollow Stem Augers

**Date Completed:** September 4, 2020

**Location:** 140 Lockhart Raod, Barrie

**UTM:** 17T: 605848m E, 4909259m N

**Elevation:** 280.5

| SUBSURFACE PROFILE |       |                                                                                     |                                                                              | SAMPLE |      |            |                  |            |    |    |                |    |    |    |                   |                                                           |
|--------------------|-------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------|--------|------|------------|------------------|------------|----|----|----------------|----|----|----|-------------------|-----------------------------------------------------------|
| Elevation<br>(m)   | Depth | Lithology                                                                           | Description                                                                  | Number | Type | % Recovery | SPT (N) / DCPT   | % Moisture |    |    | SPT (N) / DCPT |    |    |    | Well Installation | Remarks                                                   |
|                    |       |                                                                                     |                                                                              |        |      |            |                  | 25         | 50 | 75 | 10             | 20 | 30 | 40 |                   |                                                           |
| 0                  |       |    | Topsoil: Dark brown silty sand, trace clay, with organics, very loose, moist | 1      | SS   | 60         | 4                |            |    |    |                |    |    |    |                   | GSA SS3:<br>Gravel 18%<br>Sand 46%<br>Silt 27%<br>Clay 9% |
| 279                |       |    | Till: Weathered/disturbed                                                    | 2      | SS   | 70         | 25               |            |    |    |                |    |    |    |                   |                                                           |
|                    |       |                                                                                     |                                                                              |        |      |            |                  |            |    |    |                |    |    |    |                   |                                                           |
| 278                |       |   | Till: Grey brown silty sand, some gravel, trace clay, very dense, moist      | 3      | SS   | 80         | 50/<br>230<br>mm |            |    |    |                |    |    |    |                   |                                                           |
|                    |       |                                                                                     |                                                                              |        |      |            |                  |            |    |    |                |    |    |    |                   |                                                           |
| 277                |       |  |                                                                              | 4      | SS   | 20         | 50/<br>500<br>mm |            |    |    |                |    |    |    |                   | Borehole open and dry upon completion.                    |
|                    |       |                                                                                     |                                                                              |        |      |            |                  |            |    |    |                |    |    |    |                   |                                                           |
| 276                |       |                                                                                     | Borehole terminated at 3.1 mbgs due to auger refusal.                        | 5      | SS   | 10         | 50/<br>100<br>mm |            |    |    |                |    |    |    |                   |                                                           |
|                    |       |                                                                                     |                                                                              |        |      |            |                  |            |    |    |                |    |    |    |                   |                                                           |
|                    | 4     |                                                                                     |                                                                              |        |      |            |                  |            |    |    |                |    |    |    |                   |                                                           |
| 275                |       |                                                                                     |                                                                              |        |      |            |                  |            |    |    |                |    |    |    |                   |                                                           |
|                    | 5     |                                                                                     |                                                                              |        |      |            |                  |            |    |    |                |    |    |    |                   |                                                           |
| 274                |       |                                                                                     |                                                                              |        |      |            |                  |            |    |    |                |    |    |    |                   |                                                           |
|                    | 6     |                                                                                     |                                                                              |        |      |            |                  |            |    |    |                |    |    |    |                   |                                                           |
| 273                |       |                                                                                     |                                                                              |        |      |            |                  |            |    |    |                |    |    |    |                   |                                                           |
|                    | 7     |                                                                                     |                                                                              |        |      |            |                  |            |    |    |                |    |    |    |                   |                                                           |
| 272                |       |                                                                                     |                                                                              |        |      |            |                  |            |    |    |                |    |    |    |                   |                                                           |
|                    | 8     |                                                                                     |                                                                              |        |      |            |                  |            |    |    |                |    |    |    |                   |                                                           |

GSA SS3:  
Gravel 18%  
Sand 46%  
Silt 27%  
Clay 9%

Borehole open and dry upon completion.

Logged By: BW

Input By: BW



**Client:** 2640085 Ontario Inc.

**Project Name:** Geotech Investigation - 140 Lockhart Road

**Project No.:** 10957-002

**Contractor:** Walker Drilling Ltd.

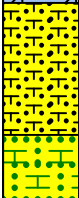
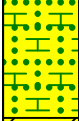
**Method:** Hollow Stem Augers

**Date Completed:** September 4, 2020

**Location:** 140 Lockhart Road, Barrie

**UTM:** 17T: 606069m E, 4909148m N

**Elevation:** 277.1

| SUBSURFACE PROFILE |       |                                                                                     |                                                                     | SAMPLE |      |            |                |            |    |    |                |    |    |    |                                                                                       |                                              |
|--------------------|-------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------|--------|------|------------|----------------|------------|----|----|----------------|----|----|----|---------------------------------------------------------------------------------------|----------------------------------------------|
| Elevation<br>(m)   | Depth | Lithology                                                                           | Description                                                         | Number | Type | % Recovery | SPT (N) / DCPT | % Moisture |    |    | SPT (N) / DCPT |    |    |    | Well Installation                                                                     | Remarks                                      |
|                    |       |                                                                                     |                                                                     |        |      |            |                | 25         | 50 | 75 | 10             | 20 | 30 | 40 |                                                                                       |                                              |
| 0                  |       |    | Topsoil: Dark brown silty sand, with organics, loose, moist         | 1      | SS   | 90         | 6              |            |    |    |                |    |    |    |    | Wet soils encountered at 2.3 mbgs.           |
| 275                | 1     |    | Silty Sand: Brown silty sand, compact, moist                        | 2A     | SS   | 90         | 7              |            |    |    |                |    |    |    |    |                                              |
|                    |       |                                                                                     |                                                                     | 2B     |      |            |                |            |    |    |                |    |    |    |    |                                              |
|                    |       |                                                                                     |                                                                     |        |      |            |                |            |    |    |                |    |    |    |                                                                                       |                                              |
| 274                | 2     |   | Clayey Silt: Grey clayey silt, trace sand, very stiff, moist to wet | 3A     | SS   | 30         | 16             |            |    |    |                |    |    |    |                                                                                       |                                              |
|                    |       |                                                                                     |                                                                     | 3B     |      |            |                |            |    |    |                |    |    |    |                                                                                       |                                              |
|                    |       |                                                                                     |                                                                     | 4      | SS   | 80         | 15             |            |    |    |                |    |    |    |  |                                              |
| 273                | 3     |  | Till: Grey brown silty sand, trace clay, trace gravel, compact, wet | 5      | SS   | 100        | 11             |            |    |    |                |    |    |    |  |                                              |
|                    |       |                                                                                     |                                                                     |        |      |            |                |            |    |    |                |    |    |    |                                                                                       |                                              |
|                    |       |                                                                                     |                                                                     |        |      |            |                |            |    |    |                |    |    |    |                                                                                       |                                              |
| 272                | 4     |                                                                                     |                                                                     |        |      |            |                |            |    |    |                |    |    |    |                                                                                       | 3.7 m: Groundwater measurement on 22/09/2020 |
| 271                | 5     |                                                                                     |                                                                     | 6      | SS   | 60         | 12             |            |    |    |                |    |    |    |  |                                              |
|                    |       |                                                                                     | Borehole terminated at 5.0 mbgs                                     |        |      |            |                |            |    |    |                |    |    |    |                                                                                       |                                              |
| 270                | 6     |                                                                                     |                                                                     |        |      |            |                |            |    |    |                |    |    |    |                                                                                       |                                              |
| 269                | 7     |                                                                                     |                                                                     |        |      |            |                |            |    |    |                |    |    |    |                                                                                       |                                              |
| 268                | 8     |                                                                                     |                                                                     |        |      |            |                |            |    |    |                |    |    |    |                                                                                       |                                              |

**Logged By:** BW

**Input By:** BW



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# Log of Borehole:

BH107-20

Page 1 of 1

**Client:** 2640085 Ontario Inc.

**Project Name:** Geotech Investigation - 140 Lockhart Road

**Project No.:** 10957-002

**Contractor:** Walker Drilling Ltd.

**Method:** Hollow Stem Augers

**Date Completed:** September 4, 2020

**Location:** 140 Lockhart Road, Barrie

**UTM:** 17T: 605820m E, 4908951m N

**Elevation:** 279.1

| SUBSURFACE PROFILE |       |           |                                                                          | SAMPLE |      |            |                  |            |    |    |                |    |    |    |                   |         |
|--------------------|-------|-----------|--------------------------------------------------------------------------|--------|------|------------|------------------|------------|----|----|----------------|----|----|----|-------------------|---------|
| Elevation<br>(m)   | Depth | Lithology | Description                                                              | Number | Type | % Recovery | SPT (N) / DCPT   | % Moisture |    |    | SPT (N) / DCPT |    |    |    | Well Installation | Remarks |
|                    |       |           |                                                                          |        |      |            |                  | 25         | 50 | 75 | 10             | 20 | 30 | 40 |                   |         |
| 0                  |       |           | Topsoil: Dark brown silty sand, with organics, very loose, moist         | 1      | SS   | 90         | 4                |            |    |    |                |    |    |    |                   |         |
| 277                | 1     |           | Till: Weathered/disturbed                                                | 2A     | SS   | 90         | 25               |            |    |    |                |    |    |    |                   |         |
|                    |       |           |                                                                          | 2B     |      |            |                  |            |    |    |                |    |    |    |                   |         |
| 276                | 2     |           | Till: Grey brown silty sand, trace gravel, trace clay, very dense, moist | 3      | SS   | 100        | 27               |            |    |    |                |    |    |    |                   |         |
|                    |       |           |                                                                          | 4      | SS   | 10         | 25               |            |    |    |                |    |    |    |                   |         |
| 275                | 3     |           |                                                                          | 5      | SS   | 30         | 50/<br>205<br>mm |            |    |    |                |    |    |    |                   |         |
| 274                | 4     |           |                                                                          | 6      | SS   | 70         | 50/<br>230<br>mm |            |    |    |                |    |    |    |                   |         |
| 273                | 5     |           |                                                                          | 7      | SS   | 60         | 50/<br>150<br>mm |            |    |    |                |    |    |    |                   |         |
| 272                | 6     |           |                                                                          | 8      | SS   | 20         | 50/<br>100<br>mm |            |    |    |                |    |    |    |                   |         |
| 271                | 7     |           |                                                                          |        |      |            |                  |            |    |    |                |    |    |    |                   |         |
| 270                | 8     |           | Borehole terminated at 7.7 mbgs.                                         |        |      |            |                  |            |    |    |                |    |    |    |                   |         |

GSA SS7:  
Gravel 3%  
Sand 61%  
Silt 31%  
Clay 5%

Borehole open and dry upon completion.

**Logged By:** BW

**Input By:** BW



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## **Appendix B**

### **Physical Lab Results**

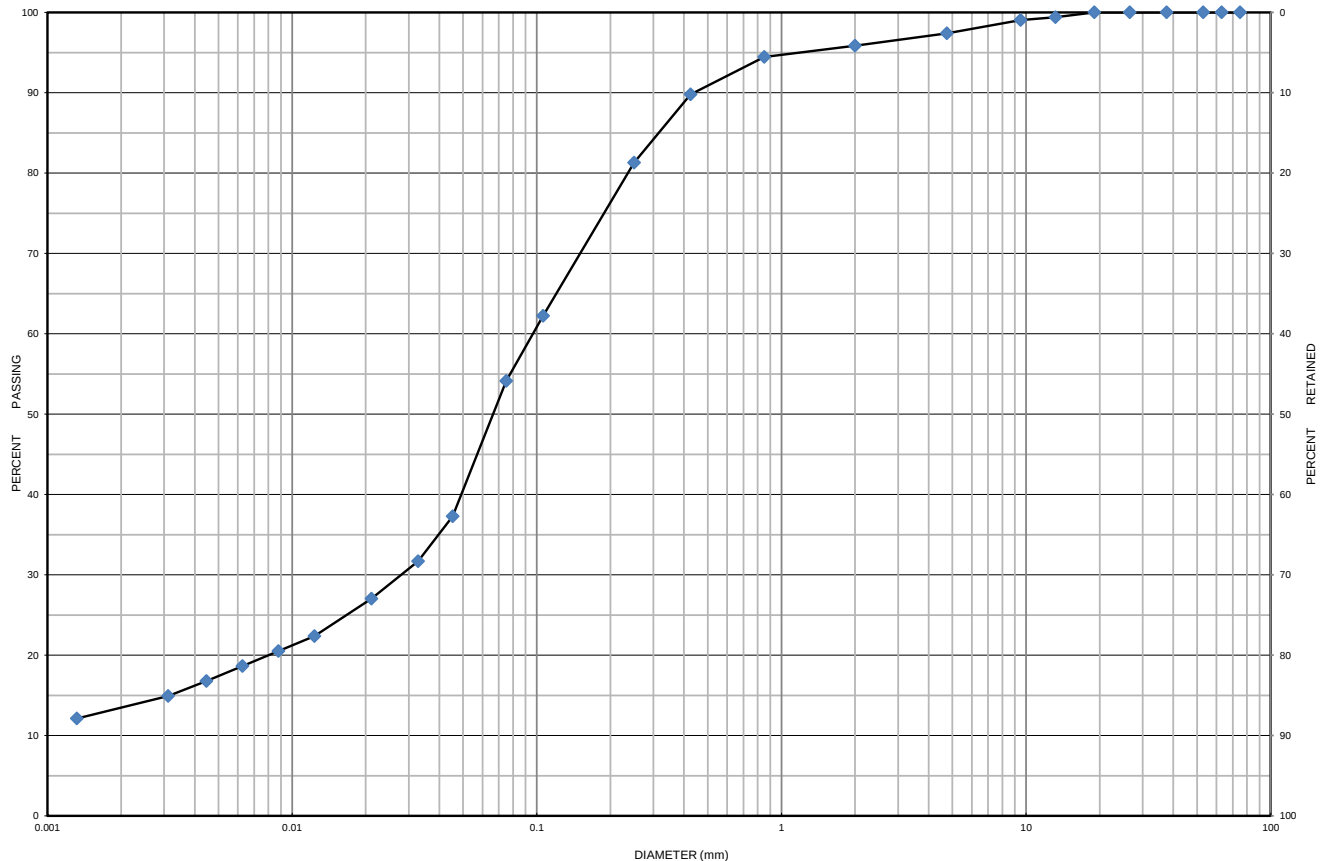
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# Grain Size Distribution Chart

**Project Number:** 10957-002      **Client:** 2640085 Ontario Inc. - Paul Racco  
**Project Name:** 140 Lockhart Road, Barrie  
**Sample Date:** September 3 & 4, 2020      **Sampled By:** Ben White - Cambium Inc.  
**Location:** BH 101-20 SS 2      **Depth:** 0.6 m to 1.2 m      **Lab Sample No:** S-20-0751

| 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 101-20                            | SS 2       | 0.6 m to 1.2 m | 3               | 43              | 41              | 13             | 11.2           |
| Description                          |            | Classification | D <sub>60</sub> | D <sub>30</sub> | D <sub>10</sub> | C <sub>u</sub> | C <sub>c</sub> |
| Sand and Silt some Clay trace Gravel |            | ML             | 0.098           | 0.028           | 0.000           | -              | -              |

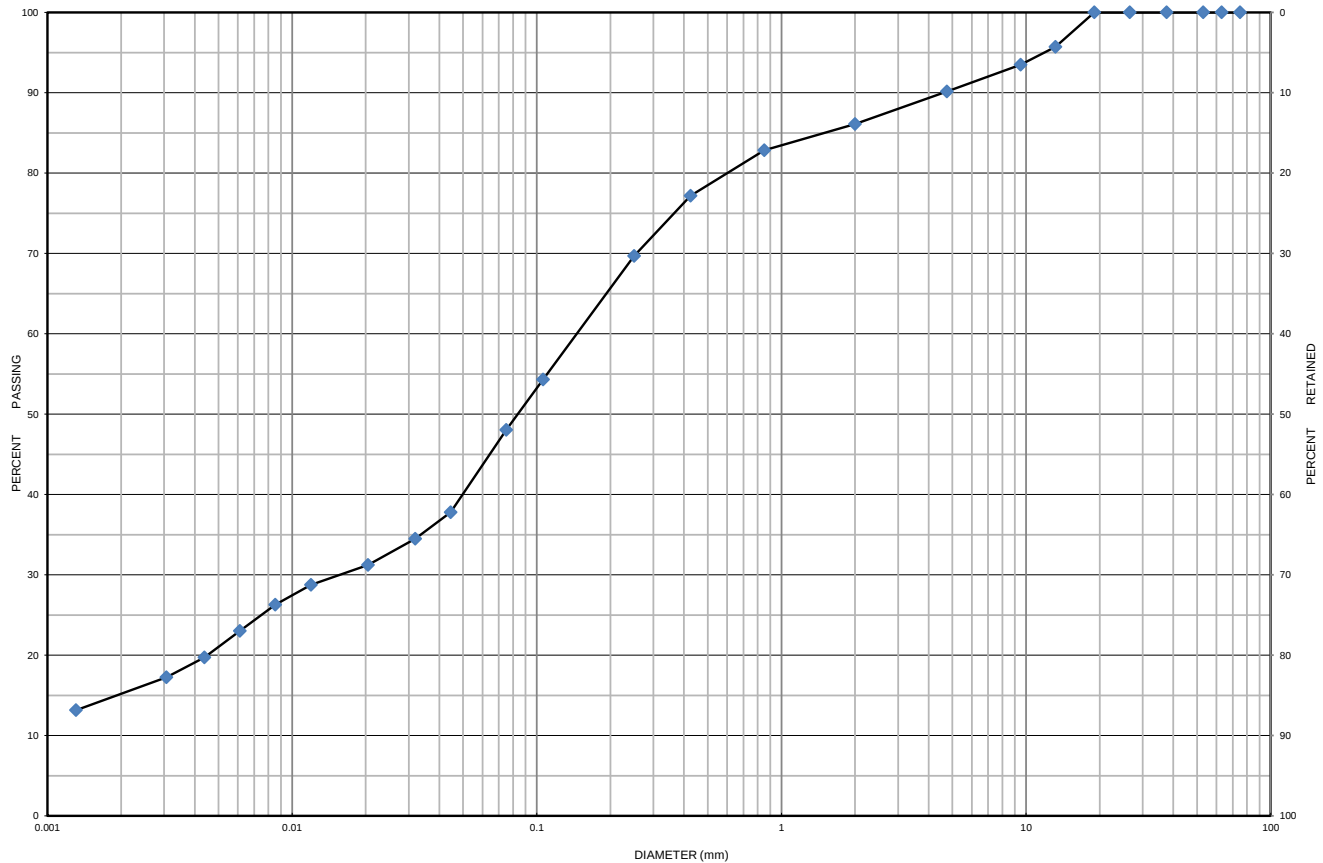
**Issued By:**  (Senior Project Manager)      **Date Issued:** September 30, 2020



# Grain Size Distribution Chart

**Project Number:** 10957-002      **Client:** 2640085 Ontario Inc. - Paul Racco  
**Project Name:** 140 Lockhart Road, Barrie  
**Sample Date:** September 3 & 4, 2020      **Sampled By:** Ben White - Cambium Inc.  
**Location:** BH 102-20 SS 3      **Depth:** 1.5 m to 2 m      **Lab Sample No:** S-20-0750

| 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 102-20                        | SS 3       | 1.5 m to 2 m   | 10              | 42              | 33              | 15             | 8.7            |
| Description                      |            | Classification | D <sub>60</sub> | D <sub>30</sub> | D <sub>10</sub> | C <sub>u</sub> | C <sub>c</sub> |
| Silty Sand some Clay some Gravel |            | SM             | 0.150           | 0.016           | 0.000           | -              | -              |

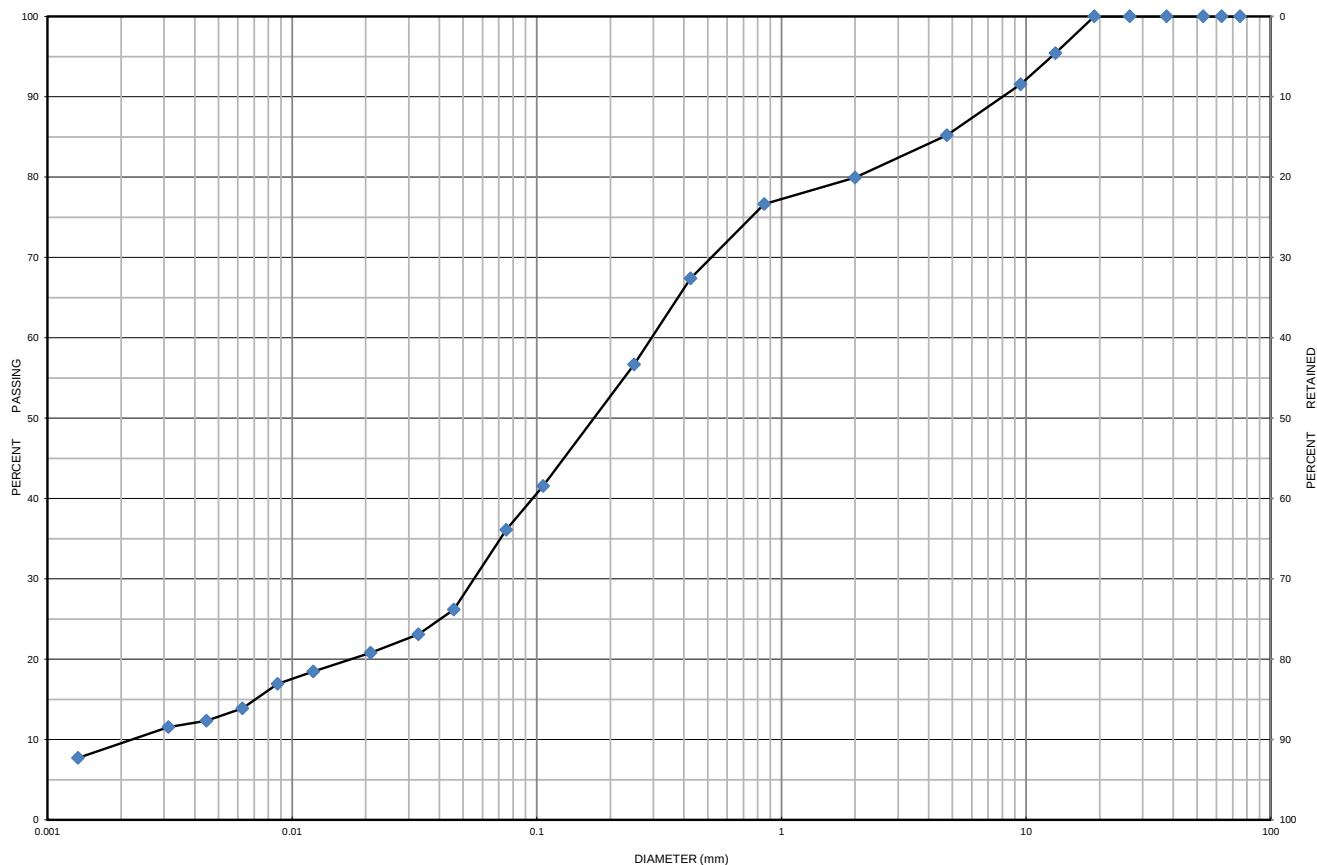
**Issued By:**  (Senior Project Manager)      **Date Issued:** September 30, 2020



# Grain Size Distribution Chart

**Project Number:** 10957-002      **Client:** 2640085 Ontario Inc. - Paul Racco  
**Project Name:** 140 Lockhart Road, Barrie  
**Sample Date:** September 3 & 4, 2020      **Sampled By:** Ben White - Cambium Inc.  
**Location:** BH 104-20 SS 5      **Depth:** 3 m to 3.5 m      **Lab Sample No:** S-20-0747

| 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 | BOULDER |
|                                |      | SAND |        |        | GRAVEL |        |        |         |

| Borehole No.                      | Sample No. | Depth          | Gravel          | Sand            | Silt            | Clay           | Moisture       |
|-----------------------------------|------------|----------------|-----------------|-----------------|-----------------|----------------|----------------|
| BH 104-20                         | SS 5       | 3 m to 3.5 m   | 15              | 49              | 27              | 9              | 5.0            |
| Description                       |            | Classification | D <sub>60</sub> | D <sub>30</sub> | D <sub>10</sub> | C <sub>u</sub> | C <sub>c</sub> |
| Silty Sand some Gravel trace Clay |            | SM             | 0.2990          | 0.0550          | 0.0023          | 130.00         | 4.40           |

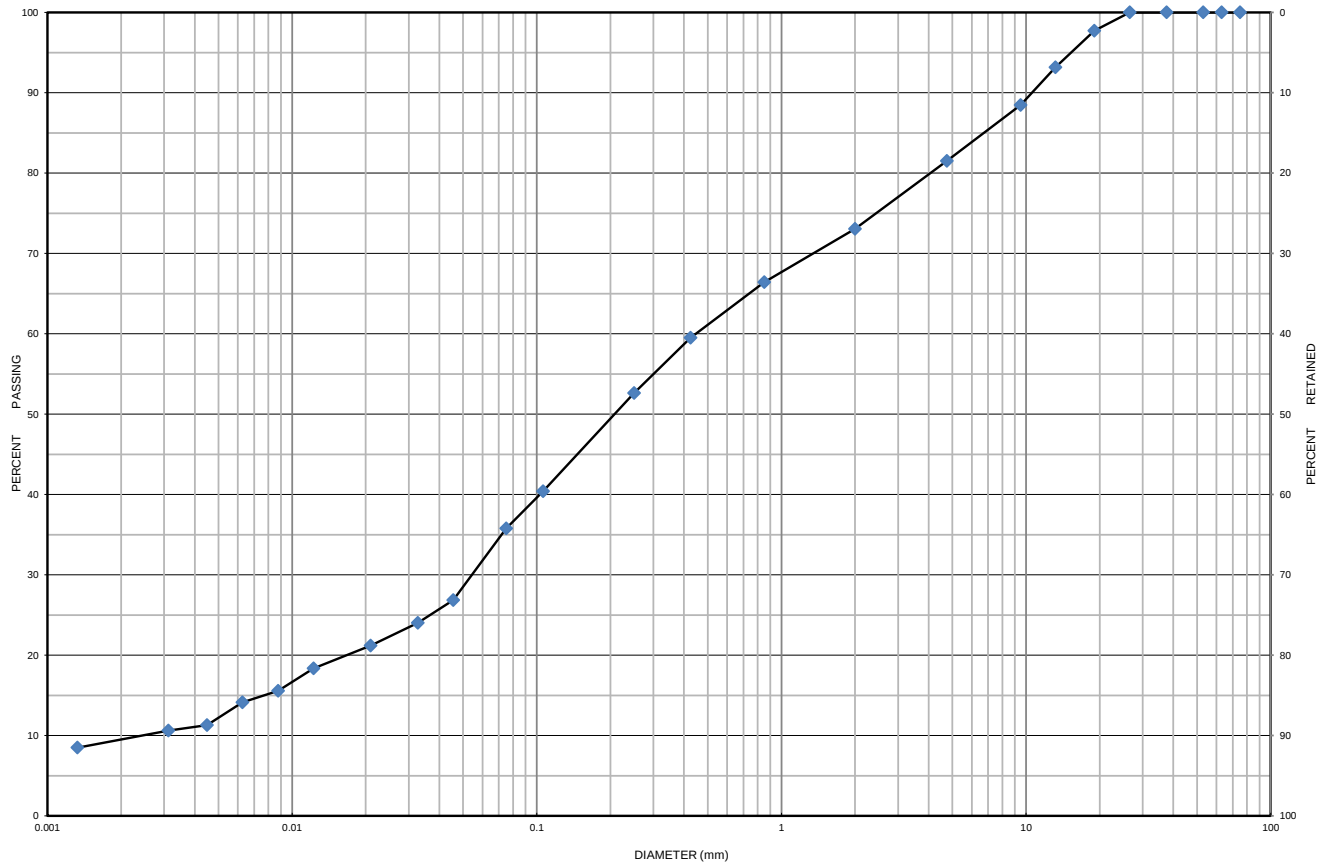
**Issued By:** *Paul Racco*      **Date Issued:** September 30, 2020  
 (Senior Project Manager)



# Grain Size Distribution Chart

**Project Number:** 10957-002      **Client:** 2640085 Ontario Inc. - Paul Racco  
**Project Name:** 140 Lockhart Road, Barrie  
**Sample Date:** September 3 & 4, 2020      **Sampled By:** Ben White - Cambium Inc.  
**Location:** BH 105-20 SS 3      **Depth:** 1.5 m to 2 m      **Lab Sample No:** S-20-0749

| 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 105-20                         | SS 3       | 1.5 m to 2 m   | 18              | 46              | 27              | 9              | 4.6            |
| Description                       |            | Classification | D <sub>60</sub> | D <sub>30</sub> | D <sub>10</sub> | C <sub>u</sub> | C <sub>c</sub> |
| Silty Sand some Gravel trace Clay |            | SM             | 0.4500          | 0.0550          | 0.0025          | 180.00         | 2.69           |

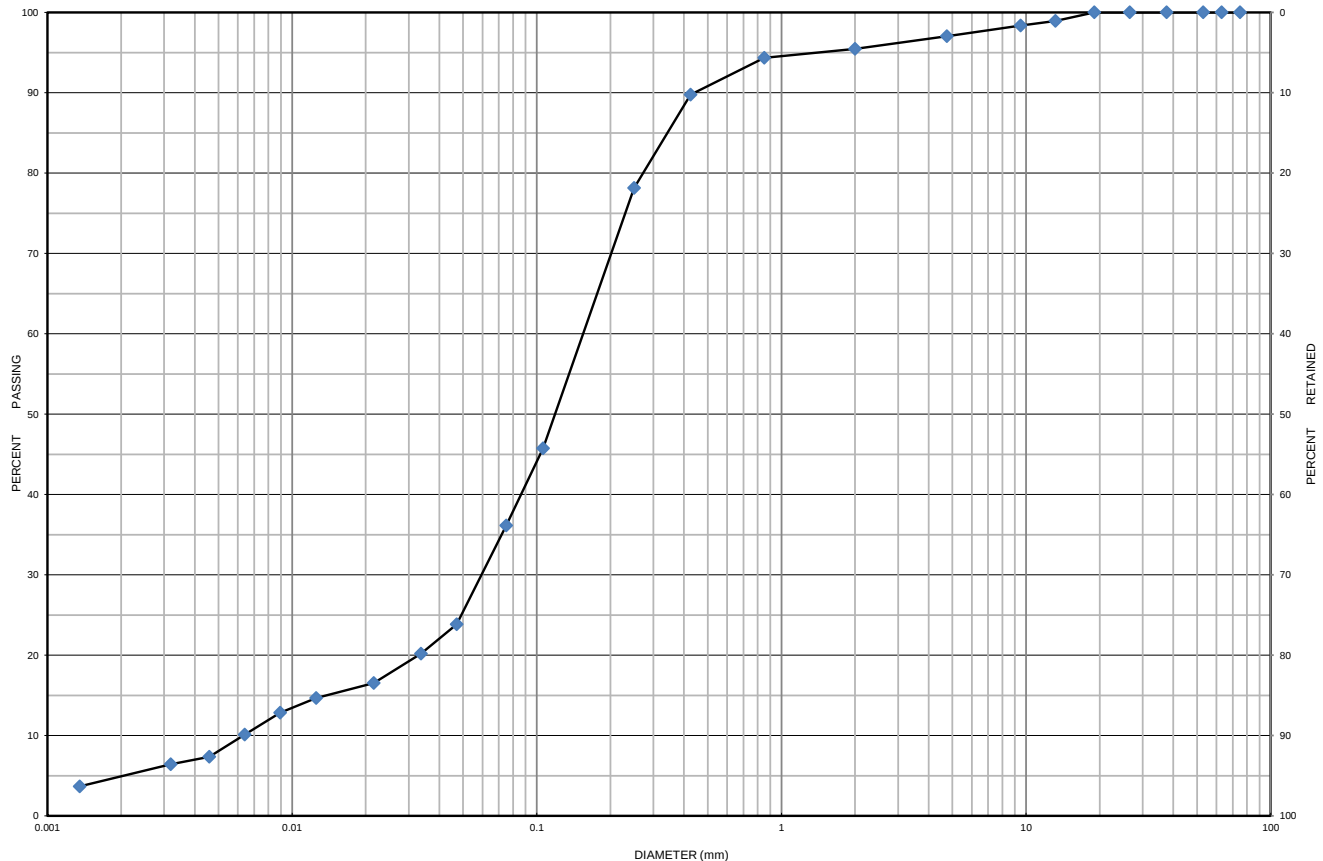
**Issued By:** *Paul Racco*      **Date Issued:** September 30, 2020  
 (Senior Project Manager)



# Grain Size Distribution Chart

**Project Number:** 10957-002      **Client:** 2640085 Ontario Inc. - Paul Racco  
**Project Name:** 140 Lockhart Road, Barrie  
**Sample Date:** September 3 & 4, 2020      **Sampled By:** Ben White - Cambium Inc.  
**Location:** BH 107-20 SS 7      **Depth:** 6.1 m to 6.6 m      **Lab Sample No:** S-20-0748

| 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 107-20                          | SS 7       | 6.1 m to 6.6 m | 3               | 61              | 31              | 5              | 7.8            |
| Description                        |            | Classification | D <sub>60</sub> | D <sub>30</sub> | D <sub>10</sub> | C <sub>u</sub> | C <sub>c</sub> |
| Silty Sand trace Clay trace Gravel |            | SM             | 0.1600          | 0.0600          | 0.0065          | 24.62          | 3.46           |

**Issued By:** Paul Racco (Senior Project Manager)      **Date Issued:** September 30, 2020