SOLA ENGINEERING

RE: GEOTECHNICAL INVESTIGATION
PROPOSED MIXED-USE BUILDINGS
535 BAYFIELD STREET
BARRIE, ONTARIO

FOR: 2709557 Ontario Inc.
18 Erica Road
Thornhill, Ontario
L4J 2G1
c/o
Evans Planning

ATTENTION: Mr. Frank Venditti

REPORT NO.: 2023-17792

DATE: April 4, 2023

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Original: (File No. 10855A-S0619-GEO)

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April 4, 2023 **REPORT NO.: 2023-17792**
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1.0 INTRODUCTION

Sola Engineering Inc. (Sola) was retained by Evans Planning on behalf of 2709557 Ontario Inc. (the Client) to carry out a geotechnical investigation for the proposed mixed-use buildings located at 535 Bayfield Street, Barrie, Ontario (the subject site or site). Authorization to proceed with the investigation was received on January 4, 2023, through the acceptance of Sola's Proposal No. 2022-3264 dated December 15, 2022.

In 2021, Sola conducted a geotechnical investigation at the site. This initial investigation was to support a conversion to a commercial condominium at the subject site as well as expanding the parking lot area. As the result of this investigation, the following report was then submitted in 2021 to the Client: Geotechnical Investigation Report for Proposed Engineering Services, 535 Bayfield Street, Barrie, prepared for 2709557 Ontario Inc., Report No. 2021-15471, dated August 31, 2021.

The Client is presently contemplating to develop the site with two 4-storey mixed-use buildings with no basement and an investigation was conducted to support this concept. This present investigation has been carried out to include additional boreholes to support the new development. As per the scope of services detailed in Sola's proposal, the purpose of this investigation is to collect information on the soil and groundwater conditions at the subject site and, based on the investigation data, provide recommendations to assist with the geotechnical design of the proposed buildings. This report must be read in conjunction with the above-mentioned reports.

This report presents the details of Sola's fieldwork and laboratory testing, outlines the soil and groundwater conditions at the site, and provides comments on the aforementioned items.

In this report, standard site investigation procedures have been adopted. The procedures including those developed by the Ontario Building Code (OBC), Canadian Foundation Engineering Manual (CFEM), American Society for Testing and Materials (ASTM), Ontario Ministry of Transportation (MTO) and Toronto Transit Commission (TTC), are considered by far the most accepted methods by the local geotechnical society for the general engineering purposes. Soil Classification Systems used for developing this report have been in general conformance with those outlined in the above-mentioned procedures, with modifications where appropriate. Where in doubt, this office must be contacted for further interpretation or clarification.

This report has been prepared for the Client, and their nominated engineers and designers. Third-party use or reproduction, in part or in full, of this report, is prohibited without written authorization from Sola. This report is also subject to the *Statement of Limitations* which forms an integral part of this document.

2.0 SITE SETTING

2.1 SITE LOCATION, DESCRIPTION AND PROPOSED DEVELOPMENT

The subject site is located at 535 Bayfield Street in Barrie, Ontario. The site is currently occupied by a single-storey commercial building. The site is bounded to the north and south by commercial properties, to the west by Bayfield Street, and to the east by a vacant property.

It is proposed to develop two 4-storey mixed-use buildings at the subject site. The proposed buildings will be of slab-on-grade construction.

2.2 PUBLISHED GEOLOGY

Based on a review of the existing geological publication for the site area, Ontario Geological Survey (OGS) Map 2645: "*Quaternary Geology, Eastern Half of the Barrie and Elmvale Areas*", the site surrounding area is underlain by Glaciofluvial Ice-Contact Stratified Sediments: fine- to very coarse-grained sand, gravelly sand and gravel, minor amounts of silt, clay and flow till. According to the OGS Map M2544: "*Bedrock Geology of Ontario – Southern Ontario*", the superficial geology is underlain by the bedrock of the Middle Ordovician Ottawa Group; Simcoe Group; Shadow Lake Formation, comprising limestone, dolostone, shale, arkose and sandstone.

3.0 GROUND INVESTIGATION

3.1 FIELD INVESTIGATION

3.1.1 Soil Investigation

Prior to undertaking field drilling, Sola obtained clearances of existing public utility services to the site from all applicable agencies and companies. In addition, private utility locates were also carried out.

The geotechnical field program was carried out from February 13 to 14, 2023 and comprised the advancing of nine (9) boreholes. The boreholes were advanced through the existing ground surface to depths ranging from approximately 4.8 m (BH1) to 6.6 m (BH2 and BH9) below the ground surface using a track-mounted drill rig equipped for split spoon sampling. The approximate locations of the boreholes are shown on **Enclosure 1**. Four (4) monitoring wells were installed in the drilled boreholes (in boreholes BH2, BH5, BH8 and BH9).

All drilling and testing equipment were supplied and operated by Terra Firma Environmental Services Ltd. of North York, Ontario, and the field works were completed under the full-time supervision of a qualified Sola Technician.

Standard Penetration Tests (SPTs) split spoon samples were collected in the drilled boreholes using a 50 mm outer diameter and 35 mm inner diameter split barrel sampler driven with a 63.5 kg automatic hammer freely dropping a vertical distance of 760 mm. All soil samples were logged in the field and returned to Sola's laboratory in Vaughan for review and subsequent laboratory testing.

The logs of the boreholes completed are presented on **Enclosures 2 through 10**.

3.1.2 Groundwater Investigation

Groundwater level observations were made during drilling and in the open boreholes upon completion of the drilling of each borehole. In addition, monitoring wells were installed in four (4) boreholes (BH2, BH5, BH8 and BH9) to enable the measurement of groundwater, over a prolonged period of time without interference from surface water. Details of groundwater observations for the boreholes are presented on the borehole logs on **Enclosures 2 through 10**. Further discussion on groundwater is provided in **Section 4.2** of this report.

3.2 GEOTECHNICAL LABORATORY TESTING

All soil samples were submitted to Sola's laboratory for natural moisture content determination. The results of the moisture content testing are presented on the borehole logs on **Enclosures 2 through 10**. In addition, two (2) representable soil samples were selected and submitted for testing of particle size distribution. The results of the laboratory tests are provided in **Enclosures 13 and 14**.

4.0 SUBSURFACE CONDITIONS

Detailed descriptions of the subsurface conditions encountered at each borehole location are given on the Borehole Logs on **Enclosures 2 through 10**.

The borehole data collected by Sola only represents the subsurface conditions at the borehole locations. It should be pointed out that the material boundaries indicated on the Borehole Logs are approximate and based on visual observations and interpolation between successive samples. These boundaries typically represent a transition from one material type to another and should not be regarded as an exact plane of geological change. It should also be noted that the subsurface conditions may vary across the site.

A summary of the characteristics of each unit of subsoil encountered within the borehole depths is given in the following paragraphs.

4.1 SOIL CHARACTERISATION

4.1.1 Topsoil

A layer of topsoil was encountered at borehole locations BH1 through BH5. The thickness of the topsoil at the borehole locations was measured from approximately 100 mm (BH2 through BH5) to 200 mm (BH1).

It is important to note that topsoil thicknesses may vary throughout the site area, depending upon their location. As such, these findings should not be relied upon for any estimation of topsoil quantities to be stripped prior to construction.

4.1.2 Pavement

A layer of asphaltic concrete was encountered at borehole locations BH6 through BH9. The thickness of the asphaltic concrete was measured from approximately 40 mm (BH6 through BH8) to 50 mm (BH9) at the borehole locations. A granular base/subbase layer consisting of sand and gravel was encountered below the asphaltic concrete with thicknesses ranging from approximately 265 mm (BH7 and BH8) to 340 mm (BH6) at the borehole locations.

4.1.3 Fill Materials

Fill materials were encountered at all borehole locations. The thicknesses of the fill materials at the borehole locations vary from approximately 0.5 m (BH7) to 2.2 m (BH3 and BH4). In the boreholes, the fill extended to depths from 0.8 m (BH7) to 2.3 m (BH1, BH3 and BH4) below the existing ground surface.

Fill materials generally consisted of sand, sandy silt to silty sand, clayey silt and sand and gravel (with asphalt fragments in BH3 and BH4). The fill was generally brown with localized grey and dark brown in colour. In-situ resistance testing results ranged from 7 (BH1, BH4 and BH5) to more than 59 (BH3) blows per 300 mm of spoon penetration indicating that the fill was not constructed under engineering control.

In the fill materials, the measured moisture contents of the samples retrieved from the boreholes ranged from 2.7% (BH2) to 18.4% (BH4), indicating a moist to very moist condition.

4.1.4 Silty Sand Till to Sandy Silt Till

Silty sand till and sandy silt till deposits were encountered below the fill materials or cohesionless soils in boreholes BH1, BH3 and BH6 through BH9 at depths ranging from approximately 2.3 m (BH1 and BH6 through BH8) to 3.0 m (BH3 and BH9) below the ground surface and extended to depths ranging from 3.3 m (BH3) to 6.6 m (BH9) below the ground surface. In boreholes BH1 and BH3, the till deposits were found to extend to 4.6 m and 3.3 m below the ground surface, respectively, while boreholes BH6 through BH9 were terminated in these deposits. The presence of cobbles and boulders was inferred in these deposits in borehole BH6. Owing to their mode of formation, the presence of cobbles and boulders should always be anticipated in these deposits.

SPT "N" values for these deposits were recorded from 48 (BH6) to in excess of 97 (BH7) blows per 300 mm of spoon penetration, indicating the deposit is in a dense to very dense condition but generally a very dense condition.

In the till deposits, the measured moisture contents of the samples recovered ranged from approximately 6.5% (BH1 and BH7) to 8.8% (BH9), indicating a moist to very moist condition.

4.1.5 Cohesionless Soils

Cohesionless deposits consisting of sand and silty sand were encountered below the fill materials or till deposits in all the boreholes at depths ranging from approximately 0.8 m (BH7) to 4.6 m (BH1) below the ground surface and extended to the depths ranging from 2.3 m (BH6 through BH8) to the termination depth of 6.6 m (BH2) below the ground surface. Boreholes BH1 through BH5 were terminated in these deposits. The presence of cobbles and boulders was inferred in these deposits in boreholes BH1, BH3 and BH5 through BH7.

SPT "N" values for these deposits were recorded from 14 (BH5) to in excess of 87 (BH4) blows per 300 mm of spoon penetration, indicating the deposit is in a compact to very dense condition.

In these deposits, the measured moisture contents of the samples recovered ranged from approximately 2.3% (BH3) to 18.6% (BH6), indicating a moist to very moist condition.

4.2 GROUNDWATER

The groundwater conditions encountered during the drilling and cave-in depths are presented on the borehole logs on **Enclosures 2 through 10** as well as in **Table 1.**

Table 1: Borehole Water Depth and Cave-in

Borehole Number	Water Depth Upon Drilling Completion (mBGS)	Cave-in Depth Upon Drilling Completion (mBGS)	Groundwater Depth (mBGS) taken by Project Hydrogeologist on February 27, 2023
BH1	Dry	Open	-
BH2	Dry	Open	Dry
BH3	Dry	Open	-
BH4	Dry	Open	-
BH5	Dry	5.7	Dry
BH6	Dry	Open	-
BH7	Dry	Open	-
BH8	Dry	Open	Dry
BH9	Dry	Open	Dry

Note: mBGS = meters below ground surface

It should be noted that water levels can vary in response to seasonal fluctuations and major weather events. In addition, a perched water condition can occur due to the accumulation of surface water in the more pervious soils (e.g., granular pavement fill or cohesionless soils), overlying less pervious deposits (e.g., clayey silt fill or silty sand till to sandy silt till) especially during seasonally wetter periods.

Long-term “stabilized” groundwater level measurements should refer to the project hydrogeological study.

5.0 DISCUSSION AND RECOMMENDATIONS

The investigation and comments should be considered ongoing as new information about the underground conditions will continue to become available. When more specific information is available with respect to the soil conditions, the interpretation and the recommendations of this report must therefore be checked through field inspections carried out by Sola to validate the information for use during construction.

It is proposed to develop two 4-storey mixed-use buildings at the subject site. The proposed buildings will be slab-on-grade construction.

Based on the ground conditions found at the site, our recommendations are presented in the following sections.

5.1 FROST PROTECTION

All footings and structural elements exposed to seasonal freezing conditions must have at least 1.5 metres of permanent soil cover, or equivalent artificial insulation, for frost protection.

5.2 CONVENTIONAL SPREAD OR STRIP FOUNDATIONS

At the time of preparation of this report, design loading requirements have not been made available. The following discussions are provided to assist the design phase of the proposed buildings. For geotechnical design purposes, it is assumed that the footings will be positioned below the frost penetration depth, i.e., at least 1.5 m below the finished grade.

Based on borehole data, the proposed buildings can be supported by spread and strip footings founded on undisturbed native soil and designed for geotechnical reactions at Serviceability Limit States (SLS) and factored geotechnical resistances at Ultimate Limit States (ULS) at the depths as outlined in **Table 2**.

Table 2: Recommended Bearing Resistances and Highest Founding Depths

Borehole Number	SLS (kPa)	ULS (kPa)	Highest Founding Depth (mBGS)	Founding Stratum
BH1	400	600	2.3	Very dense silty sand till
BH2	300	450	1.2*	Very dense sand
	400	600	1.6	Very dense sand
BH3	400	600	2.3	Very dense sand
BH4	400	600	2.3	Very dense sand
BH5	150	225	1.5	Compact sand
	400	600	2.3	Very dense sand
BH6	300	450	1.6	Dense silty sand
	400	600	2.3	Dense to very dense silty sand till
BH7	300	450	1.2*	Compact to dense silty sand
	400	600	2.3	Very dense silty sand till
BH8	150	225	1.5	Compact silty sand
	400	600	2.3	Very dense silty sand till
BH9	200	300	1.5	Compact silty sand
	300	450	2.3	Dense silty sand
	400	600	2.8	Dense to very dense silty sand

Note: The highest founding depth below existing grade is provided assuming grade raising is permitted. Frost protection requirements should always be met as specified in **Section 5.1**.

The design values provided above are based on the presumption that the bearing resistance at SLS is governed by total and differential settlements of 25 mm and 20 mm respectively, and the structures will tolerate an angular distortion of 1 in 300. The configuration of all foundations (e.g., depth, size, etc.) must be checked by Sola to verify that settlements would be within tolerable limits with the proposed bearing resistances in this report.

Where it is necessary to place footings on the soil at different levels, the upper footing must be founded below an imaginary 10 horizontal to 7 vertical line (10H:7V) drawn up from the base of the lower footing. The lower footing must be installed first to minimize the risk of undermining the upper footing. The minimum footing size should be 0.8 m to utilize the recommended bearing resistances. Footings and any foundation wall should be reinforced as per the design to be provided by the Structural Engineer of the project.

The recommended bearing resistances and the corresponding founding elevations would need to be confirmed by geotechnical engineering staff at the site prior to pouring footing concrete.

It should be noted that the recommended bearing resistances have been calculated by Sola from the borehole information for the design stage only. Should higher bearing values be required, this office should be contacted to review this report.

Where construction is undertaken during winter conditions, footing subgrades should be protected from freezing. Foundation walls and columns should be protected against heave due to soil adfreeze.

We recommend that the foundation design should be reviewed by this office.

5.3 EARTHQUAKE CONSIDERATIONS

Using the information provided by the site investigation, the general soil profile comprises *"Stiff Soil – Site Class D"* as defined by Table 4.1.8.4.A *"Site Classification for Seismic Site Response"* of the Ontario Building Code.

For building constructions, cost savings may be achieved if the Site Classification can be upgraded through shear wave velocity testing. This testing can be carried out by a specialist geophysics firm.

5.4 SLAB-ON-GRADE CONSTRUCTION

The floor slab for the proposed buildings can be adequately supported at the exposed native or on approved fill by the Geotechnical engineer. Depending on the design grade and loading conditions, some of the existing geotechnically and environmentally clean fill may be used to raise the grade after stripping. Any fill used to raise the grade to the underside of the underfloor granular layer

should consist of approved, environmentally acceptable on-site excavated sand or imported granular materials, such as Granular 'A' or Granular 'B' materials. After stripping and excavation, if unsuitable soils are encountered, they should also be removed and discarded. Exposed soil subgrade must be proof rolled to detect any soft or unstable areas, which must be removed and replaced with suitably compacted engineered fill. Once the required subgrade has been developed, Sola recommends that the exposed subgrade be evaluated, inspected and approved by the Geotechnical Engineer before the placement of any fill or concrete.

Upon approval, the on-site excavated clean selected material can be used to raise the grade. All the under-floor fill should be placed in layers not exceeding 300 mm in thickness before compaction and compacted to not less than 100% of its SPMDD (Standard Proctor Maximum Dry Density). For normal-duty concrete floor slab, at least a 200 mm thick layer of either OPSS Granular A or 20 mm Crusher-Run Limestone should be used and compacted to at least 100% SPMDD. For heavy-duty or settlement sensitive floor slabs, the granular thickness should be increased to 300 mm. All of these above recommendations need to be adjusted when the details are known. Such an under-floor layer has been proven to be an effective moisture barrier for conventional floor surfaces. However, if special floor coverings such as sheet PVC with heat-sealed seams are considered, either a high-efficiency vapour barrier or venting may be added to the granular layer to prevent moisture from accumulating between the concrete floor and the PVC flooring.

Completed excavations for floor slabs should not be left open before pouring concrete for any period longer than 24 hours, particularly if the floor construction works are being completed during the winter months or wet weather periods. The base of any floor slab excavation that is to be left exposed for longer than 24 hours should be suitably covered and protected from water ponding, and/or protected to prevent degradation of the exposed founding stratum with the construction of a mud mat.

Prior to placing the stone bedding, the final subgrade should be proof-rolled and approved by the Geotechnical Engineer.

The design of the concrete slabs on improved fill or native soils may be made on the basis of a value of modulus of subgrade reaction which is 20 MPa/m on the surface of the granular moisture barrier.

The floor slab should be structurally independent from any load-bearing structural elements.

5.5 PERMANENT DRAINAGE CONSIDERATIONS

The finished exterior ground surface should be sloped away from the proposed building areas at a minimum cross-fall of 2%.

Perimeter drainage should be provided around all floor slab areas where water may accumulate. The perimeter drainage is not required if the interior finish floor elevation is at least 200 mm higher than the exterior elevation. If the interior finish floor elevation is less than 200 mm, this office should be contacted, and drainage details can be provided. Based on the groundwater condition at the site, underfloor drains may probably not be required, however, the need for a subfloor drainage system should be determined by the designer in accordance with the latest Ontario Building Code requirements.

5.6 SITE PREPARATORY WORKS

The site preparation work may include stripping the ground cover and existing fill in order to develop the required construction or engineered fill subgrades. Depending on the final grading plan, stripping depths will likely vary locally and should be adjusted to remove all unsuitable materials.

It is recommended that the Geotechnical Engineer monitor the stripping operations to ensure that unsuitable materials have been fully removed prior to construction works or the placement of engineered fill. Unacceptable areas identified are to be remediated as soon as practicable and, the procedures would be dependent upon the conditions encountered.

5.7 EXCAVATABILITY AND SITE EXCAVATIONS

It is assumed that the general excavations for the proposed buildings and utilities will be open-cut. In order to enable entry into excavations during the construction process, all excavations must comply with the definitions prescribed by the "*Occupational Health and Safety Act*" (OHSA), Ontario Regulation 213/91 "*Construction Projects*".

The borehole data indicate that the fill materials and native cohesionless deposits can be classified as a Type 3 material above the groundwater table and Type 4 below the groundwater table and dense to very dense glacial till deposits can be classified as a Type 2 material above the groundwater table and Type 3 below the groundwater table as defined in the OHSA and Regulations for Construction Projects (Part III Excavations, Section 226). Excavations in these materials should be constructed in conformance with the regulations. It is noted that the above classifications have been estimated based on small, discontinuous samples from boreholes. The excavation conditions must be confirmed and/or modified on the basis of field inspections during the construction stage when large-scale observations can be made with ease.

As defined by the OHSA, excavation walls within the Type 3 soils will require battering back at slopes no steeper than 1H (horizontal):1V (vertical) and flatter for Type 4 material. Within the fill materials, a flatter than 1:1 side slope may be required even above the water table. As well, the

native sand may require a flatter than 1:1 side slope when dry or when exposed to the elements for a prolonged period of time.

Depending on the construction feasibility the excavation walls can be supported by temporary shoring systems. During excavations, adjacent existing structures if present, must be protected by proper shoring or sloping.

Based on the findings of the investigation, it is considered that excavation of the overburden soils at the site can be carried out using a conventional backhoe excavator.

Cobbles and boulders were inferred in some of the drilled boreholes and should always be expected in glacial till deposits and possibly in fill materials. The contractor carrying out the excavation work should account for removing cobbles and boulders in their site excavation work.

It is important to note that the above discussion about the excavation is for information purposes only. Contractor bidding on the projects must make their own assessment based on the real site conditions.

It is assumed that the groundwater will be lowered to at least 0.8 m below the required excavation depth to enable the construction to be carried out in the 'dry' condition. Based on the groundwater level measurements, the groundwater level may be considered to be lower than the expected excavation depths and the details of the stabilized groundwater table should be determined by a hydrogeologist. It is not likely that for excavations not exceeding 2.5 m below the existing ground surface an aggressive dewatering method may be required for excavations, however, if required, a hydrogeologist and/or a dewatering specialist should be consulted.

5.8 CONSTRUCTION DEWATERING

The borehole data and groundwater measurements have indicated that for excavations extending to about 2.5 m below the existing ground surface, unusual groundwater seepage problems are unlikely to be expected during excavation and 'perched water' can be controlled by conventional sump pumping. However, the construction dewatering requirements should refer to the project hydrogeology study.

5.9 ENGINEERED FILL

On-site excavated, clean inorganic approved earth (native and/or fill) may selectively be reused as engineered fill material, provided that they are environmentally acceptable, and the moisture contents are strictly controlled. On-site excavated sand can be expected to be on the dry side of the optimum and will likely require adjustment of the moisture content.

If imported inorganic mineral soils are used for engineered fill construction, they must also meet the applicable environmental guidelines, and their moisture contents should preferably be close to their respective optimum water content values.

The soil should be placed in thin lifts and suitable compaction equipment should be employed to achieve the specified degree of field density. However, vibrations due to compaction may need to be reduced or curtailed to prevent damage to the existing structures, if any.

Consideration may also be given to backfilling excavations with well-graded, compacted granular soil such as Granular B as it, if thoroughly compacted, would reduce the post-construction settlements to an acceptable level and may also expedite the compaction process.

Fill materials required for replacing locally softened soils or raising grades within the footprint of the structures are to comprise suitably organic-free materials approved for use by a Geotechnical Engineer. Fill materials are to be placed in lifts of a maximum thickness of 300 mm when first placed and compacted, using appropriate compaction equipment, to not less than 100 % of its SPMDD.

Fill located in areas outside of the footprint of the proposed buildings should be compacted to at least 95 % of the material's SPMDD below 1.0 m of the subgrade level, and then to at least 98 % of its SPMDD up to the required grade. In confined areas, backfill should be compacted using hand-held compaction equipment only.

Sola recommends that any and all engineered subgrades beneath the proposed structures including pavements be inspected and proof-rolled prior to construction.

5.10 PAVEMENT

This section can be read, if desired, in conjunction with the 2021 report to delineate the extend and nature of the fill in the previous boreholes.

5.10.1 Pavement Thickness Design

Undisturbed native ground, or the existing fill soils, approved and re-compacted, as required under Sola's supervision, can support the proposed pavements. Any unsuitable soils, such as topsoil/organic mixed soil and other spongy materials, if found, should be sub-excavated and replaced with approved materials and the profiled subgrade compacted to not less than 98% of its SPMDD.

It is anticipated that the final subgrade will comprise predominantly on-site improved fill (by proof-rolling and surface compaction). Accordingly, in view of the frost susceptibility and drainage characteristics of the final subgrade soils, the following pavement designs presented in **Table 3** are recommended. It is assumed that there will be only occasional delivery truck travels allowed for light-duty areas. In the areas where haul routes are expected, the heavy-duty pavement design should be implemented.

Table 3: Recommended Pavement Design

Pavement Layer	Light Duty Thickness (mm)	Heavy Duty Thickness (mm)	Compaction Requirements
Asphaltic Concrete Surface Course (HL-3)	40	40	Minimum of 92.0% of Maximum Relative Density (MRD)
Asphaltic Concrete Binder Course (HL-8)	50	80	
Granular Base (Granular 'A')	150	150	100% SPMDD
Granular Sub-Base (Granular 'B' Type I)	400	450	

The recommended granular base and sub-base materials shall meet the OPSS 1010 requirements. The granular base and subbase should be compacted to at least 100% of their respective SPMDD.

The asphaltic concrete courses are to be hot-mixed and hot-laid in accordance with current OPSS specifications and compacted to a minimum of 92% of Maximum Relative Density (MRD).

The pavement design as presented above assumes that construction will be undertaken under dry weather conditions and that the subgrade is stable and not heaving under construction equipment traffic. However, if the construction conditions are non-ideal, with the final subgrade being wet and/or unstable, additional imported subbase material may become necessary.

The pavement makeup for the entrance driveways/roads should match the respective road pavement design at the road/driveway interface.

Prior to placing the granular subbase, the final subgrade should be proof rolled to identify soft spots, if any, and rectified as required in consultation with the Geotechnical Engineer.

The recommended pavement structure should be considered for preliminary design purposes only. The functional design life of fifteen (15) years has been used to establish pavement recommendations. This represents the number of years to the first rehabilitation, assuming regular maintenance is carried out. If required, a more refined pavement structure design can be performed based on specific design life requirements. Such further analysis will also involve specific laboratory tests to determine the frost susceptibility and strength characteristics of the subgrade soils, as well as specific traffic loading data input from the Client.

Pavement Drainage: The ability of the soils to provide adequate subgrade support is reduced if allowed to become too wet. Therefore, in order to intercept infiltrating water and provide drainage of the subgrade and pavement material, sub-drains of 100 mm diameter sub-drains, wrapped in filter cloth, may be considered along both sides of the roads/driveways; in addition, similar sub-drains may be considered to be installed in four (4) directions from the catch basins and at strategic locations under parking lot pavement. Furthermore, the subgrade should be graded to promote the flow of water toward the subdrains. In the cases where the sub-drains connecting to the municipal sewer system are not preferred, the pavement profile can be adjusted to direct any runoff flow of water to the on-site stormwater management system, e.g., infiltration gallery.

5.10.2 Pavement Construction Considerations

For pavement construction, the subgrade must be compacted to at least 98% SPMDD, for at least the upper 300 mm, unless an alternative is approved by Sola.

The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure uniform subgrade moisture and density conditions are achieved.

Additional comments on the construction of pavement areas are as follows:

- The subgrade preparation should include stripping of any objectionable materials, e.g., loose fill with organics. The base should be properly shaped and thoroughly proof-rolled using a piece of suitable equipment. Weak and/or unstable subgrade areas should be further sub-excavated and backfilled to the design subgrade level using an approved material, placed in thin lifts, and compacted to at least 98% of its SPMDD;
- The locations and extent of sub-drainage required within the paved areas should be reviewed by this office in conjunction with the proposed grading. Assuming that satisfactory crossfalls in the order of 3.0% have been provided, subdrains extending from and between catch basins may be satisfactory. In the event that flatter

crossfalls are considered, a more extensive system of sub-drainage may be necessary and should be reviewed by Sola;

- The most severe loading conditions on the pavement areas and subgrade may occur during construction. Consequently, special provisions such as restricted access routes, half-loads during paving, etc., may be required, especially if construction is carried out during unfavourable weather. It should also be pointed out that during the construction if the subgrade is disturbed by the construction traffic (e.g., loaded gravel trucks), then the subgrade will be damaged, causing undulations. This would impede surface drainage of the prepared subgrade. Water collected in the low points of the undulating subgrade surface will cause differential frost heave, leading to damage to the paved surface; and,
- The boreholes show that in general, the existing fill is suitable to support the pavement. For this purpose, we recommend that the top 0.3 m of the subgrade be stripped. The exposed soil after stripping should be inspected, evaluated, and approved. If necessary, shallow test pits can be dug to check the soil below. After approval, the approved subgrade should be rolled with a suitably heavy roller in the presence of Geotechnical personnel. The grade can then be brought up to the pavement subgrade level, using on-site excavated selected material, if approved by the Geotechnical personnel. This layer should be compacted to not less than 98% of SPMDD.

It is recommended that Sola be retained to review the final pavement structure designs and drainage plans prior to construction to ensure that they are consistent with the recommendations in this report.

5.11 SERVICE INSTALLATION CONSIDERATIONS (WHERE APPLICABLE)

5.11.1 General

In general, the native materials are suitable for pipeline support. Localized loose subgrade conditions, if encountered during construction, should be sub-excavated to a depth of at least 300 mm or to a firm base, if shallower, and backfilled with clean, compactable materials and stabilized as per the project specifications. If the invert of the pipes falls within the fill soils, the fill should be removed and replaced with engineered fill, unless otherwise directed by the Geotechnical Engineer.

Prior to the placement of bedding, the exposed subgrade at the bottom of each servicing trench excavation should be inspected by the Geotechnical Engineer to identify any soft, loose, or disturbed base conditions. All disturbed soils resulting from construction activities should be removed and replaced as noted above.

Design and construction considerations for both flexible (PVC) and rigid (concrete) pipes are included in the following sections.

5.11.2 Excavations and Health and Safety Considerations

The same recommendations as given in **Section 5.7** will generally apply to the excavations for laying the underground services. The excavated soils should be placed not closer than the depth of the trenches from the trench edge plus 1 m.

5.11.3 Bedding

The improved fill materials and native subgrade in an undisturbed state will provide adequate support for the proposed service pipes and will allow the use of normal Class B type bedding. The bedding should conform to the current Ontario Provincial Standard Specifications (OPSS 1010) and/or the City of Barrie standards for bedding stone gradation requirements. The pipes should be placed with a minimum bedding thickness in conformance with Ontario Provincial Standard Drawing OPSD 802.010 (for flexible pipes) or OPSD 802.031 (for rigid pipes), though the bedding thickness will be subject to variation and ultimately be based on the proposed pipe diameter, bedding specifications used, etc. It is recommended that clear stone should not be used for bedding and as backfill above the obvert of the pipe, as soil fines from the subgrade may infiltrate into the voids of the clear stone, giving rise to settlements of the surface pipes and the trench surface, after the trenches are backfilled. Depending on the conditions observed during trenching, the use of suitable geotextile may be necessary on the surface of the silty subgrade beside the excavations (to a suitable distance above), as directed by the Geotechnical Engineer.

Where the pipe invert falls within weaker soils, the thickness of the bedding may need to be increased at the discretion of the Geotechnical Engineer.

On completion of the servicing pipe installation, a granular surround of the same bedding material should be placed around the pipe to cover it to at least 300 mm above the pipe obvert.

The backfill above the bedding and cover materials may consist of a clean, compactable fill that possesses similar properties to the existing subgrade soil. Based on the borehole data, it is anticipated that the local soil material may be difficult to reuse as trench backfill, depending on site conditions. Some moisture conditioning of the soil will likely be required to facilitate soil compaction. Dilatation of the subgrade and backfill during compaction must be prevented. In the event that imported soil is used as a trench backfill, it must be ensured that the drainage properties of the subgrade are maintained and that any differential frost

movement is minimized by proper tapering. Trench back-fill should be compacted to at least 95% of the material's SPMDD or the City of Barrie standards, whichever is more stringent. The degree of compaction should be increased to at least 98% within 1.0 m of the finished surface of the paved areas.

5.11.4 Trench Backfill

Backfilling During Dry-Weather Conditions

The excavated fill soils, if approved by the Geotechnical personnel at the time of construction, are considered suitable for re-use as fill to backfill service trenches, provided that suitable compaction equipment can be used to compact the fill material.

The use of heavy compactors in the narrow-confined service trenches may not be feasible. In confined areas, consideration may be also given to backfilling the areas with a well-graded, compacted granular soil such as Granular 'B' material. As such material, if thoroughly compacted, would reduce the post-construction settlements to an acceptable level and may also expedite the compaction process. However, proper tapering should be provided to prevent differential frost heave of the paved surface.

Each lift should be no greater than 300 mm thick when first placed and compacted using an appropriate heavy compaction machine to at least 95 % of the material's SPMDD to within 1.0 m of the top of the subgrade, and then to at least 98 % SPMDD up to the required grade.

Exposed, excavated soil stockpiles that are to be reused as fill on-site should be compacted at the surface or temporarily covered during wet weather to help maintain their original moisture content. Such stockpiles are prone to wet weather exposure and, as such, the increased moisture contents will make these materials too wet to achieve the required levels of compaction.

Conversely, if the excavated soils are too dry to achieve the required levels of compaction (which is a likely scenario), some moisture addition/conditioning by means of water hosing or misting should be expected.

We recommend the subgrade be observed and approved by a Geotechnical Engineer prior to the placement of the bedding material to confirm that the subgrade conditions are consistent with the recommendations given in this report. Where unsuitable subgrade conditions are observed, remedial procedures can be established in the field to avoid construction delays.

Backfilling During Winter Months

Should this project proceed during the winter months or when the ambient temperatures are below freezing, the following additional recommendations will apply in order to avoid any detrimental effects of frost.

In this situation, it is imperative that the excavation and backfilling operations follow simultaneously. This procedure is required to avoid time gaps between the two construction stages, as prolonged exposure to frost may lead to the inclusion of frozen material during backfilling. It is recommended that prior to resuming backfilling over the frozen surface, all frost should be removed to achieve a satisfactory bond between the current and previously laid fills. Also, this procedure would prevent leaving frozen layers of soil which could cause long-term settlements while undergoing slow thawing.

It is further recommended that any accumulation of water or ice in the sheepsfoot compactor footprint overnight or on weekends should be prevented by adequately shaping up and back blading the compacted grades prior to leaving the site.

In order to ensure that no frozen material is being backfilled in the trenches, it is recommended that the backfilling and compaction operations should be supervised and closely monitored by Sola on a continuous basis.

For the construction of the driveway and floor slab, the final subgrade should be prepared during 'dry weather' conditions so as to achieve a satisfactory end product.

5.12 CONSTRUCTION CONSIDERATIONS

Load-bearing soils are susceptible to disturbance from environmental factors (temperature, moisture change, etc.) and construction activity. Therefore, due care should be given to minimizing the trafficking of such areas during periods of excavation and the construction of the floor slab and footings to minimize the disturbance of the bearing soils.

Any excessive disturbances of the load-bearing and underlying soils affected during construction works could influence the long-term settlement of the structures and will therefore require further excavation and replacement of such impacted soils with suitable engineered fill.

During winter seasons, foundations and slab-on-grade construction should be carried out to avoid pouring concrete on frozen soil. Foundations must be adequately protected at all times from cold weather and freezing conditions.

A Geotechnical Engineer should evaluate all subgrade surfaces to confirm that the subgrade and founding conditions are consistent with the recommendations given by this report.

6.0 MATERIAL TESTING AND INSPECTION

It is recommended that Sola be appointed to carry out field inspection and materials testing during construction to ensure that the construction complies with the design recommendations.

7.0 DRAWING REVIEW

Once the final design drawings for this project are prepared, it is recommended that one (1) set of the drawings should be submitted to Sola for review and to make any amendments to our recommendations that may be required, prior to starting construction. The adequacy of the existing subgrade condition should be checked by Sola.

Sola should also be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, Sola will assume no responsibility for the interpretation of the recommendations in this report.

The comments given in this report are preliminary and intended only for the guidance of design engineers. Contractors bidding on or undertaking the works should make their own interpretations of the factual borehole results, so that they may draw their own conclusions on how the subsurface conditions may affect them.

The information in this report in no way reflects on the environmental aspects of soil conditions at the site and has not been addressed in this report, since this aspect was beyond the scope and terms of reference.

8.0 CLOSURE

This report is subject to the Statement of Limitations which forms an integral part of this document. The Statement of Limitations is not intended to reduce the level of responsibility accepted by Sola, but rather to ensure that all parties who have been given reliance for this report are aware of the responsibilities each assumes in so doing.

We trust that this report meets your needs. Should you have any queries, please contact the Sola office.

Sincerely,
SOLA ENGINEERING INC.

George Hao P. Eng.

Bill Feng P.Eng.
Chief Engineer

Y:\PROJECTS\10855A-(3264)-2709557 Ontario Inc. co Evans Planning-GEO-Engineering Services for Proposed Mixed Use Building-535 Bayfield Street-Barrie-Jan\GEO\08 Draft Reports\2023-17792-10855A-S0619-GEO-Final.docx

Enclosures

STATEMENT OF LIMITATIONS

Standard of Care and Basis of this Report
Sola Engineering Inc. ("Sola Engineering") has prepared this report in a manner consistent with generally accepted engineering and/or environmental practices in the jurisdiction in which the specified services were provided. The information and conclusions set out in this report reflects Sola Engineering's best professional judgment in light of the information available to Sola Engineering at the time of preparation. Sola Engineering disclaims any and all warranties, express or implied, including without limitation any warranty of merchantability and/or fitness for a particular purpose, and makes no representations concerning the legal effect, interpretation or significance of this report or the information, conclusions or recommendations contained in it.

The conclusions and recommendations provided in this report have been prepared in relation to the specified site (the "Site") and the proposed project (the "Project"), as described by the Client to Sola Engineering. Given the nature of the work undertaken by Sola Engineering as part of this report, the Client acknowledges that ground conditions may vary over distances and may change over time. Should there arise any changes to the conditions of the Site or the Project (as to purpose or design), Sola Engineering is to be notified within a reasonable period of time, and in any event within 24 hours of the Client's learning of such changes, so as to give Sola Engineering an opportunity to review and revise this report in light of such changes. Sola Engineering accepts no liability or responsibility for any use of this report or reliance on this report following any changes to the conditions of the Site or the Project.

The scope of professional services provided by Sola Engineering for the Project are as set out in this report. Should such services be limited to those of a geotechnical nature, Sola Engineering shall not be held liable or responsible for any environmental services that may be required, nor shall this report be interpreted to reflect any environmental aspects of the Project. Alternatively, should such services be limited to those of an environmental nature, Sola Engineering shall not be held liable or responsible for any geotechnical services that may be required, nor shall this report be interpreted to reflect any geotechnical aspects of the Project.

This report is not intended to provide recommendations for possible future conditions or use of the Site or adjoining properties. Should the need arise for such recommendations Sola Engineering may need to conduct further investigations.

Use of this Report
This report is intended to be read and used in its entirety. No reliance may be made upon any individual portion or section of this report without reference to the entire report as a whole. In preparing this report, Sola Engineering has relied on information, instructions and communications given by the Client to Sola Engineering, the applicability, truth and accuracy of which is the sole responsibility of the Client.

This report with the information, sampling data, analysis, conclusions and recommendations contained in it (if any), has been prepared for and may only be used by the Client and only for the specific purpose as specified by the Client to Sola Engineering in connection with the Project. Without prior written consent from Sola Engineering, use of this report or any portion thereof by any person or entity other than the Client, or for any purpose other than as communicated by the Client to Sola Engineering, is strictly prohibited. Sola Engineering accepts no liability or responsibility for the unauthorized use of this report. This report and all documents that form part of it are the sole property of Sola Engineering. Sola Engineering relies on and retains any and all intellectual property rights it has in this report, including any copyright to which it is entitled. The Client shall not give, lend or sell this report, or any portion thereof, to any entity, person or association without the express prior written consent of Sola Engineering. This report and the information contained herein shall be treated as strictly confidential.

The contents of this report, inclusive of Sola Engineering's conclusions and recommendations in relation to the Project, are intended only for the guidance of the Client in carrying out the specified services for the Project, as described by the Client to Sola Engineering. Accordingly, Sola Engineering does not accept any liability or responsibility for any inaccuracy contained in this report arising as a result of or in any way connected with any exclusion, oversight or falsification of the information provided to Sola Engineering by the Client. This report, including the effect of the subsurface conditions as described in this report, is to be interpreted at the risk and discretion of the Client and any contractors or others bidding on or undertaking contractual work to be performed as part of the Project who may come into possession of or learn of this report or its contents. It is exigent that all contractors bidding or undertaking the work are to rely on their own interpretations of the data contained in this report in addition to their own investigations and conclusions. Sola Engineering shall not be held liable or responsible for any interpretation of or conclusions that may be drawn from the data or information contained in this report.

The information, recommendations and conclusions presented in this report are based on Sola Engineering's interpretation of conditions revealed through the limited investigation conducted within a defined scope of services. In no event will Sola Engineering be held responsible or liable to the Client or any other person or entity for any special, indirect, incidental, punitive or consequential loss or damage (including, loss of use, lost profits or expenses incurred) resulting from or in any way related to the independent interpretations, interpolations, conclusions or decisions of the Client or any other person or entity, based on the information contained in this report. The restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

Notwithstanding the exclusions of liability contained herein but without in any way limiting their effect or generality, if there is found to be any finding of liability or responsibility whatsoever on the part of Sola Engineering which in any way relates to or arises from this report, or the information, conclusions or recommendations contained in it, such liability and/or responsibility shall cease and forever be extinguished from and after the date which is two (2) years from the date of this report. In no event shall any liability or responsibility of Sola Engineering exceed the fees charged by Sola Engineering to the Client for the preparation of this report (excluding any arms' length disbursements or expenditures made or incurred by Sola Engineering as a result thereof and reimbursed by the Client).

Site Conditions
The material conditions, classifications, conclusions and recommendations contained in this report were based on the site conditions observed or tested by Sola Engineering or otherwise communicated to Sola Engineering by the Client. The description, identification and classification of soils, rocks, chemical contamination and other materials have been made based on limited investigations, sampling and testing of materials performed by Sola Engineering and its qualified representatives in reliance on the use of relevant or applicable equipment, all in accordance with commonly acceptable standards in the geotechnical and/or environmental disciplines. Accordingly, this report may include assumptions of conditions which are based on discrete sample locations and thus some conditions may not have been detected. The Client accepts all liability and risk for the use of this report and the information and data contained in it. Sola Engineering shall not be held liable or responsible for any conditions beyond the scope of tests conducted on samples of the subsurface and soil conditions of the subject property as set out in this report.

For clarity, the Client acknowledges and accepts that unique risks exist whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive sampling and testing program may fail to detect certain conditions. The environmental, geological, geotechnical, geochemical and hydrogeological conditions that Sola Engineering interprets to exist between sampling points may differ from those that actually exist. As a result, the Client acknowledges and accepts that because of the inherent uncertainties in subsurface evaluations, unanticipated underground conditions may occur or become known subsequent to Sola Engineering's investigation that could affect conclusions, recommendations, total Project cost and/or execution.

Indemnification of Risk
Though Sola Engineering adheres to the highest degree of integrity and employs due diligence in limiting the potential release of toxins and hazardous substances, the risk of accidental release of such substances is a possibility when providing geotechnical and environmental services.

In consideration of the provision of services by Sola Engineering, the Client agrees to defend, indemnify and hold Sola Engineering and its employees and agents harmless from and against any and all claims, liabilities, damages, causes of action, judgments, costs or expenses (including reasonable legal fees and disbursements), resulting from or arising by reason of the death or bodily injury to persons, damage to property, or other loss, whether related to an accidental release of pollutants or hazardous substances occurring as a result of carrying out this Project or otherwise, and whether or not resulting from Sola Engineering's negligent actions or omissions. This indemnification shall include and extend to any and all third party claims brought or threatened against Sola Engineering under any federal or provincial law or statute as a result of Sola Engineering conducting work on the Project. In addition to and notwithstanding the foregoing, the Client further agrees to unconditionally and irrevocably release Sola Engineering from, and not to bring any claims against Sola Engineering in connection with, any of the aforementioned claims or causes.

Subconsultants and Contractor Services
In conjunction with the services provided by Sola Engineering's own employees, external services provided by other persons or entities that are specializing in services other than those offered by Sola Engineering, such as drilling, excavation and laboratory testing, are often employed in order to carry out the defined scope of work. If such external services have been employed for this Project, the Client acknowledges that Sola Engineering is not in any way liable or responsible for any costs, claims or damages in relation to the services rendered by such other persons or entities or payment therefor, nor shall Sola Engineering be liable or responsible for damages for errors, omissions or negligence caused by such other persons or entities while providing such external services.

Work and Job Site Safety
Sola Engineering shall be responsible only for its activities and that of its employees on the Site. Sola Engineering shall not direct any of the fieldwork nor the work of any other person or entity on the Project. The presence of Sola Engineering staff on the Site does not relieve the Client or any contractor on the Site from their responsibilities pertaining to site safety. The Client at all times retains any and all responsibility for the safety of those individuals present on the Site and/or working on the Project, including Sola Engineering's employees.

SOLA ENGINEERING	File No.: 10855A-S0476-GEO	**BH Location Plan**	The figure provided is for the intended purpose of presenting the approximate borehole locations. This figure should not be used for any other purposes including construction, architecture or for accuracy of dimensions and orientation of objects.	Enclosure No.: **1**
	Report Number: 2023-17792	**Propsed Mixed-Use Buildings**		
		535 Bayfield Street, Barrie, Ontario		
	Date: March 27, 2023	**2709557 Ontario Inc.**		Not to Scale

SOLA ENGINEERING

ENCLOSURE No. 2

RECORD OF BOREHOLE No. BH1

1 OF 1

METRIC

PROJECT NUMBER 10855A | LOCATION 535 Bayfield Street, Barrie, Ontario | ORIGINATED BY TS

NAME Proposed Mixed-Use Buildings | CLIENT 2709557 Ontario Inc. | METHOD Soild Stem Augers | COMPILED BY TS

DATUM | DATE 2023.02.14 - 2023.02.14 | NORTHING | EASTING | CHECKED BY SM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	TOPSOIL - 200 mm thick Topsoil		1A	SS	7				○		
0.2	FILL - sand, trace gravel, brown, very moist		1B								
			2A	SS	7				○		
0.9	FILL - clayey silt, some sand, trace gravel, brown, very moist		2B								
			3	SS	16				○		
2.3	SILTY SAND TILL - trace gravel, brownish grey, very dense, moist		4	SS	50/ 13 cm				○		
			5	SS	50/ 13 cm				○		
4.6	SAND - some gravel, occasionally inferred cobbles and boulders, grey, very dense, moist		6	SS	50/ 10 cm				○		
4.8	End of Borehole at Targeted Depth; Borehole was Open and Dry upon Completion of Drilling Period.										

$+^3$, $\times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

SOLA ENGINEERING

ENCLOSURE No. 3

RECORD OF BOREHOLE No. BH2 1 OF 1 METRIC

PROJECT NUMBER 10855A LOCATION 535 Bayfield Street, Barrie, Ontario ORIGINATED BY CC

NAME Proposed Mixed-Use Buildings CLIENT 2709557 Ontario Inc. METHOD Soild Stem Augers COMPILED BY TS

DATUM _____ DATE 2023.02.13 - 2023.02.13 NORTHING _____ EASTING _____ CHECKED BY SM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	Topsoil										
0.1	TOPSOIL - 100 mm thick		1A	SS	12						
	FILL - sand and gravel, grey, moist to very moist		1B								
			2A	SS	37						
1.1	SAND - trace gravel, brown to grey, dense to very dense, moist to very moist		2B								
			3	SS	70						
	- pockets of sandy silt		4	SS	75/ 25 cm						
			5	SS	68						
			6	SS	63						
			7	SS	65						
6.6	End of Borehole at Targeted Depth; Borehole was Open and Dry upon Completion of Drilling Period.										

+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

SOLA ENGINEERING

ENCLOSURE No. 4

RECORD OF BOREHOLE No. BH3 1 OF 1 METRIC

PROJECT NUMBER 10855A LOCATION 535 Bayfield Street, Barrie, Ontario ORIGINATED BY CC

NAME Proposed Mixed-Use Buildings CLIENT 2709557 Ontario Inc. METHOD Soild Stem Augers COMPILED BY TS

DATUM _____ DATE 2023.02.13 - 2023.02.13 NORTHING _____ EASTING _____ CHECKED BY SM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	Topsoil TOPSOIL - 100 mm thick		1A								
0.1	FILL - sandy silt, trace gravel, containing asphalt fragments, brown, moist		1B	SS	12				○		
0.8	FILL - sand, trace gravel, brown, moist		2	SS	59/ 20 cm				○		
			3	SS	10				○		
2.3	SAND - trace gravel, occasionally inferred cobbles and boulders, very dense, moist		4	SS	50/ 13 cm						
3.0	SANDY SILT TILL - trace gravel, trace clay, grey, very dense, moist		5A	SS	50/ 13 cm				○		
3.3	SAND - trace gravel, occasionally inferred cobbles and boulders, brown, very dense, moist		5B						○		
			6	SS	50/ 13 cm				○		
4.9	End of Borehole at Targeted Depth; Borehole was Open and Dry upon Completion of Drilling Period.										

$+^3$, $\times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

SOLA ENGINEERING

ENCLOSURE No. 5

RECORD OF BOREHOLE No. BH4

1 OF 1

METRIC

PROJECT NUMBER 10855A | LOCATION 535 Bayfield Street, Barrie, Ontario | ORIGINATED BY CC

NAME Proposed Mixed-Use Buildings | CLIENT 2709557 Ontario Inc. | METHOD Soild Stem Augers | COMPILED BY TS

DATUM | DATE 2023.02.13 - 2023.02.13 | NORTHING | EASTING | CHECKED BY SM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	Topsoil TOPSOIL - 100 mm thick		1A								
0.1	FILL - sandy silt, trace gravel, containing asphalt fragments, dark brown, moist		1B	SS	10				○		
0.8	FILL - sand, brown, moist		2	SS	7				○		
	- pockets of sandy silt		3	SS	31				○		
2.3	SAND - trace gravel, brown, very dense, moist		4	SS	87/ 28 cm				○		
			5	SS	50/ 13 cm				○		
4.6	SILTY SAND - trace gravel, grey, very dense, very moist		6	SS	50/ 13 cm				○		
4.9	End of Borehole at Targeted Depth; Borehole was Open and Dry upon Completion of Drilling Period.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

SOLA ENGINEERING

ENCLOSURE No. 6

RECORD OF BOREHOLE No. BH5 1 OF 1 METRIC

PROJECT NUMBER 10855A | LOCATION 535 Bayfield Street, Barrie, Ontario | ORIGINATED BY CC

NAME Proposed Mixed-Use Buildings | CLIENT 2709557 Ontario Inc. | METHOD Soild Stem Augers | COMPILED BY TS

DATUM | DATE 2023.02.13 - 2023.02.13 | NORTHING | EASTING | CHECKED BY SM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	Topsoil TOPSOIL - 100 mm thick		1A								
0.1	FILL - silty sand, trace gravel, brown, moist		1B	SS	14				○		
0.8	FILL - sand, trace gravel, brown, moist		2	SS	7				○		
1.5	SAND - trace to some gravel, brown, compact to very dense, moist		3	SS	14				○		
	- occasionally inferred cobbles and boulders		4	SS	70				○		
			5	SS	39				○		
			6	SS	54/ 28 cm				○		
			7	SS	61/ 28 cm				○		
6.5	End of Borehole at Targeted Depth; Borehole Caved at 5.7 m Below Existing Ground Surface and was Dry upon Completion of Drilling Period.										

$+^3$, $\times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

SOLA ENGINEERING

ENCLOSURE No. 7

RECORD OF BOREHOLE No. BH6 1 OF 1 METRIC

PROJECT NUMBER 10855A LOCATION 535 Bayfield Street, Barrie, Ontario ORIGINATED BY TS

NAME Proposed Mixed-Use Buildings CLIENT 2709557 Ontario Inc. METHOD Soild Stem Augers COMPILED BY TS

DATUM _____ DATE 2023.02.14 - 2023.02.14 NORTHING _____ EASTING _____ CHECKED BY SM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	Asphaltic Concrete										
0.0	ASPHALTIC CONCRETE - 40 mm thick			AS							
	GRANULAR BASE/SUBBASE (sand and gravel) - 340 mm thick		1A / 1B	SS	16				○		
0.4	FILL - sand, trace gravel, brown, moist		2	SS	9				○		
1.5	SILTY SAND - brown, dense, very moist		3	SS	30				○		
2.3	SILTY SAND TILL - trace gravel, occasionally inferred cobbles and boulders, brown, dense to very dense, moist		4	SS	48				○		
			5	SS	50/ 13 cm				○		
			6	SS	50/ 13 cm				○		
4.9	End of Borehole at Targeted Depth; Borehole was Open and Dry upon Completion of Drilling Period.										

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

SOLA ENGINEERING

ENCLOSURE No. 8

RECORD OF BOREHOLE No. BH7

1 OF 1

METRIC

PROJECT NUMBER 10855A | LOCATION 535 Bayfield Street, Barrie, Ontario | ORIGINATED BY TS

NAME Proposed Mixed-Use Buildings | CLIENT 2709557 Ontario Inc. | METHOD Soild Stem Augers | COMPILED BY TS

DATUM | DATE 2023.02.14 - 2023.02.14 | NORTHING | EASTING | CHECKED BY SM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	Asphaltic Concrete ASPHALTIC CONCRETE - 40 mm thick			AS							
0.3	GRANULAR BASE/SUBBASE (sand and gravel) - 265 mm thick		1A 1B	SS	11				○		
0.8	FILL - sand, trace gravel, brown, moist		2	SS	23				○		
	SILTY SAND - trace gravel, trace clay, occasionally inferred cobbles and boulders, brownish grey, compact to dense, moist		3	SS	37				○		
2.3	SILTY SAND TILL - trace gravel, greyish brown, very dense, moist to very moist		4	SS	97/ 28 cm				○		
			5	SS	50/ 13 cm				○		
	- trace clay		6	SS	59				○		
5.0	End of Borehole at Targeted Depth; Borehole was Open and Dry upon Completion of Drilling Period.										

$+^3$, $\times^3$: Numbers refer to Sensitivity $\circ^{3\%}$ STRAIN AT FAILURE

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ENCLOSURE No. 9

RECORD OF BOREHOLE No. BH8

1 OF 1

METRIC

PROJECT NUMBER 10855A | LOCATION 535 Bayfield Street, Barrie, Ontario | ORIGINATED BY TS

NAME Proposed Mixed-Use Buildings | CLIENT 2709557 Ontario Inc. | METHOD Soild Stem Augers | COMPILED BY TS

DATUM | DATE 2023.02.14 - 2023.02.14 | NORTHING | EASTING | CHECKED BY SM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
Asphaltic Concrete											
0.0	ASPHALTIC CONCRETE - 40 mm thick			AS							
0.3	GRANULAR BASE/SUBBASE (sand and gravel) - 265 mm thick		1A	SS	32				○		
	FILL - sand, some gravel, dark brown, moist		1B						○		
			2	SS	13				○		
1.5	SILTY SAND - trace gravel, brown, compact, moist		3	SS	15				○		
2.3	SILTY SAND TILL - trace gravel, brown, very dense, moist		4	SS	58				○		
			5	SS	50/ 10 cm				○		
			6	SS	50/ 13 cm				○		
6.1	SANDY SILT TILL - trace gravel, trace clay, grey, very dense, moist		7	SS	50/ 13 cm				○		
6.4	End of Borehole at Targeted Depth; Borehole was Open and Dry upon Completion of Drilling Period.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

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ENCLOSURE No. 10

RECORD OF BOREHOLE No. BH9 1 OF 1 METRIC

PROJECT NUMBER 10855A LOCATION 535 Bayfield Street, Barrie, Ontario ORIGINATED BY TS

NAME Proposed Mixed-Use Buildings CLIENT 2709557 Ontario Inc. METHOD Soild Stem Augers COMPILED BY TS

DATUM _____ DATE 2023.02.14 - 2023.02.14 NORTHING _____ EASTING _____ CHECKED BY SM

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Asphaltic Concrete										
0.0 / 0.1	ASPHALTIC CONCRETE - 50 mm thick			AS							
0.4	GRANULAR BASE/SUBBASE (sand and gravel) - 330 mm thick		1A	SS	14				○		
	FILL - silty sand, trace gravel, brown, moist		1B						○		
			2A	SS	14				○		
1.1	SAND - trace gravel, brown, compact, moist		2B						○		
1.5	SILTY SAND - trace gravel, trace clay, brown, compact to dense, very moist		3	SS	20				○		
			4	SS	41				○		
3.0	SILTY SAND TILL - trace gravel, greyish brown, very dense, moist		5	SS	96/ 25 cm				○		
			6	SS	50/ 15 cm				○		
			7	SS	77				○		
6.6	End of Borehole at Targeted Depth; Borehole was Open and Dry upon Completion of Drilling Period.										

$+^3$, $\times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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KEY TO SYMBOLS

Enclosure No.: 11

PROJECT NUMBER 10855A

PROJECT NAME Proposed Mixed-Use Buildings

LOCATION 535 Bayfield Street, Barrie, Ontario

CLIENT 2709557 Ontario Inc.

LITHOLOGIC SYMBOLS (Unified Soil Classification System)


ASPHALT: Asphalt


FILL: TTC Fill (made ground)


GRVYSAND: Gravelly Sand


SL-SN: silty sand


SL-SN-TL: silty sand till


SN: sand


SN-SL-TL: sandy silt till


TOPSOIL: Topsoil/peat/organics

SAMPLER SYMBOLS


Auger Sample


Split Spoon Sample

WELL CONSTRUCTION SYMBOLS


Bentonite Seal: 1 pipe group, 1 pipe


Concrete: 1 pipe group, 1 pipe


Filter Pack: 1 pipe group, 1 pipe


Slotted Pipe: 1 pipe group, 1 pipe


Slough at bottom of hole

Notes:

Terms describing RELATIVE DENSITY, based on Standard Penetration Test "N"-Value for COURSE GRAINED soils (major portion retained on No. 200 seive):

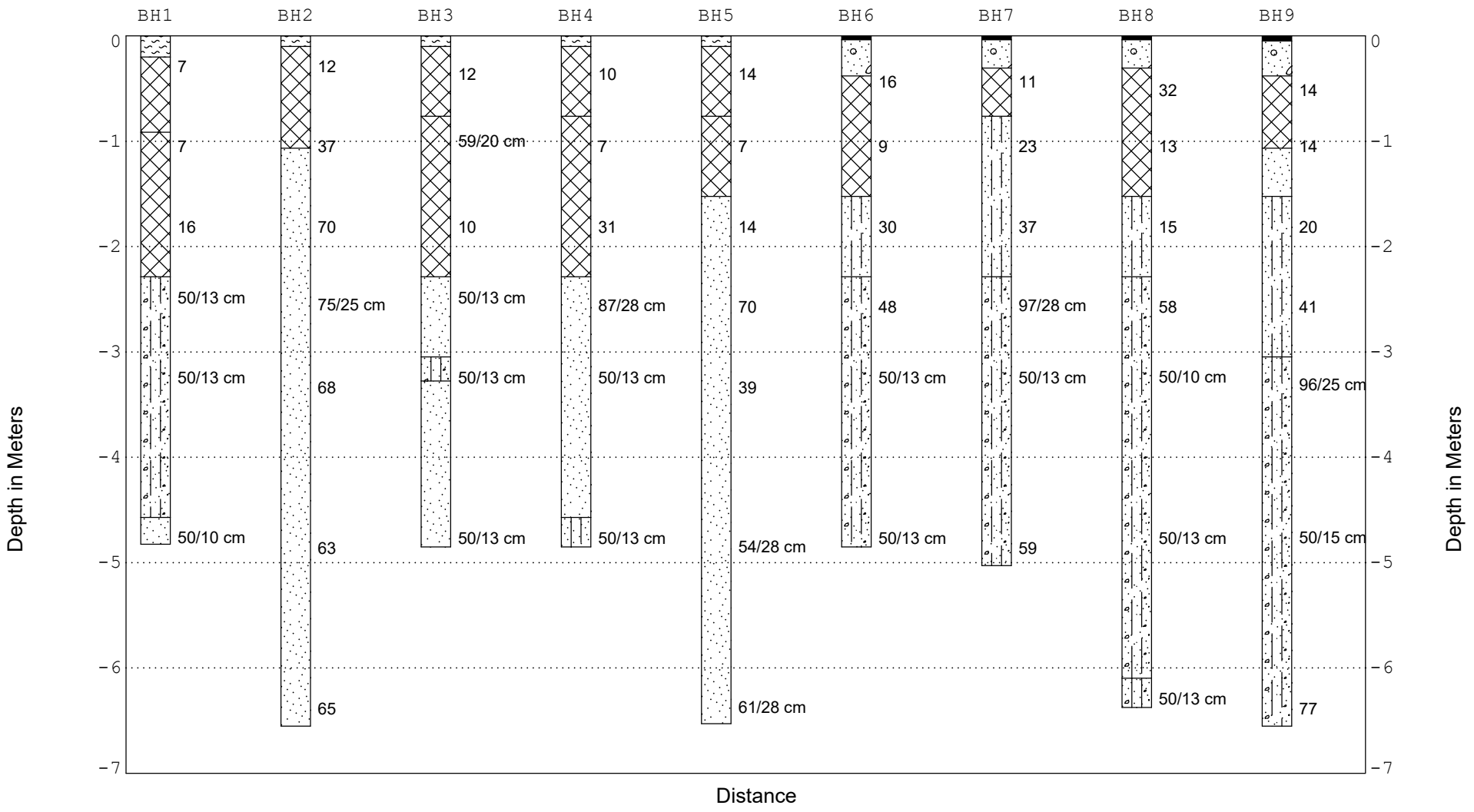
DESCRIPTIVE TERM ["N"-Value (blows/0.3m), Relative Density (%)]

- **Very Loose [less than 4, less than 15]**
- **Loose [4 to 10, 15 to 35]**
- **Compact or Medium [10 to 30, 35 to 65]**
- **Dense [30 to 50, 65 to 85]**
- **Very Dense [greater than 50, greater than 85]**

Terms describing CONSISTENCY, based on Standard Penetration Test "N"-Value for FINE GRAINED soils (major portion passing No. 200 sieve):

DESCRIPTIVE TERM [Unconfined Compressive Strength (kPa), "N"-Value (blows/0.3m)]

- **Very Soft [less than 25, less than 2]**
- **Soft [25 to 50, 2 to 4]**
- **Firm [50 to 100, 4 to 8]**
- **Stiff [100 to 200, 8 to 15]**
- **Very Stiff [200 to 400, 15 to 30]**
- **Hard [greater than 400, greater than 30]**



Plan View

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CONCEPTUAL SOIL PROFILE

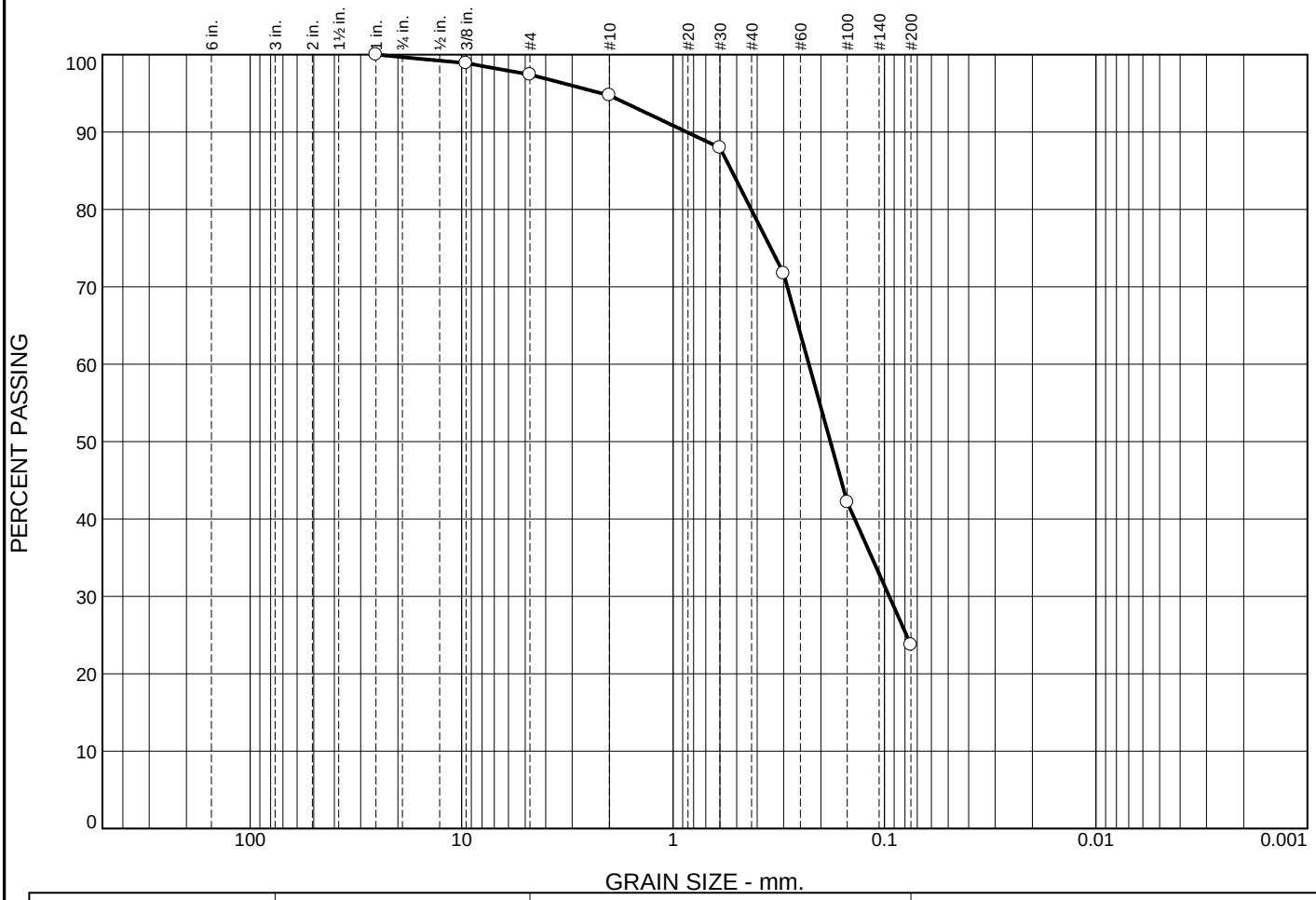
Horizontal Scale:	Drawn By:	
Vertical Scale:	Approved By:	

Proposed Mixed-Use Buildings
535 Bayfield Street, Barrie, Ontario

Project Number: 10855A

Enclosure No.: 12

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines
		Coarse	Fine	Coarse	Medium	Fine	
○	0	0	3	2	15	56	24

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.5286	0.2279	0.1803	0.0949				

Material Description	USCS	AASHTO
○ SILTY SAND TILL (VISUAL/MANUAL) SILTY SAND (LAB)		

Project No. 10855A **Client:** 2709557 Ontario Inc. c/o Evans Planning

Project: Proposed Mixed-Use Buildings

○ **Location:** BH1 SS4 **Depth:** 7'6"-9' **Sample Number:** 23-058

Remarks:

○Sampled By:Tripat
Date: February 14,2023
Note:Additional information is available upon request

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Enclosure 13

Particle Size Distribution Report

	% +3"	% Gravel		% Sand			% Fines
		Coarse	Fine	Coarse	Medium	Fine	
○	0	3	15	5	15	35	27

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			6.6565	0.3877	0.2407	0.0914				

Material Description	USCS	AASHTO
○ SILTY SAND (VISUAL/MANUAL) SILTY SAND WITH GRAVEL (LAB)		

Project No. 10855A **Client:** 2709557 Ontario Inc. c/o Evans Planning

Project: Proposed Mixed-Use Buildings

○ **Location:** BH9 SS4 **Depth:** 7'6"-9' **Sample Number:** 23-058

Remarks:

○Sampled By:Tripat

Date: February 14,2023

Note:Additional information is available upon request

SOLA ENGINEERING INC.

Enclosure 14