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A REPORT TO
1655570 ONTARIO INC.

A GEOTECHNICAL INVESTIGATION FOR RESIDENTIAL DEVELOPMENT

THE TERRAZZO
11283 HIGHWAY 26

TOWN OF COLLINGWOOD

REFERENCE NO. 2112-S027

APRIL 2022
(REVISION OF REPORT DATED MARCH 2022)

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1.0 INTRODUCTION

In accordance with written authorization dated November 22, 2021, from Mr. Fior Paolucci, P.Eng., President of 1655570 Ontario Inc., a geotechnical investigation was carried out at 11283 Highway 26 in the Town of Collingwood.

The purpose of this investigation was to reveal the subsurface conditions and determine the engineering properties of the disclosed soils for the design and construction of the proposed development. The geotechnical findings and resulting recommendations are presented in this Report.

2.0 SITE AND PROJECT DESCRIPTION

The Town of Collingwood is situated in the Simcoe Lowlands bordering the Niagara Escarpment where lacustrine sand, silt and clay deposits, outwash sands and glacial till have bedded onto undulated Black River and Trenton Group of bedrock.

The subject site, encompasses an approximate area of 0.8 hectare, is bounded by Highway 26 to the west, Dawson Drive to the east, an existing residential development to the south and a residential development under development to the north. At the time of investigation, the site is vacant and tree-covered. The existing site gradient is undulating, generally descending towards the west.

Based on the Preliminary Concept Plan provided by Tatham Engineering Limited, the property will be provided with 33 slab-on-grade building units. The development will provide municipal services and access roadways meeting urban standards.

3.0 FIELD WORK

The fieldwork, consisting of five (5) sampled boreholes extending to a depth of 4.0 to 6.6 m, was performed on January 13, 2022, at the locations shown on the Borehole Location Plan, Drawing No. 1.

The boreholes were advanced at intervals to the sampling depths by a track-mounted, continuous-flight power-auger machine equipped for soil sampling. Standard Penetration Tests, using the procedures described on the enclosed “List of Abbreviations and Terms”, were performed at the sampling depths. The test results are recorded as the Standard Penetration Resistance (or ‘N’ values) of the subsoil. The field work was supervised, and the findings were recorded by a Geotechnical Technician. The relative density of the non-cohesive strata and the consistency of the cohesive strata are inferred from the ‘N’ values. Split-spoon samples were recovered for soil classification and laboratory testing.

The ground elevation at each borehole location was provided by Tatham Engineering Limited.

4.0 SUBSURFACE CONDITIONS

The boreholes were carried out in a tree-covered area. The investigation revealed that beneath a topsoil veneer, the site is generally underlain by a deposit of sandy silt till overlying a deposit of sand.

Detailed descriptions of the encountered subsurface conditions from the boreholes are presented on the Borehole Logs, comprising Figures 1 to 5, inclusive. The revealed stratigraphy is plotted on the Subsurface Profile, Drawing No. 2. The engineering properties of the disclosed soils are discussed herein.

4.1 **Topsoil** (All Boreholes)

A layer of topsoil, 15 to 20 cm thick, was encountered at the ground surface. Topsoil thicker than that found in the boreholes may occur in places. It can be reused in landscaped areas of the development and must not be buried below any structures or deeper than 1.2 m below the finished grade.

4.2 **Sandy Silt Till** (All Boreholes)

The stratum of sandy silt till was contacted in all boreholes, either above or interstratified between the sand. It consists of a random mixture of particle sizes ranging from clay to gravel, with sand and silt being the dominant fraction. A grain size analysis was performed on one representative sample of the sandy silt till; the result is illustrated on Figure 6.

The obtained ‘N’ values range from 2 to over 50, with a median of 47 blows per 30 cm of penetration, showing the till is very loose to very dense, being generally dense in relative density. The very loose till is generally restricted to the weathered layer near the ground surface, within a depth of 1.2 m from grade.

The natural water content values of the till samples range from 6% to 16%, with a median of 8%, showing the till is generally in a moist condition.

The engineering properties of the till deposits are presented below:

- Moderately high frost susceptibility.
- The till deposit will be stable in relatively steep cuts; however, localized sheet failure with sand layers or pockets may collapse under prolonged exposure.
- A poor pavement-supportive material, with an estimated California Bearing Ratio (CBR) value of 3% to 5%.
- Moderate corrosivity to buried metal, with an estimated electrical resistivity of 4500 ohm·cm.

4.3 **Sand** (Boreholes 1, 3 and 5)

The sand deposit was contacted beneath the sandy silt till in Boreholes 1, 3 and 5. It is fine to medium-grained and contains some gravel with traces of silt and coarse sand. It contains occasional cobbles and boulders. A grain size analysis was performed on one representative sample of the sand; the result is illustrated in Figure 7.

The obtained ‘N’ values for the sand range between 11 and over 50, with a median of over 50 blows per 30 cm of penetration, indicating the sand is compact to very dense, generally very dense in relative density. The sand within the 1 m from grade is generally weathered.

The natural water contents of the sand samples are plotted on the Borehole logs. The values range from 5% to 15%, with a median of 11%, showing the sand is in damp to wet conditions. The sand is water bearing below a depth of 2 to 4 m from grade.

The engineering properties of the sand deposit are given below:

- Low to moderate frost-susceptibility
- High water erodibility
- In excavation, the sand will slough to its angle of repose, run with water seepage and boil with a piezometric head of about 0.3 m.
- A fair to pavement-supportive material, with an estimated CBR value of 8% to 10%.
- Moderately low corrosivity to buried metal, with an estimated electrical resistivity of 5000 ohm·cm.

4.4 Interpretation of Refusal to Augering

Refusal to augering was encountered in all the boreholes, except for Borehole 5. The refusal depth ranges from 4.0 to 5.5 m below the prevailing ground surface, or El. 174.8 to 176.3 m. It is inferred that either boulder or bedrock occurs at this level. However, the presence of bedrock has not been proven by rock coring, which is beyond the scope of this investigation.

4.5 Compaction Characteristics of the Revealed Soils

The obtainable degree of compaction depends primarily on the soil moisture and, to a lesser extent, on the type of compactor used, and the effort applied. As a general guide, the typical water content values of the revealed soils for Standard Proctor compaction are presented in Table 1:

Table 1 - Estimated Water Content for Compaction

Soil Type	Determined Natural Water Content (%)	Water Content (%) for Standard Proctor Compaction	
		100% (optimum)	Range for 95% or +
Sandy Silt Till	6 to 16 (median 8)	12	8 to 15
Sand	5 to 15 (median 11)	11	8 to 13

The values show that the in situ soils are generally suitable for a 95% or + Standard Proctor compaction. A portion of the sand may be too wet and will require aeration, or properly stockpiled to drain of excess moisture.

The lifts for compaction should be limited to 20 cm, or to a suitable thickness as assessed by test strips performed by the equipment which will be used at the time of construction.

The presence of boulders will prevent the transmission of the compactive energy into the underlying material to be compacted. Any boulder over 15 cm in size must be removed from the backfill material.

5.0 GROUNDWATER CONDITION

The boreholes were checked for the presence of groundwater or cave-in upon completion of drilling. The data is summarized in Table 2.

Table 2 - Groundwater/Cave-in Levels upon Completion of Drilling

Borehole No.	Ground Elevation (m)	Borehole Depth (m)	Groundwater/Cave-in* Level upon Completion	
			Depth (m)	Elevation (m)
1	180.4	5.5	4.0/4.3*	176.4/176.1*
2	180.3	4.0	3.7	176.6
3	180.3	5.5	2.4/3.0*	177.9/177.3*
4	180.1	4.0	2.1	178.0
5	180.8	6.6	3/5.3	177.8/175.5*

The recorded groundwater and cave-in levels ranges from 2.1 m and 5.3 m from grade, or between EI. 176.1 to 178.0 m. The water level detected in the sand generally represents the groundwater regime within the property. The groundwater level is subject to seasonal fluctuation.

6.0 DISCUSSION AND RECOMMENDATIONS

The subject property is a wooded area. The boreholes revealed that beneath a layer of topsoil, the site is underlain by strata of sandy silt till, very loose to very dense, generally dense in relative density, overlying, in placed a deposit of sand, compact to very dense, generally very dense in relative density. The weathered surficial zone extends to approximately 0.8 m below grade.

Upon completion of the fieldwork, groundwater was recorded in the boreholes at depths of 2.1 m and 5.3 m, or between EI. 176.1 to 178.0 m, representing the groundwater regime within the property. The groundwater level is subject to seasonal fluctuation.

Based on the Preliminary Concept Plan provided by Tatham Engineering, the property will be developed into 33 slab-on-grade building units. The development will be provided with municipal services and paved roadways meeting urban standards.

The geotechnical findings which warrant special consideration are presented below:

1. The vegetation and topsoil must be removed for site development. The topsoil can only be reused for landscaping in designated areas only. Any surplus should be removed off-site.

2. The site can be re-graded with an engineered fill for development. Disturbed soils and weathered soils must be sub-excavated, sorted free of topsoil and organics before reuse for engineered fill or structural backfill.
3. The weathered soils are not suitable for supporting any structure sensitive to movement. They should be subexcavated, sorted free of organics and deleterious material, and further assessed to determine its suitability for reuse.
4. The building structures can be constructed on conventional footings founded on the undisturbed native soil stratum or on engineered fill.
5. Class 'B' bedding, consisting of compacted 19-mm Crusher-Run Limestone (CRL), or equivalent, is recommended for the construction of the underground utilities. Where wet subgrade is encountered or where dewatering is required, Class 'A' concrete bedding should be used instead. The service pipes must consist of leak-proof joints, or the joints must be wrapped with a waterproof membrane.

The recommendations appropriate for the project described in Section 2.0 are presented herein. One must be aware that the subsurface conditions may vary between boreholes. Should this become apparent during construction, a geotechnical engineer must be consulted to determine whether the following recommendations require revision.

6.1 Site Preparation

Prior to site grading, the vegetation and topsoil must be removed. The topsoil can be stockpiled on-site for reuse in landscaped areas.

The engineering requirements for a certifiable fill for building foundations, slab-on-grade, municipal services and pavement construction are presented below:

1. All the existing topsoil must be removed, and the subgrade must be inspected and proof-rolled prior to any fill placement. The badly weathered soils should be subexcavated, sorted free of topsoil inclusions and deleterious materials, if any, aerated and compacted adequately in layers.
2. Inorganic soils must be used, and they must be uniformly compacted in 20 cm thick lifts to 98% or + of their maximum Standard Proctor dry density (SPDD) up to the proposed finished grade. The soil moisture must be properly controlled near the optimum. If the foundations are to be built soon after the fill placement, the densification process for the engineered fill must be increased to 100% of the maximum Standard Proctor compaction.

3. If the engineered fill is compacted with the moisture content on the wet side of the optimum, the underground services and pavement construction should not begin until the pore pressure within the fill mantle has completely dissipated. This must be further assessed at the time of the engineered fill construction.
4. If imported fill is to be used, it should be inorganic soils, free of deleterious or any material with environmental issue (contamination). Any potential imported earth fill from off site must be reviewed for geotechnical and environmental quality by the appropriate personnel as authorized by the developer or agency, before it is hauled to the site.
5. The engineered fill must not be placed during the period where freezing ambient temperatures occur either persistently or intermittently. This is to ensure that the fill is free of frozen soils, ice and snow. If the engineered fill is to be left over the winter months, adequate earth cover, or equivalent, must be provided for protection against frost action.
6. The fill operation must be fully supervised and monitored by a technician under the direction of a geotechnical engineer.
7. The engineered fill envelope and finished elevations must be clearly and accurately defined in the field, and they must be precisely documented.
8. Any excavation carried out in certified engineered fill must be reported to the geotechnical consultant who supervised the fill placement in order to document the locations of the excavation and/or to supervise reinstatement of the excavated areas to engineered fill status. If construction on the engineered fill does not commence within a period of 2 years from the date of certification, the condition of the engineered fill must be assessed for re-certification.
9. Foundations founded on engineered fill must be reinforced in the footings and in the upper section of the foundation walls. It should be designed by a structural engineer to allow distribution of stress induced by the abrupt differential settlement (about 15 mm) in engineered fill.
10. The footing and underground services subgrade must be inspected by the geotechnical consulting firm that supervised the engineered fill placement. This is to ensure that the foundations and service pipes are placed within the engineered fill envelope, and the integrity of the fill has not been compromised by interim construction, environmental degradation and/or disturbance by the footing excavation.

6.2 Foundations

The development will consist of 33 slab-on-grade building units. These structures can be supported on conventional footings, founded on engineered fill or sound native soil. The recommended soil bearing pressures for the design of footings are provided below:

- Maximum Soil Bearing Pressure at Serviceability Limit State (SLS) = 150 kPa
- Factored Bearing Pressure at Ultimate Limit State (ULS) = 250 kPa

The total and differential settlements of the conventional spread and strip footings, designed for the bearing pressure at SLS, are estimated to be 25 mm and 20 mm, respectively.

The footing subgrade must be inspected by a geotechnical engineer, or a geotechnical technician under the supervision of a geotechnical engineer, to assess its suitability for bearing the designed foundations.

Footings exposed to weathering or in unheated areas, should have at least 1.4 m of earth cover for protection against frost action or must be adequately insulated.

Where water seepage is encountered during footing excavations, or where the subgrade of the foundations is found to be wet, the subgrade should be protected by a concrete mud-slab immediately after exposure. This will prevent construction disturbance and costly rectification.

The foundations should meet the requirements specified in the latest Ontario Building Code, and the structure should be designed to resist an earthquake force using Site Classification ‘D’ (stiff soil).

6.3 Slab-On-Grade Construction

The slab-on-grade for the buildings must be placed on sound native soils or properly compacted engineered fill. The final subgrade should be inspected and assessed by proof-rolling in the presence of a geotechnical technician. Where a soft spot is identified, it should be subexcavated and replaced with inorganic material, uniformly compacted to 98% Standard Proctor Dry Density (SPDD).

The slab-on-grade should be constructed on a granular base, 20 cm thick, consisting of 19-mm Crusher-Run Limestone (CRL) compacted to 100% SPDD.

A Modulus of Subgrade Reaction of 25 MPa/m can be used for the design of the floor slab.

6.4 Underground Services

The subgrade for underground services should consist of sound native soils or engineered fill. Where badly weathered or soft/loose soil is encountered, it should be subexcavated and replaced with the bedding material, compacted to at least 98% SPDD.

A Class ‘B’ bedding, consisting of compacted 19-mm CRL, or equivalent, is recommended for the construction of the underground services. Where wet or erodible sand is contacted or where dewatering is required, a Class ‘A’ bedding should be considered.

The pipe joints into manholes and catch basins should be leak-proof or wrapped with an appropriate waterproof membrane.

Openings to subdrains and catch basins should be shielded with a fabric filter to prevent blockage by silting.

In order to prevent pipe floatation when the sewer trench is deluged with water, a soil cover of at least two times the diameter of the pipe should be in place at all times after completion of the pipe installation.

All ductile iron pipes and metal fittings for the underground services should be protected against soil corrosion. To estimate anode weight requirements, the electrical resistivities of the disclosed soils can be used. The proposed anode weight must meet the minimum requirements according to the Town of Collingwood and County of Simcoe Standard.

6.5 Backfilling in Trenches and Excavated Areas

The on-site materials are suitable for trench backfill. The soils used for backfilling and/or construction of engineered fill must be sorted free of oversized cobbles or boulders (over 15 cm in size). The wet soil must be aerated prior to backfill.

The backfill in service trenches should be compacted in 20 cm layers, or the lift thickness should be determined by test strips, to at least 95% SPDD. Below slab-on-grade and in the zone within 1.0 m below the road subgrade, the material should be compacted with the water content at 2% to 3% drier than the optimum, and the compaction should be increased to at least 98% SPDD. This is to provide the required stiffness for floor and pavement construction.

In normal construction practice, the problem areas of settlement largely occur adjacent to manholes, catch basins, service crossings, foundation walls and columns. In areas which are inaccessible to a heavy compactor, granular backfill should be used for compaction with a smaller vibratory compactor.

One must be aware of the possible consequences during trench backfilling and exercise caution as described below:

- When construction is carried out in freezing winter weather, allowance should be made for these following conditions. Despite stringent backfill monitoring, frozen soil layers may inadvertently be mixed with the structural trench backfill. Should the in-situ soils have a water content on the dry side of the optimum, it would be impossible to wet the soils due to the freezing condition, rendering difficulties in obtaining uniform and proper compaction. Furthermore, the freezing condition will prevent flooding of the backfill when it is required, such as in a narrow vertical trench section, or when the trench box is removed. The above will invariably cause backfill settlement that may become evident within 1 to several years, depending on the depth of the trench which has been backfilled.
- In areas where the underground services construction is carried out during the winter months, prolonged exposure of the trench walls will result in frost heave within the soil mantle of the walls. This may result in some settlement as the frost recedes, and repair costs will be incurred prior to final surfacing of the new pavement and the slab-on-grade.
- To backfill a trench, one must be aware that future settlement is to be expected, unless the side of the cut is flattened to at least 1V:1.5+H, and the lifts of the fill and its moisture content are stringently controlled; i.e., lifts should be no more than 20 cm (or less if the backfilling conditions dictate) and uniformly compacted to achieve at least 95% SPDD, with the moisture content on the wet side of the optimum.
- It is often difficult to achieve uniform compaction of the backfill in the lower vertical section of a trench which is an open cut or is stabilized by a trench box, particularly in the sector close to the trench walls or the sides of the box. These sectors must be backfilled with sand. In a trench stabilized by a trench box, the void left after the removal of the box will be filled by the backfill. It is necessary to backfill this sector with sand, and the compacted backfill must be flooded for 1 day, prior to the placement of the backfill above this sector, i.e., in the upper sloped trench section. This measure

is necessary in order to prevent consolidation of inadvertent voids and loose backfill which will compromise the compaction of the backfill in the upper section.

- In areas where groundwater movement is expected, anti-seepage collars should be provided, at every 100 m interval.

6.6 Sidewalks, Garages and Driveways

The on-site soils are mostly frost susceptible, and the ground will be subject to frost heaving during cold weather. The sidewalk in open areas, thus, should be designed to tolerate the ground movement.

In areas where ground movement cannot be tolerated, the pavement or sidewalk can be constructed on a free-draining granular base of 0.3 to 1.2 m thick, depending on the degree of tolerance for settlement. These measures, with proper drainage at the bottom, will minimize the movement by preventing the accumulation of water in the granular base.

The driveway at the entrance to the garage should be backfilled with non-frost-susceptible granular material, with a frost taper at a slope flatter than 1 vertical:3 horizontal. In areas where frost susceptible material is present beneath the garage floor slab, the subgrade should be insulated with 50-mm Styrofoam or its thermal equivalent.

6.7 Pavement Design

The recommended pavement design for local residential roads is presented in Table 3.

Table 3 - Pavement Design

Course	Thickness (mm)	OPS Specifications
Asphalt Surface	40	HL3
Asphalt Binder	50	HL8
Granular Base	150	Granular ‘A’
Granular Sub-base	300	Granular ‘B’

After fine grading, the pavement subgrade should be inspected and proof-rolled. Any soft spots as identified should be subexcavated and replaced with selected on-site material, free of organics, compacted to 98% SPDD, with the water content at 2% to 3% drier than the optimum.

All the granular bases should be compacted to 100% SPDD.

The subgrade will suffer a strength regression if water is allowed to saturate the mantle.

The following measures should, therefore, be incorporated in the construction procedures and road design:

- If the pavement construction does not immediately follow the trench backfilling, the subgrade should be properly crowned and smooth-rolled to allow interim precipitation to be properly drained.
- Lot areas adjacent to the roads should be properly graded to prevent ponding of large amounts of water. Otherwise, the water will seep into the subgrade mantle and induce a regression of the subgrade strength with costly consequences for the pavement construction.
- Fabric filter-encased curb subdrains should be provided on both sides of roadways, as required by the Town.
- If the pavement is to be constructed during wet seasons and extensively soft subgrade occurs, the granular sub-base should be thickened in order to compensate for the inadequate strength of the subgrade. This can be assessed during construction.

6.8 Soil Parameters

The recommended soil parameters for the project design are given in Table 4.

Table 4 - Soil Parameters

Unit Weight and Bulk Factor	**Unit Weight γ (kN/m^3)**		**Estimated Bulk Factor**	
	Bulk	**Submerged**	**Loose**	**Compacted**
Sandy Silt Till	22.5	12.5	1.33	1.05
Sand	21.0	11.0	1.20	1.00

Lateral Earth Pressure Coefficients	**Active K_a**	**At Rest K_0**	**Passive K_p**
Sandy Silt Till	0.32	0.48	3.12
Sand	0.29	0.46	3.36

Estimated Coefficients of Permeability/Percolation Time	**K (cm/sec)**	**T (min/cm)**
Sandy Silt Till	10^{-7}	80

Table 4 - Soil Parameters (Cont'd)

Estimated Coefficients of Permeability/Percolation Time	**K (cm/sec)**	**T (min/cm)**
Sand	10^{-2} to 10^{-3}	4 to 8
Coefficients of Friction		
Between Concrete and Granular Base	0.50	
Between Concrete and Sound Native Soils	0.35	

6.9 Excavation

Excavation should be carried out in accordance with Ontario Regulation 213/91. The types of soils are classified in Table 5.

Table 5 - Classification of Soils for Excavation

Material	Type
Sound Till	2
Weathered Soils and Drained Sand	3
Wet Sand	4

Due to the low permeability of the sandy silt till, the yield of groundwater is expected to be limited in quantity, and can be removed by conventional pumping from sumps. Continuous groundwater is apparent in the sand deposit. Any excavation extending into the saturated sand below El. 177.8 m will require vigorous pumping from closely spaced sump wells or if necessary, the use of well points.

Excavation into the sandy silt till containing boulders may require extra effort and the use of a heavy-duty excavator. Boulders larger than 15 cm in size are not suitable for structural backfill and/or construction of engineered fill.

Prospective contractors must be asked to assess the in situ subsurface conditions for soil cuts by digging test pits to 0.5 m below the anticipated depth of excavation. These test pits should be allowed to remain open for a few hours to assess the trenching conditions.

7.0 LIMITATIONS OF REPORT

This report was prepared by Soil Engineers Ltd. for the account of 1655570 Ontario Inc., and for review by its designated consultants and government agencies. Use of this report is subject to the conditions and limitations of the contractual agreement.

The material in the report reflects the judgement of Thomas Tingson, EIT and Kelvin Hung, P.Eng., in light of the information available to it at the time of preparation. Any use which a Third Party makes of this report, or any reliance on decisions to be made based on it, is the responsibility of such Third Parties. Soil Engineers Ltd. accepts no responsibility for damages, if any, suffered by any Third Party as a result of decisions made or actions based on this report.

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LIST OF ABBREVIATIONS AND DESCRIPTION OF TERMS

The abbreviations and terms commonly employed on the borehole logs and figures, and in the text of the report, are as follows:

SAMPLE TYPES

AS	Auger sample
CS	Chunk sample
DO	Drive open (split spoon)
DS	Denison type sample
FS	Foil sample
RC	Rock core (with size and percentage recovery)
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

PENETRATION RESISTANCE

Dynamic Cone Penetration Resistance:

A continuous profile showing the number of blows for each foot of penetration of a 2-inch diameter, 90° point cone driven by a 140-pound hammer falling 30 inches.

Plotted as '—•—'

Standard Penetration Resistance or 'N' Value:

The number of blows of a 140-pound hammer falling 30 inches required to advance a 2-inch O.D. drive open sampler one foot into undisturbed soil.

Plotted as '○'

WH	Sampler advanced by static weight
PH	Sampler advanced by hydraulic pressure
PM	Sampler advanced by manual pressure
NP	No penetration

SOIL DESCRIPTION

Cohesionless Soils:

'N' (blows/ft)	Relative Density
0 to 4	very loose
4 to 10	loose
10 to 30	compact
30 to 50	dense
over 50	very dense

Cohesive Soils:

Undrained Shear Strength (ksf)	'N' (blows/ft)	Consistency
less than 0.25	0 to 2	very soft
0.25 to 0.50	2 to 4	soft
0.50 to 1.0	4 to 8	firm
1.0 to 2.0	8 to 16	stiff
2.0 to 4.0	16 to 32	very stiff
over 4.0	over 32	hard

Method of Determination of Undrained Shear Strength of Cohesive Soils:

x 0.0	Field vane test in borehole; the number denotes the sensitivity to remoulding
△	Laboratory vane test
□	Compression test in laboratory

For a saturated cohesive soil, the undrained shear strength is taken as one half of the undrained compressive strength

METRIC CONVERSION FACTORS

1 ft = 0.3048 metres

1 inch = 25.4 mm

1lb = 0.454 kg

1ksf = 47.88 kPa

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JOB NO.: 2112-S027

LOG OF BOREHOLE NO.: 1

FIGURE NO.: 1

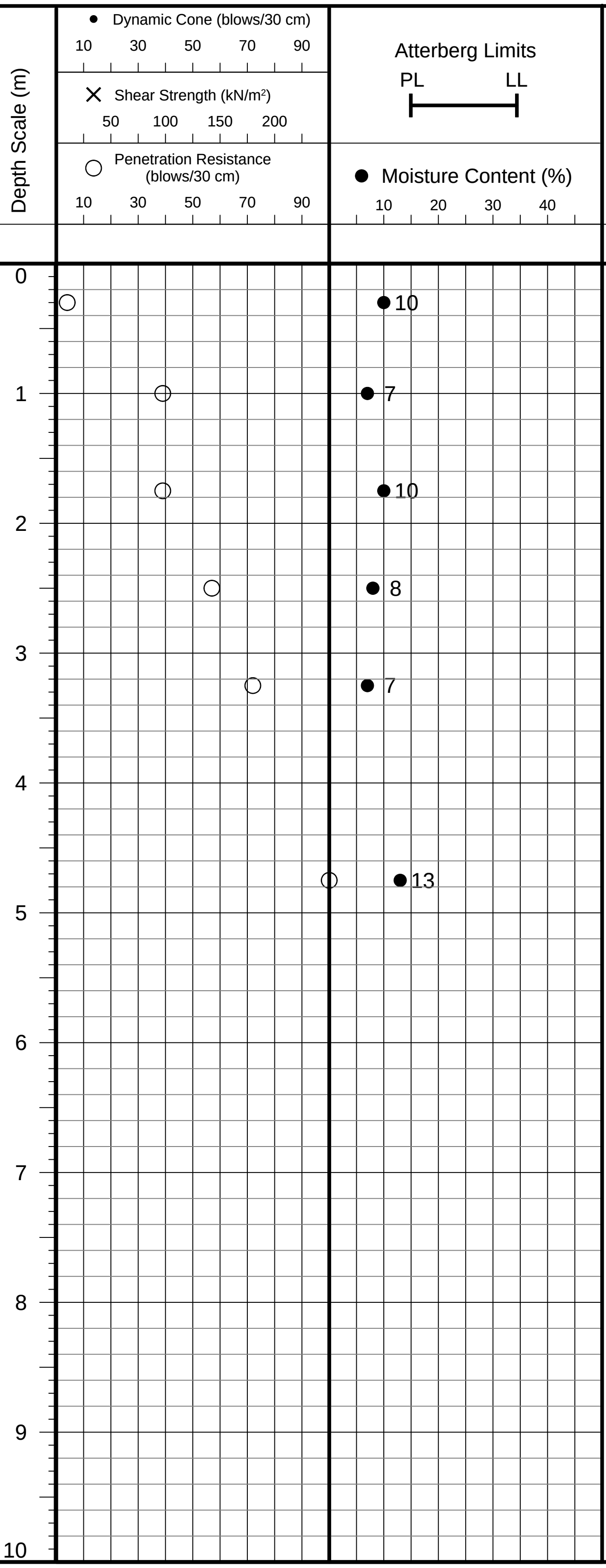
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger (Solid Stem)

PROJECT LOCATION: 11283 Highway 26, Town of Collingwood

DRILLING DATE: January 13, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES		
		Number	Type	N-Value
180.4 0.0	Ground Surface **15 cm Topsoil**			
	Brown, loose to very dense weathered **SANDY SILT TILL** some clay and gravel occ. clay layers, cobbles and boulders	1	DO	4
		2	DO	39
		3	DO	39
		4	DO	57
177.5 2.9	Grey, very dense **SAND** fine to medium grained some gravel traces of silt and coarse sand occ. cobbles & boulders wet below 4.0 m	5	DO	72
		6	DO	72/28
174.9 5.5	**END OF BOREHOLE** **Refusal to augering due to probable boulder or bedrock**			



WATER LEVEL

W.L. @ El. 176.4 m upon completion

Cave-in @ El. 176.1 m upon completion

Soil Engineers Ltd.

JOB NO.: 2112-S027

LOG OF BOREHOLE NO.: 2

FIGURE NO.: 2

PROJECT DESCRIPTION: Proposed Residential Development

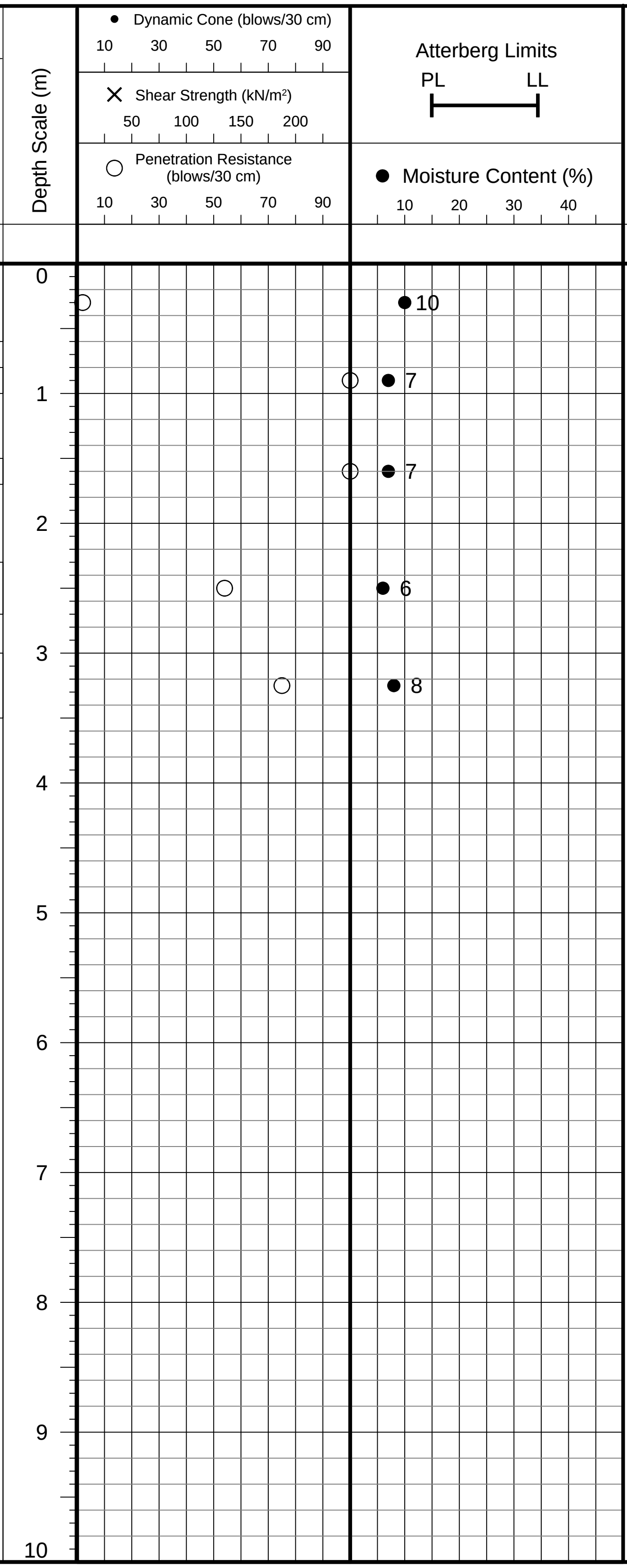
METHOD OF BORING: Flight Auger (Solid Stem)

PROJECT LOCATION: 11283 Highway 26, Town of Collingwood

DRILLING DATE: January 13, 2022

El. (m) Depth (m)	SOIL DESCRIPTION
180.3 0.0	Ground Surface **15 cm Topsoil**
	Loose to very dense **SANDY SILT TILL** some clay and gravel occ. cobbles & boulders weathered brown grey
176.3 4.0	**END OF BOREHOLE** **Refusal to augering due to probable boulder or bedrock**

SAMPLES		
Number	Type	N-Value
1	DO	2
2	DO	50/15
3	DO	50/15
4	DO	54
5	DO	75



WATER LEVEL

W.L. @ El. 176.6 m upon completion ▽

Soil Engineers Ltd.

JOB NO.: 2112-S027

LOG OF BOREHOLE NO.: 3

FIGURE NO.: 3

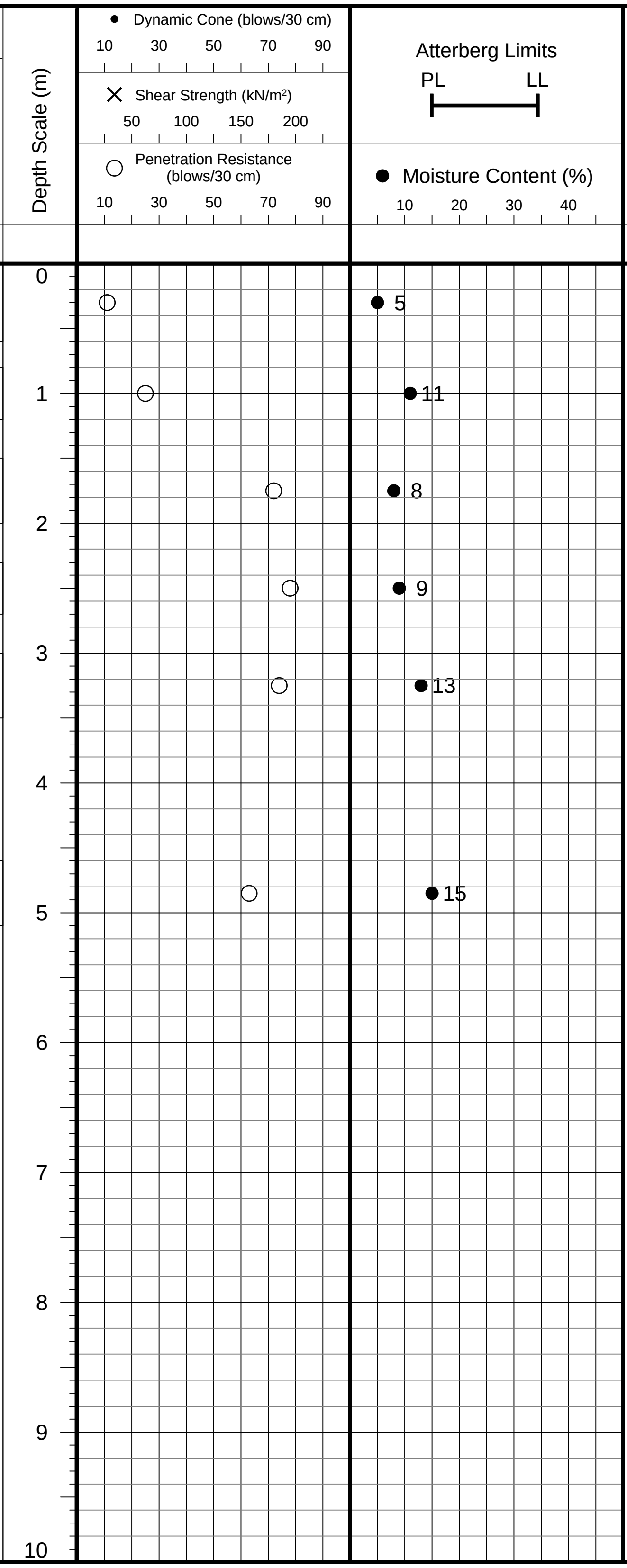
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger
(Solid Stem)

PROJECT LOCATION: 11283 Highway 26, Town of Collingwood

DRILLING DATE: January 13, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
180.3	Ground Surface			
0.0	**18 cm Topsoil**			
	Brown, compact weathered **SAND** fine to medium grained occ. rootlets	1 2	DO DO	11 25
178.8 1.5	Brown, very dense **SANDY SILT TILL** some clay and gravel occ. cobbles and boulders	3	DO	72
178.2 2.1	Very dense brown grey **SAND** fine to medium grained some gravel traces of silt and coarse sand occ. cobbles & boulders	4 5 6	DO DO DO	78 74 63
174.8 5.5	**END OF BOREHOLE** **Refusal to augering due to probable boulder or bedrock**			



WATER LEVEL

W.L. @ El. 177.9 m upon completion ▽

Cave-in @ El. 177.3 m upon completion

Soil Engineers Ltd.

JOB NO.: 2112-S027

LOG OF BOREHOLE NO.: 4

FIGURE NO.: 4

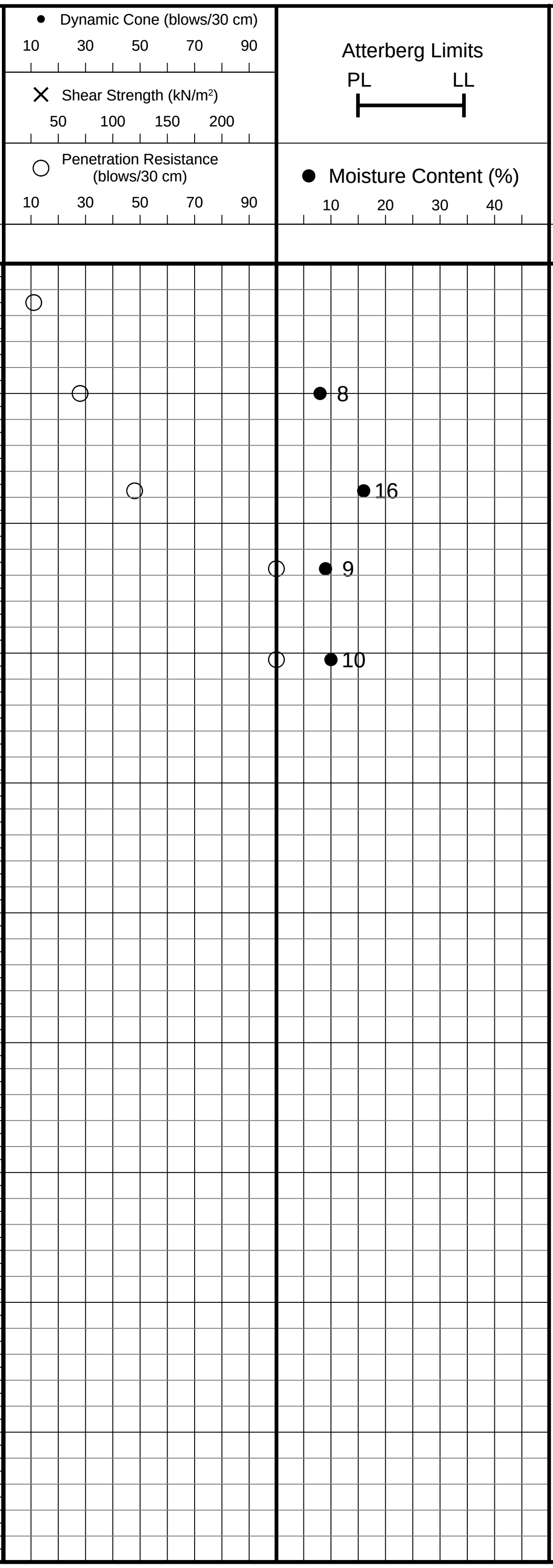
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger
(Solid Stem)

PROJECT LOCATION: 11283 Highway 26, Town of Collingwood

DRILLING DATE: January 13, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	Depth Scale (m)
180.1 0.0	Ground Surface **15 cm Topsoil**				0
	Grey, compact to very dense	1	DO	11	
	weathered **SANDY SILT TILL** some clay and gravel occ. cobbles & boulders	2	DO	28	1
		3	DO	48	2
		4	DO	50/10	
	brown grey	5	DO	50/10	3
176.1 4.0	**END OF BOREHOLE** **Refusal to augering due to probable boulder or bedrock**				4



WATER LEVEL

W.L. @ El. 178.0 m upon completion ▽

Soil Engineers Ltd.

JOB NO.: 2112-S027

LOG OF BOREHOLE NO.: 5

FIGURE NO.: 5

PROJECT DESCRIPTION: Proposed Residential Development

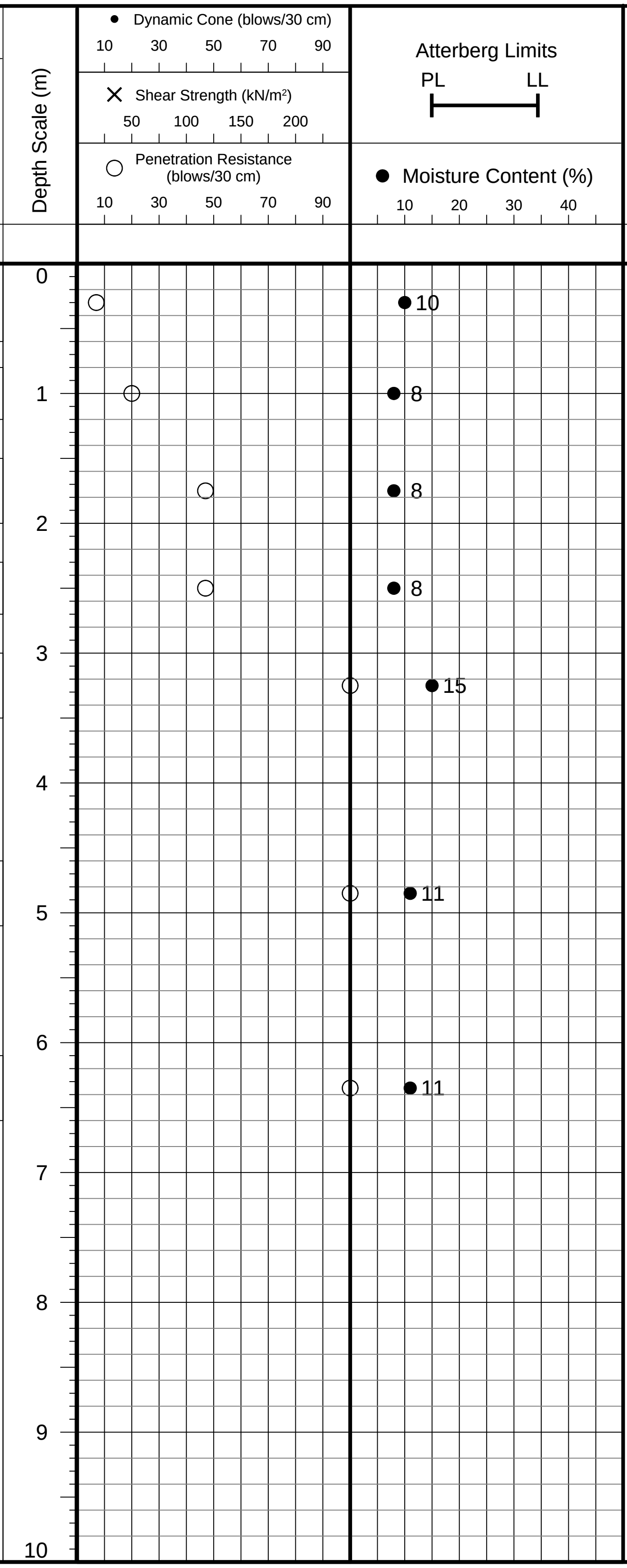
METHOD OF BORING: Flight Auger
(Solid Stem)

PROJECT LOCATION: 11283 Highway 26, Town of Collingwood

DRILLING DATE: January 13, 2022

El. (m) Depth (m)	SOIL DESCRIPTION
180.8	Ground Surface
0.0	**20 cm Topsoil**
	Brown, loose to dense **SANDY SILT TILL** some clay and gravel occ. cobbles & boulders weathered
178.7 2.1	Very dense, wet **SAND** fine to medium grained some gravel traces of silt and coarse sand occ. cobbles & boulders brown grey
174.2 6.6	**END OF BOREHOLE**

SAMPLES		
Number	Type	N-Value
1	DO	7
2	DO	20
3	DO	47
4	DO	47
5	DO	50/15
6	DO	80/23
7	DO	50/10



WATER LEVEL

▽ W.L. @ El. 177.8 m upon completion

Cave-in @ El. 175.5 m upon completion

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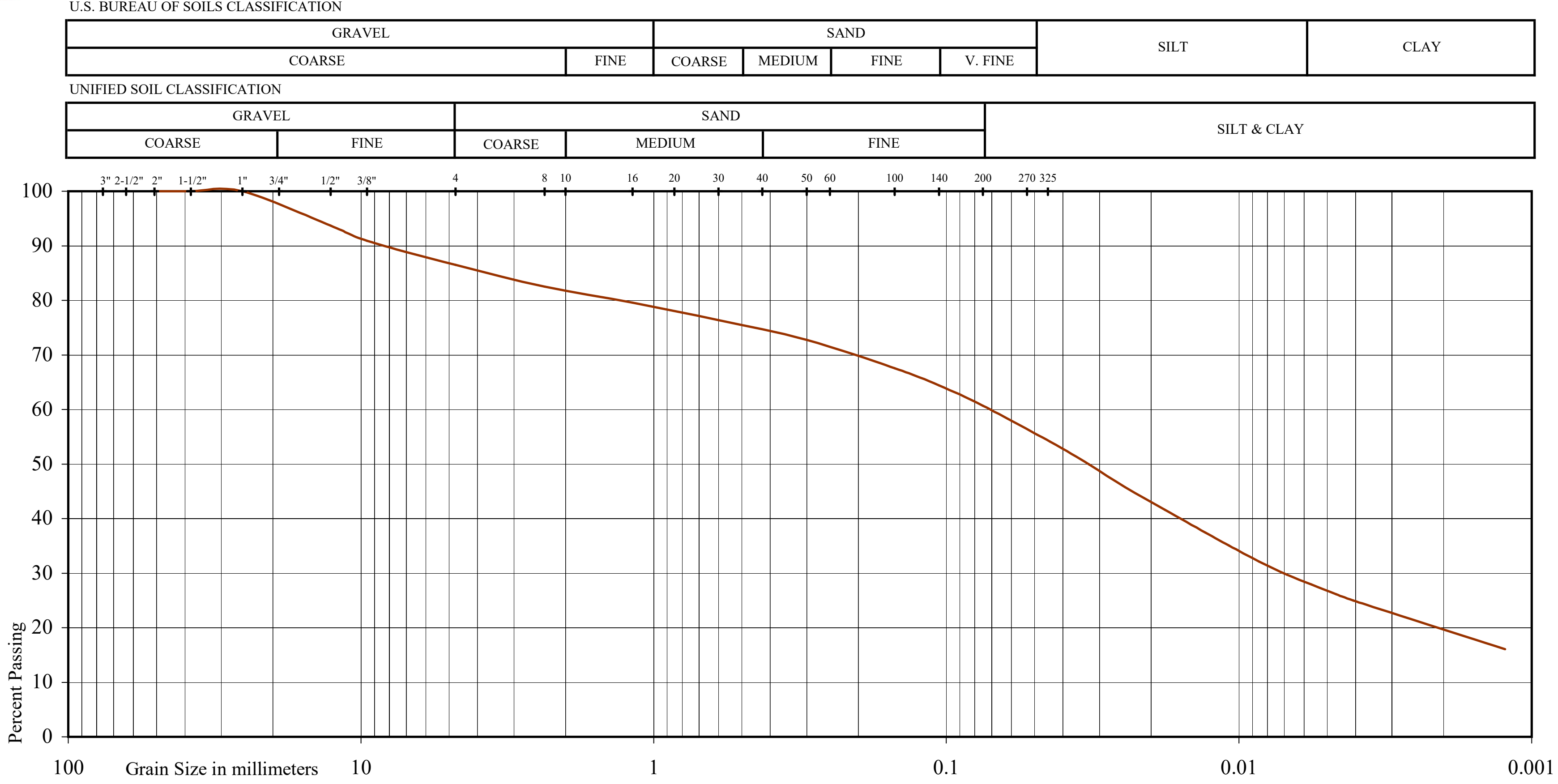
GRAIN SIZE DISTRIBUTION

Reference No: 2112-S027



Project: Proposed Residential Development

Location: 11283 Highway 26, Town of Collingwood

Borehole No:	1
Sample No:	4
Depth (m):	2.5
Elevation (m):	177.9

Liquid Limit (%) =	-
Plastic Limit (%) =	-
Plasticity Index (%) =	-
Moisture Content (%) =	8
Estimated Permeability (cm./sec.) =	10^{-7}

Classification of Sample [& Group Symbol]: SANDY SILT TILL
some clay and gravel

Figure: 6

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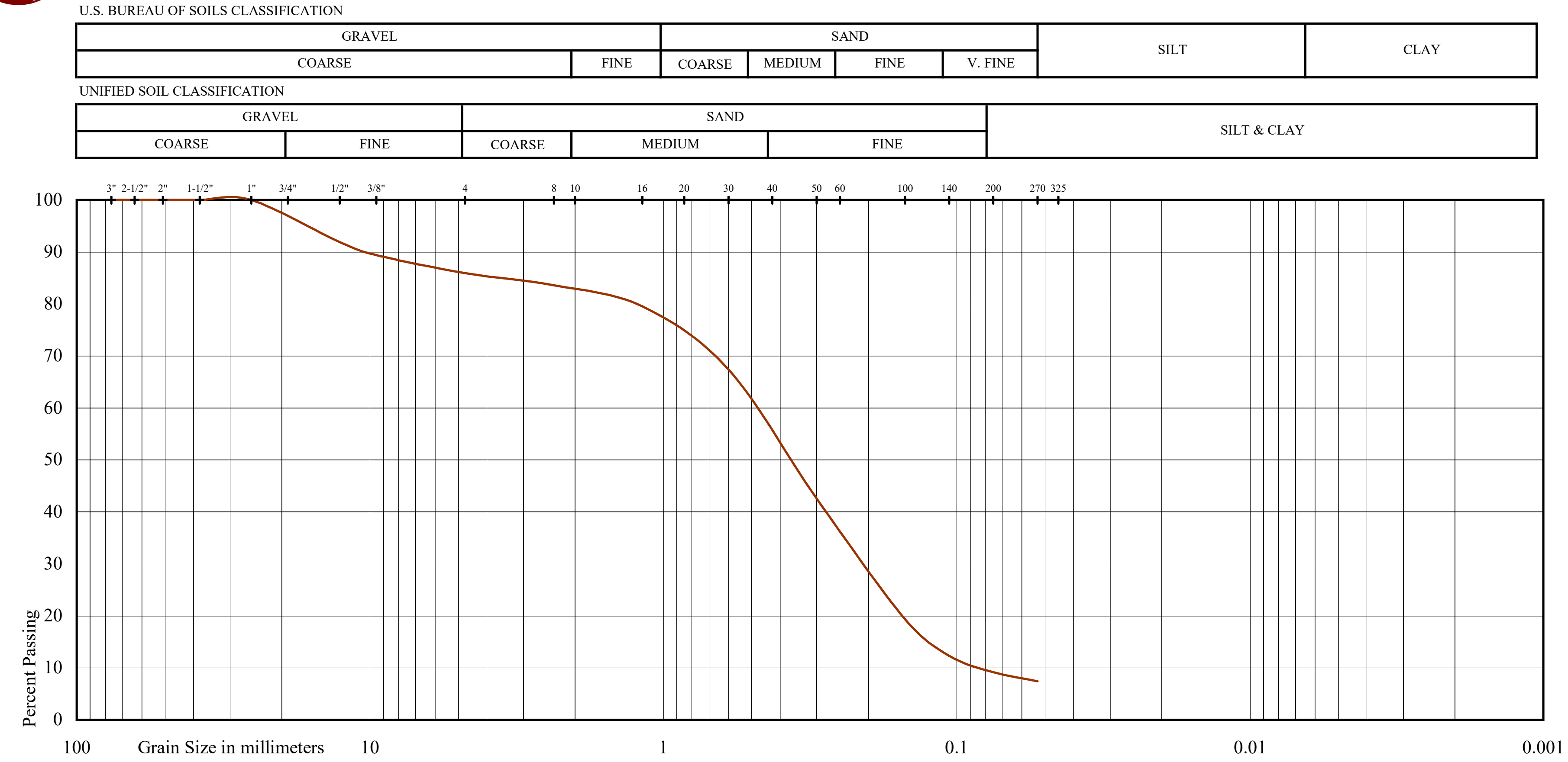
GRAIN SIZE DISTRIBUTION

Reference No: 2112-S027



Project: Proposed Residential Development

Location: 11283 Highway 26, Town of Collingwood

Liquid Limit (%) =	-
Plastic Limit (%) =	-
Plasticity Index (%) =	-
Moisture Content (%) =	15
Estimated Permeability (cm./sec.) =	10^{-2}

Borehole No: 5

Sample No: 5

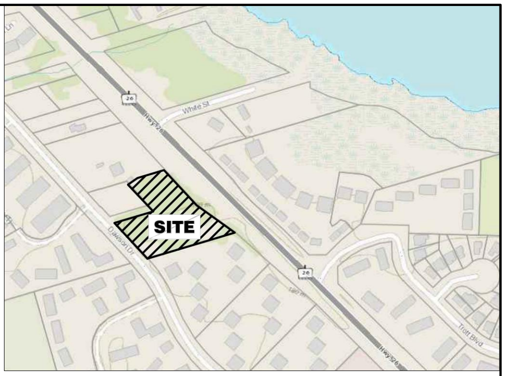
Depth (m): 3.2

Elevation (m): 177.6

Classification of Sample [& Group Symbol]: SAND

fine to medium grained, some gravel, traces of silt and coarse sand

Figure 7



LEGEND

⊕ Borehole Location

Soil Engineers Ltd.
CONSULTING ENGINEERS
GEOTECHNICAL | ENVIRONMENTAL | HYDROGEOLOGICAL | BUILDING SCIENCE
90 WEST BEAVER CREEK ROAD, SUITE #100, RICHMOND HILL, ONTARIO L4B 1E7 · TEL: (416) 754-8515 · FAX: (905) 881-8335

BOREHOLE LOCATION PLAN

SITE: 11283 Highway 26, Town of Collingwood

DESIGNED BY: -
CHECKED BY: -
DWG NO.: 1
SCALE: 1:750
REF. NO.: 2112-S027
DATE: April 2022
REV 1

Soil Engineers Ltd.

CONSULTING ENGINEERS

GEOTECHNICAL | ENVIRONMENTAL | HYDROGEOLOGICAL | BUILDING SCIENCE

SUBSURFACE PROFILE
DRAWING NO. 2
SCALE: AS SHOWN

JOB NO.: 2112-S027

REPORT DATE: April 2022

PROJECT DESCRIPTION: Proposed Residential Development

PROJECT LOCATION: 11283 Highway 26, Town of Collingwood

LEGEND

▨ TOPSOIL ▨ SAND ▨ SANDY SILT TILL

≡ CAVE-IN ▽ WATER LEVEL (END OF DRILLING)