TOWN OF CALEDON
PLANNING
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A REPORT TO
HUMBERKING (I) DEVELOPMENTS LIMITED
AND
HUMBERKING (IV) DEVELOPMENTS LIMITED

A GEOTECHNICAL INVESTIGATION
FOR
PROPOSED MIXED-USE DEVELOPMENT

KING STREET AND HUMBER STATION ROAD

TOWN OF CALEDON

REFERENCE NO. 2108-S069

DECEMBER 2021

DISTRIBUTION

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ENCLOSURES

1.0 INTRODUCTION

In accordance with written authorization from Robert Vitullo of Humberking (I) Developments Limited and Humberking (IV) Developments Limited, dated July 23, 2021, a geotechnical investigation was conducted in the northeast and northwest quadrant of King Street and Humber Station Road in the Town of Caledon, for a proposed Mixed-Use Development.

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

2.0 SITE AND PROJECT DESCRIPTION

The Town of Caledon is situated on Peel-Markham till plain where the drift dominates the soil stratigraphy. In places, lacustrine sand, silt, clay and drift which have been reworked by the water action of Peel Ponding (glacial lake) have modified the drift stratigraphy.

The combined property, consisting of land on the east side and west side of Humber Station Road, is approximately 20 hectare in area. At the time of investigation, the majority of the property is farm field, with associated farm houses fronting Humber Station Road. The grading on the land to the west side of Humber Station Road generally descends towards the swale which meanders in a north-south direction through the centre portion of the site. The portion of land to the east side of Humber Station Road is relatively flat, descending towards the east, to the Canadian National (CN) Railway Tracks.

At the time of the report preparation, detailed design for the proposed development is not available, however, it is understood that the property will be developed into a residential subdivision with blocks reserved for parks, stormwater management facility and commercial developments.

3.0 FIELD WORK

The field work, consisting of eighteen (18) sampled boreholes extending to a depth of 6.6 m from the prevailing ground surface, was performed between September 28 and October 5, 2021, at the locations shown on the Borehole and Monitoring Well 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 results are recorded as the Standard Penetration Resistance (or 'N' values) of the subsoil. 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.

Monitoring wells, 50 mm in diameter, were installed at eight (8) borehole locations to facilitate groundwater records by the hydrogeologist. The depth and details of wells are shown on the corresponding Borehole Logs.

The fieldwork was supervised and the findings were recorded by a Geotechnical Technician. The ground elevation at each borehole location was obtained using a hand-held Global Navigation Satellite System (GNSS) equipment.

4.0 SUBSURFACE CONDITIONS

The boreholes were either completed in the farm field or on the existing driveway. The investigation has disclosed that beneath the pavement structure or topsoil, the site is underlain by a stratum of silty clay till. Localized deposit of sandy silt till, sandy silt and sand were contacted beneath the silty clay till deposit in the southern portion of the property.

Detailed descriptions of the subsurface conditions are presented on the Borehole Logs, comprising Figures 1 to 18, inclusive. The revealed stratigraphy is plotted on the Subsurface Profile, Drawing No. 2 and 3. The engineering properties of the disclosed soils are discussed herein.

4.1 **Topsoil** (All Boreholes, except Borehole 12)

The revealed topsoil is 20 cm to 60 cm in thickness. Thicker topsoil layer may be contacted in areas beyond the borehole locations, especially near the treed or low lying areas.

4.2 **Pavement Structure** (Borehole 12)

Asphaltic concrete pavement, 150 mm in thickness, overlying a granular bedding of 200 mm in thickness, was contacted at the ground surface of the driveway.

4.3 **Silty Clay Till** (All Boreholes)

The silty clay till deposit was encountered beneath the topsoil or pavement structure. The clay till consists of a random mixture of particle sizes ranging from clay to gravel, with the silt and clay being the dominant fraction. Intermittent high resistance to augering was encountered, indicating the presence of cobbles and boulders. Grain size analysis was performed on a four (4) representative samples and the results are plotted on Figure 19.

The recorded 'N' values range from 6 to more than 100, with a median of 30 blows per 30 cm of penetration, indicating that the silty clay till deposit is firm to hard, being generally very stiff in consistency. The firm deposit is restricted to the weathered zone, extending to a depth of up to 0.9 m from the ground surface.

The Atterberg Limits of four (4) representative samples and the water content of all of the clay till samples were determined. The results show that the clay till is low to medium in plasticity. The results are plotted on the Borehole Logs and summarized below:

Liquid Limit	35%, 36%, 38% and 40%
Plastic Limit	19%, 20% and 21%
Natural Water Content	11% to 27% (median of 15%)

The silty clay till with high moisture contents was contacted near the ground surface, within the weathered zone.

The engineering properties of the silty clay till deposit are listed below:

- High frost susceptibility, with low soil-adfreezing potential.
- Low permeability, with an estimated coefficient of permeability of 10^{-7} cm/sec and a percolation time of more than 80 min/cm and the runoff coefficients are:

Slope	
0% - 2%	0.15
2% - 6%	0.20
6% +	0.28

- It will generally be stable in a relatively steep cut; however, under prolonged exposure, the sand and silt seams and layers may become wet from infiltrated precipitation which may lead to localized sloughing.
- A poor pavement-supportive material, with an estimated California Bearing Ratio (CBR) value of 3% to 5%.

- Moderately high corrosivity to buried metal, with an estimated electrical resistivity of 3000 to 3500 ohm·cm.

4.4 **Sandy Silt Till** (Borehole 17)

The sandy silt till was contacted beneath the silty clay till in Borehole 17. It consists of a random mixture of particle sizes ranging from clay to gravel, with the sand and silt being the dominant fraction. A tactile examination of the soil samples indicated that the till is slightly cemented. Grain size analysis was performed on a representative sample; the result is plotted on Figure 20.

The relative density of the deposit is dense to very dense, as inferred from the 'N' values of 37 to more than 100 blows per 30 cm of penetration. Intermittent hard resistance to augering was encountered, indicating the presence of cobbles and boulders.

The natural water content of the soil samples are 11% and 14%, showing moist to very moist conditions.

The engineering properties of the sandy silt till deposit are listed below:

- High frost susceptibility and low water erodibility.
- Low permeability, with the estimated coefficient of permeability and rate of percolation of 10^{-6} cm/sec and 50 min/cm, respectively; the runoff coefficients are:

Slope	
0% - 2%	0.15
2% - 6%	0.20
6% +	0.28

- The till will be stable in relatively steep cuts; however, under prolonged exposure, localized sheet sliding may occur in the sand layers.
- A fair pavement-supportive material, with an estimated CBR value of 8%.
- Moderate corrosivity to buried metal, with an estimated electrical resistivity of 4500 ohm·cm.

4.5 Sand and Sandy Silt (Borehole 18)

At Borehole 18, localized layers of sandy silt and sand were contacted. They are fine to very fine grained, with variable amount of silt and sand. Grain size analysis was performed on a representative sample each of the sand and sandy silt. The results are plotted on Figures 21 and 22, respectively.

The obtained 'N' values are 33, 35 and 41 blows per 30 cm of penetration, indicating the sand and silt are dense in relative density. The moisture contents of the sand and silt are 18% and 20%, indicating saturated conditions.

The engineering properties of the sand deposits are listed below:

- High frost susceptibility, with high soil-adfreezing potential.
- High water erodibility, it is susceptible to migration through small opening under seepage pressure.
- Pervious to relatively pervious, with an estimated coefficient of permeability and percolation times of 10^{-3} cm/sec and 8 min/cm for the sand and 10^{-4} cm/sec and 12 min/cm for the sandy silt respectively, and runoff coefficients of:

Slope	
0% - 2%	0.04 to 0.07
2% - 6%	0.09 to 0.12
6% +	0.13 to 0.18

- In excavation, the sand and silt will slough to its angle of repose, run with water seepage and boil under a piezometric head of 0.3 m to 0.4 m.
- Fair pavement-supportive material, with an estimated CBR value of 8%.
- Low to moderately low corrosivity to buried metal, with an estimated electrical resistivity of 5000 to 6000 ohm·cm.

4.6 Compaction Characteristics of the Revealed Soils

The obtainable degree of compaction is primarily dependent 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 of On-Site Material

Soil Type	Determined Natural Water Content (%)	Water Content (%) for Standard Proctor Compaction	
		100% (optimum)	**Range for 95% or +**
Silty Clay Till	11 to 27 (median 15)	16	12 to 20
Sandy Silt Till	11 and 14	12	8 to 15
Sand and Silt	18 and 20	10 to 12	8 to 15

The above values show the in-situ soils are mostly suitable for 95% or + Standard Proctor compaction. The weathered till near the ground surface, sand, and silt are either on the wet side of the optimum or too wet and will require aeration prior to compaction. Aeration can be achieved by spreading the wet soil thinly on the ground in the dry and warm weather. The weathered till must also be screened, segregated the topsoil and organics, before aeration for reuse as structural backfill.

When compacting the tills on the dry side of the optimum, the compactive energy will frequently bridge over the chunks in the soil and be transmitted laterally into the soil mantle. Therefore, the lifts must be limited to 20 cm or less (before compaction). Boulders over 15 cm in size must be sorted and removed from the backfill.

5.0 GROUNDWATER CONDITION

Upon completion of the borehole drilling, groundwater was evident only in Borehole 17, at a depth of 6.1 m, or El. 260.1 m. Borehole 18 caved in the silt deposit, at a depth of 3.3 m from grade, or El. 262.5 m. All other boreholes remained dry during and upon completion of the field work.

Continuous groundwater is not anticipated in the boreholes where the glacial tills were contacted. In Borehole 18, the cave-in level in the silt deposit generally represents the groundwater regime. It is subject to seasonal fluctuation.

The water level in the monitoring wells will be recorded by the hydrogeologist. Detailed groundwater condition of the site will be discussed in the hydrogeological report under separate cover.

6.0 DISCUSSION AND RECOMMENDATIONS

The investigation revealed that beneath the pavement structure or topsoil, the site is underlain by a firm to hard, generally very stiff silty clay till stratum. Localized deposits of sandy silt till, sand and sandy silt, dense to very dense in relative density were contacted in the southern portion of the property.

Upon the completion of borehole drilling, groundwater was evident in Borehole 17, at a depth of 6.1 m, or El. 260.1 m in the sandy silt till deposit. Borehole 18 caved at a depth of 3.3 m from grade, or El. 262.5 m and generally represents the groundwater regime in the vicinity and will subject to seasonal fluctuation. The water level in the monitoring wells will be recorded by the hydrogeologist.

Part of the proposed development will be a residential subdivision, with municipal services and blocks reserved for stormwater management facility, park and commercial purposes. The geotechnical findings warranting special consideration for the proposed project are presented below:

1. The topsoil must be removed for site development. It can only be re-used for landscaping in designated areas only.
2. After demolition of the existing structures and foundations, the debris must be removed and disposed of off-site. The cavities must be inspected by the geotechnical engineer before backfilling with an engineered fill for building construction.
3. The site can be re-graded with an engineered fill for development. The weathered soils must be sub-excavated, sorted free of topsoil and organics before reuse for engineered fill or structural backfill.
4. The engineered fill and sound native soils are suitable for supporting the proposed structures, underground services and road pavement.
5. The footing subgrade must be inspected by a geotechnical engineer or a senior geotechnical technician to assess its suitability for supporting the structures at the designed bearing pressures.
6. Backfill of any trenches and house foundation should consist of on-site excavated material, free of organics.
7. Where sand and silt deposit may be contacted in the stormwater management pond, an impermeable clay liner must be provided and the liner thickness has to be capable of resisting any buoyancy uplift while the pond is empty.

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 any subsurface variance become apparent during construction, a geotechnical engineer must be consulted to determine whether the following recommendations require revision.

6.1 **Site Preparation**

The existing topsoil must be removed for site development.

The existing structures and foundations will be demolished. The debris must be removed and disposed of off-site. The cavity must be inspected by the geotechnical engineer before backfilling for building construction. The backfill in cavities must be free of topsoil or deleterious material, placed and compacted to engineered fill specifications. Any disturbed soils should also be removed. It may be stockpiled on site for reuse.

The site can be re-graded with an engineered fill for development. The requirements for the engineered fill are presented below:

1. The topsoil must be removed; any disturbed soils and weathered soils must be subexcavated and further assessed of their suitability for engineered fill.
2. The native soil subgrade must be inspected and proof-rolled prior to any fill placement.
3. Inorganic soils must be used for the fill, and they must be uniformly compacted in lifts 20 cm thick to 98% or + of the maximum Standard Proctor dry density 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.
4. 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.
5. If imported fill is to be used, it should be inorganic soils, free of any deleterious 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.

6. 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.
7. The fill operation must be fully supervised and monitored by a technician under the direction of a geotechnical engineer.
8. The engineered fill envelope and finished elevations must be clearly and accurately defined in the field, and they must be precisely documented.
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 properly distribute the stress induced by the abrupt differential settlement (about 20 mm) in engineered fill.
10. 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 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.
11. 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 proposed structures can be supported on conventional spread and strip footings, founded on the undisturbed native soil or engineered fill. The recommended soil bearing pressures for the design of conventional footings are provided:

- Maximum Bearing Pressure at Serviceability Limit State (SLS) = 150 kPa
- Factored Bearing Pressure at Ultimate Limit State (ULS) = 240 kPa

The total and differential settlements of structures designing for the bearing pressure at SLS are estimated within 25 mm and 20 mm, respectively.

The foundation subgrade should be inspected by the geotechnical engineer or a senior geotechnical technician to ensure that the revealed conditions are compatible with the foundation design requirements.

Foundations exposed to weathering or in unheated areas should have at least 1.2 m of earth cover for protection against frost action.

If groundwater seepage is encountered in excavation, the foundation must be poured immediately after subgrade inspection or the subgrade should be protected by a mud-slab of lean concrete immediately after exposure. This will prevent construction disturbance and costly rectification of the bearing subsoil.

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

6.3 **Basement Structures**

The basement structure should be provided with a drainage system (Drawing No. 4) at the wall base and damp-proofing of the perimeter walls. The subdrains should be encased in a fabric filter to protect them against blockage by silting.

The perimeter walls should be designed to sustain a lateral earth pressure calculated using the soil parameters stated in Section 6.9. Any applicable surcharge loads adjacent to the basement must also be considered in the wall design.

The basement floor subgrade should consist of sound native soil or well compacted inorganic earth fill. The floor slab should be constructed on a granular base, at least 15 cm thick, consisting of 19-mm Crusher-Run Clearstone, or equivalent.

The exterior gradient beside the basement structure must be graded to direct runoff away from the structures.

6.4 **Sidewalk, 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 must be backfilled with non-frost-susceptible granular material, with a frost taper at a slope flatter than 1 vertical:1 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.

6.5 **Underground Services**

The underground services should be founded on sound natural soil or properly compacted inorganic earth fill. Where incompetent or weathered soil is encountered, it should be subexcavated and replaced with the bedding material, compacted to at least 98% SPDD.

A Class 'B' bedding is recommended for the underground services construction. It should consist of compacted 19-mm Crusher-Run Limestone, or equivalent, as approved by a geotechnical engineer.

The pipe joints into the manholes and catch basins must be leak-proof to prevent the migration of fines through the joints. Openings to subdrains and catch basins should be shielded with a fabric filter to prevent blockage by silting.

A soil cover of at least two times the diameter of the pipe should be in place at all times after pipe installation, to prevent pipe floatation when the trench is deluged with water derived from precipitation.

The on-site clay till that is moderately high in corrosivity to ductile iron pipes and metal fittings; therefore, the underground services should be protected against soil corrosion. For estimation for the anode weight requirements, the electrical resistivity of the disclosed soils can be used. The proposed anode weight must meet the minimum requirements according to the Peel Region Standard.

6.6 **Backfilling in Trenches and Excavated Areas**

The backfill in service trenches should be compacted to at least 98% SPDD, particularly below concrete floor subgrade and in the zone within 1.0 m below the pavement. The material should be compacted with the water content at 2% to 3% drier than the optimum.

Selected on site inorganic soils are suitable for use as trench backfill. Wet soils will require aeration prior to its use as structural backfill. The till should be sorted free of oversized boulders (over 15 cm in size).
In normal construction practice, the problem areas of pavement settlement largely occur adjacent to manholes, catch basins, services crossings, foundation walls and columns, it is recommended that a sand backfill should be used.

The narrow trenches for services crossings should be cut at 1 vertical:2 horizontal so that the backfill in the trenches can be effectively compacted. Otherwise, soil arching in the trenches will prevent achievement of the proper compaction. In confined areas where the desired slope cannot be achieved or the operation of a proper kneading-type roller cannot be facilitated, imported sand fill, which can be appropriately compacted by using a smaller vibratory compactor, must be used.

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

- To backfill a deep trench, one must be aware that future settlement is to be expected, unless the sides is flattened to 1V:2H, 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 98% 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 and the compaction must be carried out diligently 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 in the pipe bedding or trench backfill mantle, anti-seepage collars (OPSS 802.095) should be provided.
- When construction is carried out in freezing weather, 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 wetting of the backfill or when it is required, such as when the trench box is removed. The above will invariably cause backfill settlement in the next few years.

- In areas where the underground services construction is carried out during 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.

6.7 Pavement Design

The pavement design for local, collector and arterial roads meeting the Town of Caledon standards is presented in Table 2.

Table 2 - Pavement Design

Course	Thickness (mm)	Specifications
Asphalt Surface		
Local Roads	40	OPSS HL3
Collectors	40	OPSS HL3 HS
Arterial	50	OPSS HL3 HS
Asphalt Binder		OPSS HL-8
Local Roads	80	
Collectors	100	
Arterial	100	
Granular Base	150	20-mm Crusher Run Limestone
Granular Sub-base		50-mm Crusher Run Limestone
Local Roads	300	
Collectors	350	
Arterial	350	

In preparation of pavement subgrade, all topsoil and compressible material should be removed. The final subgrade must be proof-rolled using a heavy roller or loaded dump truck. Any soft spot identified must be rectified by subexcavation and replacing with selected dry inorganic material. The subgrade within 1.0 m below the underside of the granular sub-base must be compacted to at least 98% SPDD, with the water content at 2% to 3% drier than its optimum.

All the granular bases should be compacted in 150 to 200 mm lifts to 100% SPDD.

The pavement 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:

- The subgrade should be properly crowned and smooth-rolled to allow interim precipitation to be properly drained prior to pavement construction.
- 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 connecting to a positive outlet of catch basin, will be required on both sides of the roadway.

6.8 **Stormwater Management Facility** (Boreholes 15 and 16)

A stormwater management facility is proposed in the vicinity of Boreholes 15 and 16. Based on the borehole findings, the subsoil consists of silty clay till with occasional sand layers. The on-site silty clay till, consisting of more than 30% of clay content, is suitable for retention pond construction and can be used for the construction of liner where required. The liner thickness will depend on the invert of the facilities and the groundwater conditions in the vicinity. The thickness of the liner must be further assessed once the stormwater management design is available.

The side slopes of the stormwater management facility should be maintained at a stable slope not steeper than 3 Horizontal (H) to 1 Vertical (V) above the wet perimeter, and flatter than 4H to 1V below the wet perimeter. The final slopes must be vegetated and/or sodded to prevent runoff erosion.

If an earth berm is to be constructed in the retention facility, topsoil and badly weathered soils must be removed and the subgrade must be proof-rolled. The berm should consist of inorganic clayey soils, compacted to 98% SPDD. The final surface of the berm should be graded and vegetated properly as recommended above.

The foundation of control structures should extend into the sound natural soils below the frost depth or scouring depth, whichever is greater. A Maximum Allowable Soil Pressure (SLS) of 150 kPa and a Factored Ultimate Soil Bearing Pressure (ULS) of 240 kPa are recommended for the design of control structures.

6.9 **Soil Parameters**

The recommended soil parameters for the project design are given in Table 3.

Table 3 - Soil Parameters

Unit Weight and Bulk Factor	**Unit Weight γ (kN/m^3)**		**Estimated Bulk Factor**	
	Bulk	**Submerged**	**Loose**	**Compacted**
Sand/Silt	21.0	11.0	1.25	1.00
Glacial Tills	22.0	12.0	1.33	1.03

Lateral Earth Pressure Coefficients	**Active K_a**	**At Rest K_0**	**Passive K_p**
Glacial Tills, Sand and Silt	0.33	0.43	3.00

Coefficients of Friction	
Between Concrete and Granular Base	0.50
Between Concrete and Sound Natural Soils	0.35

Maximum Allowable Soil Pressure (SLS) For Thrust Block Design	
Engineered Fill and Sound Native Soils	75 kPa

6.10 Excavation

Excavation should be carried out in accordance with Ontario Regulation 213/91. The types of soils are classified in Table 4.

Table 4 - Classification of Soils for Excavation

Material	Type
Glacial Tills	2
Weathered Tills, drained Sand and Silt	3
Saturated Sand and Silt	4

In open excavation, the sides of excavation may suffer localized sloughing or side collapse; therefore, a stable backing slope or excavation protection will be required for stability.

Excavation into the hard and very dense tills containing boulders will require extra effort.

In the glacial till deposit, any perched groundwater yield can be collected and removed by conventional pumping from sumps. Any excavation extending into the saturated sand and silt will require extensive dewatering from closely spaced sump wells or well points.

Prospective contractors may be asked to assess the subsurface conditions by digging test pits to the intended depth of trench excavation. These test pits should be allowed to remain open for a few hours to assess the trenching conditions and the dewatering scheme for excavation.

6.11 Additional Investigation

Additional investigation by boreholes will be required to elaborate on the recommendations given in this report for the commercial mixed use block located on the southern portion of the property and the medium density building blocks located to the east of Humber Station Road.

7.0 LIMITATIONS OF REPORT

This report was prepared by Soil Engineers Ltd. for the account of Humberking (I) Developments Limited and Humberking (IV) Developments Limited, and for review by the designated consultants, contractors, financial institutions, and government agencies. The material in the report reflects the judgment of Kelvin Hung, P.Eng., and Bernard Lee, P.Eng., in light of the information available to it at the time of preparation.

Use of the report is subject to the conditions and limitations of the contractual agreement. Any use which a Third Party makes of this report, and/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

1lb = 0.454 kg

1 inch = 25.4 mm

1ksf = 47.88 kPa

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CONSULTING ENGINEERS
GEOTECHNICAL • ENVIRONMENTAL • HYDROGEOLOGICAL • BUILDING SCIENCE

JOB NO.: 2108-S069

LOG OF BOREHOLE NO.: 1

FIGURE NO.: 1

PROJECT DESCRIPTION: Proposed Mixed-Use Development

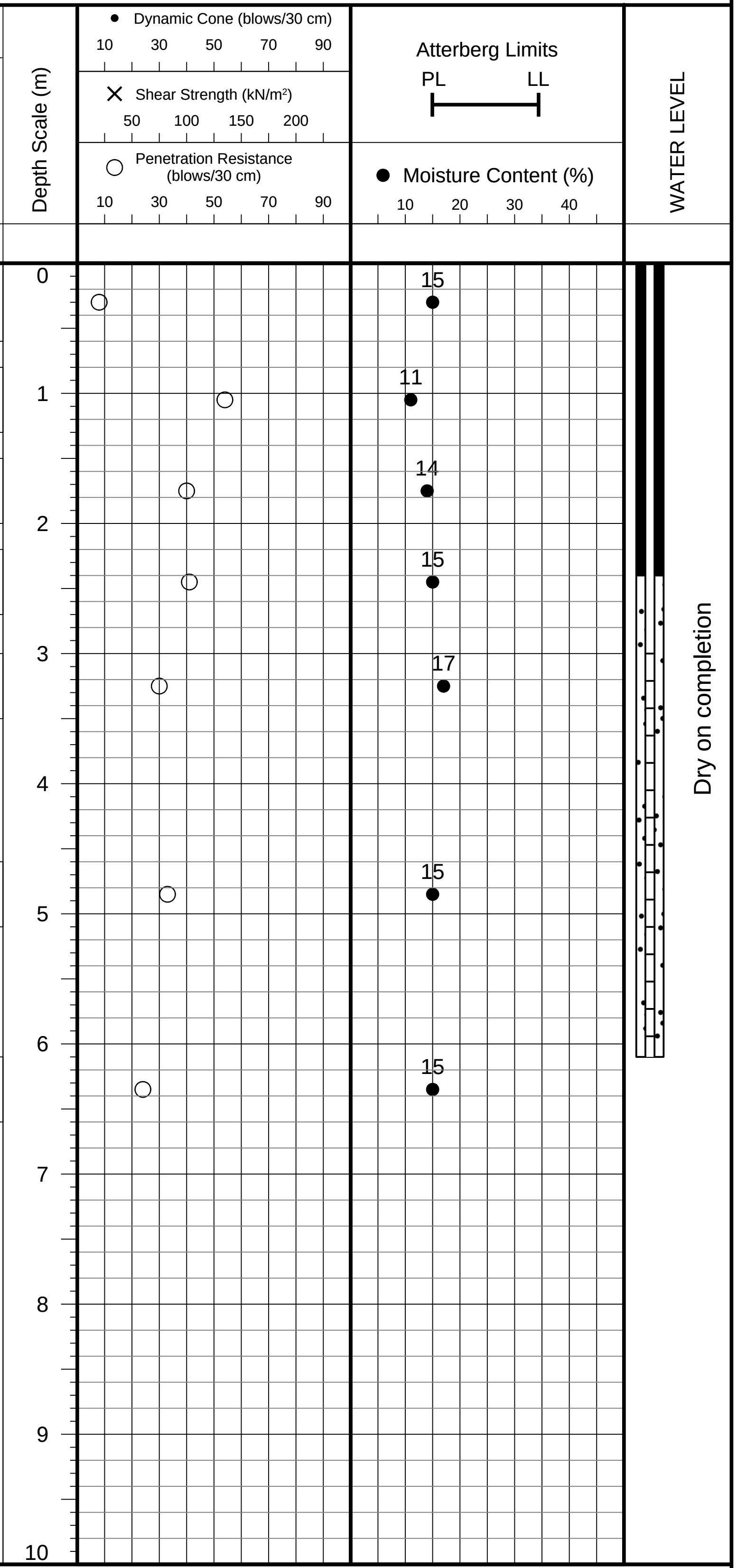
METHOD OF BORING: Flight-Auger

PROJECT LOCATION: King Street and Humber Station Road, Town of Caledon

DRILLING DATE: September 29, 2021

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
263.9 0.0	Ground Surface **40 cm TOPSOIL**			
	Stiff to hard weathered	1	DO	8
		2	DO	54
		3	DO	40
		4	DO	41
	SILTY CLAY TILL	5	DO	30
	some sand, a trace of gravel occasional cobbles and boulders brown grey			
		6	DO	33
		7	DO	24
257.3 6.6	**END OF BOREHOLE**			

Installed 50 mm Ø monitoring well to 6.1 m
completed with 3.1 m screen
Sand backfill from 2.4 to 6.1 m
Bentonite seal from 0.0 m to 2.4 m
Provided with a monument steel casing



Soil Engineers Ltd.

JOB NO.: 2108-S069

LOG OF BOREHOLE NO.: 2

FIGURE NO.: 2

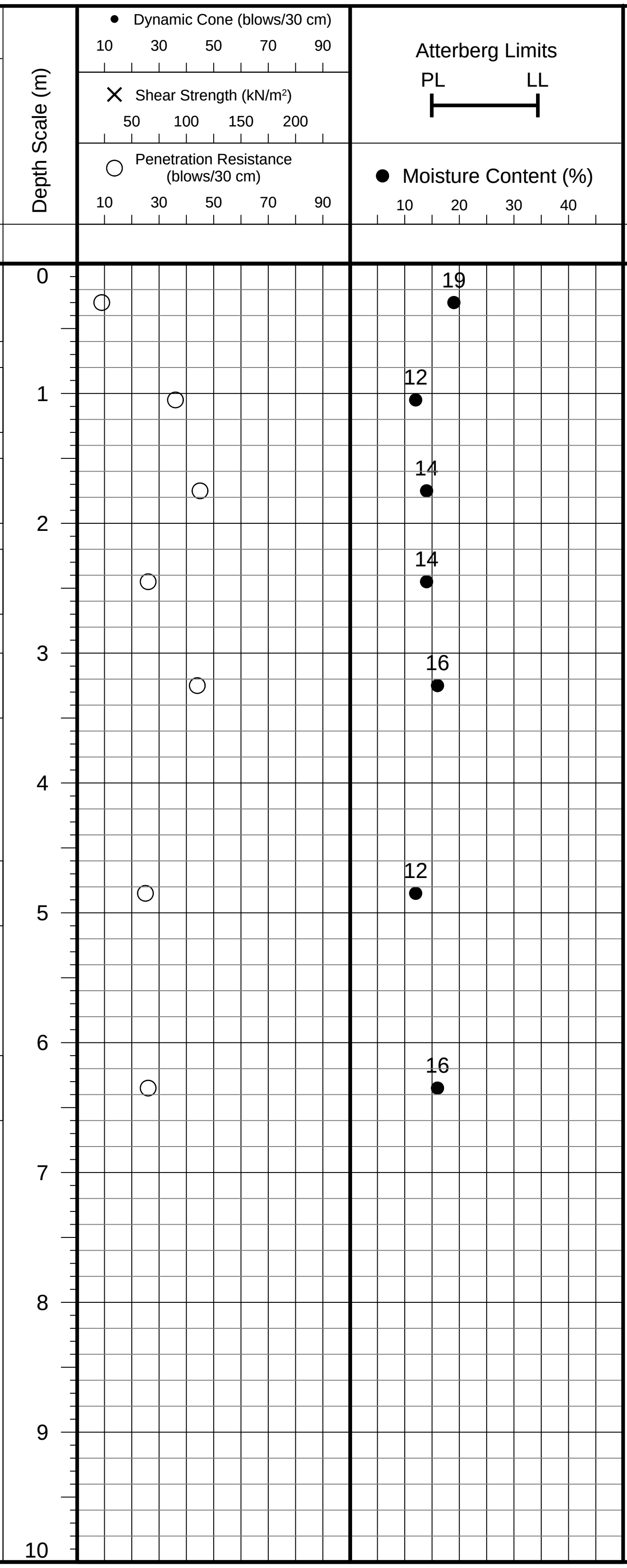
PROJECT DESCRIPTION: Proposed Mixed-Use Development

METHOD OF BORING: Flight-Auger

PROJECT LOCATION: King Street and Humber Station Road, Town of Caledon

DRILLING DATE: September 28, 2021

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	WATER LEVEL
264.1 0.0	Ground Surface **30 cm TOPSOIL**				Dry on completion
	Stiff to hard weathered	1	DO	9	
		2	DO	36	
		3	DO	45	
		4	DO	26	
	SILTY CLAY TILL	5	DO	44	
	some sand, a trace of gravel occasional cobbles and boulders brown grey				
		6	DO	25	
		7	DO	26	
257.5 6.6	**END OF BOREHOLE**				



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JOB NO.: 2108-S069

LOG OF BOREHOLE NO.: 3

FIGURE NO.: 3

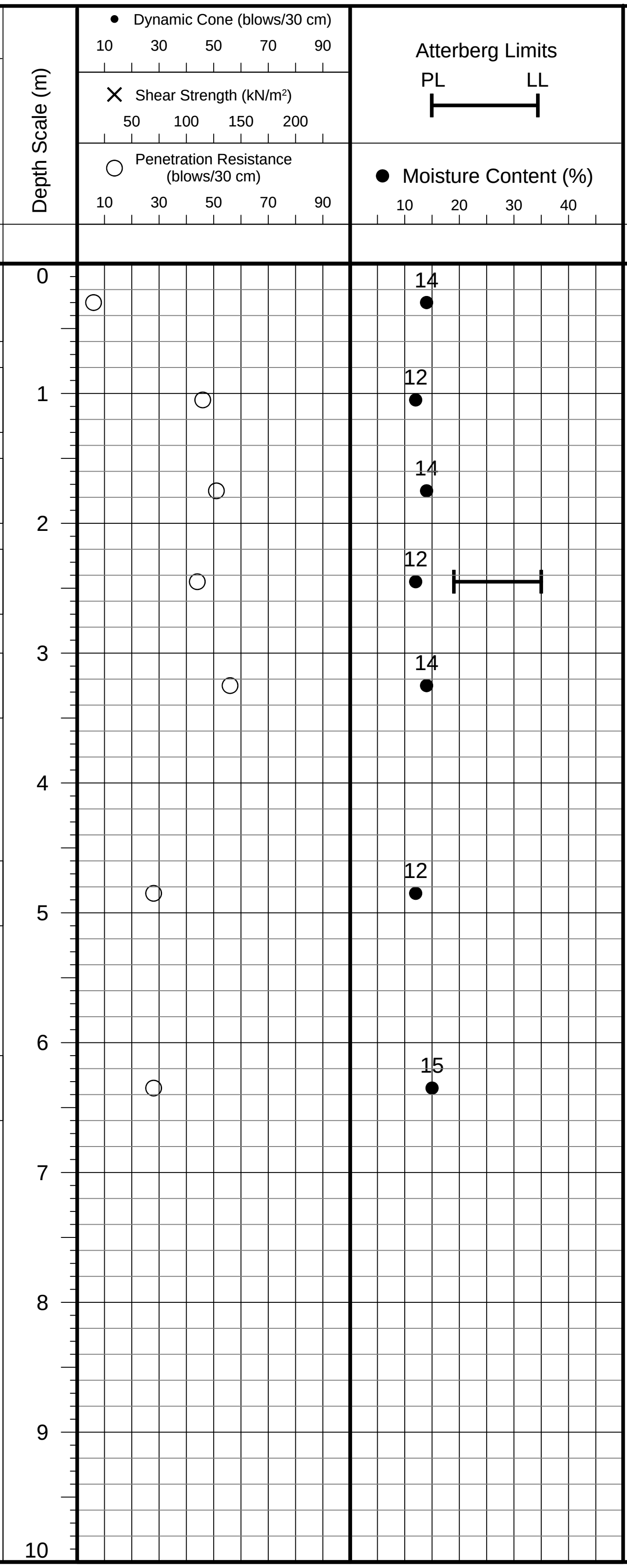
PROJECT DESCRIPTION: Proposed Mixed-Use Development

METHOD OF BORING: Flight-Auger

PROJECT LOCATION: King Street and Humber Station Road, Town of Caledon

DRILLING DATE: September 28, 2021

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	WATER LEVEL
266.3	Ground Surface				
0.0	**30 cm TOPSOIL**				Dry on completion
	Firm to hard	1	DO	6	
	weathered				
		2	DO	46	
		3	DO	51	
	SILTY CLAY TILL	4	DO	44	
		5	DO	56	
	some sand, a trace of gravel occasional cobbles and boulders — brown grey				
		6	DO	28	
		7	DO	28	
259.7 6.6	**END OF BOREHOLE**				



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JOB NO.: 2108-S069

LOG OF BOREHOLE NO.: 4

FIGURE NO.: 4

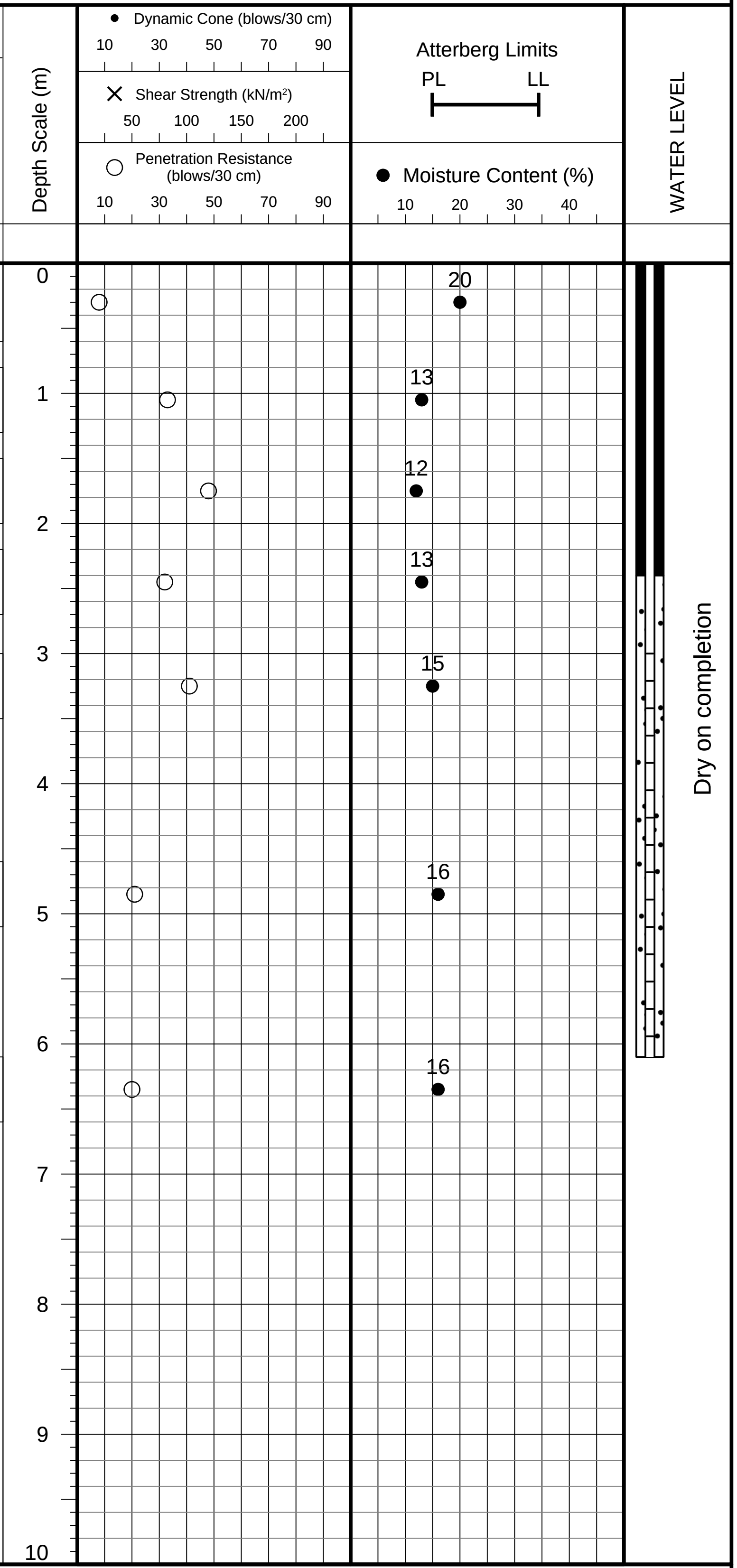
PROJECT DESCRIPTION: Proposed Mixed-Use Development

METHOD OF BORING: Flight-Auger

PROJECT LOCATION: King Street and Humber Station Road, Town of Caledon

DRILLING DATE: September 29, 2021

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
266.6	Ground Surface			
0.0	**60 cm TOPSOIL**	1	DO	8
	Very stiff to hard weathered	2	DO	33
		3	DO	48
		4	DO	32
	SILTY CLAY TILL	5	DO	41
	brown grey			
	some sand, a trace of gravel occasional cobbles and boulders	6	DO	21
		7	DO	20
260.0 6.6	**END OF BOREHOLE**			



Installed 50 mm Ø monitoring well to 6.1 m
completed with 3.1 m screen
Sand backfill from 2.4 to 6.1 m
Bentonite seal from 0.0 m to 2.4 m
Provided with a monument steel casing

Soil Engineers Ltd.

JOB NO.: 2108-S069

LOG OF BOREHOLE NO.: 5

FIGURE NO.: 5

PROJECT DESCRIPTION: Proposed Mixed-Use Development

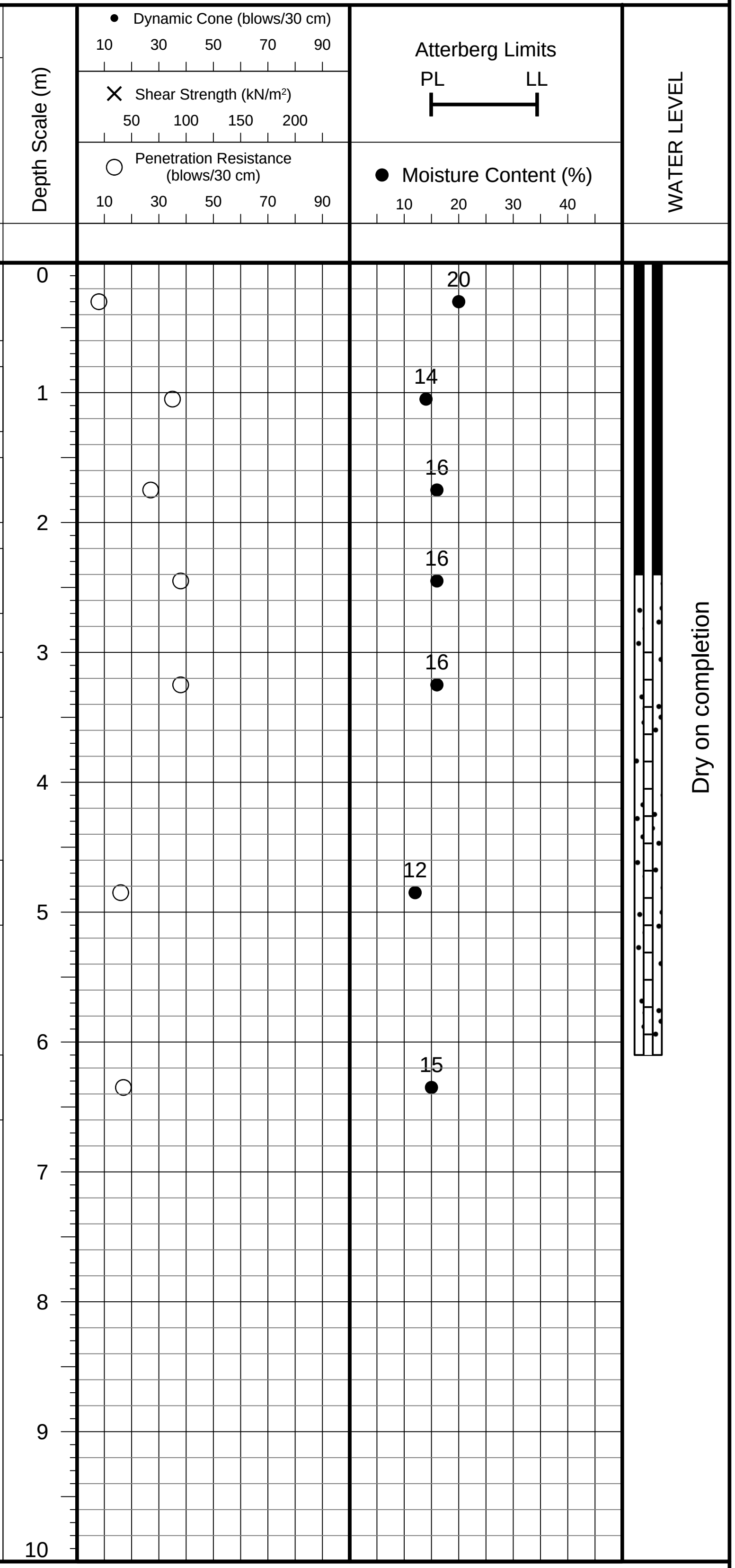
METHOD OF BORING: Flight-Auger

PROJECT LOCATION: King Street and Humber Station Road, Town of Caledon

DRILLING DATE: October 4, 2021

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
267.9	Ground Surface			
0.0	**20 cm TOPSOIL**			
	Stiff to hard	1	DO	8
	weathered			
		2	DO	35
		3	DO	27
	SILTY CLAY TILL	4	DO	38
		5	DO	38
	some sand, a trace of gravel occasional cobbles and boulders — brown grey			
		6	DO	16
261.3		7	DO	17
6.6	**END OF BOREHOLE**			

Installed 50 mm Ø monitoring well to 6.1 m
completed with 3.1 m screen
Sand backfill from 2.4 to 6.1 m
Bentonite seal from 0.0 m to 2.4 m
Provided with a monument steel casing



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JOB NO.: 2108-S069

LOG OF BOREHOLE NO.: 6

FIGURE NO.: 6

PROJECT DESCRIPTION: Proposed Mixed-Use Development

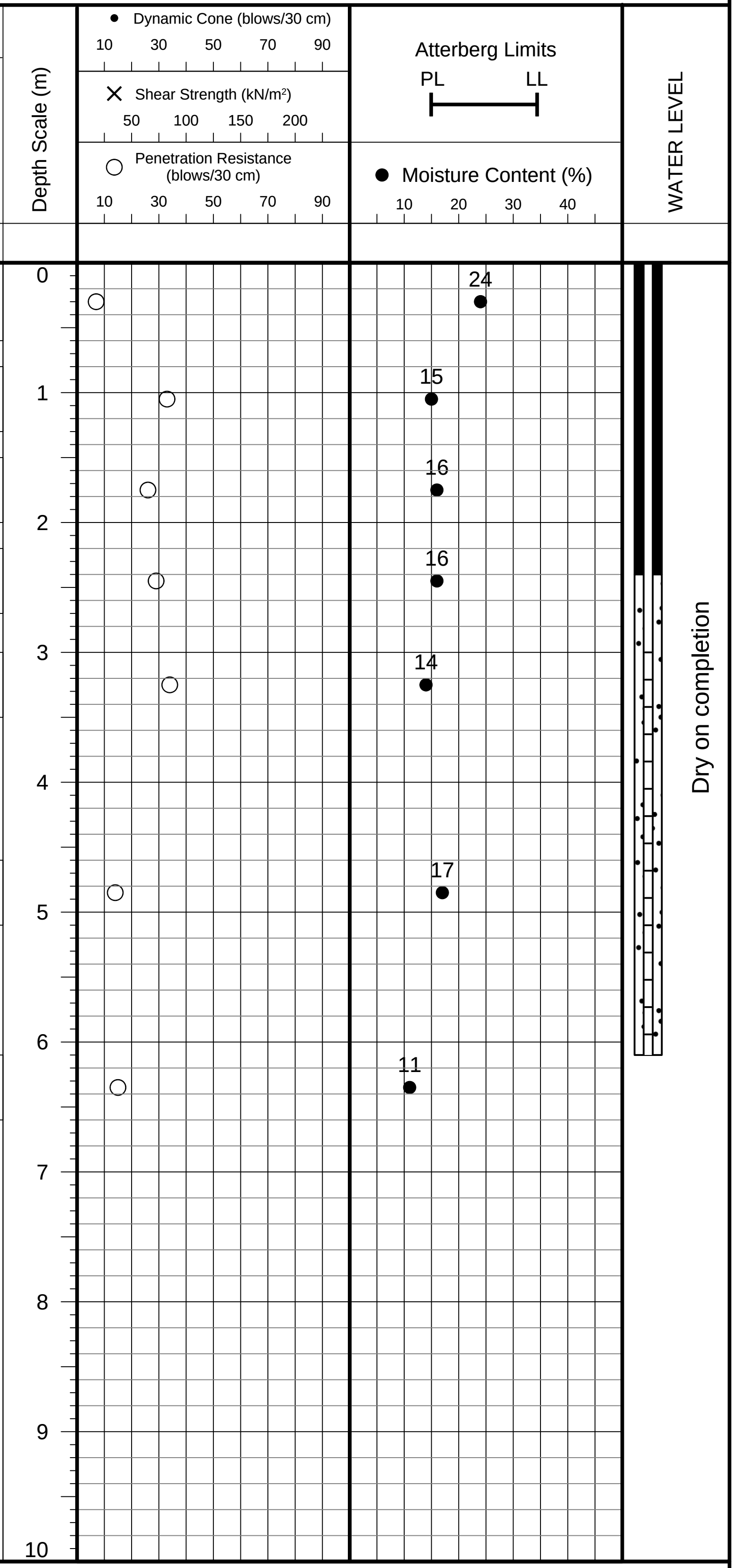
METHOD OF BORING: Flight-Auger

PROJECT LOCATION: King Street and Humber Station Road, Town of Caledon

DRILLING DATE: September 29, 2021

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
268.1	Ground Surface			
0.0	**30 cm TOPSOIL**			
	Firm to hard — weathered	1	DO	7
		2	DO	33
		3	DO	26
		4	DO	29
	SILTY CLAY TILL	5	DO	34
	some sand, a trace of gravel occasional cobbles and boulders — brown grey			
		6	DO	14
		7	DO	15
261.5 6.6	**END OF BOREHOLE**			

Installed 50 mm Ø monitoring well to 6.1 m
completed with 3.1 m screen
Sand backfill from 2.4 to 6.1 m
Bentonite seal from 0.0 m to 2.4 m
Provided with a monument steel casing



Soil Engineers Ltd.

JOB NO.: 2108-S069

LOG OF BOREHOLE NO.: 7

FIGURE NO.: 7

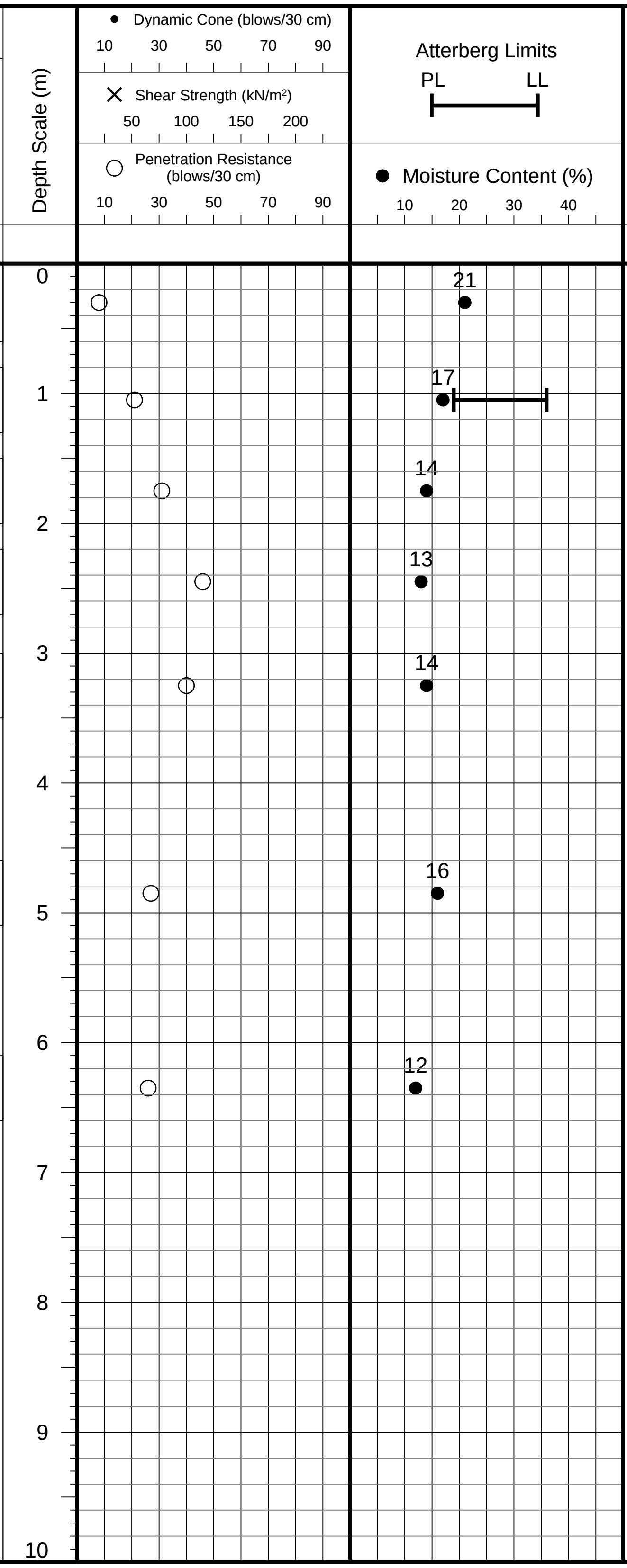
PROJECT DESCRIPTION: Proposed Mixed-Use Development

METHOD OF BORING: Flight-Auger

PROJECT LOCATION: King Street and Humber Station Road, Town of Caledon

DRILLING DATE: September 29, 2021

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
266.6 0.0	Ground Surface **20 cm TOPSOIL**			
	Stiff to hard	1	DO	8
	weathered			
		2	DO	21
		3	DO	31
	SILTY CLAY TILL	4	DO	46
		5	DO	40
	some sand, a trace of gravel occasional cobbles and boulders — brown / grey			
		6	DO	27
260.0 6.6		7	DO	26
	END OF BOREHOLE			



WATER LEVEL

Dry on completion

Soil Engineers Ltd.

JOB NO.: 2108-S069

LOG OF BOREHOLE NO.: 8

FIGURE NO.: 8

PROJECT DESCRIPTION: Proposed Mixed-Use Development

METHOD OF BORING: Flight-Auger

PROJECT LOCATION: King Street and Humber Station Road, Town of Caledon

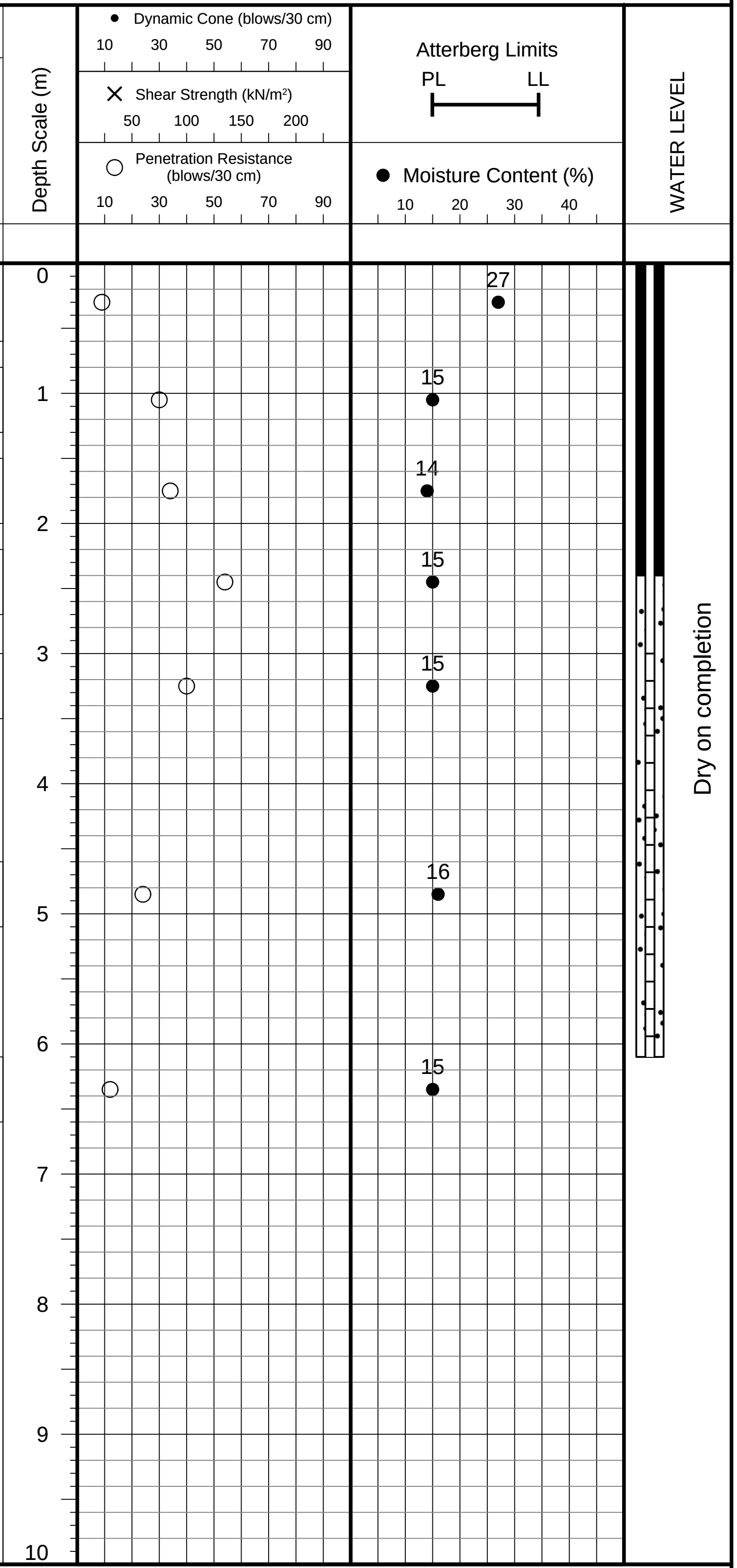
DRILLING DATE: September 29, 2021

El. (m) Depth (m)	SOIL DESCRIPTION
265.6 0.0	Ground Surface **25 cm TOPSOIL**
	Stiff to hard weathered **SILTY CLAY TILL** some sand, a trace of gravel occasional cobbles and boulders — brown / grey
259.0 6.6	**END OF BOREHOLE**

Installed 50 mm Ø monitoring well to 6.1 m
completed with 3.1 m screen
Sand backfill from 2.4 to 6.1 m
Bentonite seal from 0.0 m to 2.4 m
Provided with a monument steel casing

SAMPLES

Number	Type	N-Value	Moisture Content (%)
1	DO	9	27
2	DO	30	15
3	DO	34	14
4	DO	54	15
5	DO	40	15
6	DO	24	16
7	DO	12	15



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JOB NO.: 2108-S069

LOG OF BOREHOLE NO.: 9

FIGURE NO.: 9

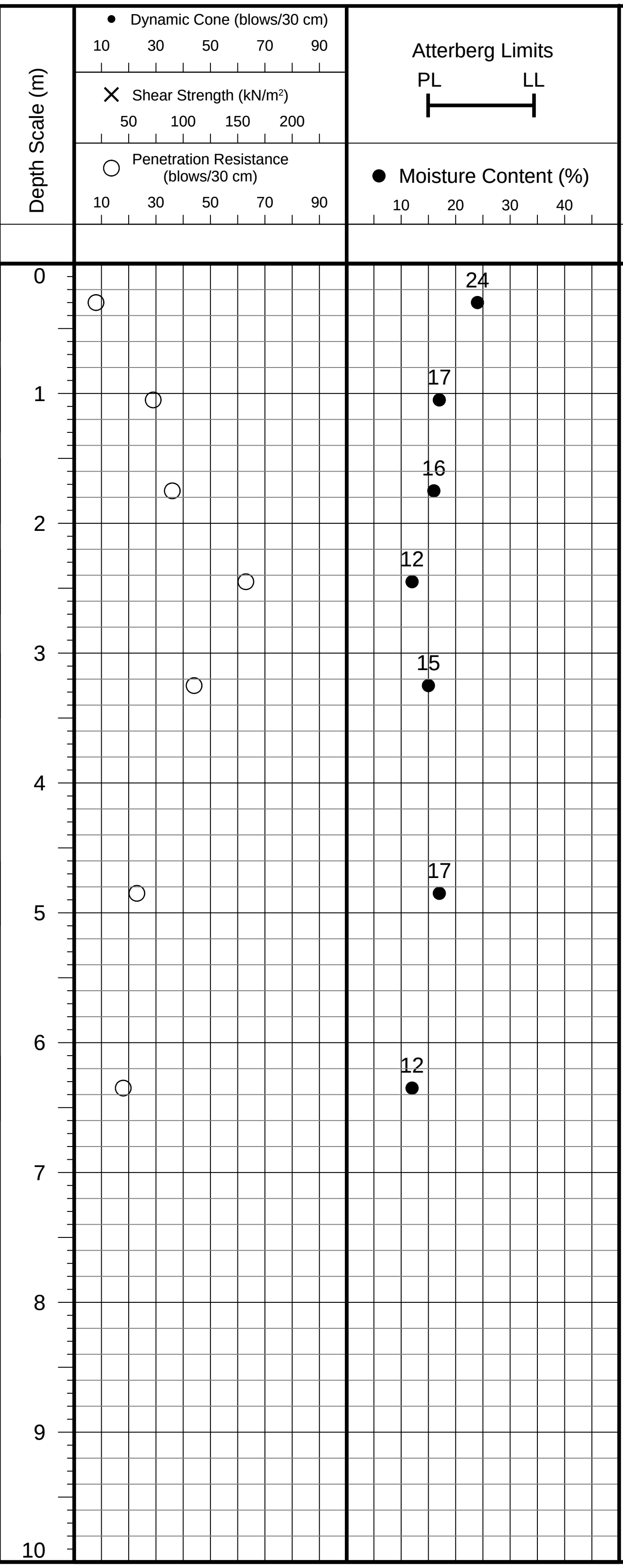
PROJECT DESCRIPTION: Proposed Mixed-Use Development

METHOD OF BORING: Flight-Auger

PROJECT LOCATION: King Street and Humber Station Road, Town of Caledon

DRILLING DATE: September 29, 2021

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	WATER LEVEL
267.7 0.0	Ground Surface				
	50 cm TOPSOIL	1	DO	8	Dry on completion
	Stiff to hard weathered	2	DO	29	
		3	DO	36	
		4	DO	63	
	SILTY CLAY TILL	5	DO	44	
	brown grey some sand, a trace of gravel occasional cobbles and boulders				
		6	DO	23	
		7	DO	18	
261.1 6.6	**END OF BOREHOLE**				



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JOB NO.: 2108-S069

LOG OF BOREHOLE NO.: 10

FIGURE NO.: 10

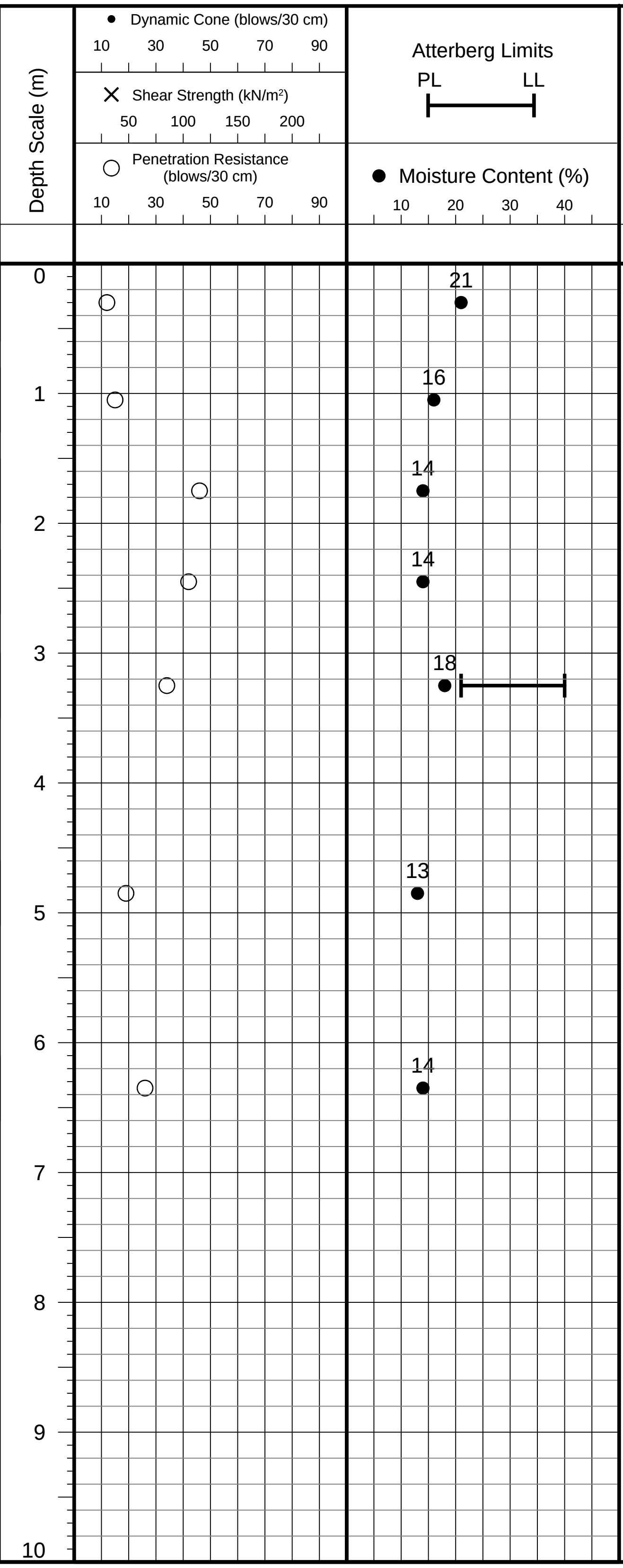
PROJECT DESCRIPTION: Proposed Mixed-Use Development

METHOD OF BORING: Flight-Auger

PROJECT LOCATION: King Street and Humber Station Road, Town of Caledon

DRILLING DATE: October 5, 2021

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	WATER LEVEL
267.6 0.0	Ground Surface **20 cm TOPSOIL**				
	Stiff to hard	1	DO	12	Dry on completion
	weathered	2	DO	15	
		3	DO	46	
	SILTY CLAY TILL	4	DO	42	
		5	DO	34	
	some sand, a trace of gravel occasional cobbles and boulders — brown grey				
		6	DO	19	
		7	DO	26	
261.0 6.6	**END OF BOREHOLE**				



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Page: 1 of 1

JOB NO.: 2108-S069

LOG OF BOREHOLE NO.: 11

FIGURE NO.: 11

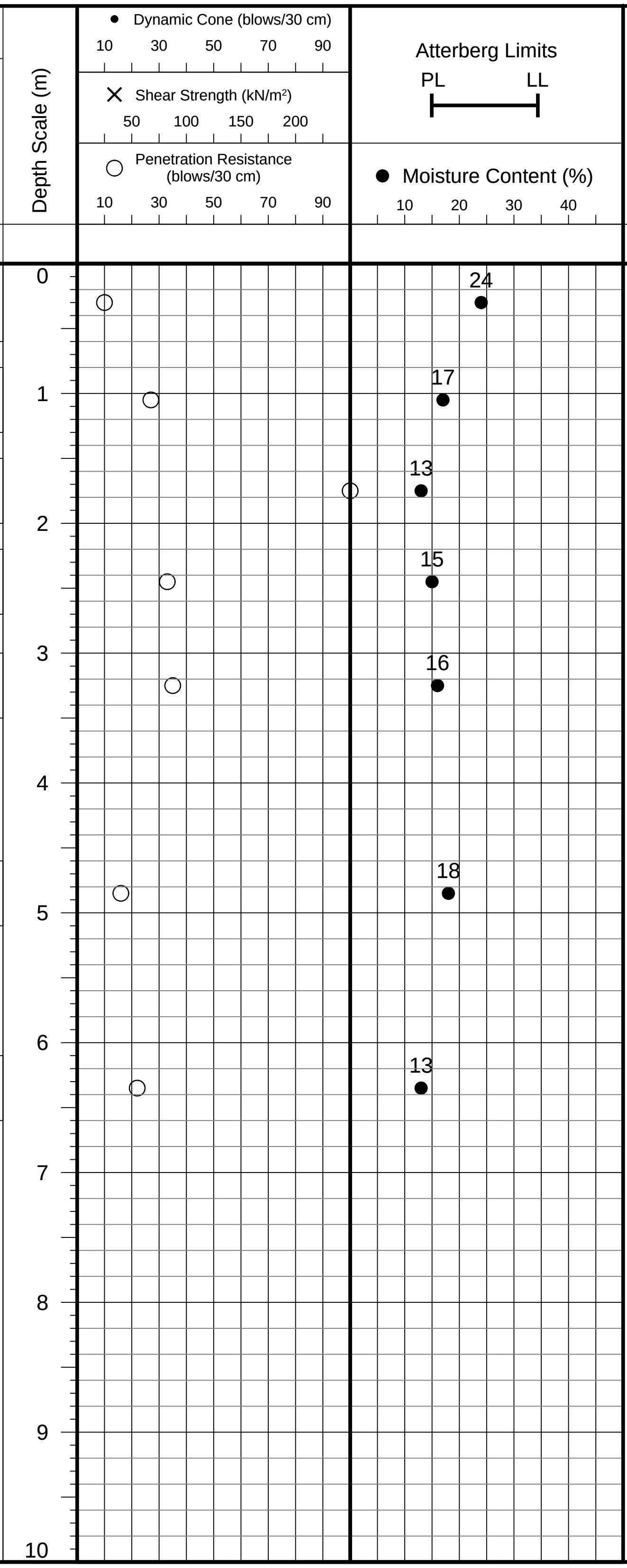
PROJECT DESCRIPTION: Proposed Mixed-Use Development

METHOD OF BORING: Flight-Auger

PROJECT LOCATION: King Street and Humber Station Road, Town of Caledon

DRILLING DATE: October 5, 2021

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	WATER LEVEL
267.2	Ground Surface				
0.0	**20 cm TOPSOIL**				Dry on completion
	Stiff to hard	1	DO	10	
	weathered				
		2	DO	27	
		3	DO	50/15	
	SILTY CLAY TILL	4	DO	33	
		5	DO	35	
	some sand, a trace of gravel occasional cobbles and boulders — brown / grey				
		6	DO	16	
		7	DO	22	
260.6 6.6	**END OF BOREHOLE**				



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JOB NO.: 2108-S069

LOG OF BOREHOLE NO.: 12

FIGURE NO.: 12

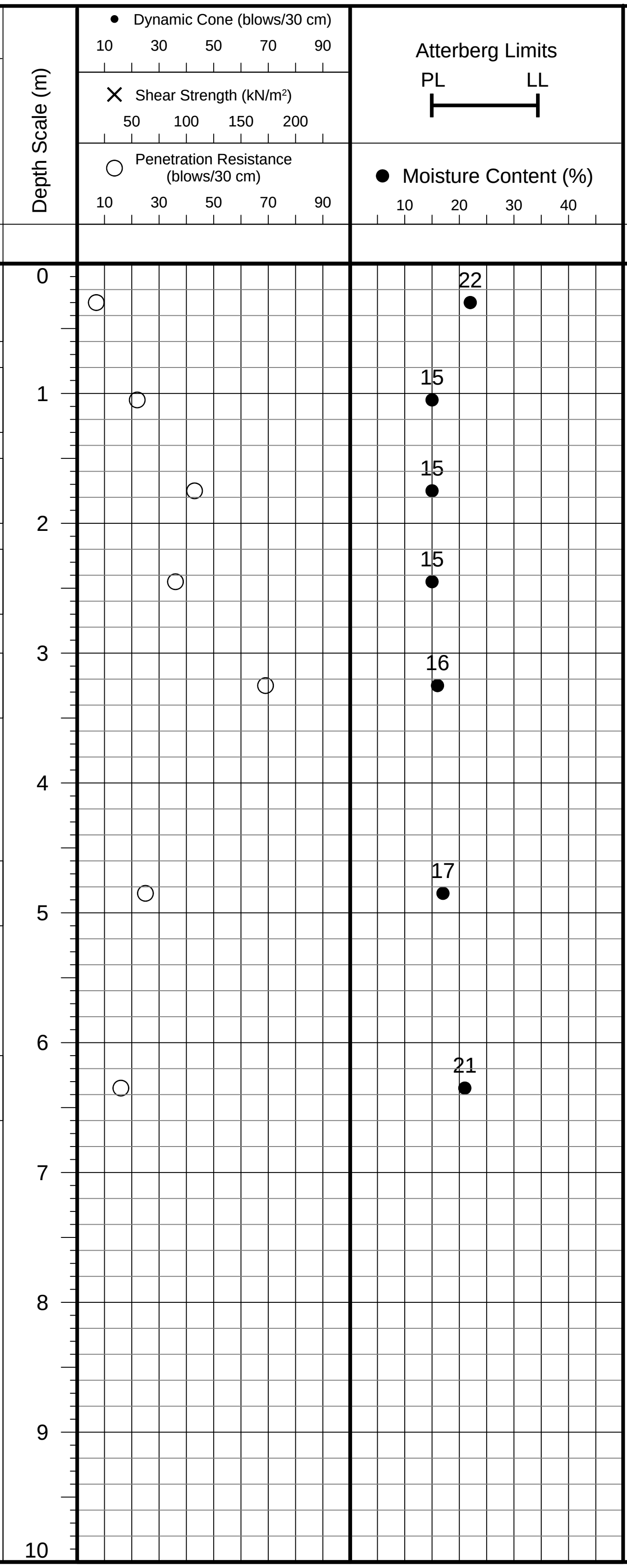
PROJECT DESCRIPTION: Proposed Mixed-Use Development

METHOD OF BORING: Flight-Auger

PROJECT LOCATION: King Street and Humber Station Road, Town of Caledon

DRILLING DATE: October 4, 2021

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
266.4	Ground Surface			
0.0	**100 mm ASPHALTIC CONCRETE** **200 mm GRANULAR FILL**	1	DO	7
	Firm to hard weathered	2	DO	22
		3	DO	43
		4	DO	36
	SILTY CLAY TILL	5	DO	69
	brown grey some sand, a trace of gravel occasional cobbles and boulders	6	DO	25
		7	DO	16
259.8 6.6	**END OF BOREHOLE**			



WATER LEVEL

Dry on completion

Soil Engineers Ltd.

JOB NO.: 2108-S069

LOG OF BOREHOLE NO.: 13

FIGURE NO.: 13

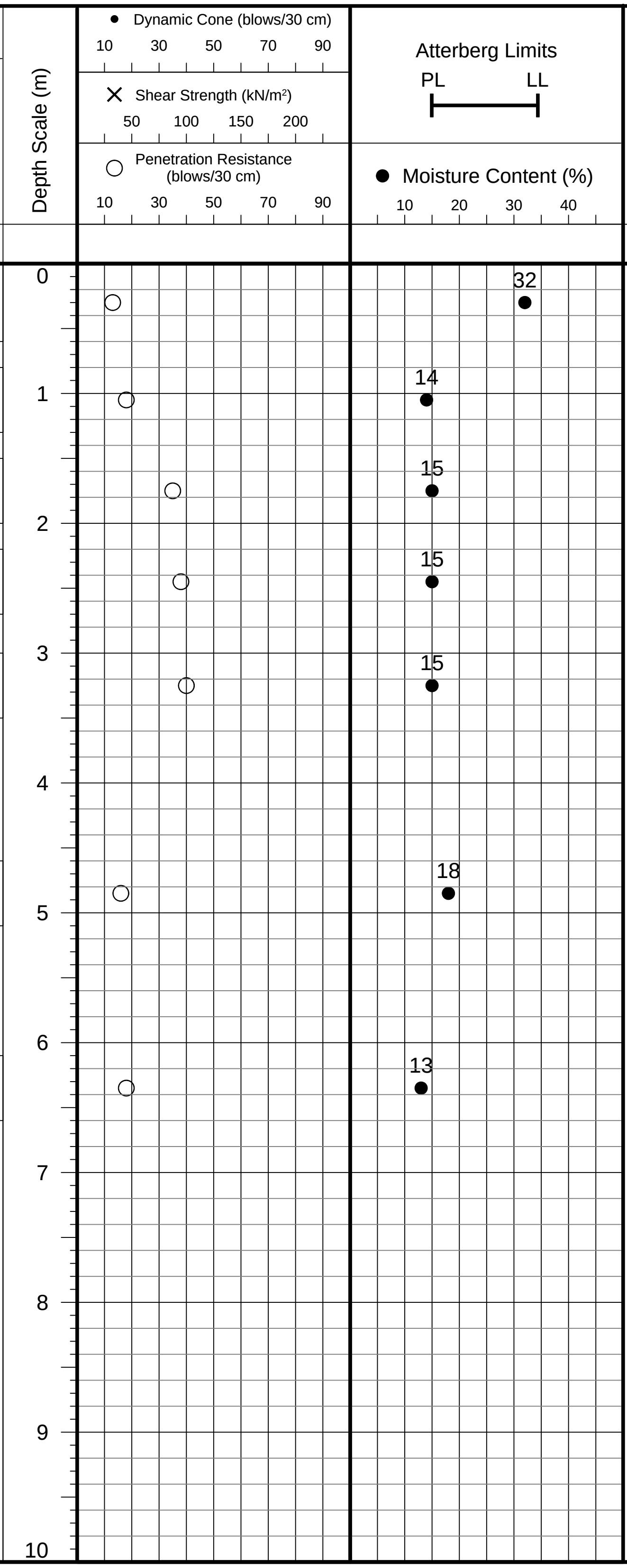
PROJECT DESCRIPTION: Proposed Mixed-Use Development

METHOD OF BORING: Flight-Auger

PROJECT LOCATION: King Street and Humber Station Road, Town of Caledon

DRILLING DATE: October 1, 2021

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
265.8	Ground Surface			
0.0	**60 cm TOPSOIL**	1	DO	13
	Very stiff to hard weathered	2	DO	18
		3	DO	35
		4	DO	38
	SILTY CLAY TILL	5	DO	40
	brown grey some sand, a trace of gravel occasional cobbles and boulders			
		6	DO	16
		7	DO	18
259.2 6.6	**END OF BOREHOLE**			



WATER LEVEL

Dry on completion

Soil Engineers Ltd.

JOB NO.: 2108-S069

LOG OF BOREHOLE NO.: 14

FIGURE NO.: 14

PROJECT DESCRIPTION: Proposed Mixed-Use Development

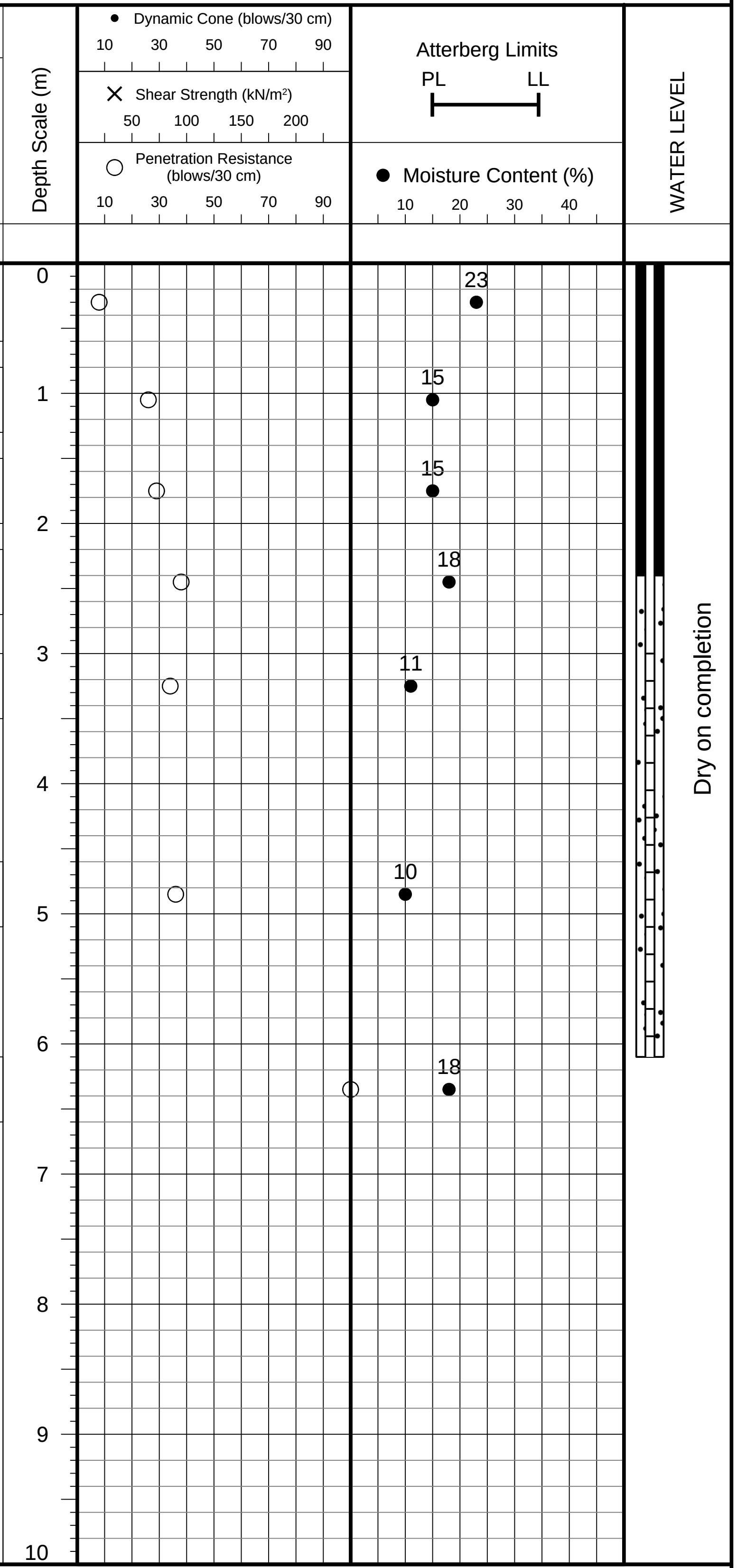
METHOD OF BORING: Flight-Auger

PROJECT LOCATION: King Street and Humber Station Road, Town of Caledon

DRILLING DATE: October 4, 2021

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
267.8 0.0	Ground Surface			
	60 cm TOPSOIL	1	DO	8
	Very stiff to hard weathered	2	DO	26
		3	DO	29
		4	DO	38
	SILTY CLAY TILL	5	DO	34
	brown grey some sand, a trace of gravel occasional cobbles and boulders	6	DO	36
		7	DO	87/23
261.2 6.6	**END OF BOREHOLE**			

Installed 50 mm Ø monitoring well to 6.1 m
completed with 3.1 m screen
Sand backfill from 2.4 to 6.1 m
Bentonite seal from 0.0 m to 2.4 m
Provided with a monument steel casing



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JOB NO.: 2108-S069

LOG OF BOREHOLE NO.: 15

FIGURE NO.: 15

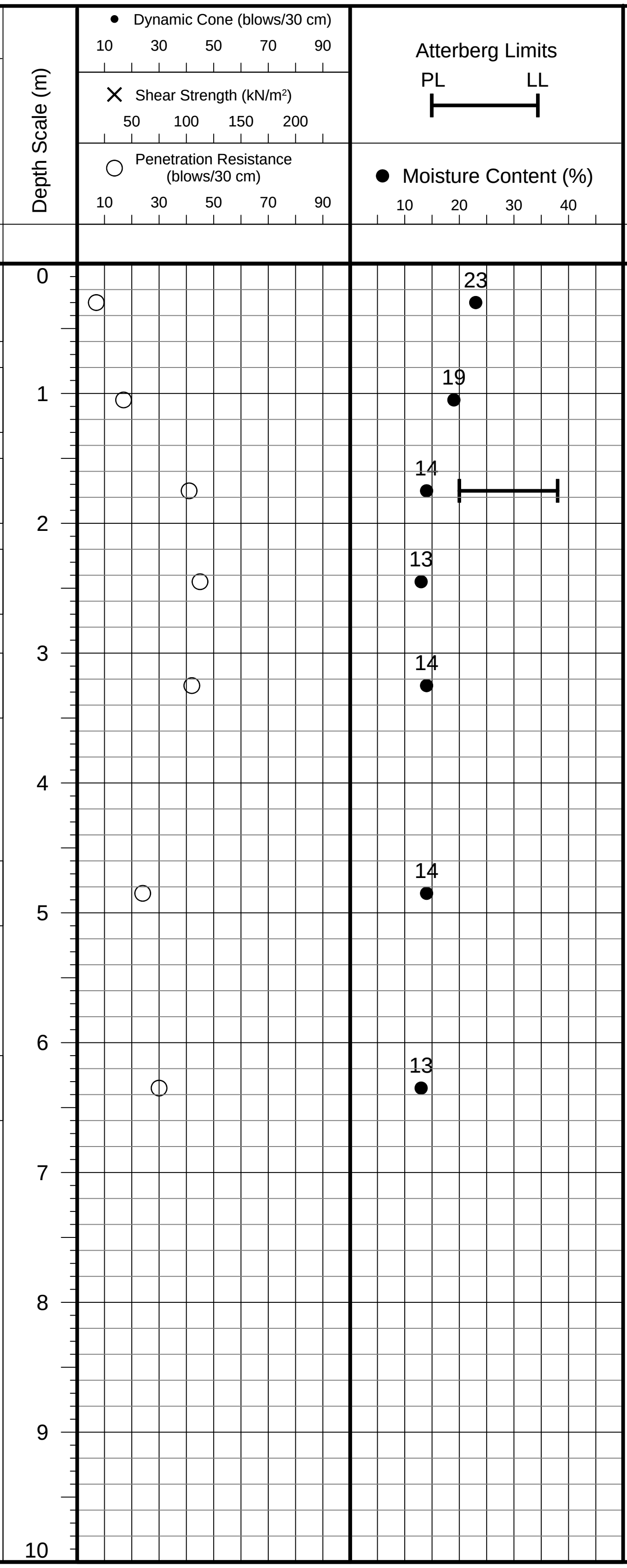
PROJECT DESCRIPTION: Proposed Mixed-Use Development

METHOD OF BORING: Flight-Auger

PROJECT LOCATION: King Street and Humber Station Road, Town of Caledon

DRILLING DATE: October 1, 2021

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	WATER LEVEL
266.2 0.0	Ground Surface				
	60 cm TOPSOIL	1	DO	7	Dry on completion
	Very stiff to hard weathered	2	DO	17	
		3	DO	41	
		4	DO	45	
	SILTY CLAY TILL	5	DO	42	
	brown grey some sand, a trace of gravel occasional cobbles and boulders				
		6	DO	24	
259.6 6.6		7	DO	30	
	END OF BOREHOLE				



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JOB NO.: 2108-S069

LOG OF BOREHOLE NO.: 16

FIGURE NO.: 16

PROJECT DESCRIPTION: Proposed Mixed-Use Development

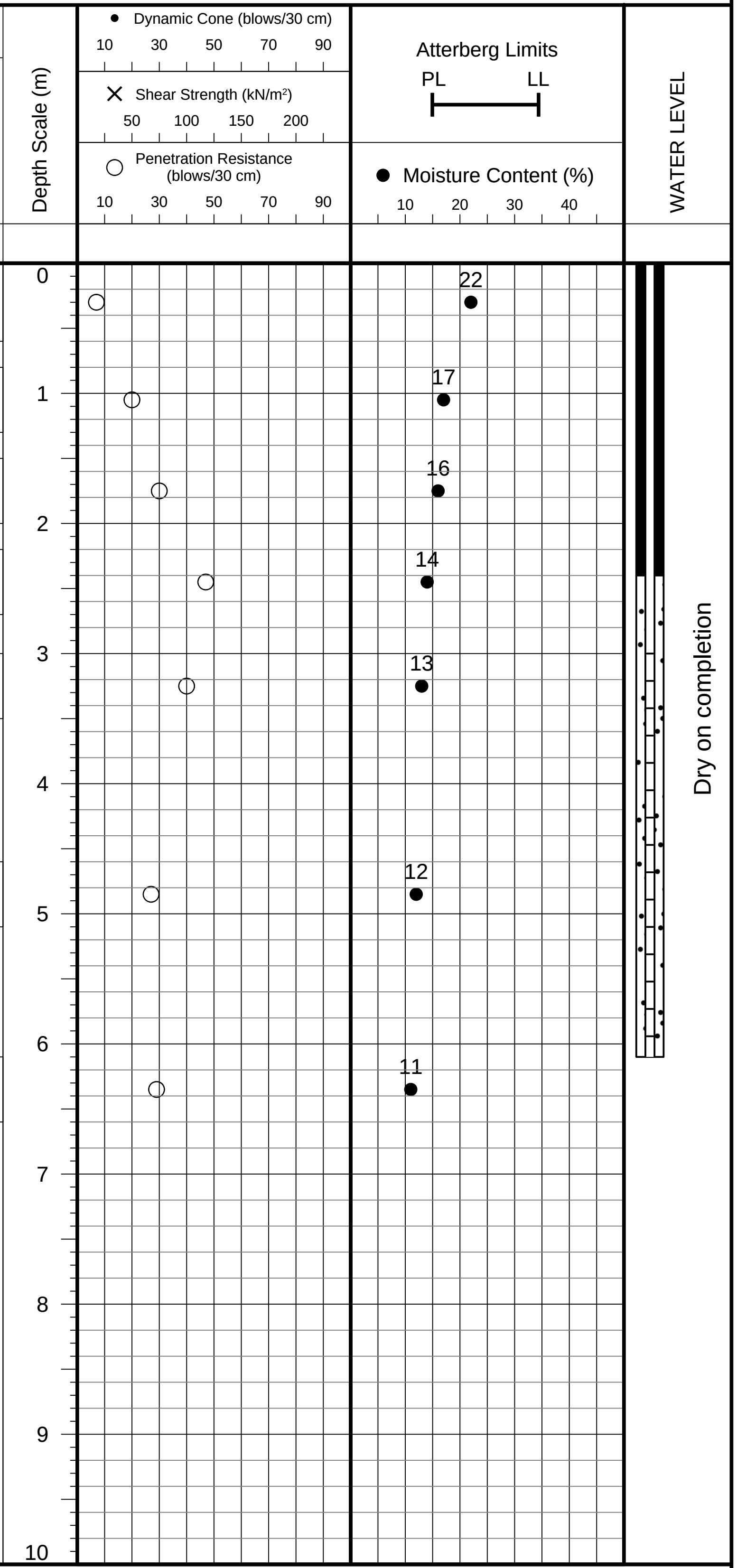
METHOD OF BORING: Flight-Auger

PROJECT LOCATION: King Street and Humber Station Road, Town of Caledon

DRILLING DATE: October 1, 2021

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
266.0	Ground Surface			
0.0	**60 cm TOPSOIL**	1	DO	7
	Very stiff to hard weathered	2	DO	20
		3	DO	30
		4	DO	47
	SILTY CLAY TILL brown grey	5	DO	40
	some sand, a trace of gravel occasional cobbles and boulders	6	DO	27
		7	DO	29
259.4 6.6	**END OF BOREHOLE**			

Installed 50 mm Ø monitoring well to 6.1 m
completed with 3.1 m screen
Sand backfill from 2.4 to 6.1 m
Bentonite seal from 0.0 m to 2.4 m
Provided with a monument steel casing



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JOB NO.: 2108-S069

LOG OF BOREHOLE NO.: 17

FIGURE NO.: 17

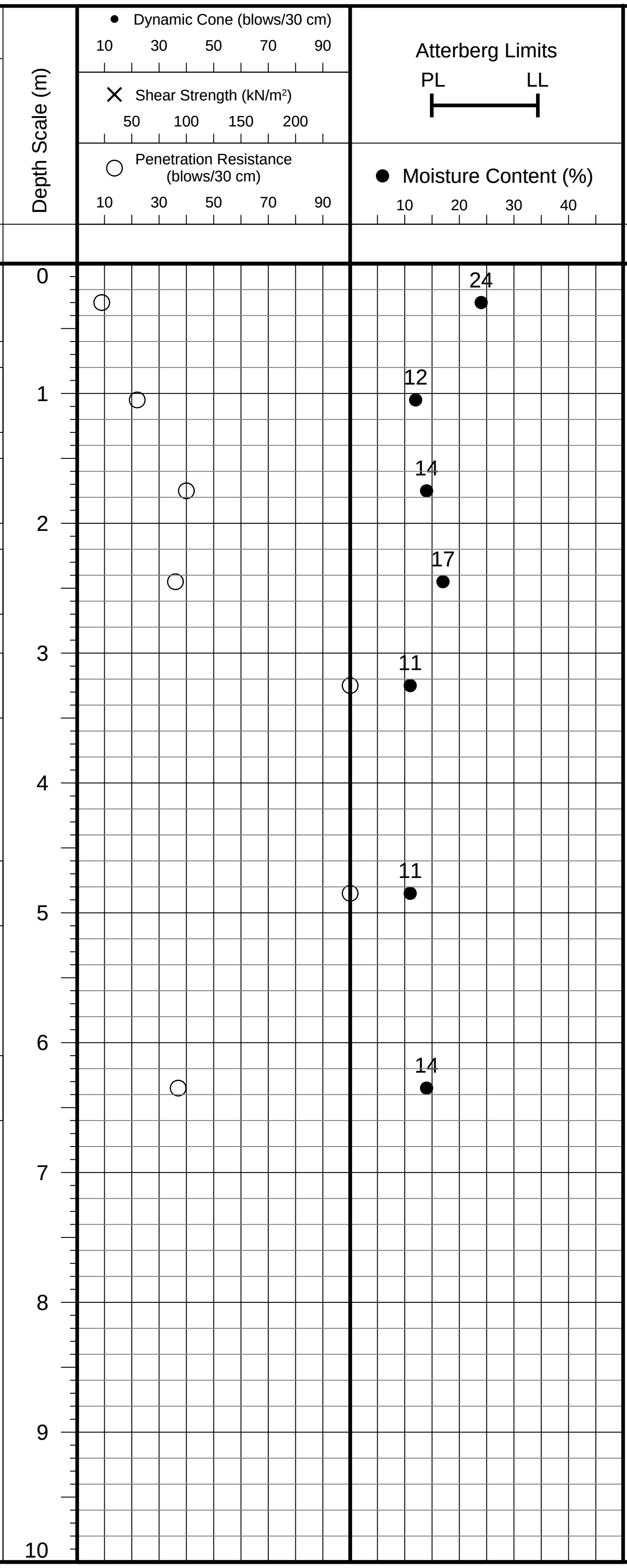
PROJECT DESCRIPTION: Proposed Mixed-Use Development

METHOD OF BORING: Flight-Auger

PROJECT LOCATION: King Street and Humber Station Road, Town of Caledon

DRILLING DATE: October 1, 2021

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
266.2	Ground Surface			
0.0	**60 cm TOPSOIL**	1	DO	9
	Brown, stiff to hard weathered	2	DO	22
	SILTY CLAY TILL	3	DO	40
	some sand, a trace of gravel occasional cobbles and boulders	4	DO	36
263.3 2.9	Dense to very dense	5	DO	50/13
	brown grey **SANDY SILT TILL**	6	DO	93/28
	traces of clay and gravel occasional cobbles and boulders	7	DO	37
259.6 6.6	**END OF BOREHOLE**			



WATER LEVEL

W.L. @ El. 260.1 m on completion ∇

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JOB NO.: 2108-S069

LOG OF BOREHOLE NO.: 18

FIGURE NO.: 18

PROJECT DESCRIPTION: Proposed Mixed-Use Development

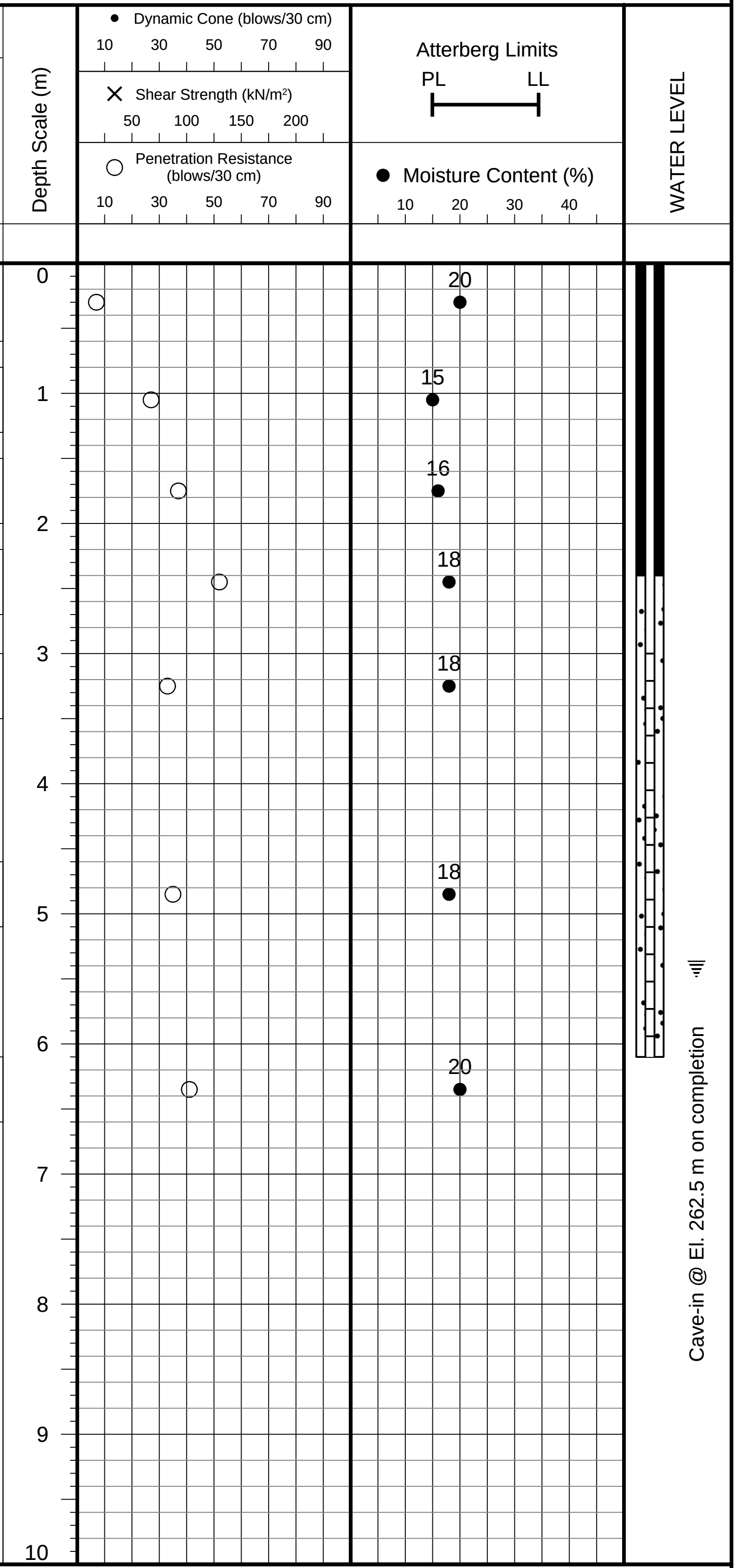
METHOD OF BORING: Flight-Auger

PROJECT LOCATION: King Street and Humber Station Road, Town of Caledon

DRILLING DATE: October 1, 2021

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	Moisture Content (%)
265.8	Ground Surface				
0.0	**20 cm TOPSOIL**				
	Firm to hard	1	DO	7	20
	weathered				
	SILTY CLAY TILL	2	DO	27	15
		3	DO	37	16
	some sand, a trace of gravel occasional cobbles and boulders	4	DO	52	18
262.9 2.9	Dense	5	DO	33	18
	SANDY SILT brown / grey				
	a trace of clay wet	6	DO	35	18
260.2 5.6	Grey, dense **SAND** fine-grained, silty wet	7	DO	41	20
259.2 6.6	**END OF BOREHOLE**				

Installed 50 mm Ø monitoring well to 6.1 m
completed with 3.1 m screen
Sand backfill from 2.4 to 6.1 m
Bentonite seal from 0.0 m to 2.4 m
Provided with a monument steel casing



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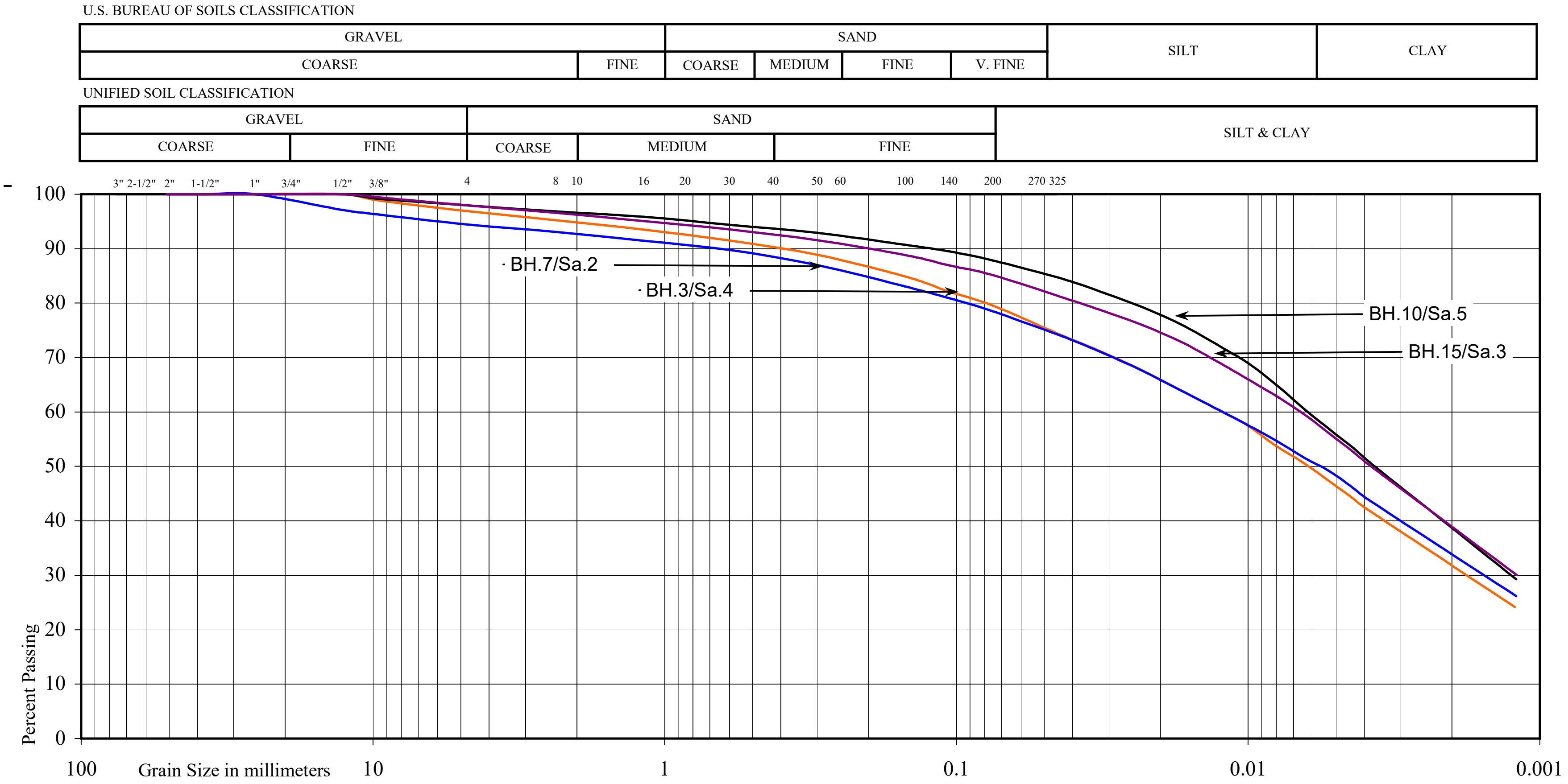
GRAIN SIZE DISTRIBUTION

Reference No: 2108-S069



Project: Proposed Mixed-Use Development

Location: King Street and Humber Station Road

Town of Caledon

Borehole No:	3	7	10	15
Sample No:	4	2	5	3
Depth (m):	2.5	1.1	3.3	1.8
Elevation (m):	263.8	265.5	264.3	264.4

BH./Sa.	3/4	7/2	10/5	15/3
Liquid Limit (%) =	35	36	40	38
Plastic Limit (%) =	19	19	21	20
Plasticity Index (%) =	16	17	19	18
Moisture Content (%) =	12	17	17	14
Estimated Permeability (cm./sec.) =	10^{-5}	10^{-6}	10^{-7}	10^{-8}

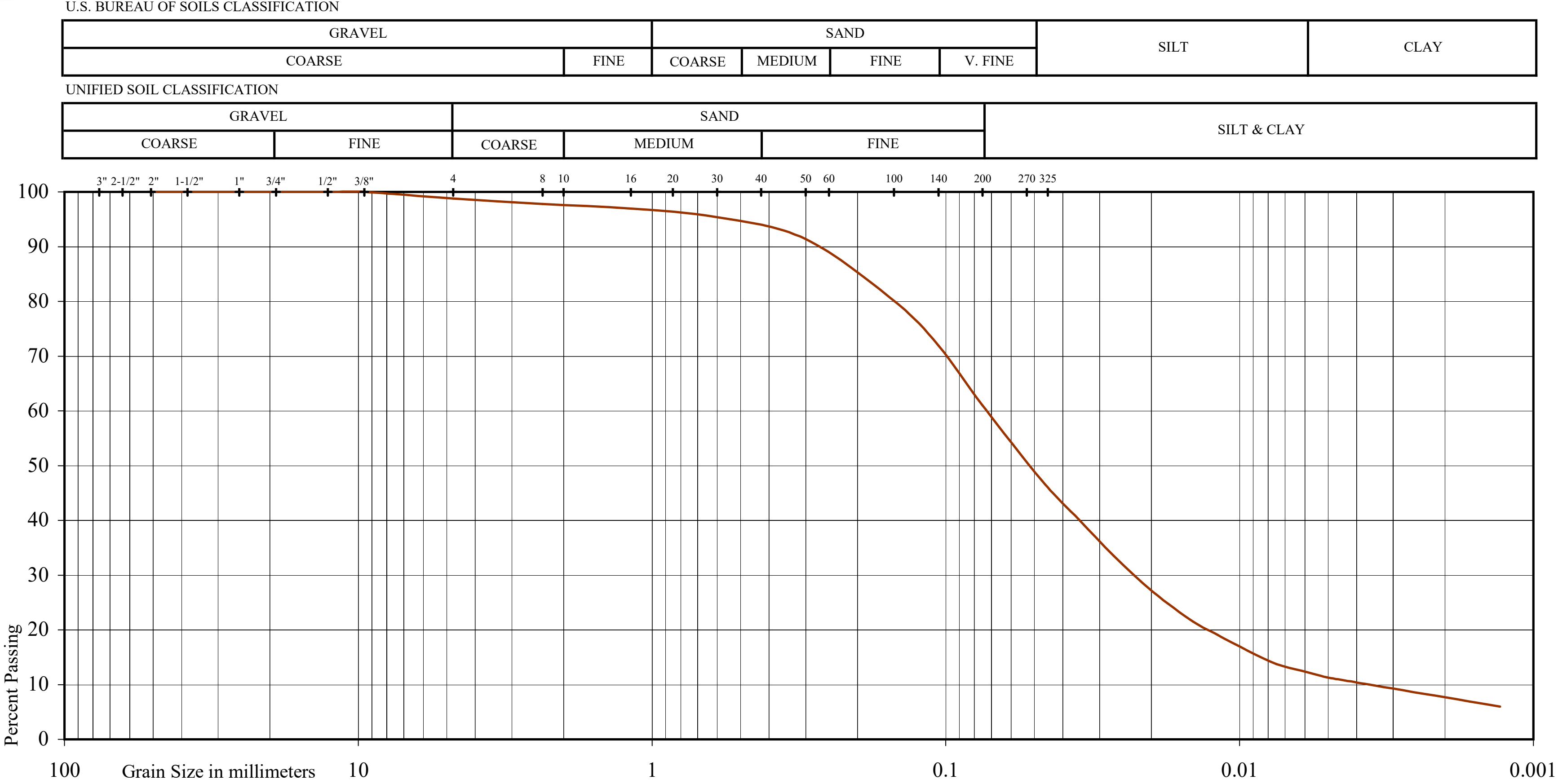
Classification of Sample [& Group Symbol]: SILTY CLAY TILL
some sand, a trace of gravel

Figure 19

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 2108-S069



Project:	Proposed Mixed-Use Development		
Location:	King Street and Humber Station Road	Liquid Limit (%) =	-
	Town of Caledon	Plastic Limit (%) =	-
Borehole No:	17	Plasticity Index (%) =	-
Sample No:	5	Moisture Content (%) =	11
Depth (m):	3.3	Estimated Permeability	
Elevation (m):	262.9	(cm./sec.) =	10^{-6}

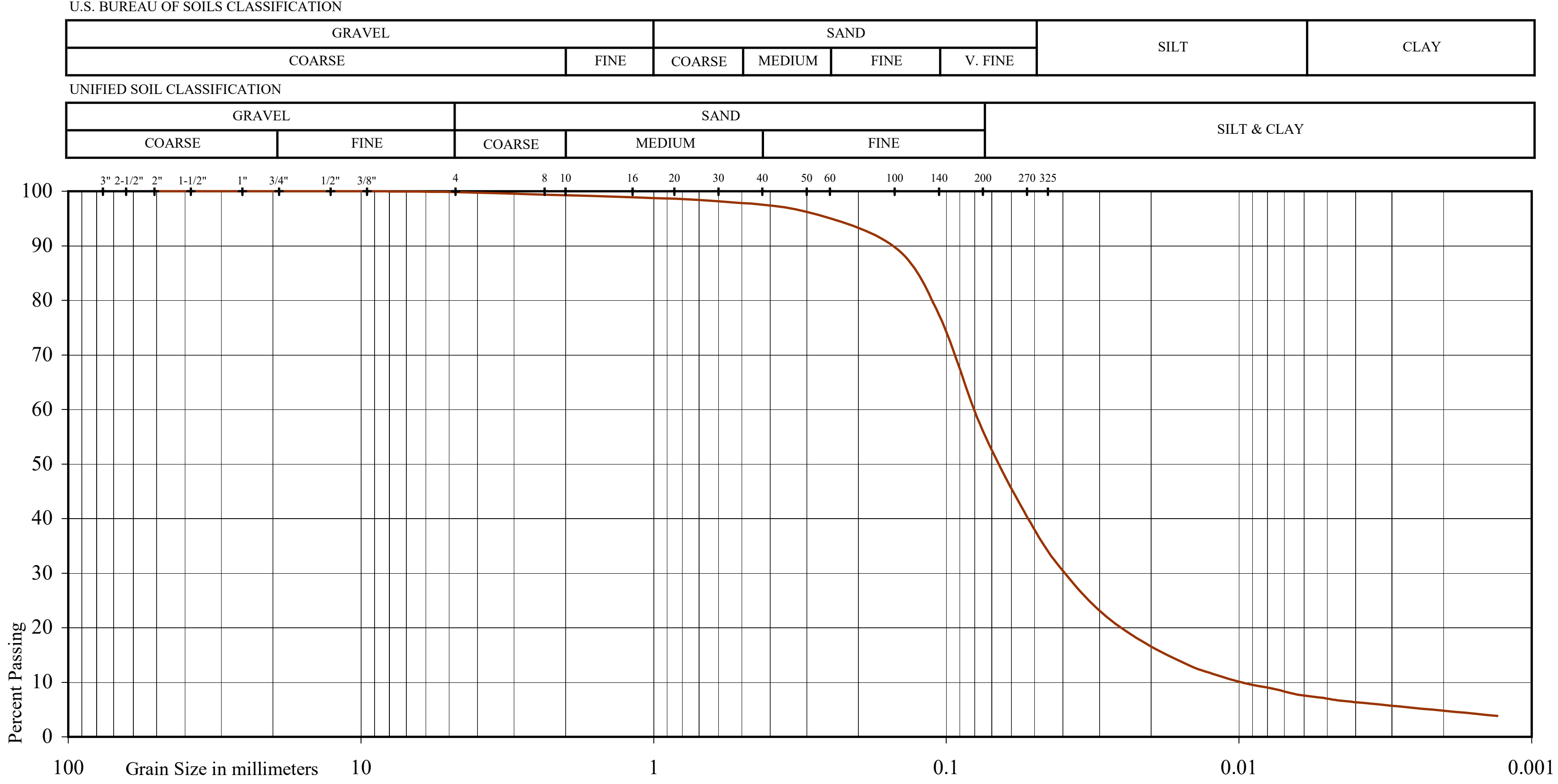
Classification of Sample [& Group Symbol]: SANDY SILT TILL
traces of clay and gravel

Figure: 20

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 2108-S069



Project: Proposed Mixed-Use Development

Location: King Street and Humber Station Road

Town of Caledon

Borehole No: 18

Sample No: 5

Depth (m): 3.3

Elevation (m): 262.5

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

Moisture Content (%) = 18

Estimated Permeability

(cm./sec.) = 10^{-4}

Classification of Sample [& Group Symbol]: SANDY SILT

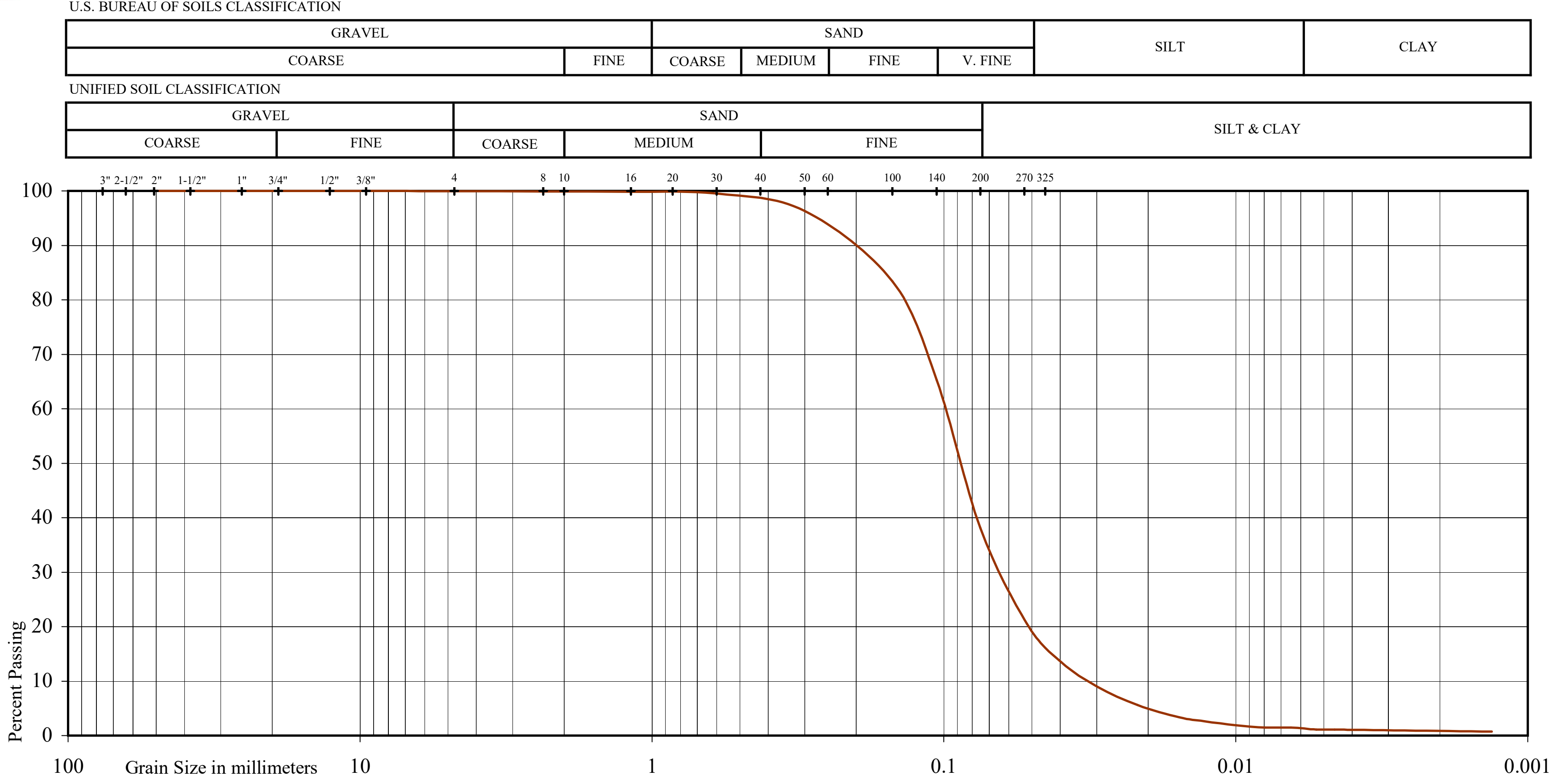
a trace of clay

Figure: 21

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 2108-S069



Project: Proposed Mixed-Use Development

Location: King Street and Humber Station Road

Town of Caledon

Borehole No: 18

Sample No: 7

Depth (m): 6.4

Elevation (m): 259.4

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

Moisture Content (%) = 20

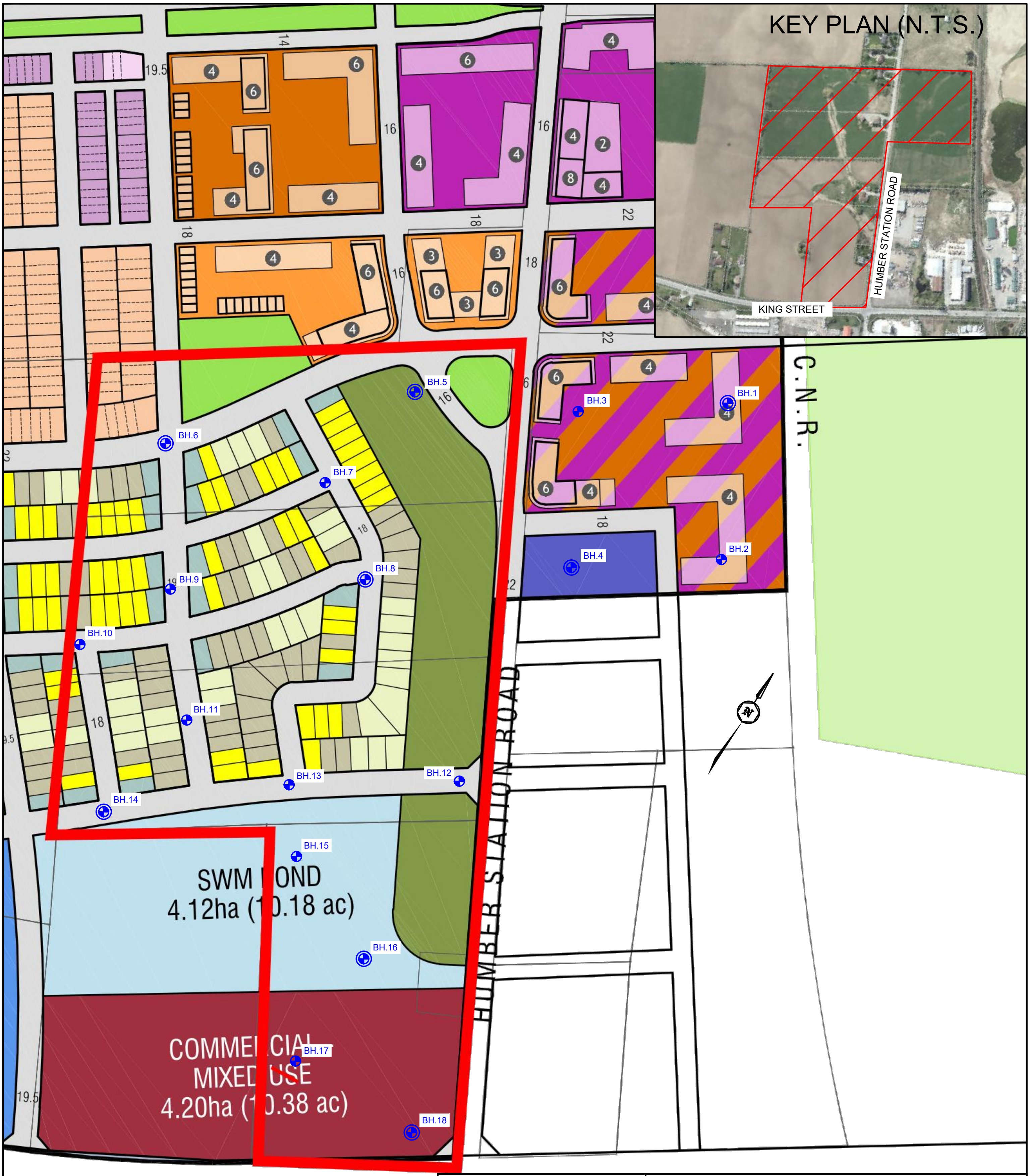
Estimated Permeability

(cm./sec.) = 10^{-3}

Classification of Sample [& Group Symbol]: SILTY FINE SAND

a trace of clay

Figure: 22



LEGEND

◉ - Borehole with monitoring well

● - Borehole

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90 WEST BEAVER CREEK ROAD, SUITE #100, RICHMOND HILL, ONTARIO L4B 1E7 · TEL: (416) 754-8515 · FAX: (905) 881-8335

BOREHOLE & MONITORING WELL LOCATION PLAN

SITE: Humber Station Road, north of King Street, Town of Caledon

DESIGNED BY: -
CHECKED BY: -
DWG NO.: 1
SCALE: 1:4000
REF. NO.: 2108-S069
DATE: December 2021
REV -

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SUBSURFACE PROFILE
DRAWING NO. 2
SCALE: AS SHOWN

JOB NO.: 2106-S069

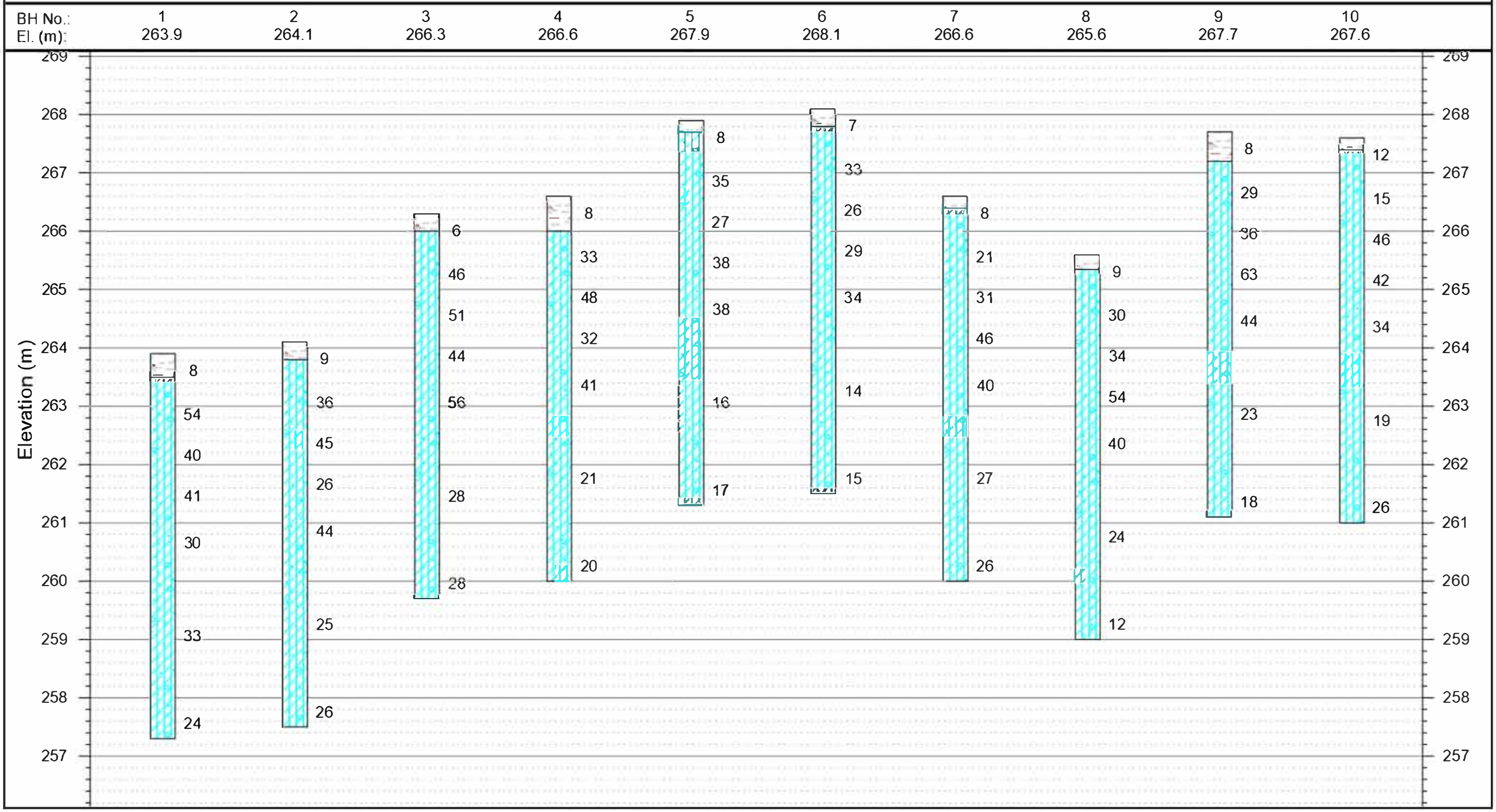
REPORT DATE: December 2021

PROJECT DESCRIPTION: Proposed Mixed-Use Development

PROJECT LOCATION: King Street and Humber Station Road, Town of Caledon

LEGEND

▨ TOPSOIL ▨ SILTY CLAY TILL



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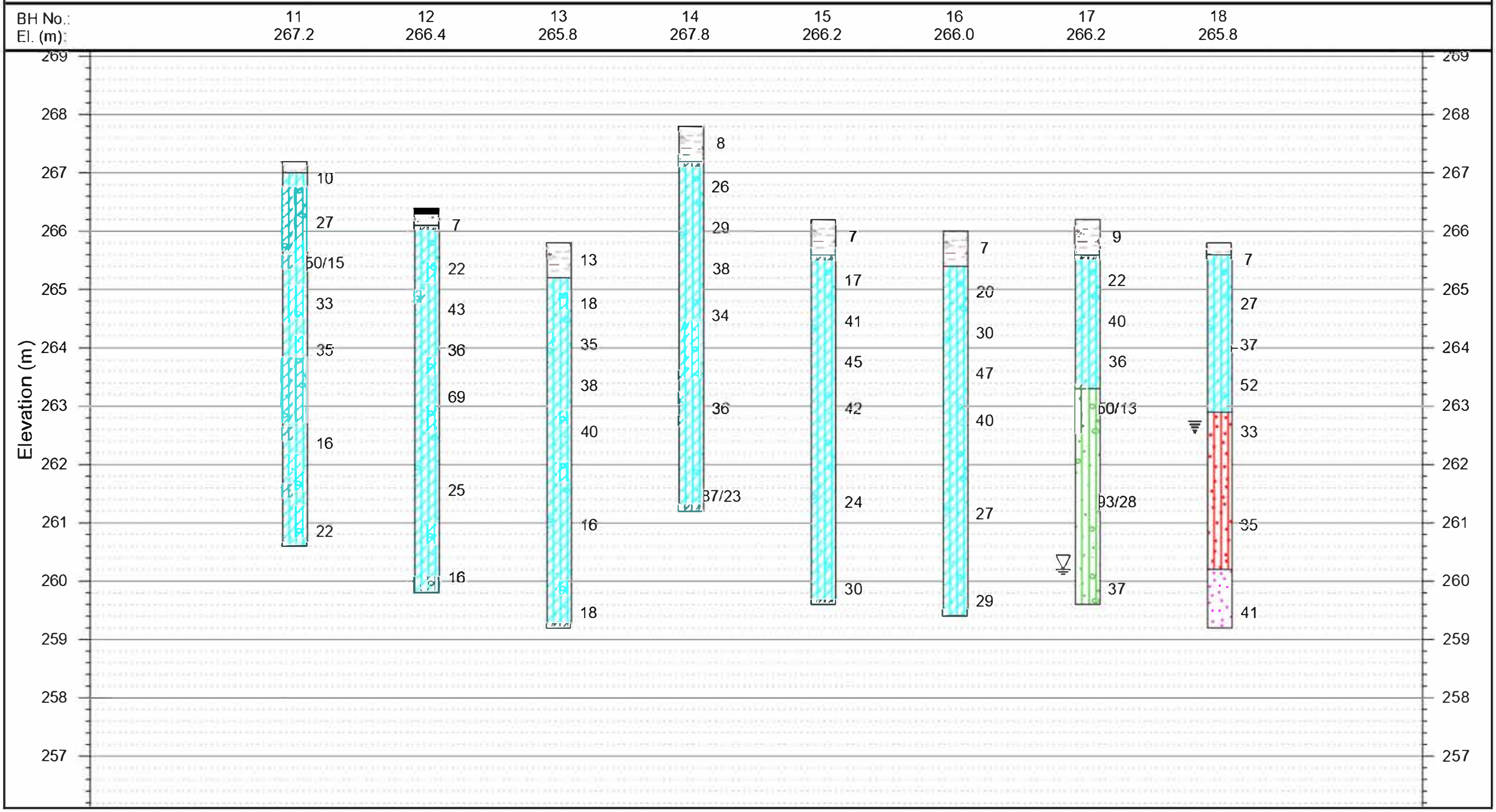
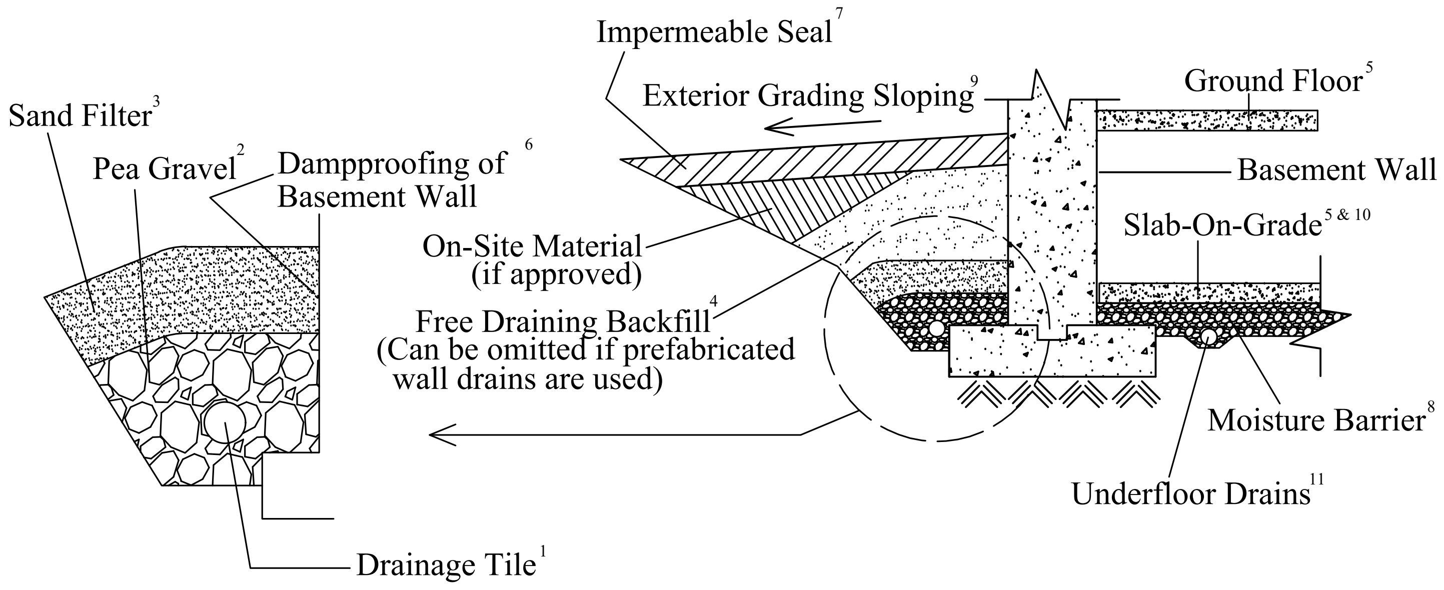
SUBSURFACE PROFILE
DRAWING NO. 3
SCALE: AS SHOWN

JOB NO.: 2108-S069
REPORT DATE: December 2021
PROJECT DESCRIPTION: Proposed Mixed-Use Development
PROJECT LOCATION: King Street and Humber Station Road, Town of Caledon

LEGEND

TOPSOIL
ASPHALT
GRANULAR
SAND
SANDY SILT
SANDY SILT TILL
SILTY CLAY TILL
WATER LEVEL (END OF DRILLING)
CAVE-IN





NOTES:

1. **Drainage tile**: consists of 100 mm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet. Invert to be at minimum of 150 mm (6") below underside of basement floor level.

2. **Pea gravel**: at 150 mm (6") on the top and sides of drain. If drain is not placed on concrete footing, provide 100 mm (4") of pea gravel below drain. The pea gravel may be replaced by 20 mm clear stone provided that the drain is covered by a porous geotextile membrane of Terrafix 270R or equivalent.

3. **Filter material**: consists of C.S.A. fine concrete aggregate. A minimum of 300 mm (12") on the top and sides of gravel. This may be replaced by an approved porous geotextile membrane of Terrafix 270R or equivalent.

4. **Free-draining backfill**: OPSS Granular 'B' or equivalent, compacted to 95% to 98% (maximum) Standard Proctor dry density. Do not compact closer than 1.8 m (6') from wall with heavy equipment. This may be replaced by on-site material if prefabricated wall drains (Miradrain) extending from the finished grade to the bottom of the basement wall are used.

5. **Do not backfill** until the wall is supported by the basement floor slab and ground floor framing, or adquate bracing.

6. **Dampproofing** of the basement wall is required before backfilling

7. **Impermeable backfill seal** of compacted clay, clayey silt or equivalent. If the original soil in the vicinity is a free-draining sand, the seal may be omitted.

8. **Moisture barrier**: 20-mm clear stone or compacted OPSS Granular 'A', or equivalent. The thickness of this layer should be 150 mm (6") minimum.

9. **Exterior Grade**: slope away from basement wall on all the sides of the building.

10. **Slab-On-Grade** should not be structurally connected to walls or foundations.

11. **Underfloor drains*** should be placed in parallel rows at 6 to 8 m (20'-25') centre, on 100 mm (4") of pea gravel with 150 mm (6") of pea gravel on top and sides. The invert should be at least 300 mm (12") below the underside of the floor slab. The drains should be connected to positive sumps or outlets. Do not connect the underfloor drains to the perimeter drains.

*Underfloor drains can be deleted where not required.

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Drainage System: Permanent Perimeter Drainage

SITE Northeast Quadrant of King Street and Humber Station Road, Town of Caledon

DESIGNED BY I.A **CHECKED BY** K.H **DWG NO.** 4

SCALE N.T.S. **REF. NO.** 2108-S069 **DATE** December 2021 **REV** -