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

BARRIE	MISSISSAUGA	OSHAWA	NEWMARKET	GRAVENHURST	HAMILTON
TEL: (705) 721-7863	TEL: (905) 542-7605	TEL: (905) 440-2040	TEL: (905) 853-0647	TEL: (705) 684-4242	TEL: (905) 777-7956
FAX: (705) 721-7864	FAX: (905) 542-2769	FAX: (905) 725-1315	FAX: (905) 881-8335	FAX: (705) 684-8522	FAX: (905) 542-2769

A REPORT TO
GALATIA LANE ESTATES INC.

A GEOTECHNICAL INVESTIGATION FOR PROPOSED INDUSTRIAL DEVELOPMENT

15450 WOODBINE AVENUE

TOWN OF WHITCHURCH-STOUFFVILLE
(WESLEY CORNERS)

REFERENCE NO. 2210-S077

MARCH 2023

DISTRIBUTION

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ENCLOSURES

1.0 INTRODUCTION

In accordance with written authorization from Mr. Angelo Baldassarra of Galatia Lane Estates Inc., dated November 7, 2022, a geotechnical investigation was carried out at 15450 Woodbine Avenue in the Town of Whitchurch-Stouffville (Wesley Corners).

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

2.0 SITE AND PROJECT DESCRIPTION

The Town of Whitchurch-Stouffville is situated on the Markham till plain where drift dominates the soil stratigraphy. In places, the drift has been eroded by Peel ponding (glacial lake) and filled with glacial flow sands and lacustrine sand, silt and clay.

The subject site, 48,562.28 m^2 in area, is located in the west side of Woodbine Avenue, approximately 600 m north of Aurora Road, in the Town of Whitchurch-Stouffville. At the time of investigation, the property was a farm field with abandoned structures fronting Woodbine Avenue. The topographic sketch prepared by Holding Jones Vanderbeen Inc., indicates that the grading of the site descends towards the south and east, having a grade difference of up to 17 m.

A review of the aerial photos of the site available from the Regional Municipality of York website indicates that the western portion of the property has been previously graded between 2002 and 2006.

Based on the architectural drawings prepared by Natale Architect Inc. dated January 26, 2023, the property will be developed with a slab-on-grade industrial building with covered loading docks. The building will be provided with a paved parking lot, an outdoor storage yard and an access roadway to Woodbine Avenue. The sewage effluent for the building will be managed by a private septic system at the northeast corner of the storage yard, designed by others.

3.0 FIELD WORK

The field work, consisting of eight (8) sampled boreholes extending to a depth of 3.5 m to 11.0 m, was performed between January 27 and 31, 2023, 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 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.

The field work was supervised and the findings were recorded by a Geotechnical Technician. The geodetic ground elevation at each borehole location was obtained using the Global Navigation Satellite System (GNSS).

4.0 SUBSURFACE CONDITIONS

The boreholes were carried out on a farm field, where beneath a layer of topsoil and earth fill, the site is underlain by strata of sand, silt, sandy silt till and silty clay.

Detailed descriptions of the subsurface conditions are presented on the Borehole Logs, comprising Figures 1 to 8, inclusive. The revealed stratigraphy is plotted on the Subsurface Profile, Drawing Nos. 2 and 3. The engineering properties of the disclosed soils are discussed herein.

4.1 **Topsoil** (Boreholes 4 to 8, inclusive)

A layer of topsoil, 13 to 38 cm in thickness, was encountered at the ground surface. The topsoil is void of engineering value and must be removed for the development. It can only be reused in landscaped areas of the development and must not be buried below any structures or deeper than 1.4 m below the finished grade.

4.2 **Earth Fill** (Boreholes 2 to 8, inclusive)

Beneath the topsoil, a layer of earth fill, consisting of sandy silt and silty clay mixed with topsoil and rootlets, was contacted in all the boreholes except Borehole 1. The earth fill extends to a depth of 0.7 to 4.0 m from the prevailing ground surface.

The obtained 'N' values range from 2 to 34, with a median of 9 blows per 30 cm of penetration, indicating that the fill is was likely placed without quality control. The natural water content values range from 12% to 39%, with a median of 20%. The high water content values indicate the presence of organic material in the fill. Accordingly, four (4) earth fill samples were retrieved to determine their organic content. The results are summarized in Table 1.

Table 1 - Organic Content of Topsoil

Borehole No./Sample No.	**2/3**	**3/3**	**4/3**	**5/2**
Organic Content (%)	5.7	3.7	5.4	3.7

The results indicate the samples contain 3.7% to 5.7% of organic content, indicating that the fill contains organic material and is generally unsuitable for reuse in its present state.

4.3 **Silt** (Boreholes 1, 2, 3, 4, 5 and 8)

The native silt was encountered in 6 of the 8 boreholes, beneath the earth fill, sand, silty clay, and/or sandy silt till and extended to the investigated depths of 3.5 to 9.5 m below grade. Grain size analyses were performed on four (4) samples of the silt; the results are plotted on Figure 9.

The silt samples are very moist to wet, as confirmed by the natural water content ranging from 14% to 26%, with a median of 20%. The silt is generally water bearing.

The obtained 'N' values ranges from 11 to 60, with a median of 24 blows per 30 cm of penetration, indicating the silt deposit is compact to very dense, being generally compact in relative density.

The engineering properties of the silt deposit are presented below:

- High frost susceptibility

- High water erodibility; it is susceptible to fine migration under seepage condition.
- It has a high water capillarity and water retention capacity.
- The wet silt is susceptible to impact disturbance, which will cause built up of pore water pressure, resulting in soil dilation and reduction in shear strength.
- In excavation, the wet silt will slough, run with water seepage and boil with a piezometric head of 0.4 m.

4.4 **Sandy Silt Till** (Boreholes 1, 2, 4 and 7)

The sandy silt till was encountered beneath the earth fill and/or silt and extended to the maximum investigated depth of Boreholes 1, 2 and 7, between 3.5 m and 9.5 m below grade. In Borehole 4, the till was found between 2 silt layers, between 2.9 m and 4.0 m below grade. It consists of a random mixture of particle sizes ranging from clay to gravel, with sand and silt predominates the soil stratigraphy.

The obtained 'N' values of the sandy silt till range from 29 to over 100, with a median of 83 blows per 30 cm of penetration, indicating that the till is compact to very dense, being generally very dense in relative density.

The natural water content values range from 7% to 15%, with a median of 9%, showing that the sandy silt till is generally in moist to very moist conditions.

The engineering properties of the sandy silt till are presented below:

- Highly frost susceptible and low water erodibility.
- In excavation, the till will be stable in steep cuts. However, local sloughing and sheet collapse may occur under prolonged exposure.

4.5 **Sand** (Boreholes 1 and 6)

The native sand stratum was encountered at the surface in Borehole 1 and below the earth fill in Borehole 6. It consists of fine-grained sand with some silt. Grain size analysis was performed on a representative sample of the sand; the result is plotted on Figure 10.

The natural water content values of the sand are 4% and 12%, showing that the sand is in a damp to wet conditions. The sand encountered in Borehole 4 is water bearing.

The obtained ‘N’ values of 8, 16 and 21 blows per 30 cm of penetration indicates that the sand is loose to compact, being generally compact in relative density.

The engineering properties of the sand are presented below:

- Low to high frost susceptibility, depending on its silt content.
- High water erodibility, it is susceptible to migration under seepage condition.
- In excavation, the sand will slough to its angle of repose, run with water seepage and will boil under a piezometric head of 0.3 m.

4.6 **Silty Clay** (Boreholes 2 and 3)

The silty clay was encountered beneath the earth fill and extended to a depth of 4.0 m below grade in Borehole 2. In Borehole 3, the silty clay was encountered beneath the silt layer and extended to the borehole depth of 10.9 m.

Grain size analysis was performed on a representative sample of the silty clay; the result is plotted on Figure 11.

The consistency of the clay is stiff to hard, generally hard, confirmed by the obtained ‘N’ values of 10 to over 100 blows, with a median of 41 blows per 30 cm of penetration.

The Atterberg Limits of the representative sample of the silty clay, and the natural water content of all the samples were determined. The results are plotted on the Borehole Logs and summarized below:

Liquid Limits	32%
Plastic Limits	18%
Natural Water Content	14% to 23% (median 20%)

The above results show that the clay is a cohesive material with medium plasticity. The natural water content generally lies below the plastic limit or between the plastic and liquid limits, confirming the consistency of the silty clay as determined by the ‘N’ values.

The engineering properties of the silty clay are presented below:

- High frost susceptibility and high soil-adfreezing potential.
- Low water erodibility.

- In excavation, the clay will be stable in relatively steep slope, but will slough under prolonged exposure.

5.0 GROUNDWATER CONDITION

All boreholes remained dry upon completion of drilling; however, seepages were encountered in the sand and silt deposit below a depth of 3.0 to 4.0 m from the prevailing ground surface in most boreholes.

6.0 DISCUSSION AND RECOMMENDATIONS

The boreholes were carried out on a farm field, where beneath a layer of topsoil, and in places, a layer of earth fill, the site is underlain by strata of sand, silt, sandy silt till and silty clay.

The boreholes remained dry and open upon completion of the fieldwork; however, seepages were encountered in the sand and silt deposits.

The conceptual site plan indicates that the property will be developed with a slab-on-grade industrial building with a covered loading dock area. It will be provided with paved parking area, an outdoor storage yard and access driveway to Woodbine Avenue. The sewage from the development will be managed by a private septic system located at the northeast corner of the storage yard.

The geotechnical findings warranting special consideration for the project are presented below:

1. The topsoil is void of engineering value and should only be reused for landscape purpose. Any surplus should be removed off site.
2. Due to the lack of quality and compaction records, the existing earth fill cannot be used to support any structure sensitive to movement. Furthermore, the fill contains relatively high organic content; therefore, it must be subexcavated to native ground, sorted free of concentrated topsoil, organics and deleterious materials, prior to be reused for structural backfill.
3. Where site grading with additional fill is required, it is economical to place an engineered fill for foundation, slab-on-grade and pavement construction.

4. The proposed building can be constructed on conventional spread and strip footings founded on engineered fill or competent native soil. The foundation subgrade must be inspected by a geotechnical engineer.

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

6.1 Site Preparation

The topsoil must be removed. It can be stockpiled on-site for reuse in landscaped areas only. Any surplus should be removed off-site.

The existing earth fill cannot be used to support any structure sensitive to movement. It should be subexcavated, sorted free of concentrated topsoil, organic or deleterious material, and compacted to the engineered fill specifications for structural uses.

In areas where the site will be re-graded with additional earth fill, the earth fill can be compacted to engineered fill specifications for construction of building foundation, pavement, and underground services. The engineering requirements for a certifiable fill are presented below:

1. After the topsoil and earth fill are removed; the subgrade must be inspected and proof-rolled prior to any fill placement. Any soft/loose soils identified should also be subexcavated.
2. Inorganic soils must be used for the fill, and they must be uniformly compacted in lifts of 20 cm to at least 98% Standard Proctor dry density (SPDD), up to the proposed finished grade. The soil moisture must be properly controlled near the optimum. Where the foundation is to be constructed immediately after the engineered fill construction, the degree of compaction must be increased to 100% SPDD.
3. 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.

4. The engineered fill must not be placed when freezing ambient temperatures occur either persistently or intermittently. This is to ensure that the fill is free of frozen soils, ice and snow.
5. 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 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.
8. Despite stringent control in the placement of the engineered fill, variations in soil type and density may occur in the engineered fill. Building foundations founded on engineered fill must be reinforced in the footings and upper section of the foundation walls, designed by a structural engineer to distribute the stress induced by the potential abrupt differential settlement.

6.2 Foundation

The proposed slab-on-grade building can be constructed on conventional footings founded in the undisturbed native soils or engineered fill. Based on the borehole findings, the recommended bearing pressures for the design of the conventional strip and spread footings are presented below:

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

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

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

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

The building foundations must meet the requirements specified in the latest Ontario Building Code. As a guide, the new building designed should be designed to resist an earthquake force using Site Classification ‘D’ (stiff soil).

The in-situ soils are high in soil ad-freezing potential. The foundation should be constructed with concrete and the perimeter foundation walls must be shielded with a polyethylene slip membrane extending to the depth of the frost penetration depth. Alternatively, the foundation wall must be backfilled with free-draining granular material, compacted to at least 95% SPDD, in lifts no more than 200 mm in thickness.

6.3 Slab-On-Grade Construction

The building subgrade for slab-on-grade construction should consist of sound native soil or engineered fill. It should be inspected and assessed by proof-rolling using a heavy roller or loaded dump truck. Where soft subgrade is identified, it should be subexcavated and replaced with inorganic material, uniformly compacted to at least 98% SPDD.

The slab should be constructed on a granular bedding of 19-mm CRL, or equivalent, compacted to 100% SPDD.

For a minimum bedding thickness of 20 cm, a Modulus of Subgrade Reaction (k_s) of 25 MPa/m can be used for slab design. The k_s value can be increased slightly with the increase of thickness in the granular bedding.

The floor slab at the entrances into the building should be insulated with 50-mm Styrofoam, or equivalent, extending 1.2 m internally. This measure is to prevent cold drafts in the winter from inducing frost action in the subgrade and causing damage to the floor slab.

The external grading must be designed to drain surface runoff away from the structure to prevent ponding of water adjacent to the structure.

6.4 Loading Docks and Concrete Aprons

In the loading dock area, the subgrade soil will be subject to freezing temperature. It is recommended that the backfill behind the loading dock should consist of non-frost susceptible granular material. In addition, a 50-mm thick rigid foam insulation should be placed behind the concrete walls exposed to freezing. The foundation walls at the truck loading docks should be designed as a retaining structure using the soil parameters presented in Section 6.9 of this report.

Concrete apron is recommended at the truck loading area and ramp. The apron should be constructed on compacted granular bedding, 300 mm in thickness, consisting of 19-mm CRL, or equivalent. Perforated subdrain, wrapped with geotextile filter fabric, should be used to drain the subsurface water around the concrete pad to prevent any excessive seasonal ground movement.

6.5 Underground Services

The subgrade for the underground services should consist of sound native soil or properly compacted, inorganic earth fill. A Class 'B' bedding, consisting of compacted 19-mm CRL, or equivalent, is recommended for the underground service construction.

Service pipes connecting into manholes and catch basins must be connected by leak-proof joints, or the joints should be wrapped with a water proof membrane, to prevent any soil penetration and upfiltration through the joints.

In order to prevent pipe floatation when the sewer trench is deluged with water derived from precipitation, a minimum soil cover of at least a diameter of the pipe should be in place at all times after completion of the pipe installation. Openings to subdrains and catch basins should be shielded with a fabric filter to prevent blockage by silting.

The on-site soils has moderate to moderately high 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 resistivities shown in Section 6.9 can be used. The proposed anode weight must meet the minimum requirements as specified by the Town of Whitchurch-Stouffville and York Region Standard.

6.6 Backfilling in Trenches and Excavated Areas

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 2 - Estimated Water Content for Compaction

Soil Type	Determined Natural Water Content (%)	Water Content (%) for Standard Proctor Compaction	
		100% (optimum)	Range for 95% or +
Existing Earth Fill	12 to 39 (median 20)	12	8 to 15
Silt	14 to 26 (median 20)	13	9 to 17
Sandy Silt Till	7 to 15 (median 9)	12	8 to 15
Sand	4 and 12	8	5 to 10
Silty Clay	14 to 23 (median 20)	18	14 to 22

Based on the above findings, portions of the native soils and inorganic earth fill are suitable for structural backfill. The soils that are too wet will require aeration by spreading them thinly on the ground during warm and dry weather, prior to reuse for structural backfill. Oversized boulders, over 15 cm, must be removed or they must be broken into pieces before reusing.

The existing earth fill should be sorted free of concentrated topsoil, organics and other deleterious materials prior to its reuse as structural backfill and/or engineered fill.

The trench backfill should be compacted to 95% SPDD. Below the floor slab, or within 1.0 m below the pavement subgrade, the compaction of the backfill should be increased to 98% SPDD. The lift of each backfill layer should either be limited to a thickness of 20 cm, or the thickness should be determined by test strips. Narrow trenches for services crossing should be cut at 1 vertical: 2 horizontal or flatter so that the backfill can be effectively compacted.

In conventional construction practice, the problem areas of pavement settlement largely occur adjacent to foundation walls, columns, manholes, catch basins and services crossings. In areas which are inaccessible to a heavy compactor, a light duty compactor can be used on imported granular backfill.

One must be aware of 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 soil 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 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 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.
- To backfill a deep trench, one must be aware that future settlement is to be expected, unless the side of the cut is flattened to at least 1 vertical:1.5 + horizontal, 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.

6.7 **Septic Bed**

A septic system is proposed at the northeast corner of the outdoor storage yard to the east of the proposed building envelope. It is understood that the design will be completed by others.

6.8 **Pavement Design**

The pavement design for light-duty parking lot, heavy duty access road and fire route is presented in Table 3.

Table 3 - Pavement Design

Course	Thickness (mm)	OPS Specifications
Asphalt Surface Course	40	HL3
Asphalt Base Course Light-Duty Parking Heavy-Duty/Fire Route	 50 100	HL8
Granular Base	150	19-mm CRL or equivalent
Granular Sub-base Light-Duty Parking Heavy-Duty/Fire Route	 300 450	50-mm CRL or equivalent

In preparation of the pavement subgrade after fine grading, the subgrade should be free of incompetent soil and it should be proof-rolled in the presence of a geotechnical technician. Any soft spot identified should be subexcavated and replaced by properly compacted inorganic earth fill. The subgrade within the 1.0 m zone below the underside of the granular base should be compacted to at least 98% SPDD with the moisture content 2% to 3% drier than the optimum.

The granular base and sub-base should be compacted to 100% of the maximum SPDD.

The pavement subgrade will suffer a strength regression if water is allowed to infiltrate prior to paving. The following measures should therefore be incorporated into the construction and pavement design:

- If the pavement is to be constructed during the wet seasons and extremely soft subgrade occurs, the granular sub-base may require thickening. This can be further assessed during construction.
- Along the perimeter where surface runoff may drain onto the pavement, or water may seep into the granular base, a swale or intercept subdrain system should be installed to prevent infiltrating precipitation from seeping into the granular bases (since this may inflict frost damage on the flexible pavement).
- Subdrains consisting of filter-wrapped weepers should be installed in the low spots and they should be connected to the catch basins or storm manholes in the paved areas. The subdrains should be backfilled with free-draining granular material.

6.9 Soil Parameters

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

Table 4 - Soil Parameters

Unit Weight and Bulk Factor	**Bulk Unit Weight (kN/m^3)**	**Estimated Bulk Factor**	
		Loose	**Compacted**
Sandy Silt Till	22.0	1.33	1.05
Existing Earth Fill	21.0	1.20	1.00
Sand/Silt	20.5	1.20	1.00
Silty Clay	20.5	1.30	1.00

Lateral Earth Pressure Coefficients	**Active K_a**	**At Rest K_0**	**Passive K_p**
Compacted Earth Fill/Silty Clay	0.40	0.55	2.50
Sand/Sandy Silt Till	0.29	0.46	3.39
Silt	0.33	0.50	3.00

Estimated Coefficient of Permeability (K) and Percolation Time (T)	**K (cm/sec)**	**T (min/cm)**
Sand	10^{-3}	8
Silt	10^{-4} to 10^{-6}	12 to 50
Sandy Silt Till	10^{-6}	50
Silty Clay	10^{-7}	> 80

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

Estimated Electrical Resistivity	**ohm·cm**
Sand	5000
Silt	4000
Sandy Silt Till	4500
Silty Clay	3500

6.10 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
Sandy Silt Till	2
Earth Fill, Silty Clay, Drained Sand and Silt	3
Wet Sand and Silt	4

In excavation, the yield of the groundwater seepage, if any, in the till and silty clay will be slow in rate and limited in quantity, and can be removed by conventional pumping from sumps. In the sand and silt, it is expected to be appreciable and persistent and will require vigorous sump pumping or well points.

7.0 LIMITATIONS OF REPORT

This report was prepared by Soil Engineers Ltd. for the account of Galatia Lane Estates Inc. and for review by its designated consultants, contractors, financial institutions, and government agencies. The material in the report reflects the judgment of Curtis Lee, B.Eng., EIT, and Kelvin Hung, 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.

SOIL ENGINEERS LTD.

Curtis Lee, B.Eng., EIT

Kelvin Hung, P.Eng.
CL/KH

LICENSED PROFESSIONAL ENGINEER
3/21/2023
K. W. K. HUNG
100124295
KH
PROVINCE OF ONTARIO

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

JOB NO.: 2210-S077

LOG OF BOREHOLE: 1

FIGURE NO.: 1

PROJECT DESCRIPTION: Proposed Industrial Development

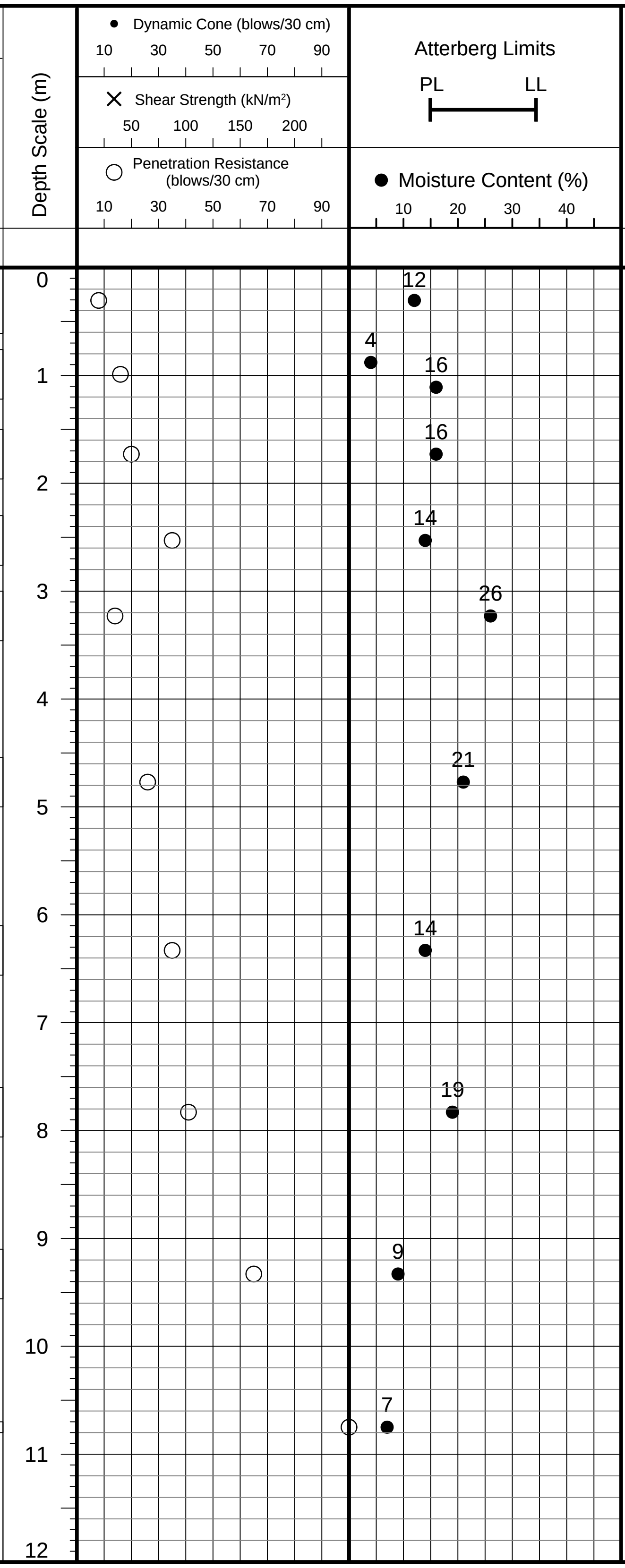
METHOD OF BORING: Solid Stem

PROJECT LOCATION: 15450 Woodbine Avenue,
Town of Whitchurch-Stouffville (Wesley Corners)

DRILLING DATE: January 31, 2023

El. (m) Depth (m)	SOIL DESCRIPTION
310.9	Ground Surface
0.0	Brown, loose to compact **SAND** fine-grained, some silt — weathered
309.9 1.0	Brown, compact to dense **SILT** occ. clay seams and layer a trace of gravel wet below 3.0 m
302.4 8.5	Brown, very dense **SANDY SILT TILL** some clay, a trace of gravel occ. cobbles and boulders
300.1 10.8	**END OF BOREHOLE**

SAMPLES		
Number	Type	N-Value
1	DO	8
2A 2B	DO	16
3	DO	20
4	DO	35
5	DO	14
6	DO	26
7	DO	35
8	DO	41
9	DO	65
10	DO	50/10



WATER LEVEL

Dry on completion

Soil Engineers Ltd.

JOB NO.: 2210-S077

LOG OF BOREHOLE: 2

FIGURE NO.: 2

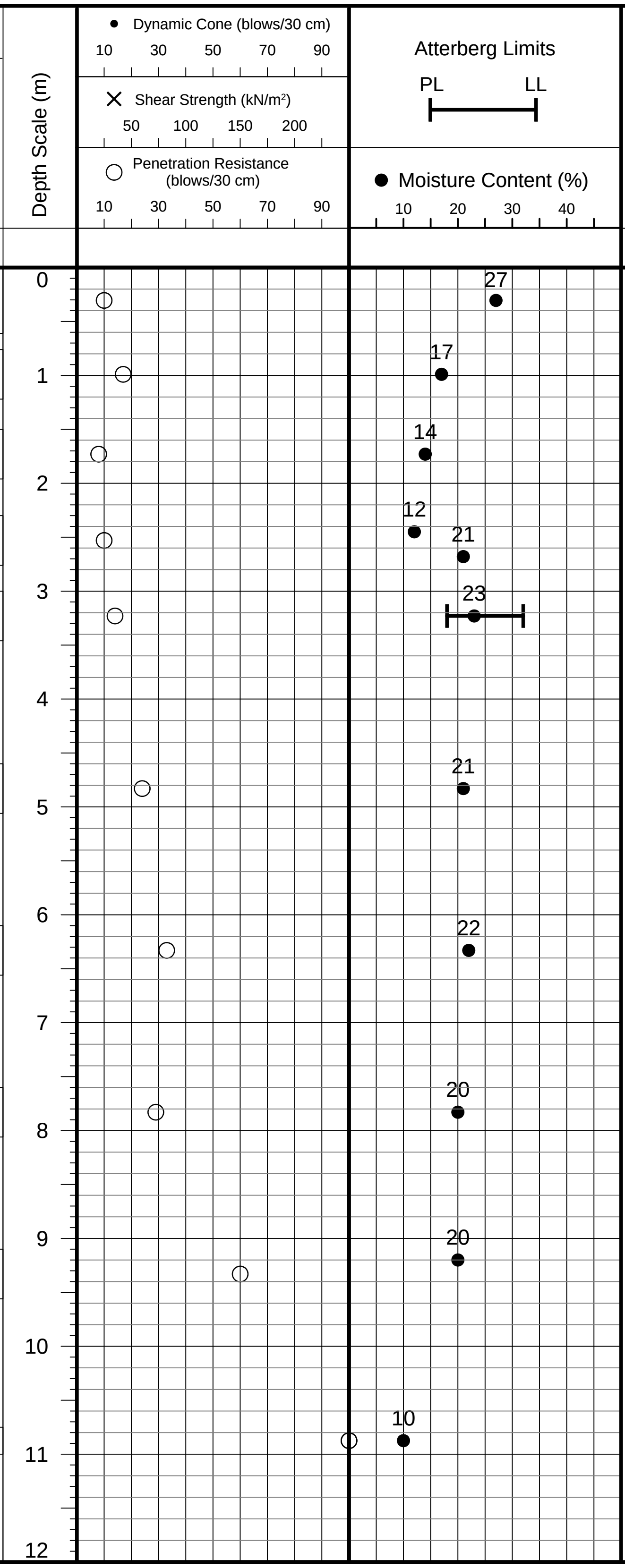
PROJECT DESCRIPTION: Proposed Industrial Development

METHOD OF BORING: Solid Stem

PROJECT LOCATION: 15450 Woodbine Avenue,
Town of Whitchurch-Stouffville (Wesley Corners)

DRILLING DATE: January 30, 2023

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
309.7	Ground Surface			
0.0	Dark brown **EARTH FILL** sandy silt mixed with topsoil with topsoil, organic inclusions and rootlets	1	DO	10
		2	DO	17
		3	DO	8
307.6 2.1	Brown **EARTH FILL** sand with clay pockets	4A	DO	10
307.1 2.6	Brown, stiff **SILTY CLAY** a trace of sand with silt layers	4B		
		5	DO	14
300.2 4.0	Brown, compact to dense **SILT** — — brown / grey traces to some clay and sand occ. clay layers, wet	6	DO	24
		7	DO	33
		8	DO	29
		9	DO	60
9.5	Brown, very dense **SANDY SILTY TILL** trace of gravel occ. cobbles and boulders	10	DO	76/25
298.7 11.0	**END OF BOREHOLE**			



WATER LEVEL

Dry on completion

Soil Engineers Ltd.

JOB NO.: 2210-S077

LOG OF BOREHOLE: 3

FIGURE NO.: 3

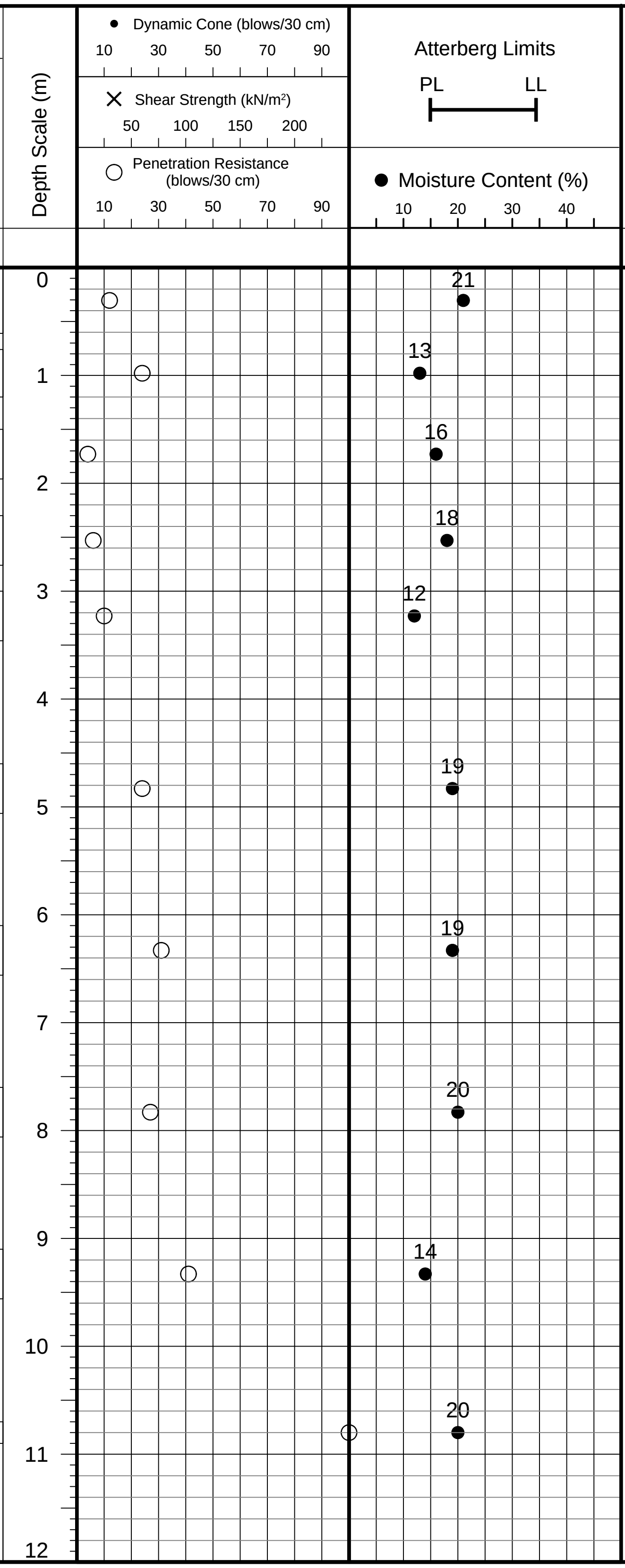
PROJECT DESCRIPTION: Proposed Industrial Development

METHOD OF BORING: Solid Stem

PROJECT LOCATION: 15450 Woodbine Avenue,
Town of Whitchurch-Stouffville (Wesley Corners)

DRILLING DATE: January 30, 2023

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	WATER LEVEL
308.4	Ground Surface				
0.0	Brown to dark brown **EARTH FILL** mixture of silty clay and sandy silt with topsoil, organic inclusions and rootlets	1	DO	12	Dry on completion
		2	DO	24	
		3	DO	4	
		4	DO	6	
		5	DO	10	
304.4 4.0	Brown, compact to dense **SILT** occ. clay seams and layer wet	6	DO	24	
		7	DO	31	
301.4 7.0	Brown, very stiff to hard **SILTY CLAY** a trace of sand with silt layers	8	DO	27	
	silt layer	9	DO	41	
		10	DO	72/23	
297.5 10.9	**END OF BOREHOLE**				



Soil Engineers Ltd.

JOB NO.: 2210-S077

LOG OF BOREHOLE: 4

FIGURE NO.: 4

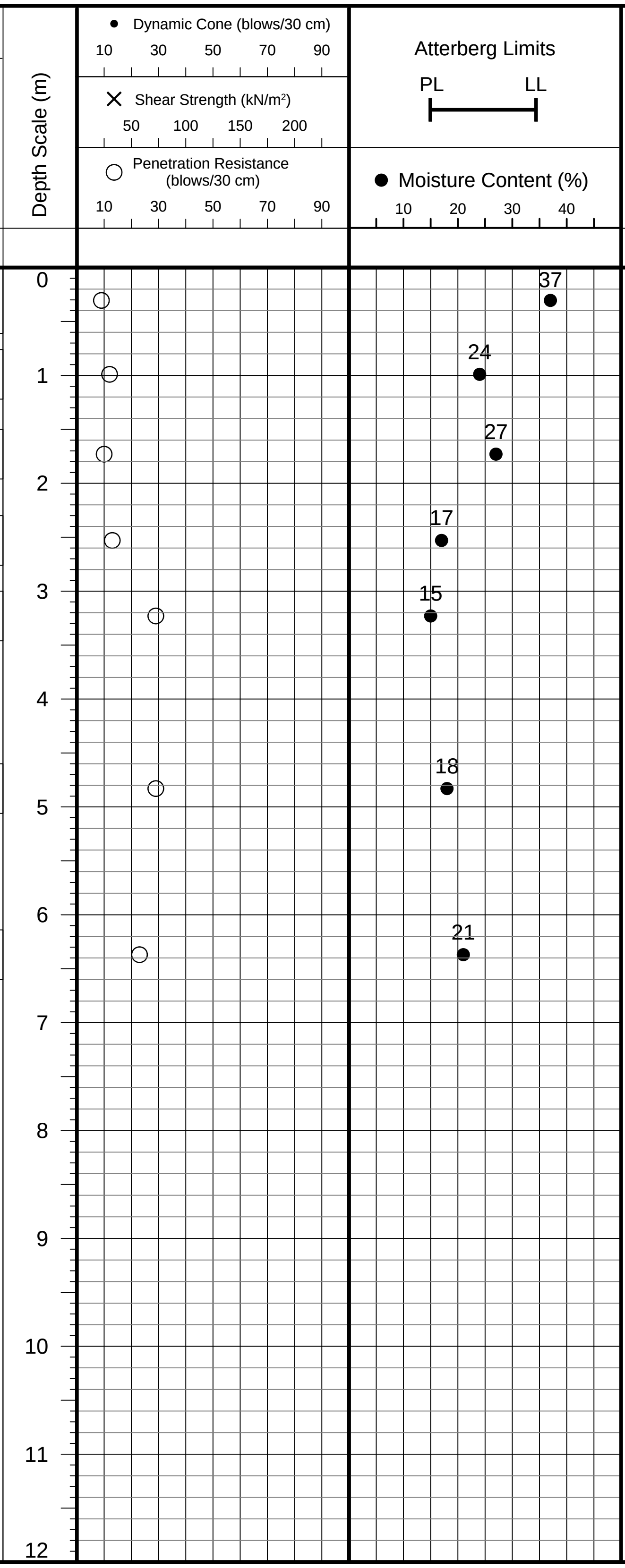
PROJECT DESCRIPTION: Proposed Industrial Development

METHOD OF BORING: Solid Stem

PROJECT LOCATION: 15450 Woodbine Avenue,
Town of Whitchurch-Stouffville (Wesley Corners)

DRILLING DATE: January 31, 2023

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
303.0	Ground Surface			
0.0	**15 cm TOPSOIL** Dark brown/brown **EARTH FILL** mixture of silty clay and sandy silt with topsoil, organic inclusions and rootlets	1 2 3	DO DO DO	9 12 10
300.9 2.1	Brown, compact **SILT** occ. clay seams and layer	4	DO	13
300.1 2.9	Brown, compact **SANDY SILTY TILL** trace of gravel occ. cobbles and boulders	5	DO	29
299.0 4.0	Brown, compact **SILT** occ. clay seams and layer wet	6 7	DO DO	29 23
296.4 6.6	**END OF BOREHOLE**			



WATER LEVEL

Dry on completion

Soil Engineers Ltd.

JOB NO.: 2210-S077

LOG OF BOREHOLE: 5

FIGURE NO.: 5

PROJECT DESCRIPTION: Proposed Industrial Development

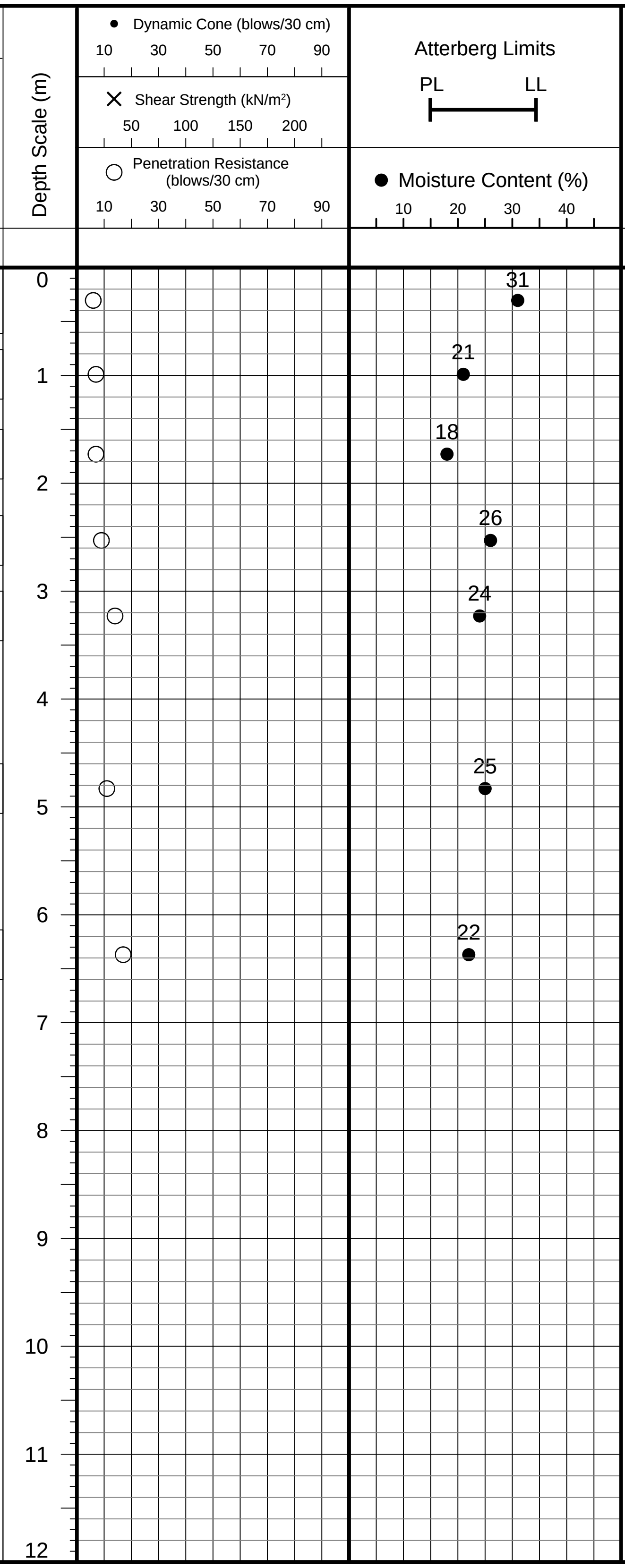
METHOD OF BORING: Solid Stem

PROJECT LOCATION: 15450 Woodbine Avenue,
Town of Whitchurch-Stouffville (Wesley Corners)

DRILLING DATE: January 27, 2023

El. (m) Depth (m)	SOIL DESCRIPTION
306.1 0.0	Ground Surface **13 cm TOPSOIL** Dark brown/brown **EARTH FILL** mixture of silty clay and sandy silt with topsoil, organic inclusions and rootlets
303.2 2.8	Brown, compact **SILT** occ. clay seams and layer wet
299.5 6.6	**END OF BOREHOLE**

SAMPLES		
Number	Type	N-Value
1	DO	6
2	DO	7
3	DO	7
4	DO	9
5	DO	14
6	DO	11
7	DO	17



WATER LEVEL

Dry on completion

Soil Engineers Ltd.

JOB NO.: 2210-S077

LOG OF BOREHOLE: 6

FIGURE NO.: 6

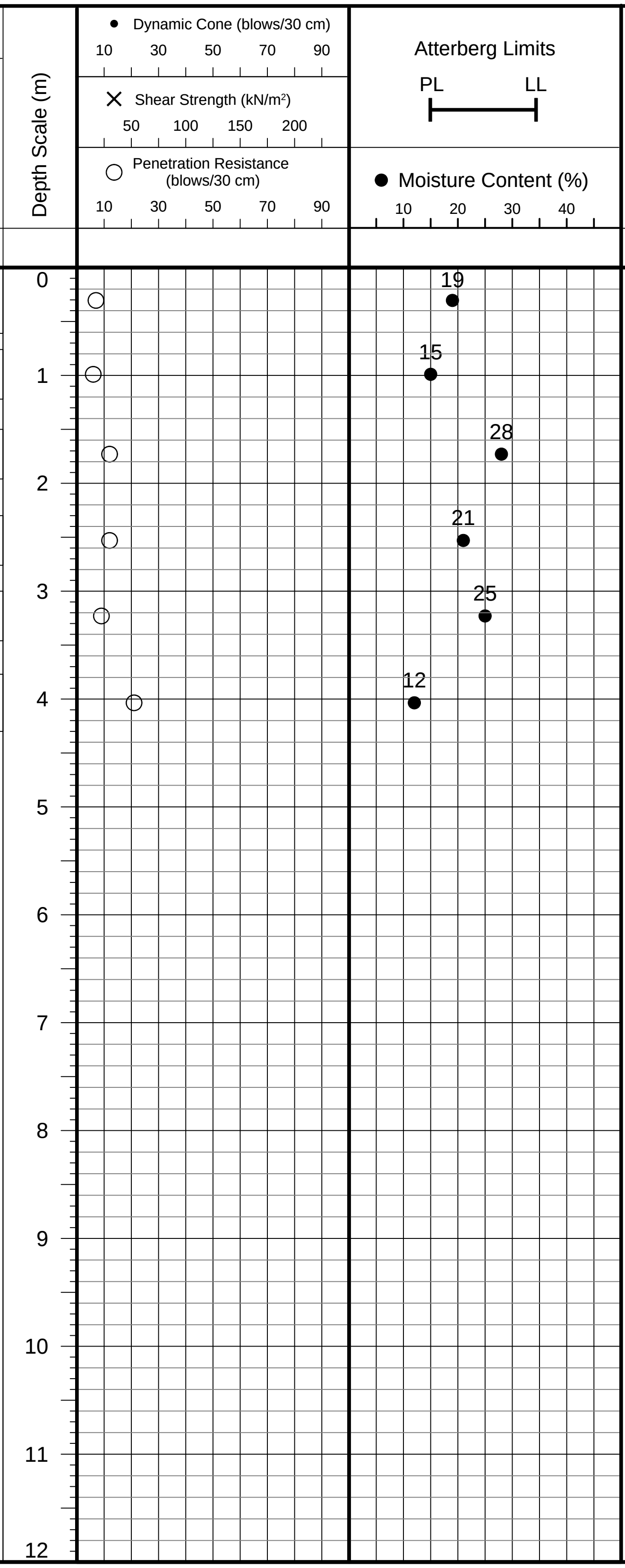
PROJECT DESCRIPTION: Proposed Industrial Development

METHOD OF BORING: Solid Stem

PROJECT LOCATION: 15450 Woodbine Avenue,
Town of Whitchurch-Stouffville (Wesley Corners)

DRILLING DATE: January 27, 2023

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
306.0 0.0	Ground Surface **15 cm TOPSOIL**			
	Dark brown to black **EARTH FILL** mixture of silty clay and sandy silt with topsoil, organic inclusions and rootlets	1	DO	7
		2	DO	6
		3	DO	12
		4	DO	12
		5	DO	9
302.3 3.7	Brown, compact **SAND** fine-grained, some silt, wet	6	DO	21
301.7 4.3	**END OF BOREHOLE**			



WATER LEVEL

Dry on completion

Soil Engineers Ltd.

JOB NO.: 2210-S077

LOG OF BOREHOLE: 7

FIGURE NO.: 7

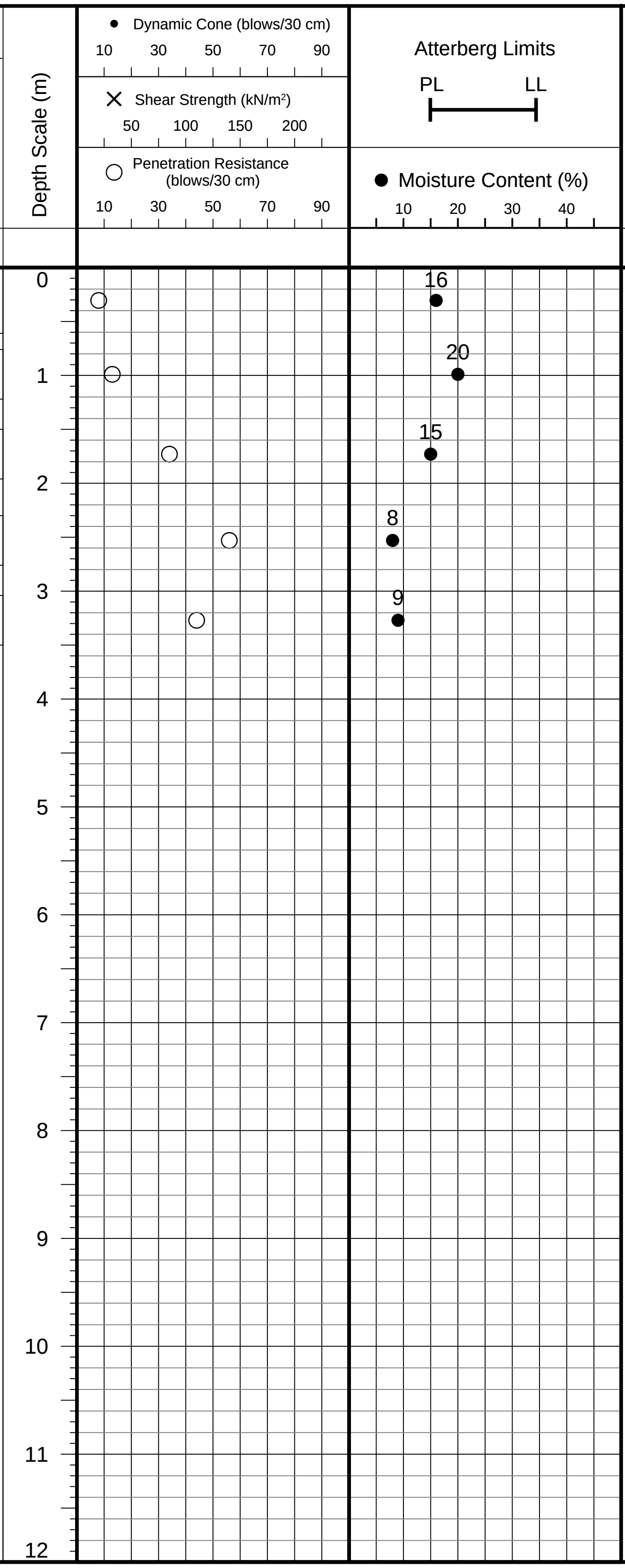
PROJECT DESCRIPTION: Proposed Industrial Development

METHOD OF BORING: Solid Stem

PROJECT LOCATION: 15450 Woodbine Avenue,
Town of Whitchurch-Stouffville (Wesley Corners)

DRILLING DATE: January 27, 2023

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
299.2	Ground Surface			
0.0	**15 cm TOPSOIL**			
	Brown **EARTH FILL** silty clay with topsoil inclusion — — cobble	1	DO	8
		2	DO	13
		3	DO	34
297.1 2.1	Brown, dense to very dense **SANDY SILT TILL** some clay, a trace of gravel occ. cobbles and boulders	4	DO	56
		5	DO	44
295.7 3.5	**END OF BOREHOLE**			



WATER LEVEL

Dry on completion

Soil Engineers Ltd.

JOB NO.: 2210-S077

LOG OF BOREHOLE: 8

FIGURE NO.: 8

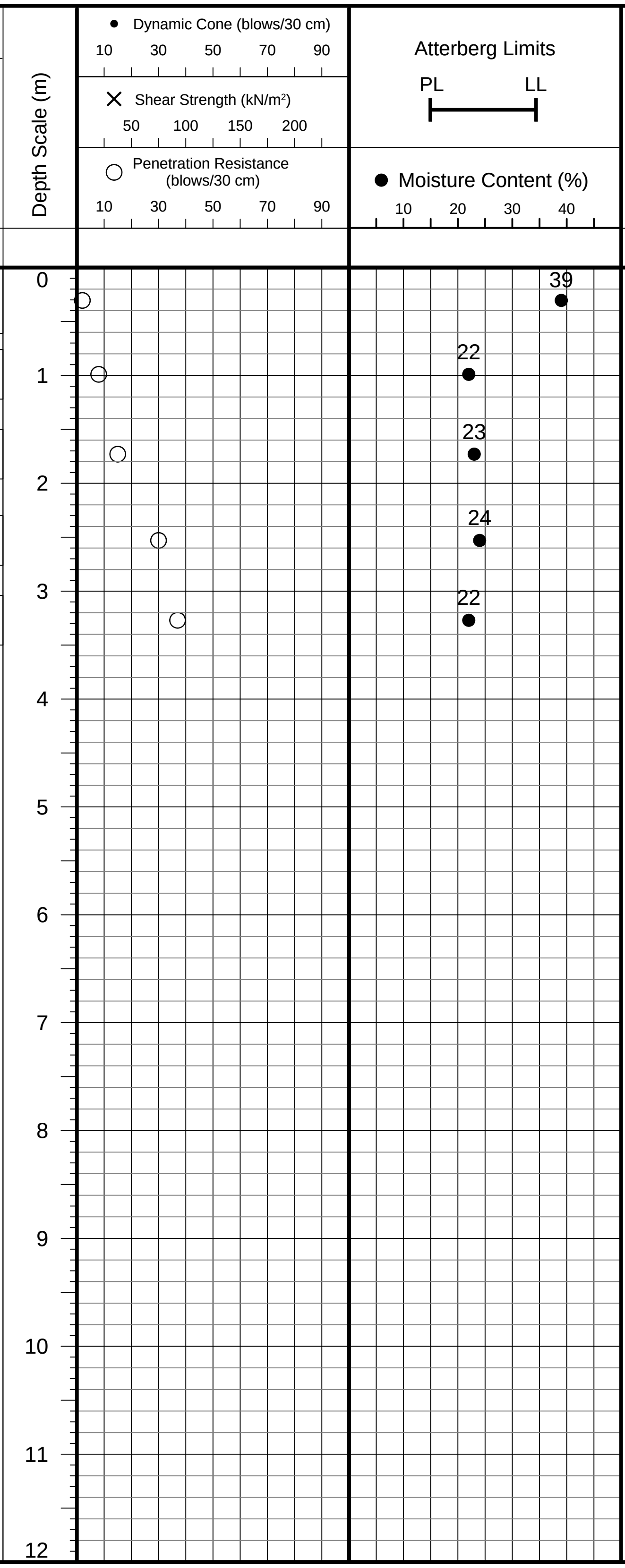
PROJECT DESCRIPTION: Proposed Industrial Development

METHOD OF BORING: Solid Stem

PROJECT LOCATION: 15450 Woodbine Avenue,
Town of Whitchurch-Stouffville (Wesley Corners)

DRILLING DATE: January 27, 2023

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
293.3 0.0	Ground Surface **38 cm TOPSOIL**			
	Brown **EARTH FILL** silty clay, occ. topsoil inclusions	1	DO	2
292.6 0.7	Brown, loose to dense weathered **SILT** traces to some clay and sand occ. clay layers wet	2	DO	8
		3	DO	15
		4	DO	30
		5	DO	37
289.8 3.5	**END OF BOREHOLE**			



WATER LEVEL

Dry on completion

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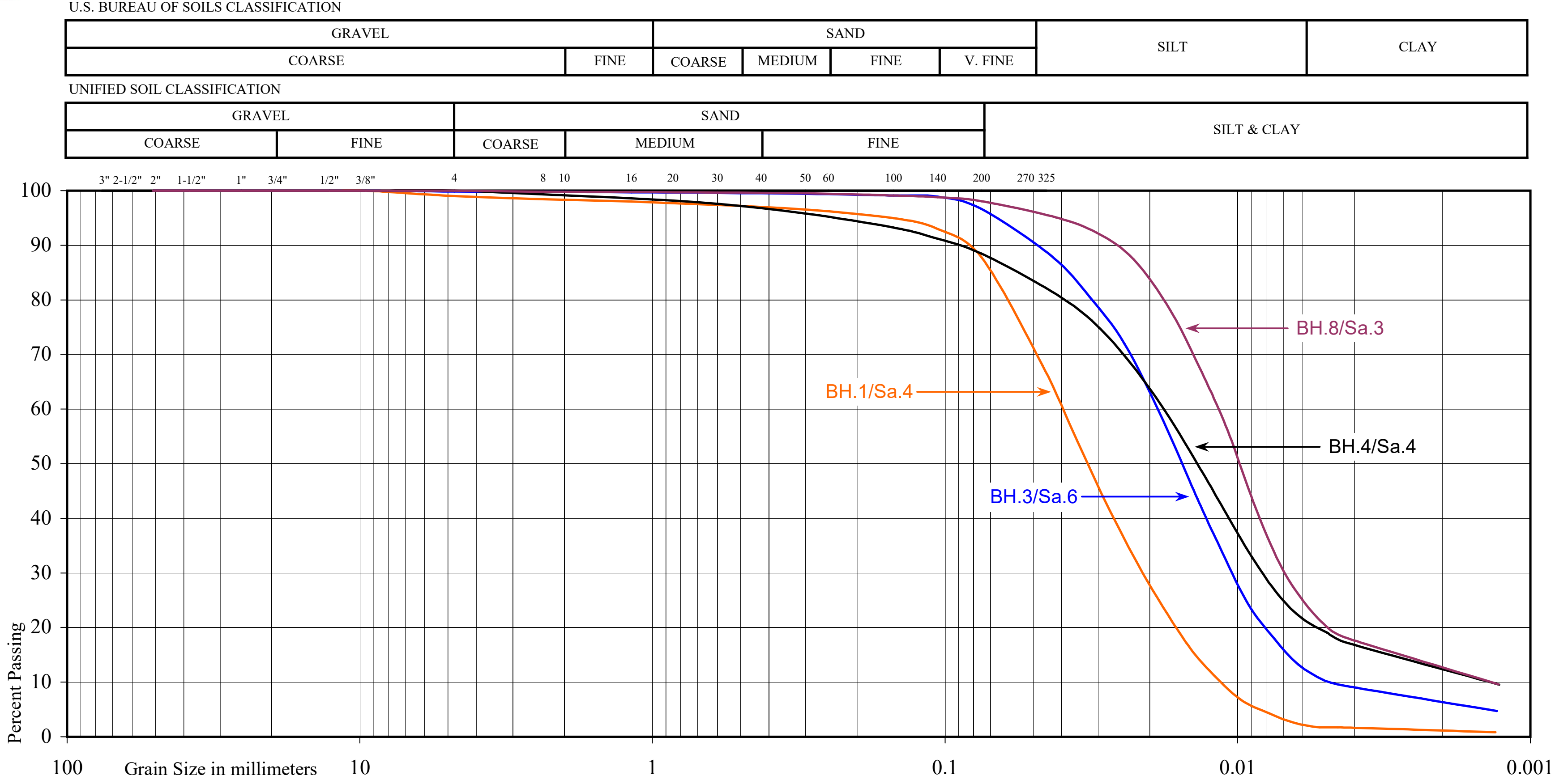
GRAIN SIZE DISTRIBUTION

Reference No: 2210-S077



Project: Proposed Industrial Development

Location: 15450 Woodbine Avenue

Town of Whitchurch-Stouffville (Wesley Corners)

Borehole No:	1	3	4	8
Sample No:	4	6	4	3
Depth (m):	2.5	4.8	2.5	1.7
Elevation (m):	308.4	303.6	300.5	291.6

BH./Sa.	1/4	3/6	4/4	8/3
Liquid Limit (%) =	-	-	-	-
Plastic Limit (%) =	-	-	-	-
Plasticity Index (%) =	-	-	-	-
Moisture Content (%) =	14	19	17	23
Estimated Permeability (cm./sec.) =	10^{-4}	10^{-5}	10^{-6}	

Classification of Sample [& Group Symbol]: SILT

trace to some sand and clay, a trace of gravel

Figure: 9

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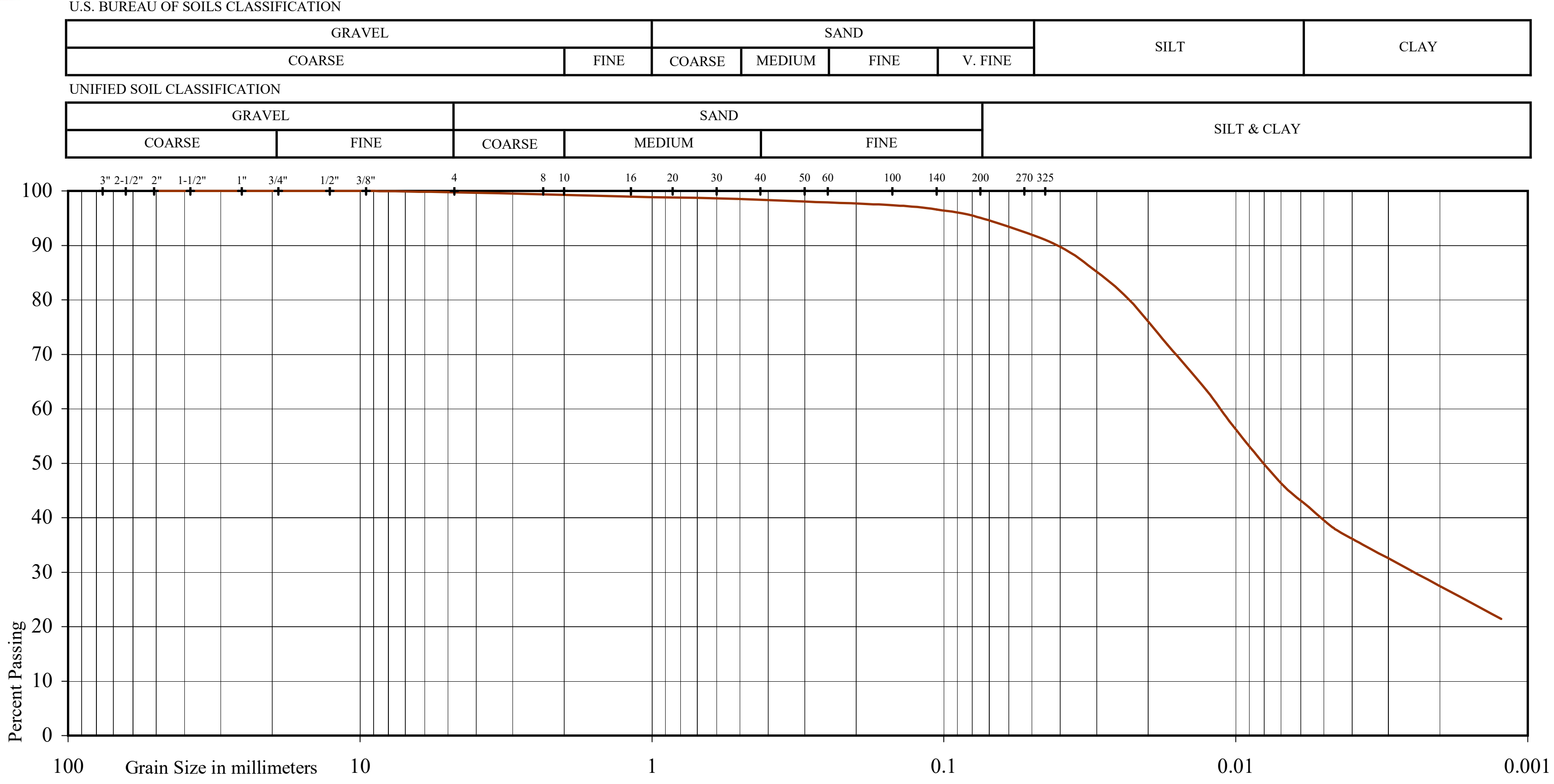
GRAIN SIZE DISTRIBUTION

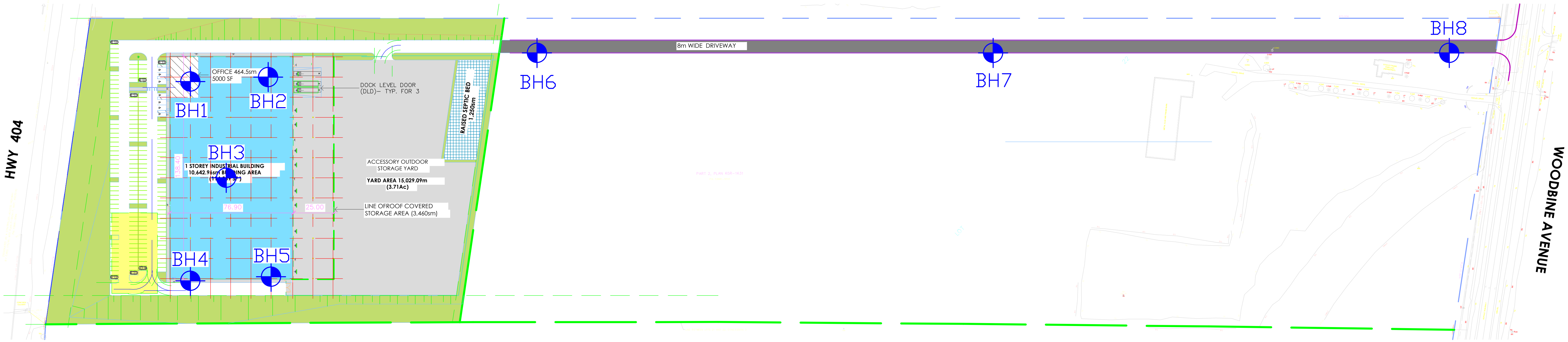
Reference No: 2210-S077



Project:	Proposed Industrial Development			
Location:	15450 Woodbine Avenue		Liquid Limit (%) =	32
	Town of Whitchurch-Stouffville (Wesley Corners)		Plastic Limit (%) =	18
Borehole No:	2		Plasticity Index (%) =	14
Sample No:	5		Moisture Content (%) =	23
Depth (m):	3.2		Estimated Permeability	
Elevation (m):	306.5		(cm./sec.) =	10^{-7}

Classification of Sample [& Group Symbol]: SILTY CLAY
a trace of sand

Figure: 11



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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 Location Plan

SITE: 15450 Woodbine Avenue,
Town of Whitchurch-Stouffville (Wesley Corners)

DESIGNED BY: C.L.	CHECKED BY: K.H.	DWG NO.: 1

SCALE: 1:2500	REF. NO.: 2210-S077	DATE: March 2023	REV –

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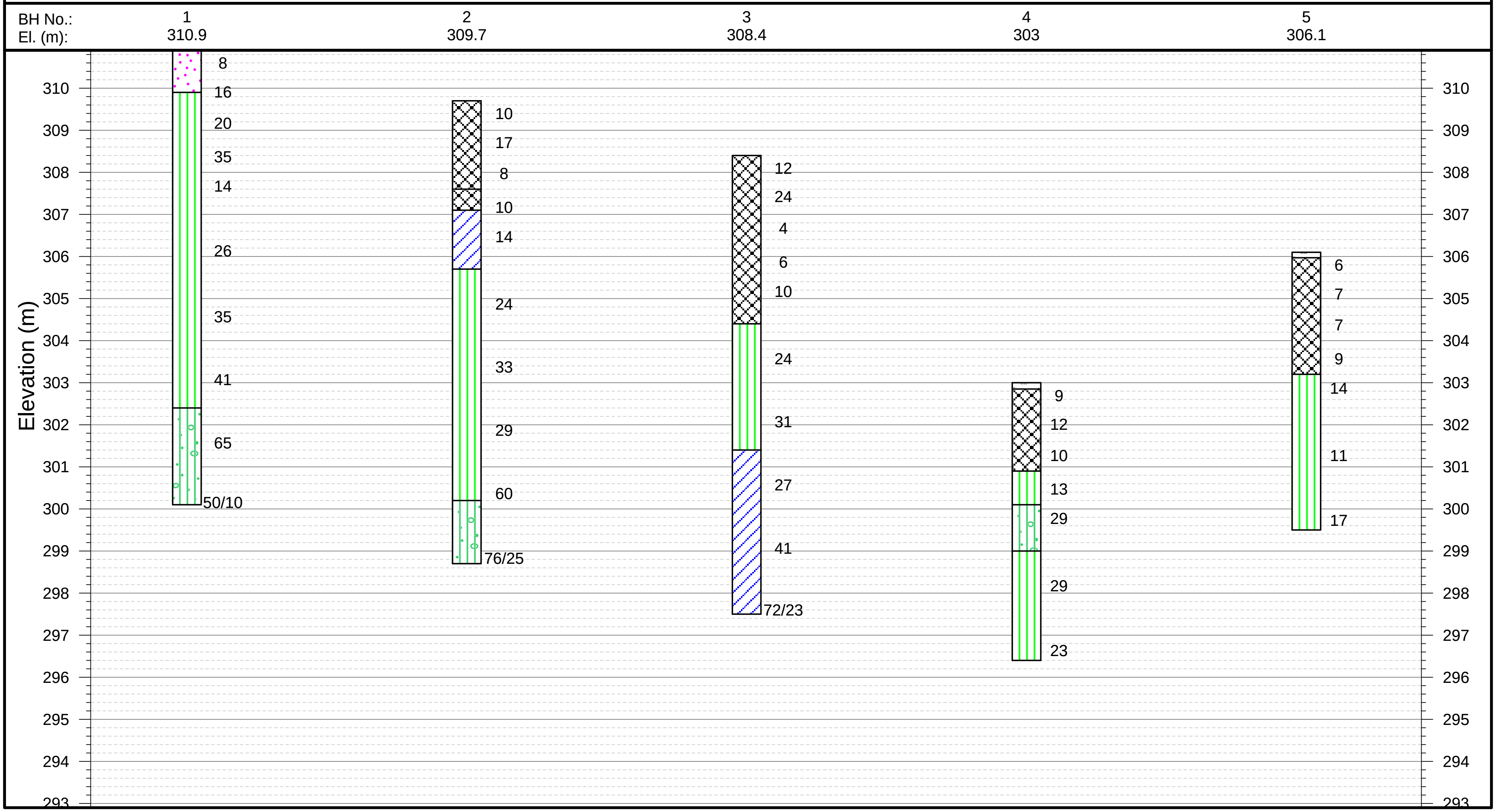
SUBSURFACE PROFILE
DRAWING NO. 2
SCALE: AS SHOWN

JOB NO.: 2210-S077
REPORT DATE: March 2023
PROJECT DESCRIPTION: Proposed Industrial Development

PROJECT LOCATION: 15450 Woodbine Avenue,
Town of Whitchurch-Stouffville (Wesley Corners)

LEGEND

▩	FILL	▥	SANDY SILT TILL	▨	SILTY CLAY	▤	TOPSOIL
⁘	SAND	▥	SILT				



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SUBSURFACE PROFILE
DRAWING NO. 3
SCALE: AS SHOWN

JOB NO.: 2210-S077
REPORT DATE: March 2023
PROJECT DESCRIPTION: Proposed Industrial Development

PROJECT LOCATION: 15450 Woodbine Avenue,
Town of Whitchurch-Stouffville (Wesley Corners)

LEGEND

▨ FILL
▥ SANDY SILT TILL
▥ SILT
▤ TOPSOIL
⁘ SAND