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A REPORT TO
ACORN NE STOUFFVILLE INC.

A GEOTECHNICAL INVESTIGATION FOR PROPOSED RESIDENTIAL DEVELOPMENT

12749 TENTH LINE

TOWN OF WHITCHURCH-STOUFFVILLE

REFERENCE NO. 2103-S118

APRIL 2026
(REVISION TO REPORT DATED JUNE 2022)

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1.0 INTRODUCTION

In accordance with written authorization from Mr. Paul Minz of Acorn NE Stouffville Inc., dated October 29, 2025, a geotechnical report update is carried out for a parcel of land located at 12749 Tenth Line, in the Town of Whitchurch-Stouffville, based on the original geotechnical investigation, as authorized by Mr. Vince Palermo of Acorn NE Stouffville Inc., dated March 17, 2021.

The purpose of this present report is to review the subsurface conditions from the original geotechnical report from 2021, and to determine the engineering properties of the disclosed soils for the design and construction of a residential development based on the latest Conceptual Demonstration Plan prepared by Bousfield Inc., updated February 12, 2026.

2.0 SITE AND PROJECT DESCRIPTION

The subject site, located in the northeastern portion of the Town of Whitchurch-Stouffville, is situated in the Physiographic Region of South Slope. Based on review of the Quaternary Geology data published by Ontario Geological Survey, the overburden at the site consists of the Halton Till plain, which is characterized predominantly as a silt to silty clay matrix, high in matrix carbonate content and clast poor. Beneath the relatively shallow upper Halton Till, the area is underlain by sediments derived from the Oak Ridges Moraine Aquifer Complex (ORAC), which is primarily composed of interbedded fine sand and silt deposits. Based on interpretation of the geological cross-section from the Oak Ridges Moraine Groundwater Program (ORMGP), the ORAC unit within the area has an approximate thickness of 30 m.

The subject parcel, approximately 10.3 hectares in area, is located on the east side of Tenth Line, approximately 730 m south of Bethesda Side Road. The site was mainly a farm field at the time of investigation and is subdivided by the Reesor Creek in the eastern portion of the property, flowing from north to south. The west (larger) portion of the site is undulating, with the grades descending towards the west and towards the east into the Reesor Creek valley. The east (smaller) portion, bounded by York Durham Line (Regional Road 30) at the property limit to the east, descends to the west into the Reesor Creek valley.

Based on the Conceptual Demonstration Plan prepared by Bousfields Inc., the site will be developed as a residential subdivision consisting of townhouse blocks and a school block, which will be provided with municipal services and paved roadways. The balance of the site consists of a stormwater management facility and environmental lands. The area bounded by the Reesor Creek valley to the west and York Durham Line to the east has been designated as a future development area with no conceptual plans available.

3.0 FIELD WORK

The field work, consisting of sixteen (16) boreholes extending to the depths of 6.2 to 11.2 m from the existing ground surface, was performed between April 7 and 17, 2021. The locations of the boreholes are shown on Drawing No. 1.

The boreholes were advanced by a track-mounted machine using solid and hollow stem augers equipped with split spoon sampler for soil sampling. In boreholes where saturated sand was contacted, water was used during the wash-boring operation to prevent caving or base heaving in the boreholes. Standard Penetration Tests, using the procedures described on the enclosed “List of Abbreviations and Terms”, were performed at intervals to the sampling depths. The test results are recorded as the Standard Penetration Resistance (or ‘N’ values) of the subsoil. The compactness of the cohesionless 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.

Upon completion of borehole drilling and sampling, monitoring wells, 50 mm in diameter, were installed in six (6) borehole locations. The depth and details of the monitoring wells are included in the corresponding borehole logs.

The ground elevation of each borehole location was determined using hand-held Global Navigation Satellite System (GNSS) equipment.

4.0 SUBSURFACE CONDITIONS

The majority of the site is a farm field. The investigation has revealed that beneath the topsoil or ploughed soil, the site is underlain by strata of silty clay, silty clay till, and silty sand. Detailed descriptions of the encountered subsurface conditions from the boreholes are presented on the Borehole Logs, comprising Figures 1 to 16, inclusive. The revealed stratigraphy is plotted on the Subsurface Profiles, Drawing No. 2. The engineering properties of the disclosed soils are discussed herein.

4.1 Topsoil

The revealed topsoil veneer ranges from 20 to 45 cm in thickness. Thicker topsoil layers may occur in places, especially in low-lying areas that have been filled during previous farming activities.

4.2 Ploughed Soil

Ploughed soil, consisting of silty clay and various amounts of organics, was contacted below the topsoil. It extends to a depth of 0.25 to 1.1 m from grade.

4.3 Silty Clay/Silty Clay Till

The silty clay deposit was contacted near the ground surface of Boreholes 2, 5, 6, 12 and 13, extending to depths of 1.5 to 4.0 m below prevailing ground surface. The silty clay till deposit was contacted in all boreholes at various depths, except Borehole 14.

The natural water content of the clay and clay till was determined to range between 5% and 25%, with a median of 12%. The obtained 'N' values range from 1 to over 100, with a median of 22 blows per 30 cm of penetration, showing the clay and clay till is very soft to hard in consistency, being generally very stiff. The low 'N' values of the clay and clay till were generally confined to within 0.6 to 1.1 m from the ground surface, likely weakened by weathering and/or farming activities.

Grain size analyses were performed on 3 selected samples of the silty clay till. The results are presented on Figure 17. Atterberg Limits were performed on 2 selected samples; having Liquid Limits of 22% and 26%, and Plastic Limit of 14%.

The engineering properties of the silty clay and clay till are presented below:

- High frost susceptibility and high in soil-adfreezing potential.
- In excavation, the clay and clay till will be stable in relatively steep slope. However, under prolonged exposure, local shrinkage cracks and sheet collapse may occur.

4.4 Silty Sand

The silty sand deposit was generally encountered below the silty clay and silty clay till deposits, extending to the termination depth of the boreholes. It is fine grained with a trace of clay. Grain size analyses were performed on 3 representative samples; the results are presented on Figure 18.

The obtained 'N' values range from 5 to 68, with a median of 43 blows per 30 cm of penetration, showing the compactness of the silty sand is loose to very dense, being generally dense. The loose silty sand may have been disturbed by farming activities and/or weathering near the ground surface, and at lower depths, by hydrostatic pressure from the groundwater.

The natural water content values of the sand samples range from 5% to 26%, with a median of 18%, showing the sand deposit is damp to wet, generally being saturated at lower depth.

The engineering properties of the silty sand are presented below:

- High in frost susceptibility and moderately-high soil adfreezing potential.
- Highly erodible, the sand particles will migrate under the hydrostatic pressure.
- The shear strength is dependent on the internal angle of friction.
- In excavation, the silty sand will slough, run with seepage and boil under an approximate piezometric head exceeding 0.3 m.

4.5 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

Soil Type	**Determined Natural Water Content (%)**	**Water Content (%) for Standard Proctor Compaction**	
		100% (optimum)	**Range for 95% or +**
Silty Clay/Clay Till	5 to 26 (median 12)	16 to 18	12 to 22
Silty Sand	5 to 26 (median 18)	10	6 to 13

Based on the above findings, the clay and clay till are generally suitable for Standard Proctor compaction, while the sand is generally too wet and will need to be properly stockpiled to drain the excess water or aerated by spreading thinly on the ground during the dry and warm weather before compaction.

The ploughed soil should be further assessed to determine its suitability for reuse at the time of construction. Any ploughed soil with high concentration of topsoil must be sub-excavated, sorted free of topsoil, organics and deleterious materials, if any, prior to being reused for site grading. Otherwise, they should be stockpiled with the topsoil for reuse for general landscaping purpose only.

5.0 SLOPE STABILITY STUDY

A slope stability study is carried out for the west valley slope of the Reesor Creek valley, where the slope gradient is steeper than 6H:1V in the northeast portion of the site. The details and results are presented in a separate letter.

6.0 GROUNDWATER CONDITIONS

The boreholes were checked for the presence of groundwater and signs of cave-in upon completion of drilling. Wash-boring was used in Boreholes 9 and 11; therefore, groundwater levels could not be recorded from these boreholes upon completion of drilling. Boreholes 4, 7, 8, 12 and 13 remained dry on completion of drilling. The recorded groundwater level in the boreholes is summarized in Table 2.

Table 2 - Groundwater Levels in Boreholes

Borehole No.	Ground Elevation (m)	Borehole Depth (m)	Groundwater/Cave-In* Level Upon Completion	
			Depth (m)	El. (m)
1	290.6	6.4	5.4	285.2
2	289.3	6.3	5.4	283.9
3	292.3	11.2	7.8*	284.5*
4	291.8	6.6	Dry	-
5	289.9	6.6	5.7	284.2
6	290.2	10.9	1.5/4.2*	288.7/286.0*
7	292.0	6.6	Dry	-
8	290.1	6.2	Dry	-
9	292.0	11.2	Not Measured	-
10	290.0	11.2	1.8/2.4*	288.2/287.6*
11	293.2	11.2	Not Measured	-
12	291.4	6.6	Dry	-
13	288.2	6.6	Dry	-
14	292.4	6.6	5.7	286.7
15	291.4	6.6	5.4	286.0
16	291.3	6.6	4.6	286.7

The groundwater level in the monitoring wells was carried out between April and December 2021, in July 2023, between November 2023 and 2024 and again in December 2025 and January 2026. The first stabilized levels recorded on April 28, 2021, after completion of the drilling program and the highest and lowest records to date are summarized in Table 3. The detailed monitoring well records are enclosed in the Appendix for reference.

Table 3 - Stabilized Groundwater Levels in Monitoring Wells

Monitoring Well No.	**Ground Elevation (m)**	**Well Depth (m)**	**April 28, 2021**		**Lowest**		**Highest**	
			Depth (m)	**El. (m)**	**Depth (m)**	**El. (m)**	**Depth (m)**	**El. (m)**
1	290.6	6.1	1.7	288.9	3.0	287.6	0.5	290.1
5	289.9	6.1	3.5	286.4	4.3	285.6	2.4	287.5
9	292.0	10.7	6.4	285.6	7.1	284.9	5.7	286.3
11	293.2	10.7	6.5	286.7	7.1	286.1	5.7	287.5
15	291.4	6.1	4.6	286.8	5.2	286.2	3.8	287.6
16	291.3	6.1	3.7	287.6	5.0	286.3	3.0	288.3

Shallow groundwater levels were recorded from El. 284.9 to 287.6 m at its lowest levels across the site, and from El. 286.3 to El. 290.1 m at the highest levels, showing a general southerly drainage pattern, or towards the creek valley. The groundwater level is subject to seasonal fluctuations. The detailed groundwater profile and interpretation will be discussed in the hydrogeological report, presented under separate cover.

7.0 DISCUSSION AND RECOMMENDATIONS

The site was primarily used for agricultural purposes. It is subdivided by Reesor Creek into a larger western portion fronting Tenth Line and a smaller eastern portion fronting York Durham Line. The investigation has revealed that beneath the topsoil or ploughed soils, the site is underlain by strata of silty clay, silty clay till, silty sand at various depths. Weathered and/or ploughed soils were found extending to approximate depths of 0.6 to 1.1 m below the existing grade. The sand deposit in the lower stratigraphy is generally saturated.

The highest groundwater levels recorded in the monitoring wells ranges from El. 286.3 to 290.1 m. It is subject to seasonal fluctuation and is anticipated to drain southerly and toward Reesor Creek.

Based on the Conceptual Demonstration Plan prepared by Bousfields Inc., the site will be developed as a residential subdivision consisting of townhouses. It will be provided with municipal services and paved roadways, with blocks reserved for a school, a stormwater management facility and environmental lands. No conceptual plans are available for the land fronting York Durham Line. The geotechnical findings which warrant special consideration are presented below:

1. The topsoil must be removed prior to project construction. It can be reused for general landscaping purposes only.
2. The ploughed soil should be further assessed to determine its suitability for reuse at the time of construction. Badly weathered or ploughed soils with high concentration of topsoil must be sub-excavated and sorted.
3. Where additional earth filling is required for site grading, it is more economical to place an engineered fill for conventional footing, underground services and pavement construction.
4. In accordance to the Town of Whitchurch-Stouffville requirement, the underside of footings should be founded at least 0.6 m above the seasonal high groundwater level and be provided with a perimeter drainage system connected to a positive outlet.
5. Any excavation extending below the water-bearing strata must be stabilized by construction dewatering or depressurization. Details of appropriate dewatering methods should be referred to the hydrogeological assessment.
6. A Class 'B' bedding, consisting of compacted 19-mm Crusher-Run Limestone (CRL), is recommended for the construction of underground services. In water-bearing sand or where extensive dewatering is necessary, a Class 'A' concrete bedding should be used.

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

7.1 <u>Site Preparation</u>

The existing topsoil and surficial vegetation must be removed for site development. The ploughed soil should be further assessed to determine its suitability for reuse at the time of construction. Badly weathered soils or ploughed soils with high concentrations of topsoil and organics must be sub-excavated, sorted free of topsoil, organics and deleterious materials, if any, aerated before reuse for site grading. Otherwise, they should be stockpiled with the topsoil for reuse for general landscaping purpose only.

In view that the site is undulating with low-lying areas, where additional earth fill is required for site grading, it is more economical to place engineered fill for conventional footing, underground services and pavement construction. The engineering requirements for a certifiable fill for pavement construction, municipal services, slab-on-grade, and house footings designed with the recommended bearing pressures in Section 7.2 are presented below:

1. The exposed subgrade must be inspected and proof-rolled prior to any fill placement. Any loose soil identified during proof-rolling must be subexcavated, sorted free of organics and deleterious materials, aerated before reuse for site grading and structural backfill.
2. Inorganic soils must be used for engineered fill construction, and they must be uniformly compacted in lifts of 20 cm thick to at least 98% Standard Proctor Maximum Dry Density (SPMDD) with its moisture content controlled near its optimum. If the foundations are to be built shortly after the fill placement, the densification process for the engineered fill must be increased to 100% SPMDD.
3. If the engineered fill is compacted with the moisture content on the wet side of the optimum, the underground services and pavement construction should not begin until the pore pressure within the fill mantle has completely dissipated. This must be further assessed at the time of the engineered fill construction.
4. If imported fill is to be used, it must be inorganic soils, free of deleterious or any material with environmental issue (contamination). Any potential imported earth fill from off site must be reviewed for geotechnical and environmental quality by the appropriate personnel as authorized by the developer or agency, before it is hauled to the site.
5. The engineered fill must not be placed during the period where freezing ambient temperatures occur either persistently or intermittently. This is to ensure that the fill is free of frozen soils, ice and snow. If the fill is to be left over the winter months, adequate earth cover, or equivalent, must be provided for protection against frost action.
6. Where the fill is to be placed on sloping ground steeper than 3 horizontal (H):1 vertical (V), the face of the sloping ground should be benched or flattened so that it is suitable for safe operation of the compactor and the required compaction can be obtained.
7. The fill operation must be inspected on a full-time basis by a geotechnical 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 by a surveyor.
9. Despite stringent control in the placement of the engineered fill, variations in soil type

and density may occur in the engineered fill. Therefore, the foundations must be reinforced, or be designed by the structural engineer for the project to allow distribution of stress induced by the abrupt differential settlement. The total and differential settlements of 25 mm and 20 mm, respectively, should be considered in the design of the foundation founded on 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, slab-on-grade and underground services subgrade must be inspected by the geotechnical consulting firm which 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 any excavation.

7.2 **Foundations**

Based on a review of the Conceptual Demonstration Plan, the site will consist of townhouses. According to the Town of Whitchurch-Stouffville's design requirement, the underside of footings is required to be founded a minimum 0.6 m above the seasonal high groundwater level, otherwise, the basements must be waterproofed to eliminate the need for long-term dewatering.

Townhouse Blocks

Conventional spread and strip footings can be used to support the house structures. The footings must be placed onto the engineered fill or sound native soil below the weathered/ploughed soil. The recommended soil bearing pressures for the design of conventional footings are provided below:

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

The total and differential settlements of foundations designed with the recommended bearing pressure at SLS, are estimated to be 25 mm and 20 mm, respectively.

School Block (Boreholes 7 and 8)

The school is anticipated to be slab-on-grade. Once the school layout becomes available, additional boreholes must be completed to assess and verify the ground condition.

For design of the school on conventional spread and strip footings, the underside of footings should be maintained at least 0.6 m above the groundwater level. As a preliminary and general guide, the recommended soil bearing pressures at SLS and ULS for the design of conventional spread and strip footings founded in the sound native soils are presented below:

- Maximum Allowable Bearing Pressure at SLS = 150 kPa
- Factored Ultimate Bearing Pressure at ULS = 240 kPa

The total and differential settlements for foundations designed with the recommended bearing pressures at SLS are estimated to be 25 mm and 20 mm, respectively.

General Recommendations

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

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

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

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

7.3 **Basement Structures and Slab-on-Grade**

With the minimum 0.6 m separation maintained between the underside of footing and the seasonal groundwater level, the basement slab will likewise remain above the groundwater level. In conventional design, the perimeter walls of the basement structure should be provided with a drainage board and subdrain system at the wall base (Drawing No. 3). The perimeter walls of the underground structure should be designed to sustain a lateral earth pressure calculated using the soil parameters stated in Section 7.8. Any applicable surcharge loads adjacent to the proposed building, must also be considered in the design of the underground structure.

The slab for the basements should be constructed on a granular base, minimum 15 cm thick, consisting of 19-mm Clear Stone, or equivalent, compacted to 100% SPMDD.

The floor slab in the school should be constructed on a granular base, 20 cm thick, consisting of 19-mm CRL, or equivalent, compacted to the maximum SPMDD.

The subgrade for the floor slabs should consist of sound native soil or properly compacted inorganic earth fill. Any new fill should consist of organic-free soil, compacted to at least 98% SPMDD.

The exterior grade should slope away from the building structures to prevent ponding of water adjacent to the underground structures.

7.4 Underground Services

The subgrade for the underground services should consist of sound native soils or properly compacted, organic-free earth fill. Where weathered/ploughed soils or soft/loose soils are encountered, they should be subexcavated and replaced with bedding material compacted to at least 95% SPMDD.

A Class ‘B’ bedding, consisting of compacted 19-mm CRL, is recommended for the construction of the underground services. Where the subgrade consists of wet sand, or extensive dewatering is required, a Class ‘A’ concrete bedding should be used.

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

The pipe joints into manholes and catch basins should be leak-proof, or wrapped with an appropriate waterproof membrane. Openings to subdrains and catch basins should be shielded with a fabric filter to prevent blockage by silting.

All ductile iron pipes and metal fittings for the underground services should be protected against soil corrosion. For estimation for the anode weight requirements, the electrical resistivity of the disclosed soils in Table 5 can be used. The proposed anode weight must meet the minimum requirements as specified by the municipality standard.

7.5 Backfilling in Trenches and Excavated Areas

The on-site inorganic soils are suitable for trench backfill. Saturated soils should be properly stockpiled to drain the excess water or they can be spread thinly on the ground for aeration prior to be reused. Boulders over 15 cm in size must be sorted and removed from the backfill material.

The backfill should be compacted to at least 95% SPMDD. In areas below the slab-on-grade and in the zone within 1.0 m below the road subgrade, the materials should be compacted to at least 98% SPMDD, with the water content at 2% to 3% drier than the optimum, in order to provide the required stiffness for floor or pavement construction. The lift of each backfill layer should be limited to a thickness of 20 cm, or the thickness should be determined by test strips at the time of compaction.

In normal construction practice, the problem areas of settlement largely occur adjacent to manholes, catch basins, service crossings, foundation walls and columns. In areas which are inaccessible to a heavy compactor, sand backfill which can be appropriately compacted using a smaller/handheld vibratory compactor should be used.

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

- Subsequent to backfilling a trench, one must be aware that minor future settlement is to be expected along the service alignment unless the sides of excavation are flattened to 2H:1V or the excavation is properly benched, and the lifts of the fill is limited to no more than 20 cm (or less if the backfilling conditions dictate) and uniformly compacted to achieve at least 98% SPMDD, with the moisture content stringently controlled within 2% to 3% of the optimum.
- It is often difficult to achieve uniform compaction of the backfill in the lower vertical section of a trench, particularly in the sector close to the trench walls or the sides of the box. These sectors must be backfilled with Granular ‘B’ Type I or sand, and the compaction must be carried out diligently prior to the placement of the backfill 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 the underground services construction is carried out during the winter months, prolonged exposure of the trench walls will result in frost heave within the soil mantle of the walls. This may result in some settlement as the frost recedes, and repair costs will be incurred prior to the final surfacing of the new pavement and slab-on-grade construction.
- When construction is carried out in freezing winter weather, allowance should be made for these following conditions. Despite stringent backfill monitoring, frozen soil layers may inadvertently be mixed with the structural trench backfill. Should the in-situ soils have a water content on the dry side of the optimum, it would be impossible to wet the soils due to the freezing condition, rendering difficulties in obtaining uniform and proper compaction. Furthermore, the freezing condition will prevent flooding of the backfill when it is required, such as in a narrow vertical trench section, or when the trench box is removed. The above will invariably cause backfill settlement that may become evident within 1 to several years, depending on the depth of the trench which has been backfilled.
- In areas where groundwater movement is expected in the pipe bedding, trench backfill and/or sand fill mantle, anti-seepage collars (OPSD 802.095) should be provided.

7.6 Pavement Design

The road subgrade is anticipated to consist of silty subsoils. The recommended minimum pavement design for local residential and collector roads is presented in Table 4.

Table 4 - Road Pavement Design

Course	Thickness (mm)	OPS Specifications
Asphalt Surface	40	HL3
Asphalt Binder		HL8
Local Residential	50	
Collector/Bus Route	100	
Granular Base	150	19-mm CRL
Granular Sub-base		50-mm CRL
Local Residential	300	
Collector/Bus Route	450	

Prior to the placement of granular bases, the subgrade must be proof-rolled. Any weak or soft areas must be subexcavated and replaced with approved material and compacted in layers. In the zone within 1.0 m below the road subgrade, the backfill should be compacted to at least 98% SPMDD, with the water content at 2% to 3% drier than the optimum. In the lower zone, a 95%+ SPMDD compaction is considered adequate. All the granular bases should be compacted to 100% SPMDD.

The subgrade will suffer a strength regression if water is allowed to saturate the mantle. The following measures should, therefore, be incorporated in the construction procedures and road design:

- If the pavement construction does not immediately follow the trench backfilling, the subgrade should be properly crowned and smooth-rolled to allow interim precipitation to be properly drained.
- Lot areas adjacent to the roadway should be properly graded to prevent ponding 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.
- In extreme cases during the wet seasons, if soft or weak subgrade is identified, the granular sub-base should be thickened in order to compensate for the inadequate strength of the soft or weak subgrade. This can be assessed during construction.
- Fabric filter-encased curb subdrains will be required on both sides of the roadway to meet the Town of Whitchurch-Stouffville requirements.

7.7 Stormwater Management Facility

Based on the Conceptual Plan, a stormwater management (SWM) facility is proposed in the vicinity of Boreholes 13 and 14, adjacent to the valley land. Detailed design of the SWM facility is not available for review at the time of this report preparation.

With reference to the borehole and monitoring well records, the subsoil is anticipated to consist of silty clay, silty clay till and silty sand deposits. Groundwater is recorded at El. 286.7 m in Borehole 14 upon completion of drilling, and a high water level of El. 287.5 m is recorded in the monitoring well at Borehole 11 located in the vicinity of the pond.

Where excavation for the pond extends into the wet sand, positive dewatering will be necessary to lower the groundwater before commencement of the excavation and construction of the SWM facility.

Where the SWM pond is constructed in the silty sand deposit, an impervious clay liner or geosynthetic liner with ballast will be required. Should the bottom of pond extend below the groundwater level, the pond must be designed to resist any hydrostatic uplift pressure. Otherwise, an underlying subdrain system will be required to relieve the hydrostatic uplift pressure beneath the pond. Further assessment will be required once the detailed design of the SWM pond is available for review.

From a slope stability point of view, the side slopes of the SWM pond should be maintained at a gradient no steeper than 3H:1V above the wet perimeter, and flatter than 4H:1V below the wet perimeter. However, the design shall conform to all town and government agencies' design requirements. All exposed slopes must be vegetated and/or sodded to prevent runoff erosion.

Where earth embankments are proposed around the SWM facility, topsoil must be removed and the subgrade must be proof-rolled before placement of earth fill for the berms. Selected silty clay and/or silty clay till material, free of organics, should be used for berm construction, compacted to 98% SPMDD in 20 cm thick lifts.

The footings of control structures must be placed below the scouring depths and be provided with a minimum earth cover of 1.2 m for the protection against frost damage. The inlets and outlets of the ponds should be lined with gabion mats, rip rap or equivalent measures for protection against scouring.

7.8 Soil Parameters

The recommended soil parameters for the project design are given in Table 5.

Table 5 - Soil Parameters

Unit Weight and Bulk Factor	**Unit Weight (kN/m^3)**		**Estimated Bulk Factor**	
	Bulk	**Submerged**	**Loose**	**Compacted**
Silty Sand	21.0	11.0	1.25	1.00
Silty Clay Till	22.5	12.5	1.30	1.05
Silty Clay	20.5	10.5	1.35	1.05

Lateral Earth Pressure Coefficients	**Active K_a**	**At Rest K_0**	**Passive K_p**
Compacted Earth Fill, Clay/Clay Till	0.39	0.56	2.56
Silty Sand	0.32	0.48	3.12

Table 5 - Soil Parameters (Cont'd)

Coefficients of Permeability (k) and Percolation Time (T)	**K (cm/sec)**	**T (min/cm)**
Silty Sand	10^{-3} to 10^{-4}	8 to 12
Silty Clay/Silty Clay Till	10^{-7}	80+
Electrical Resistivity to Corrosion of Buried Metal		
Silty Clay/Silty Clay Till	3500 ohm·cm	
Silty Sand	4500 ohm·cm	
Coefficients of Friction		
Between Concrete and Granular Base	0.50	
Between Concrete and Sound Native Soils	0.35	

7.9 Excavation

Excavation should be carried out in accordance with Ontario Regulation 213/91. The types of soils are classified in Table 6.

Table 6 - Classification of Soils for Excavation

Material	**Type**
Sound Till and Silty Clay	2
Weathered/Ploughed Soils, drained Sand	3
Saturated Soils	4

In shallow excavation, groundwater derived from infiltrated surface water or precipitation will be encountered in places. The groundwater yield from the clay till and clay is expected to be slow in rate and limited in quantity. It can be drained locally and removed by pumping sumps.

Where excavation extends into the saturated sand, the yield of groundwater will be persistent. Construction dewatering will be required to lower the groundwater to at least 1.0 m below the intended excavation depth before commencement of excavation. Detailed groundwater conditions and dewatering needs should be referred to the hydrogeological report, which is presented under a separate cover.

Prospective contractors must be asked to assess the in situ subsurface conditions for soil cuts by digging test pits to at least 1.0 m below the intended bottom of excavation. Where stable excavation slope is not feasible, the excavation must be supported by shoring, or the service trenches should be supported by trench boxes.

8.0 LIMITATIONS OF REPORT

This report was prepared by Soil Engineers Ltd. for the account of Acorn NE Stouffville Inc. and for review by their designated consultants and government agencies. Use of this report is subject to the conditions and limitations of the contractual agreement.

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

SOIL ENGINEERS LTD.

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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

Standard Penetration Resistance or ‘N’ Value:

> The number of blows of a 63.5 kg hammer falling from a height of 76 cm required to advance a 51 mm outer diameter drive open sampler 30 cm into undisturbed soil, after an initial penetration of 15 cm.
>
> Plotted as ‘○’

Dynamic Cone Penetration Resistance:

> A continuous profile showing the number of blows per each 30 cm of penetration of a 51 mm diameter, 90° point cone driven by a 63.5 kg hammer falling from a height of 76 cm.
>
> 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/30 cm)	Compactness
0 to 4	very loose
4 to 10	loose
10 to 30	compact
30 to 50	dense
> 50	very dense

Cohesive Soils:

Undrained Shear Strength (kPa)	‘N’ (blows/30 cm)	Consistency
<12	<2	very soft
12 to <25	2 to <4	soft
25 to <50	4 to <8	firm
50 to <100	8 to <15	stiff
100 to 200	15 to 30	very stiff
>200	>30	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

METRIC CONVERSION FACTORS

1 ft = 0.3048 m
1 inch = 25.4 mm
1 lb = 0.454 kg
1 ksf = 47.88 kPa

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GEOTECHNICAL • ENVIRONMENTAL • HYDROGEOLOGICAL • BUILDING SCIENCE

JOB NO.: 2103-S118

LOG OF BOREHOLE: 1

FIGURE NO.: 1

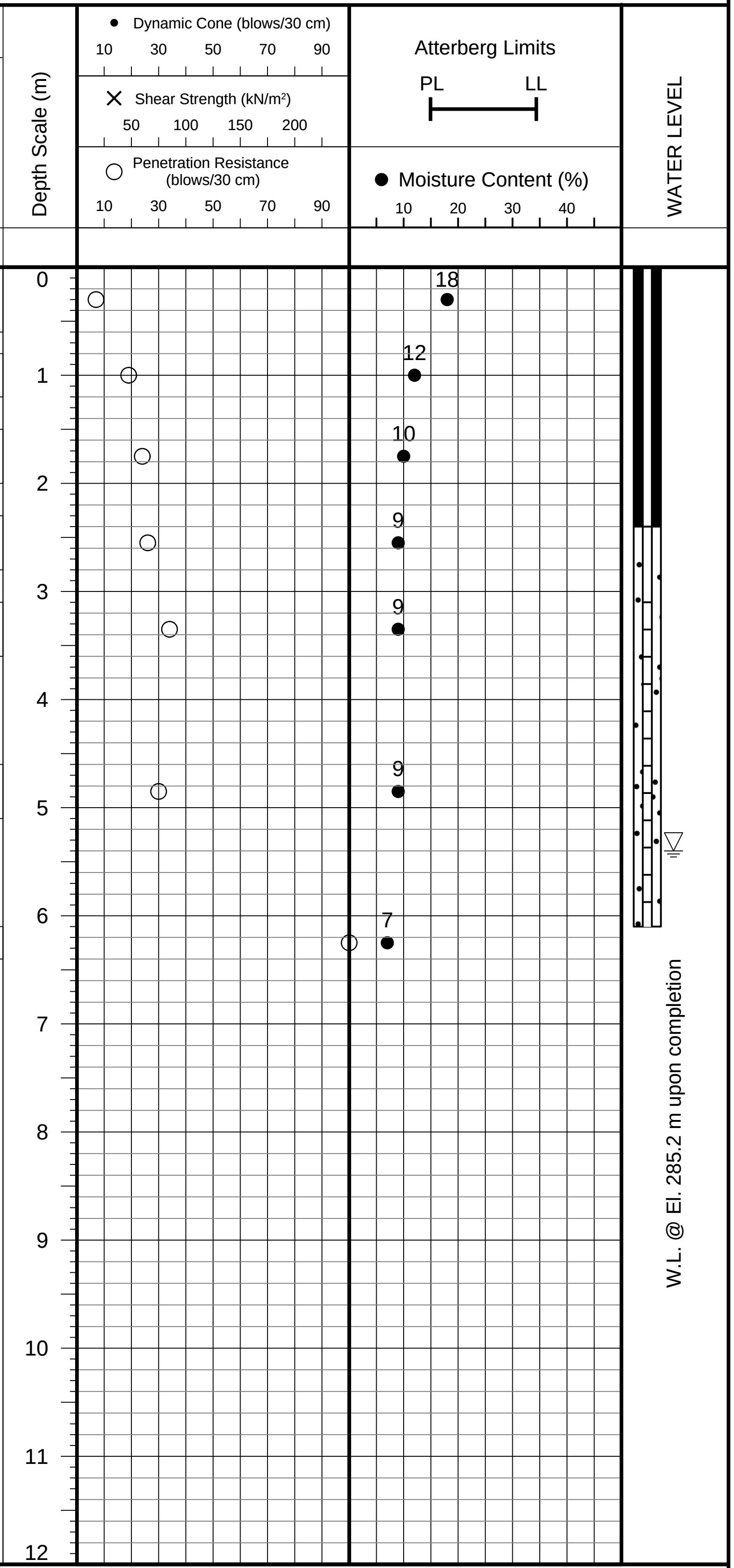
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 12749 Tenth Line, Town of Whitchurch-Stouffville

DRILLING DATE: April 7, 2021

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
290.6 0.0	Ground Surface **35 cm TOPSOIL**			
	Brown, firm to hard ploughed **SILTY CLAY TILL** low plasticity a trace of gravel occ. sand seams, cobbles and boulders	1	DO	7
		2	DO	19
		3	DO	24
		4	DO	26
		5	DO	34
		6	DO	30
		7	DO	50/15
284.2 6.4	**END OF BOREHOLE**			



Soil Engineers Ltd.

JOB NO.: 2103-S118

LOG OF BOREHOLE: 2

FIGURE NO.: 2

PROJECT DESCRIPTION: Proposed Residential Development

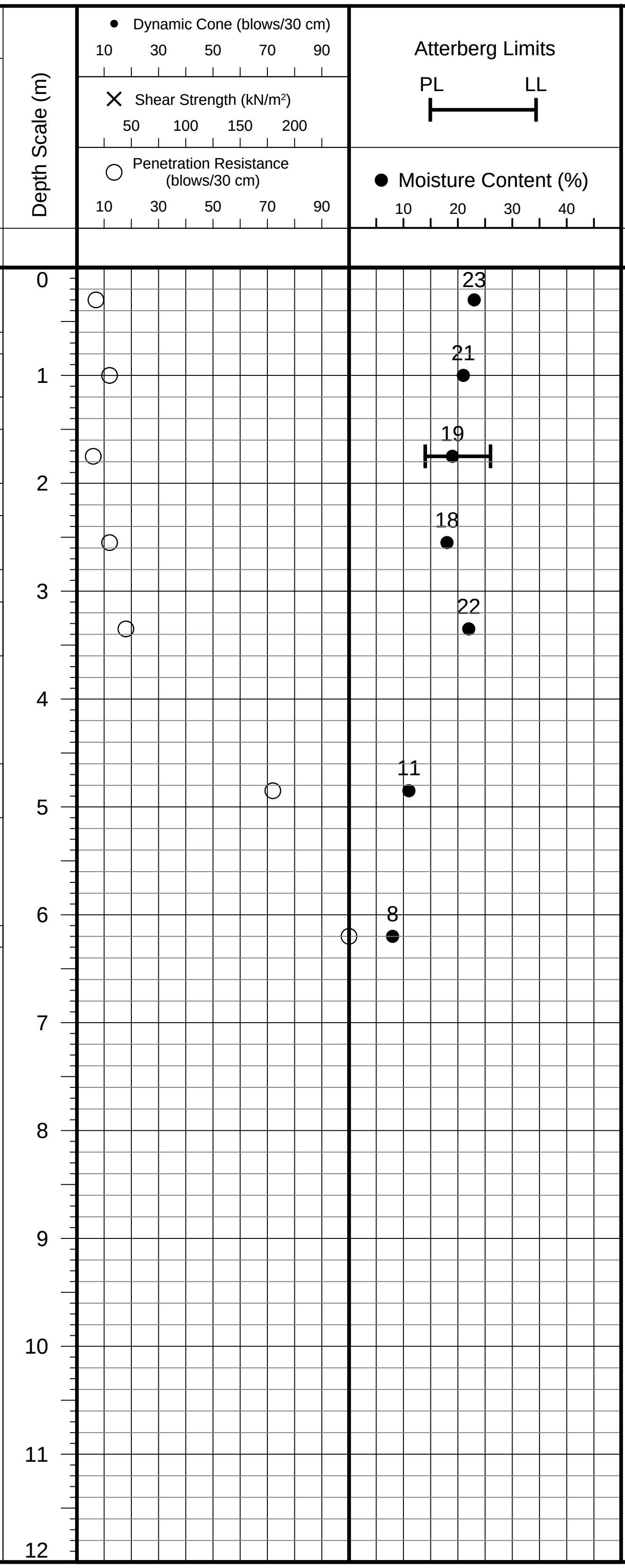
METHOD OF BORING: Flight Auger

PROJECT LOCATION: 12749 Tenth Line, Town of Whitchurch-Stouffville

DRILLING DATE: April 7, 2021

El. (m) Depth (m)	SOIL DESCRIPTION
289.3 0.0	Ground Surface **40 cm TOPSOIL**
	Firm to very stiff **SILTY CLAY** low to medium plasticity occ. sand seams ploughed brown grey
285.3 4.0	Grey, hard **SILTY CLAY TILL** low plasticity a trace of gravel occ. sand seams, cobbles and boulders
283.0 6.3	**END OF BOREHOLE**

SAMPLES		
Number	Type	N-Value
1	DO	7
2	DO	12
3	DO	6
4	DO	12
5	DO	18
6	DO	72
7	DO	50/15



WATER LEVEL

∇

W.L. @ El. 283.9 m upon completion

Soil Engineers Ltd.

JOB NO.: 2103-S118

LOG OF BOREHOLE: 3

FIGURE NO.: 3

PROJECT DESCRIPTION: Proposed Residential Development

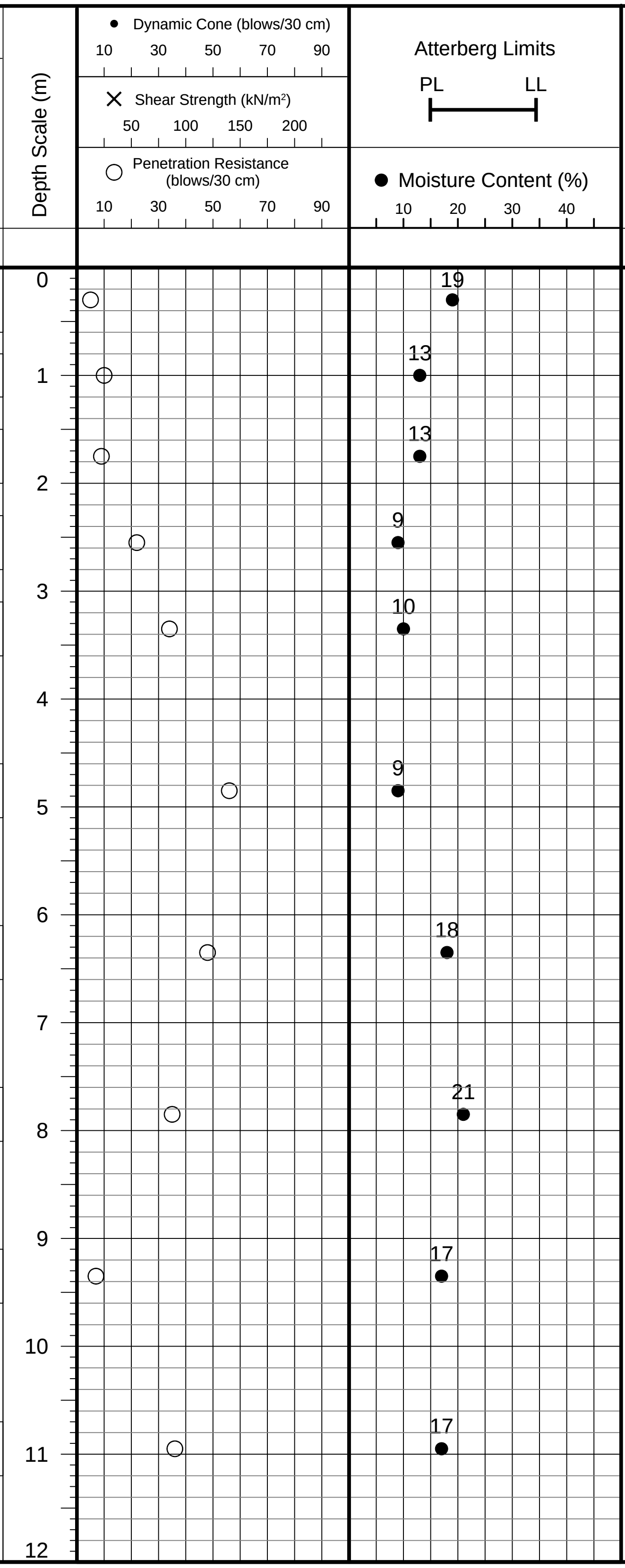
METHOD OF BORING: Flight Auger

PROJECT LOCATION: 12749 Tenth Line, Town of Whitchurch-Stouffville

DRILLING DATE: April 7, 2021

El. (m) Depth (m)	SOIL DESCRIPTION
292.3	Ground Surface
0.0	**35 cm TOPSOIL**
	Brown, firm to hard **SILTY CLAY TILL** ploughed low plasticity a trace of gravel occ. sand seams, cobbles and boulders
286.5 5.8	Brown, loose to dense **SILTY SAND** fine grained a trace of clay
281.1 11.2	**END OF BOREHOLE**

SAMPLES			
Number	Type	N-Value	Moisture Content (%)
1	DO	5	19
2	DO	10	13
3	DO	9	13
4	DO	22	9
5	DO	34	10
6	DO	56	9
7	DO	48	18
8	DO	35	21
9	DO	7	17
10	DO	36	17



WATER LEVEL

Cave-In @ El. 284.5 m upon completion

Soil Engineers Ltd.

JOB NO.: 2103-S118

LOG OF BOREHOLE: 4

FIGURE NO.: 4

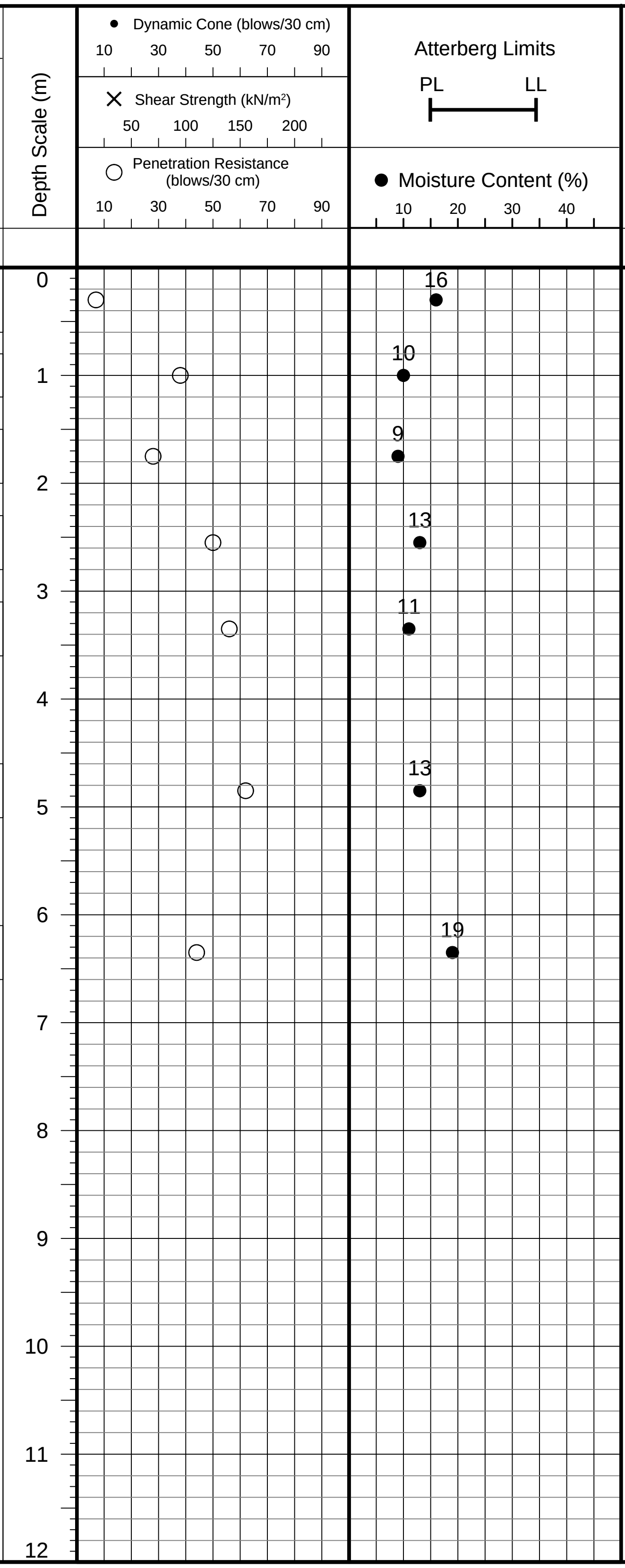
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 12749 Tenth Line, Town of Whitchurch-Stouffville

DRILLING DATE: April 9, 2021

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	WATER LEVEL
291.8	Ground Surface				
0.0	**35 cm TOPSOIL**	1	DO	7	
	Brown, firm to very dense **SILTY CLAY TILL** low plasticity a trace of gravel occ. sand seams, cobbles and boulders ploughed	2	DO	38	
		3	DO	28	
		4	DO	50	
		5	DO	56	
287.8 4.0	Brown, dense to very dense **SILTY SAND** fine grained a trace of clay	6	DO	62	Dry upon completion
		7	DO	44	
285.2 6.6	**END OF BOREHOLE**				



Soil Engineers Ltd.

JOB NO.: 2103-S118

LOG OF BOREHOLE: 5

FIGURE NO.: 5

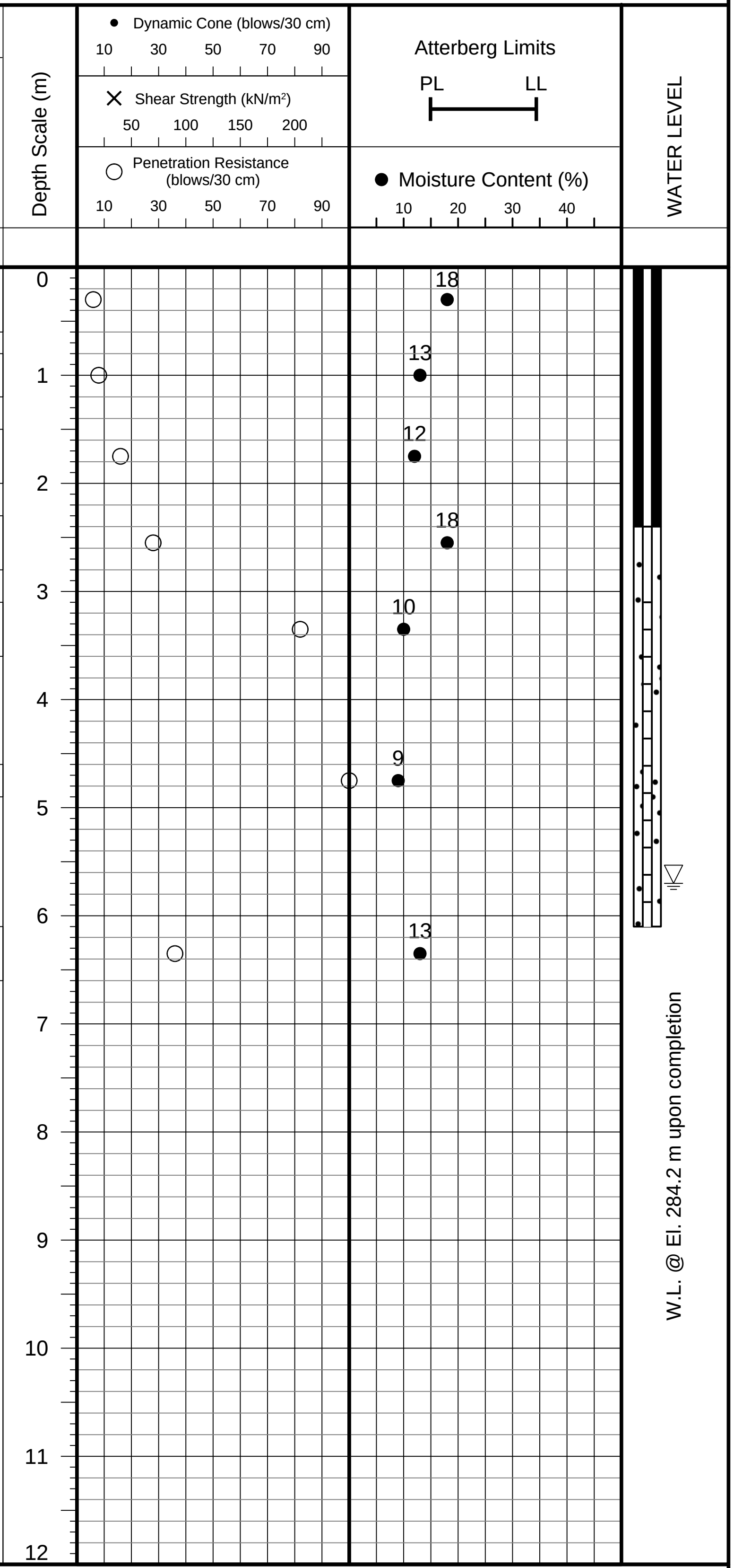
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 12749 Tenth Line, Town of Whitchurch-Stouffville

DRILLING DATE: April 7, 2021

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES		
		Number	Type	N-Value
289.9	Ground Surface			
0.0	**35 cm TOPSOIL**			
	Brown, firm to very stiff **SILTY CLAY** ploughed low to medium plasticity occ. sand seams	1	DO	6
		2	DO	8
		3	DO	16
		4	DO	28
287.1 2.8	Brown, hard **SILTY CLAY TILL** low plasticity a trace of gravel occ. sand seams, cobbles and boulders	5	DO	82
		6	DO	50/15
284.4 5.5	Brown, dense **SILTY SAND** fine grained a trace of clay	7	DO	36
283.3 6.6	**END OF BOREHOLE**			



W.L. @ El. 284.2 m upon completion

Soil Engineers Ltd.

JOB NO.: 2103-S118

LOG OF BOREHOLE: 6

FIGURE NO.: 6

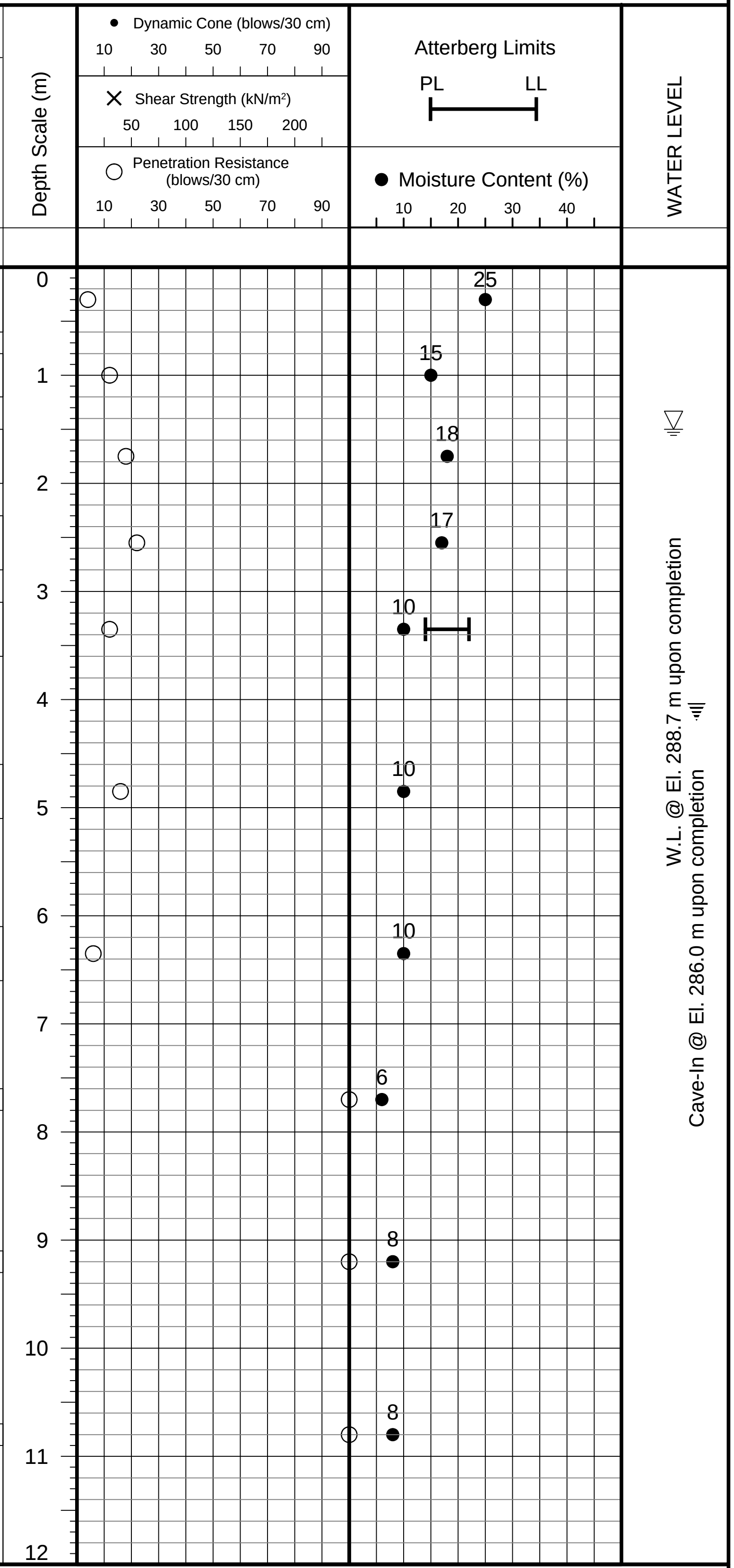
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 12749 Tenth Line, Town of Whitchurch-Stouffville

DRILLING DATE: April 8, 2021

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
290.2	Ground Surface			
0.0	**35 cm TOPSOIL** Brown, firm to very stiff ploughed **SILTY CLAY** medium plasticity occ. sand seams	1	DO	4
		2	DO	12
		3	DO	18
		4	DO	22
287.1 3.1	Grey, firm to hard **SILTY CLAY TILL** low plasticity a trace of gravel occ. sand seams, cobbles and boulders	5	DO	12
		6	DO	16
		7	DO	6
		8	DO	50/15
		9	DO	50/15
279.3 10.9	**END OF BOREHOLE**	10	DO	50/15



JOB NO.: 2103-S118

LOG OF BOREHOLE: 7

FIGURE NO.: 7

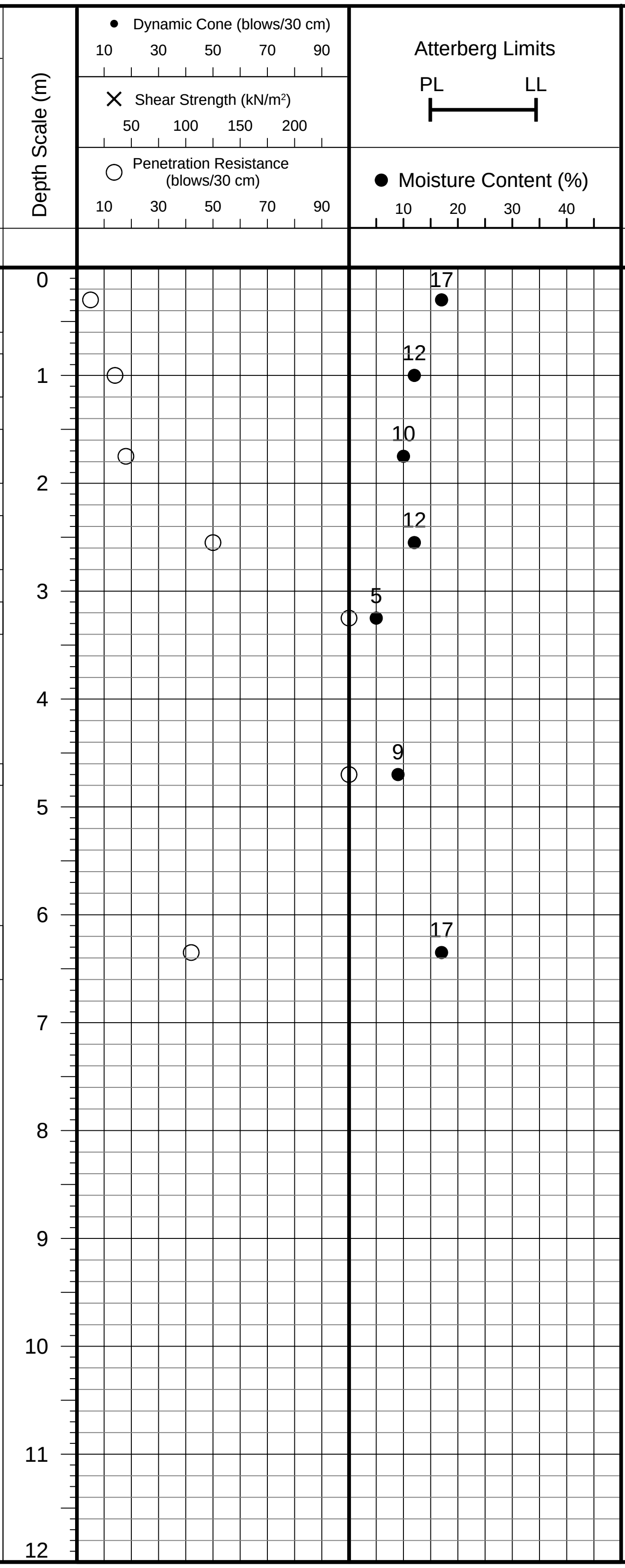
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 12749 Tenth Line, Town of Whitchurch-Stouffville

DRILLING DATE: April 9, 2021

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
292.0	Ground Surface			
0.0	**35 cm TOPSOIL**	1	DO	5
	Brown, firm to hard **SILTY CLAY TILL** ploughed	2	DO	14
	low plasticity a trace of gravel occ. sand seams, cobbles and boulders	3	DO	18
		4	DO	50
	sand layer	5	DO	50/15
		6	DO	50/15
286.5 5.5	Grey, dense **SILTY SAND** fine grained a trace of clay	7	DO	42
285.4 6.6	**END OF BOREHOLE**			



WATER LEVEL

Dry upon completion

Soil Engineers Ltd.

JOB NO.: 2103-S118

LOG OF BOREHOLE: 8

FIGURE NO.: 8

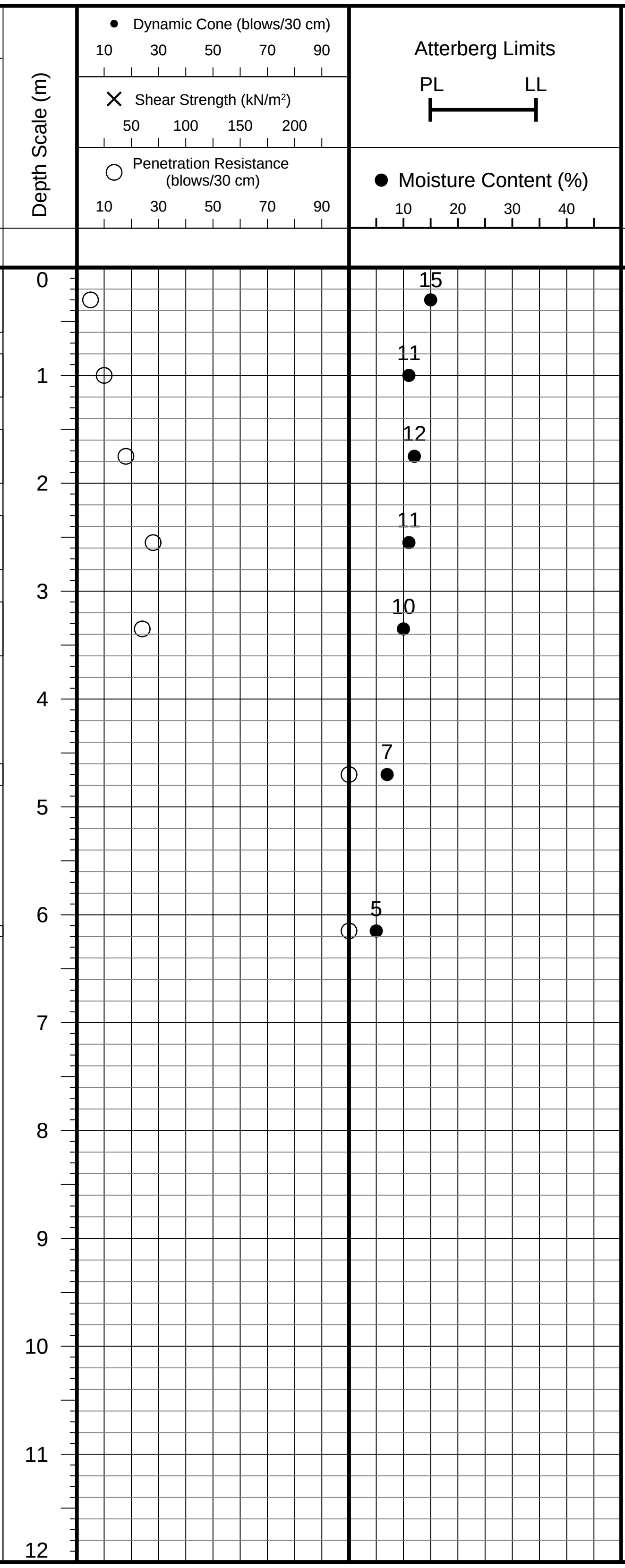
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 12749 Tenth Line, Town of Whitchurch-Stouffville

DRILLING DATE: April 8, 2021

		SAMPLES		
El. (m) Depth (m)	SOIL DESCRIPTION	Number	Type	N-Value
290.1	Ground Surface			
0.0	**35 cm TOPSOIL**			
	Firm to hard	1	DO	5
	SILTY CLAY TILL ploughed	2	DO	10
	low plasticity a trace of gravel occ. sand seams, cobbles and boulders	3	DO	18
		4	DO	28
		5	DO	24
	brown grey			
		6	DO	50/15
283.9 6.2	**END OF BOREHOLE**	7	DO	50/8



WATER LEVEL

Dry upon completion

Soil Engineers Ltd.

JOB NO.: 2103-S118

LOG OF BOREHOLE: 9

FIGURE NO.: 9

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger
(mud rotary)

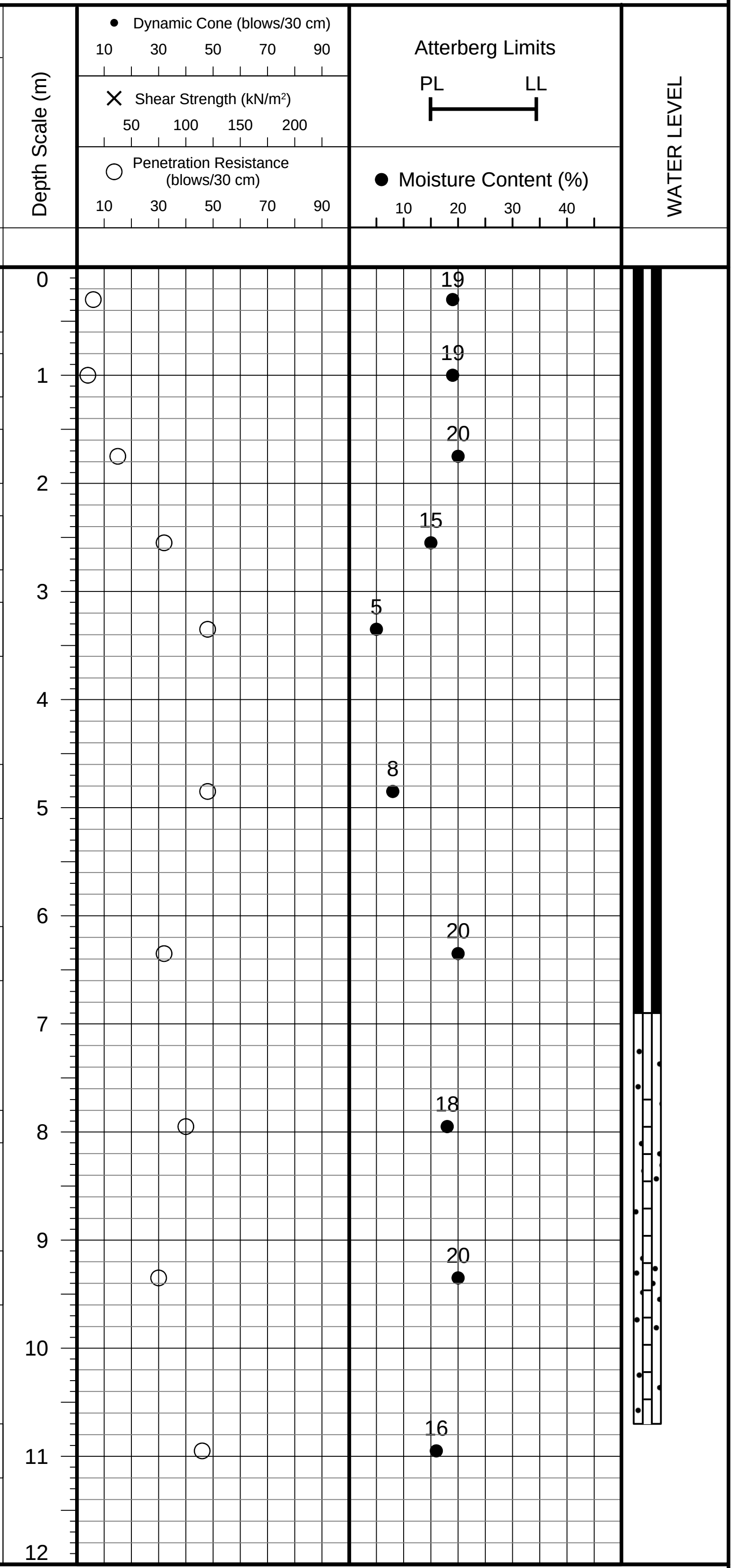
PROJECT LOCATION: 12749 Tenth Line, Town of Whitchurch-Stouffville

DRILLING DATE: April 9, 2021

El. (m) Depth (m)	SOIL DESCRIPTION
292.0	Ground Surface
0.0	**35 cm TOPSOIL** Brown, firm to hard **SILTY CLAY TILL** — ploughed low plasticity a trace of gravel occ. sand seams, cobbles and boulders
288.9 3.1	Brown, dense **SILTY SAND** fine grained a trace of clay
280.8 11.2	**END OF BOREHOLE**

SAMPLES

Number	Type	N-Value
1	DO	6
2	DO	4
3	DO	15
4	DO	32
5	DO	48
6	DO	48
7	DO	32
8	DO	40
9	DO	30
10	DO	46



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JOB NO.: 2103-S118

LOG OF BOREHOLE: 10

FIGURE NO.: 10

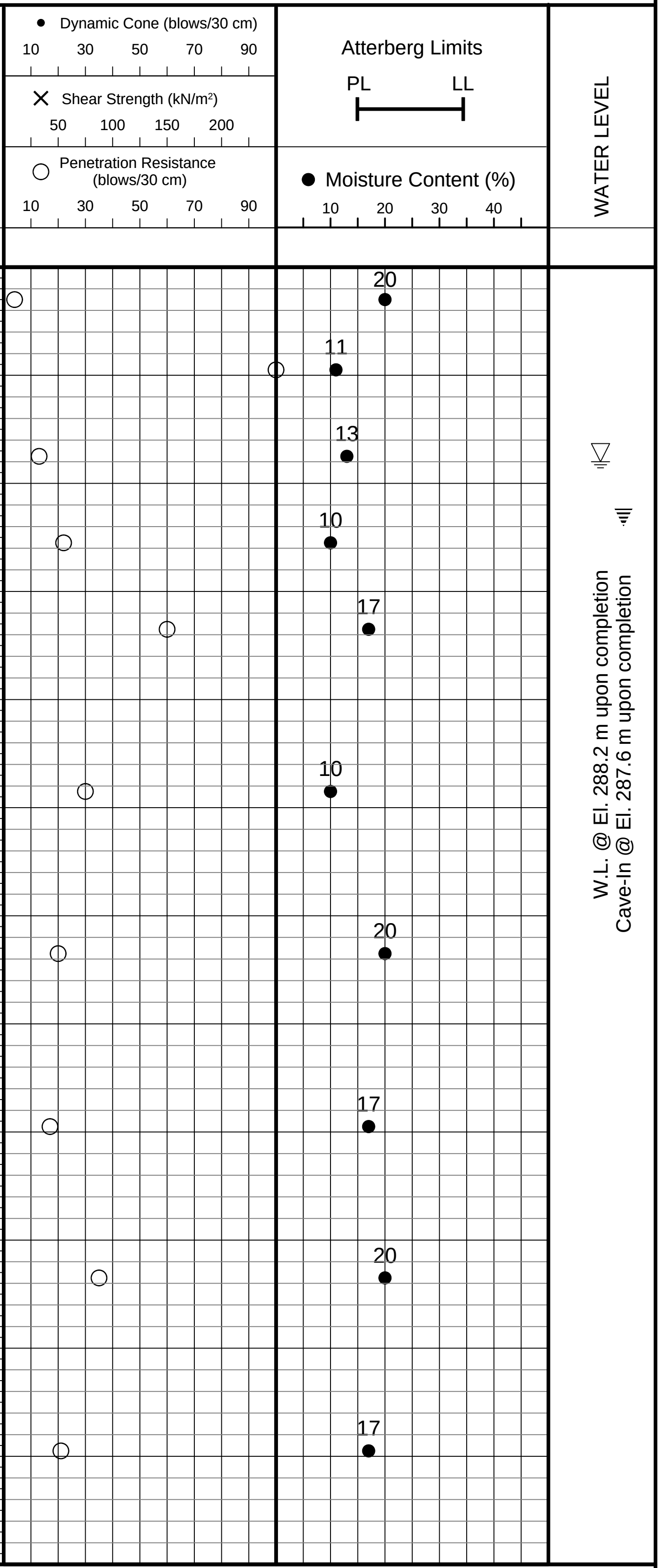
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 12749 Tenth Line, Town of Whitchurch-Stouffville

DRILLING DATE: April 9, 2021

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)
290.0	Ground Surface				
0.0	**35 cm TOPSOIL**				0
	Firm to hard	1	DO	4	
	SILTY CLAY TILL	2	DO	50/15	1
	low plasticity a trace of gravel occ. sand seams, cobbles and boulders	3	DO	13	2
		4	DO	22	
		5	DO	60	3
	brown grey				4
		6	DO	30	5
284.5 5.5	Grey, compact to dense				
	SILTY SAND				6
	fine grained a trace of clay	7	DO	20	7
		8	DO	17	8
		9	DO	35	9
					10
		10	DO	21	11
278.8 11.2	**END OF BOREHOLE**				12



W.L. @ El. 288.2 m upon completion

Cave-In @ El. 287.6 m upon completion

Soil Engineers Ltd.

JOB NO.: 2103-S118

LOG OF BOREHOLE: 11

FIGURE NO.: 11

PROJECT DESCRIPTION: Proposed Residential Development

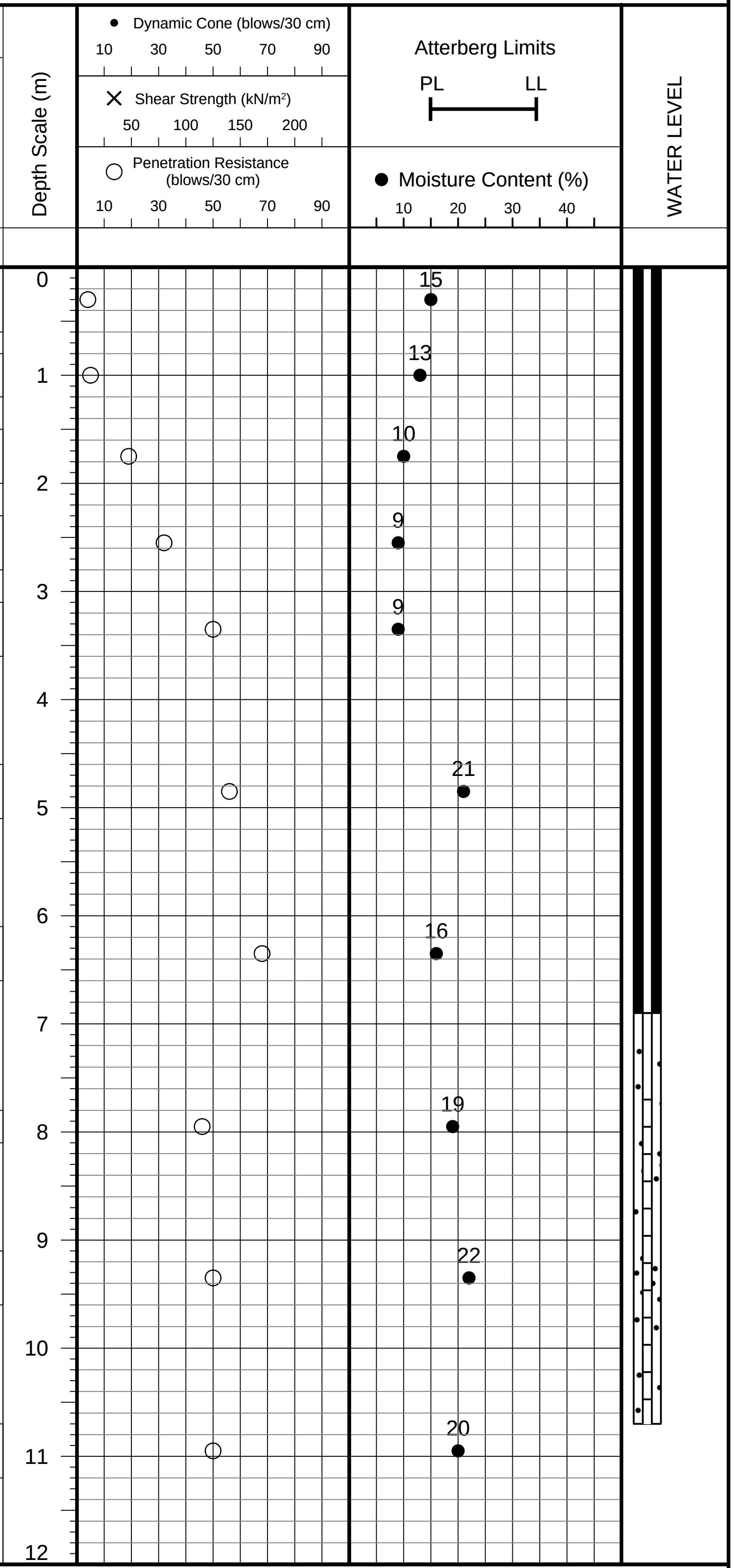
METHOD OF BORING: Flight Auger
(mud rotary)

PROJECT LOCATION: 12749 Tenth Line, Town of Whitchurch-Stouffville

DRILLING DATE: April 13, 2021

El. (m) Depth (m)	SOIL DESCRIPTION
293.2 0.0	Ground Surface **40 cm TOPSOIL**
	Brown, firm to hard **SILTY CLAY TILL** ploughed low plasticity a trace of gravel occ. sand seams, cobbles and boulders
289.2 4.0	Brown, very dense **SILTY SAND** fine grained a trace of clay
282.0 11.2	**END OF BOREHOLE**

SAMPLES		
Number	Type	N-Value
1	DO	4
2	DO	5
3	DO	19
4	DO	32
5	DO	50
6	DO	56
7	DO	68
8	DO	46
9	DO	50
10	DO	50



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JOB NO.: 2103-S118

LOG OF BOREHOLE: 12

FIGURE NO.: 12

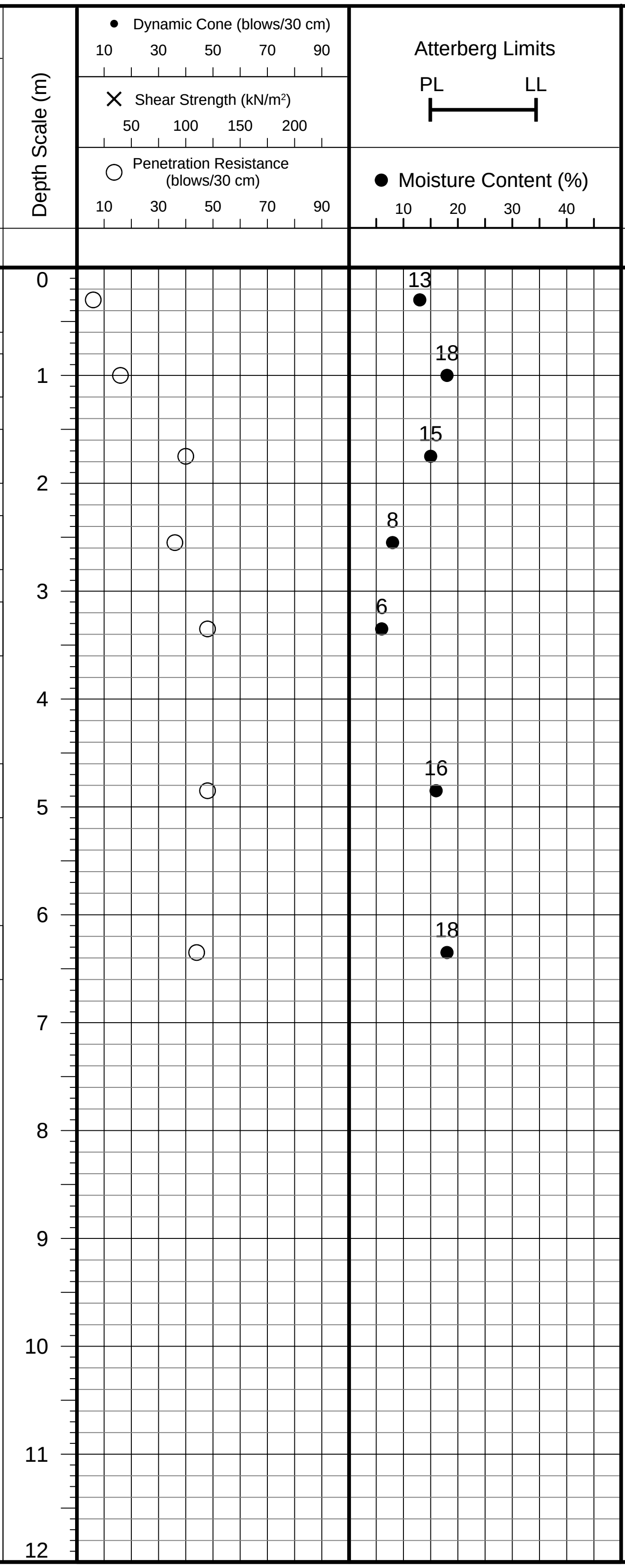
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 12749 Tenth Line, Town of Whitchurch-Stouffville

DRILLING DATE: April 8, 2021

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	WATER LEVEL
291.4	Ground Surface				
0.0	**35 cm TOPSOIL**	1	DO	6	Dry upon completion
	Brown, firm to hard **SILTY CLAY** ploughed low to medium plasticity	2	DO	16	
		3	DO	40	
289.1 2.3	Brown, dense **SILTY SAND** fine grained a trace of clay	4	DO	36	
		5	DO	48	
		6	DO	48	
		7	DO	44	
284.8 6.6	**END OF BOREHOLE**				



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JOB NO.: 2103-S118

LOG OF BOREHOLE: 13

FIGURE NO.: 13

PROJECT DESCRIPTION: Proposed Residential Development

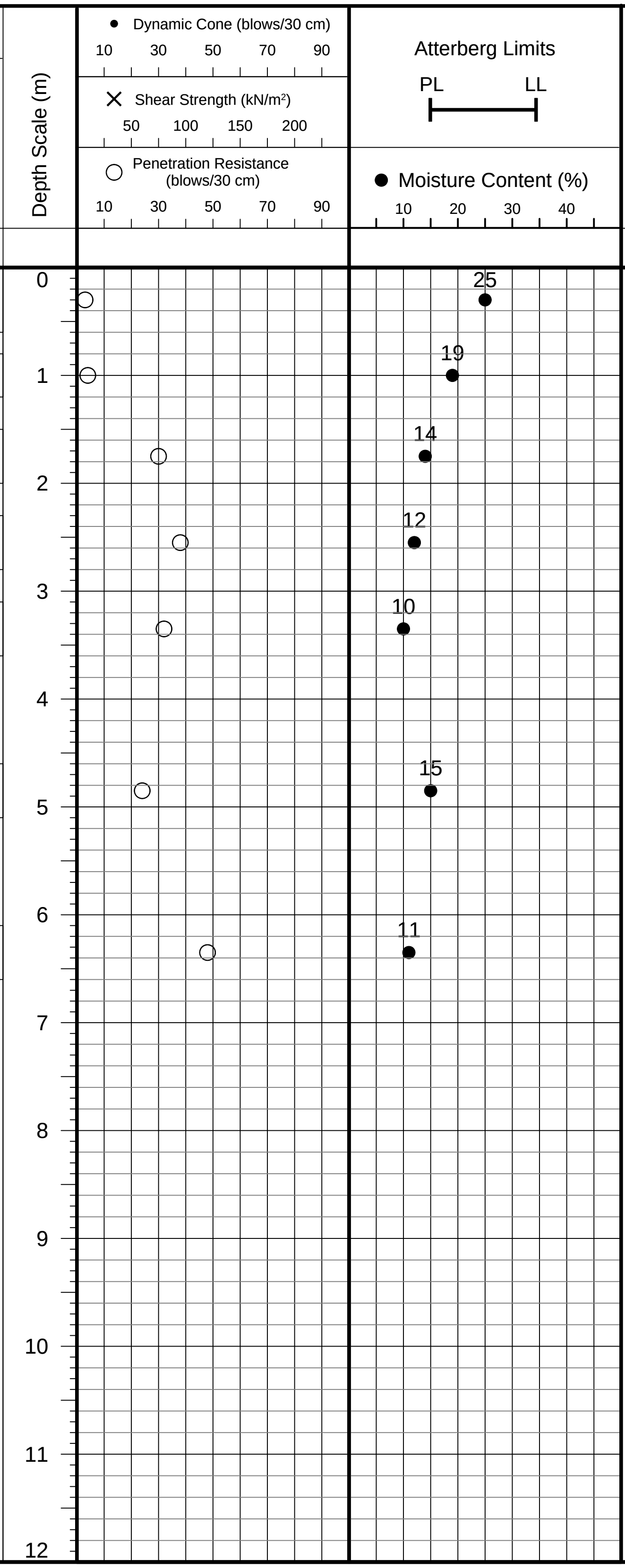
METHOD OF BORING: Flight Auger

PROJECT LOCATION: 12749 Tenth Line, Town of Whitchurch-Stouffville

DRILLING DATE: April 8, 2021

El. (m) Depth (m)	SOIL DESCRIPTION
288.2 0.0	Ground Surface **40 cm TOPSOIL**
	Brown, soft to firm **SILTY CLAY** ploughed medium plasticity occ. sand seams
286.7 1.5	Very stiff to hard **SILTY CLAY TILL** low plasticity a trace of gravel occ. sand seams, cobbles and boulders brown grey
281.6 6.6	**END OF BOREHOLE**

SAMPLES		
Number	Type	N-Value
1	DO	3
2	AS	4
3	DO	30
4	DO	38
5	DO	32
6	DO	24
7	DO	48



WATER LEVEL

Dry upon completion

JOB NO.: 2103-S118

LOG OF BOREHOLE: 14

FIGURE NO.: 14

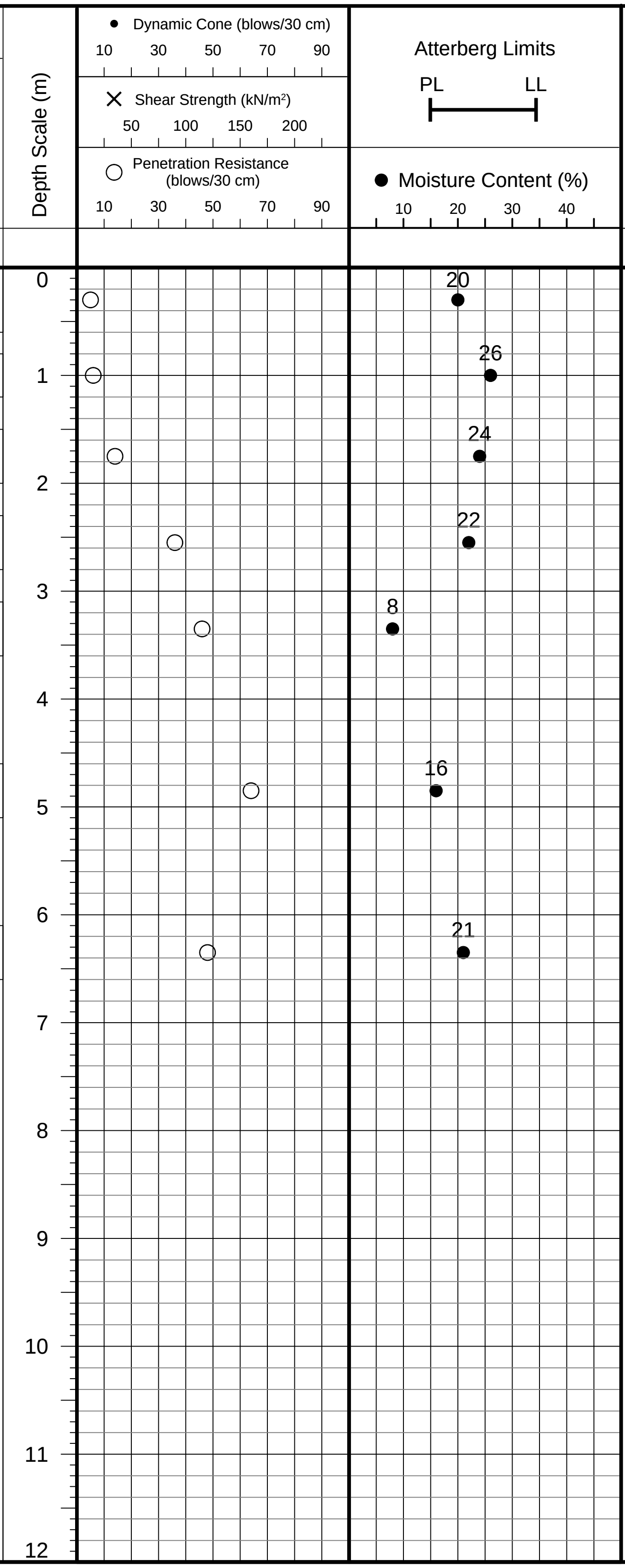
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 12749 Tenth Line, Town of Whitchurch-Stouffville

DRILLING DATE: April 8, 2021

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
292.4	Ground Surface			
0.0	**40 cm TOPSOIL**	1	DO	5
	Brown, loose to very dense **SILTY SAND** ploughed	2	DO	6
	fine grained a trace of clay	3	DO	14
		4	DO	36
	gravelly	5	DO	46
		6	DO	64
		7	DO	48
285.8 6.6	**END OF BOREHOLE**			



WATER LEVEL

W.L. @ El. 286.7 m upon completion

Soil Engineers Ltd.

JOB NO.: 2103-S118

LOG OF BOREHOLE: 15

FIGURE NO.: 15

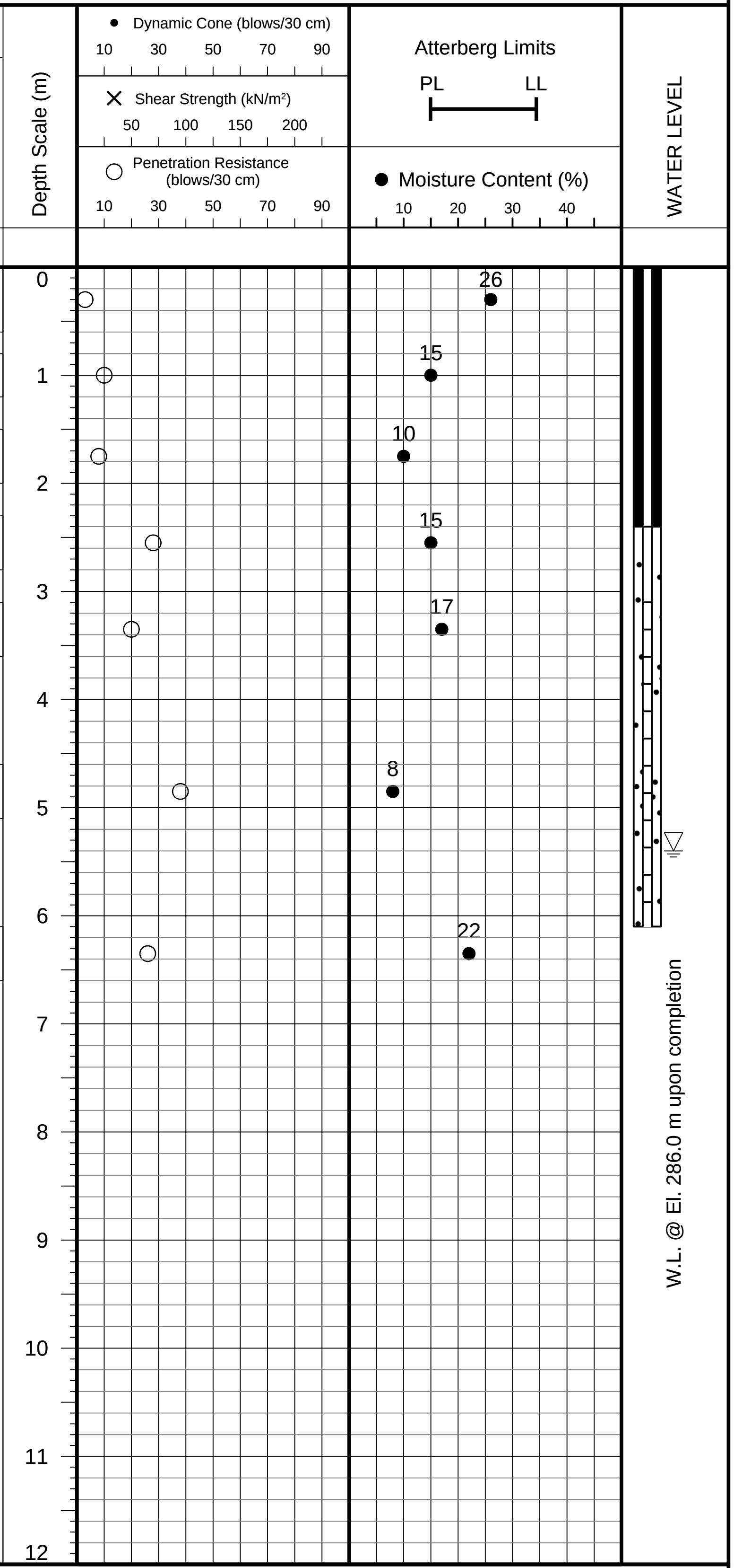
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 12749 Tenth Line, Town of Whitchurch-Stouffville

DRILLING DATE: April 17, 2021

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
291.4	Ground Surface			
0.0	**45 cm TOPSOIL**	1	DO	3
	Soil to hard ploughed **SILTY CLAY TILL** low plasticity a trace of clay occ. sand seams, cobbles and boulders	2	DO	10
		3	DO	8
		4	DO	28
		5	DO	20
	brown grey			
		6	DO	38
		7	DO	26
284.8 6.6	**END OF BOREHOLE**			



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JOB NO.: 2103-S118

LOG OF BOREHOLE: 16

FIGURE NO.: 16

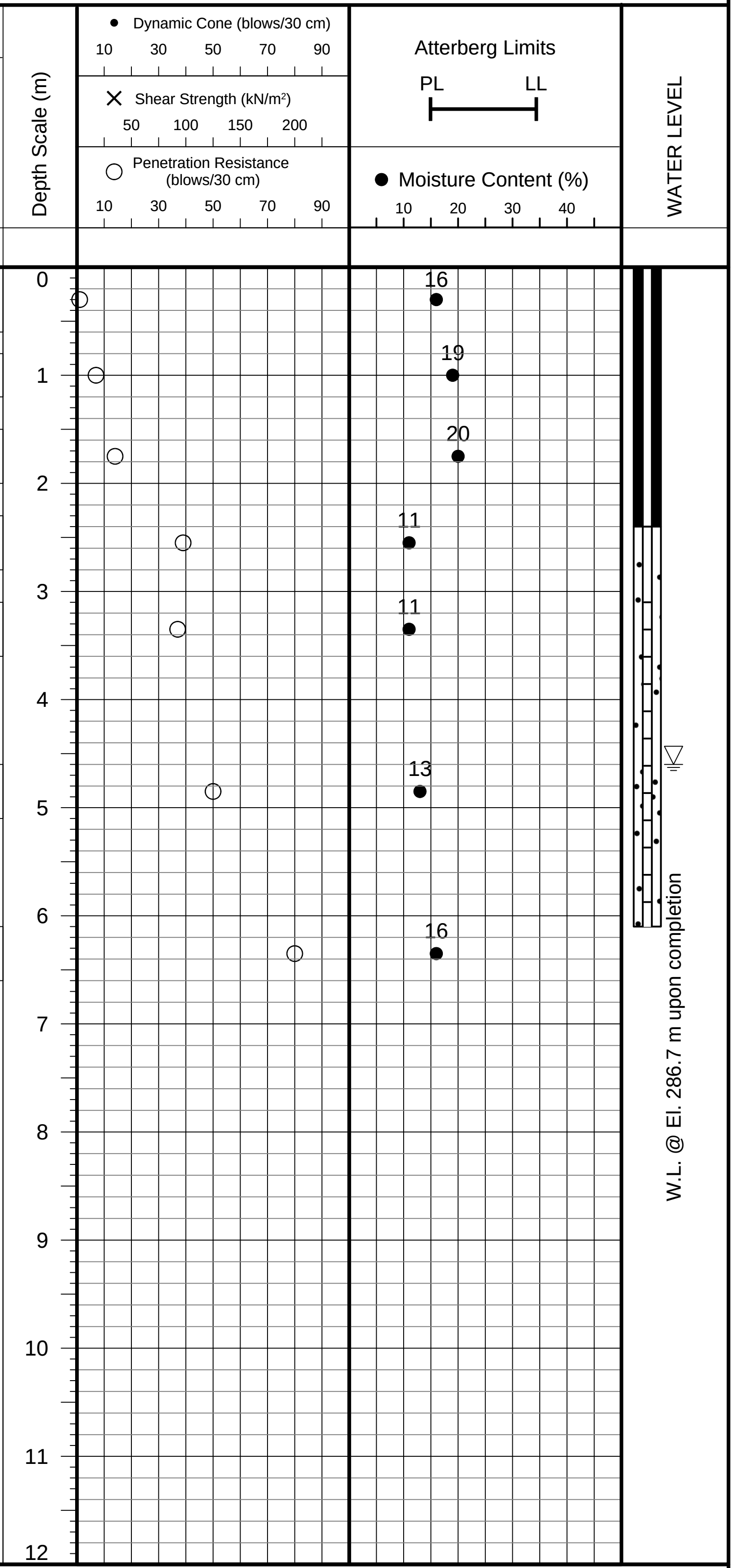
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 12749 Tenth Line, Town of Whitchurch-Stouffville

DRILLING DATE: April 17, 2021

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
291.3	Ground Surface			
0.0	**20 cm TOPSOIL**			
	Very soft to hard	1	DO	1
	SILTY CLAY TILL ploughed	2	DO	7
	low plasticity a trace of gravel occ. sand seams, cobbles and boulders	3	DO	14
		4	DO	39
		5	DO	37
	brown grey	6	DO	50
		7	DO	80
284.7 6.6	**END OF BOREHOLE**			



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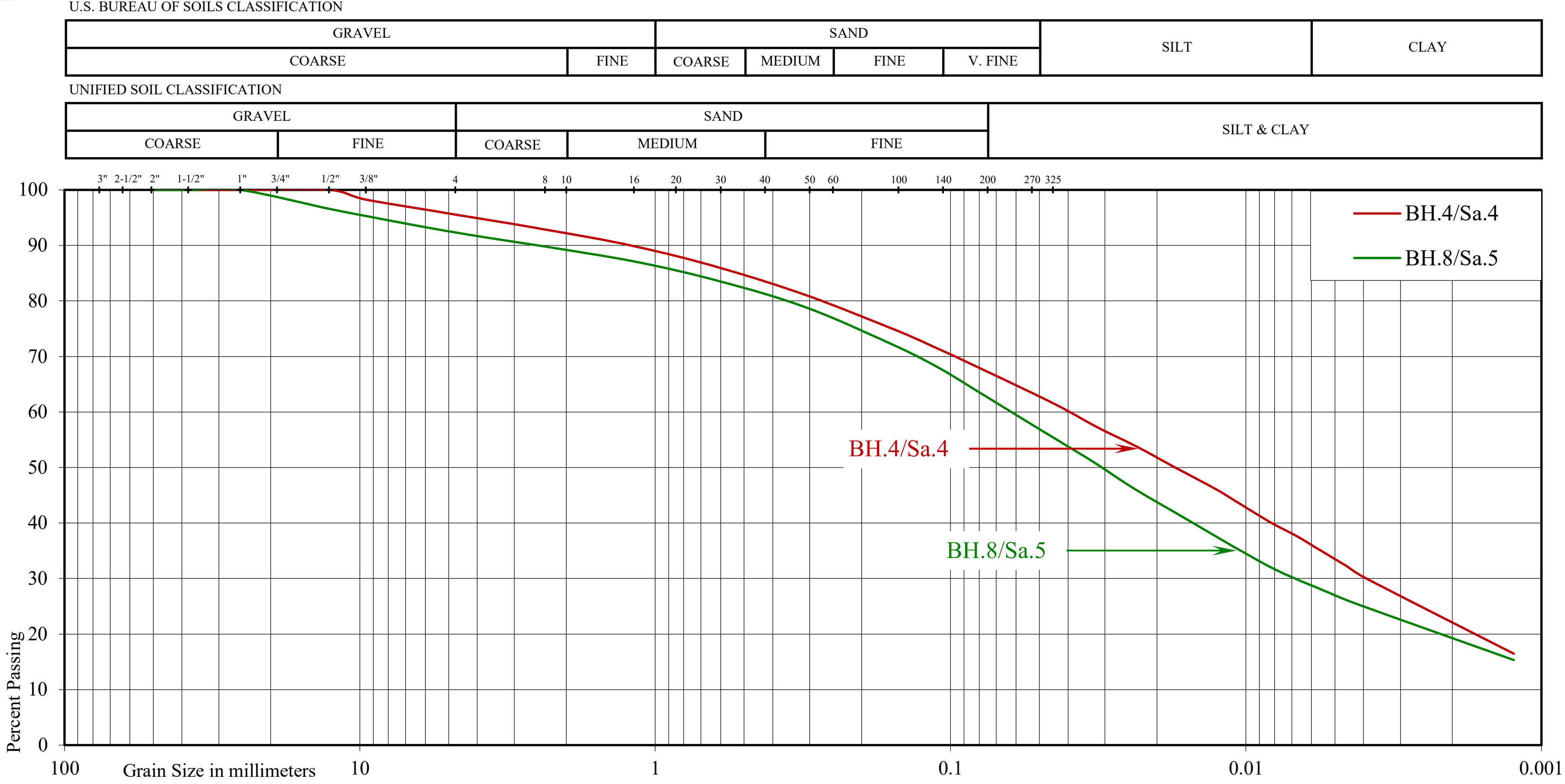
GRAIN SIZE DISTRIBUTION

Reference No: 2103-S118



Project: Proposed Residential Development

Location: 12749 Tenth Line, Town of Whitchurch-Stouffville

Borehole No:	4	8
Sample No:	4	5
Depth (m):	2.5	3.3
Elevation (m):	289.3	286.8

BH./Sa.	4/4	8/5
Liquid Limit (%) =	-	-
Plastic Limit (%) =	-	-
Plasticity Index (%) =	-	-
Moisture Content (%) =	13	24
Estimated Permeability (cm./sec.) =	10^{-7}	10^{-7}

Classification of Sample [& Group Symbol]: SILTY CLAY TILL

sandy, a trace of gravel

Figure: 17

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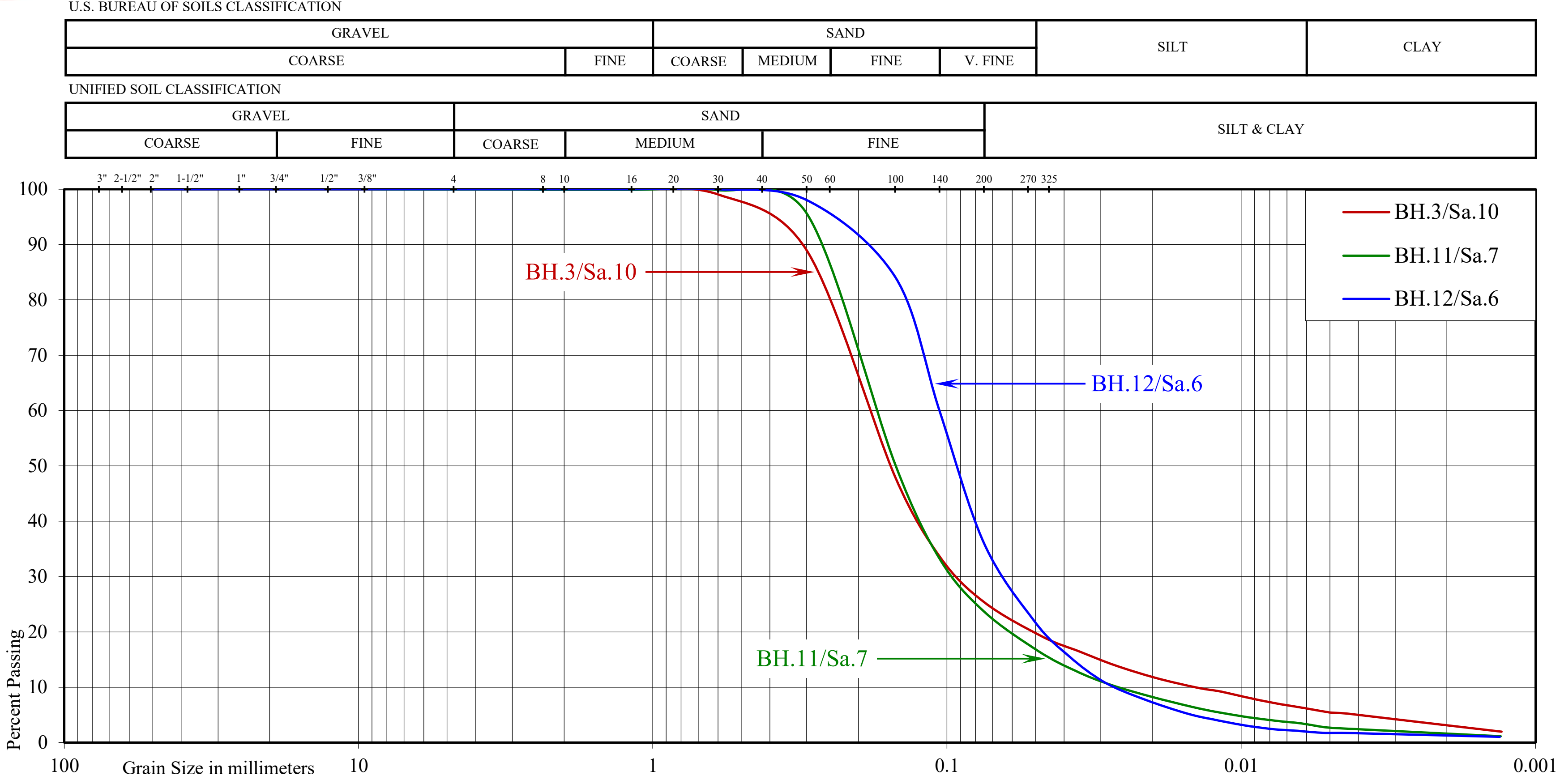
GRAIN SIZE DISTRIBUTION

Reference No: 2103-S118



Project: Proposed Residential Development

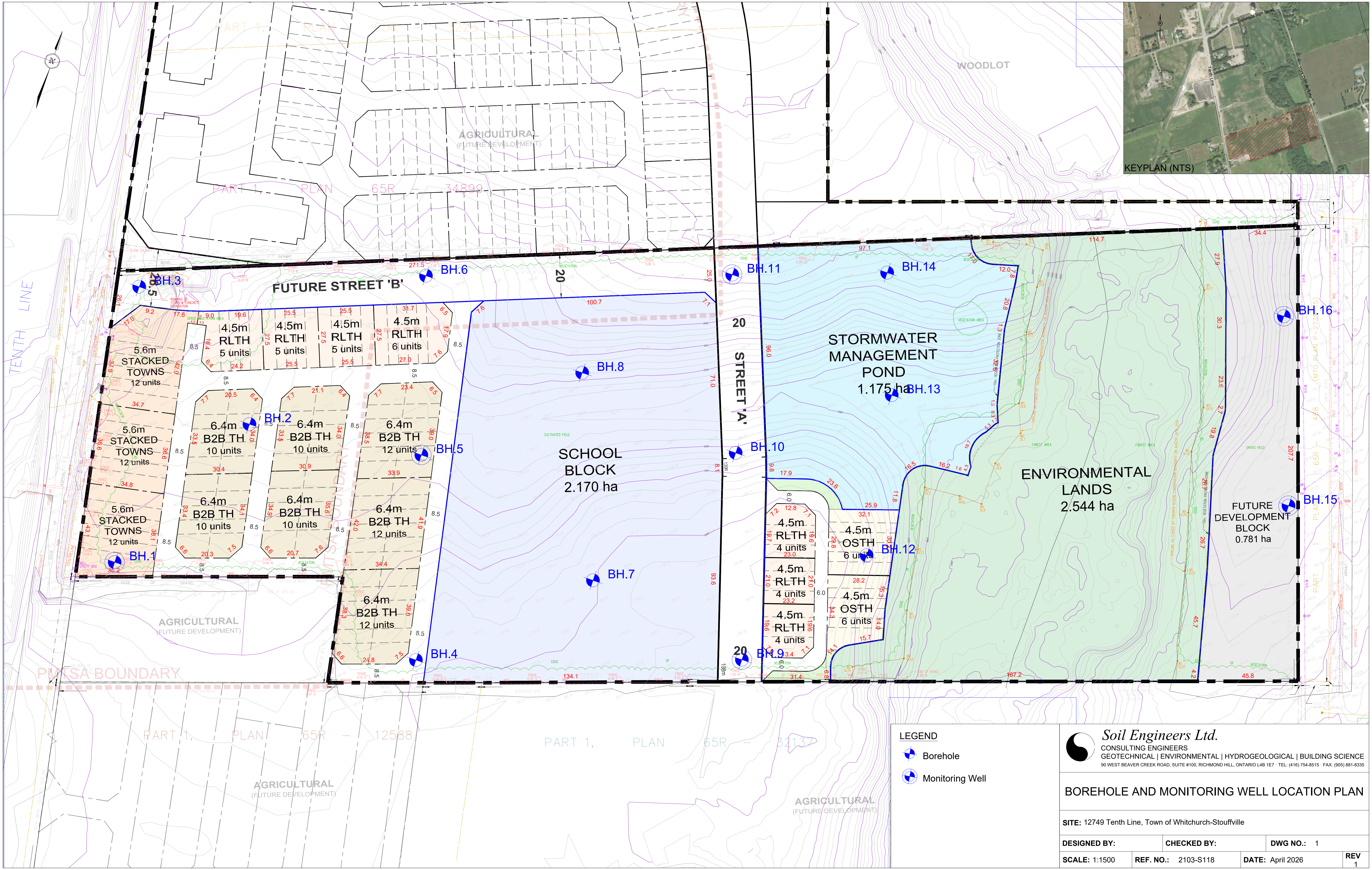
Location: 12749 Tenth Line, Town of Whitchurch-Stouffville

Borehole No:	3	11	12
Sample No:	10	7	6
Depth (m):	11.0	6.3	4.8
Elevation (m):	281.3	286.9	286.6

BH./Sa.	3/10	11/7	12/6
Liquid Limit (%) =	-	-	-
Plastic Limit (%) =	-	-	-
Plasticity Index (%) =	-	-	-
Moisture Content (%) =	17	16	16
Estimated Permeability (cm./sec.) =	10^{-4}	10^{-3}	10^{-3}

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

Figure: 18



LEGEND

Borehole

Monitoring Well

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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 AND MONITORING WELL LOCATION PLAN

SITE: 12749 Tenth Line, Town of Whitchurch-Stouffville

DESIGNED BY:	**CHECKED BY:**	**DWG NO.:** 1	
SCALE: 1:1500	**REF. NO.:** 2103-S118	**DATE:** April 2026	**REV** 1

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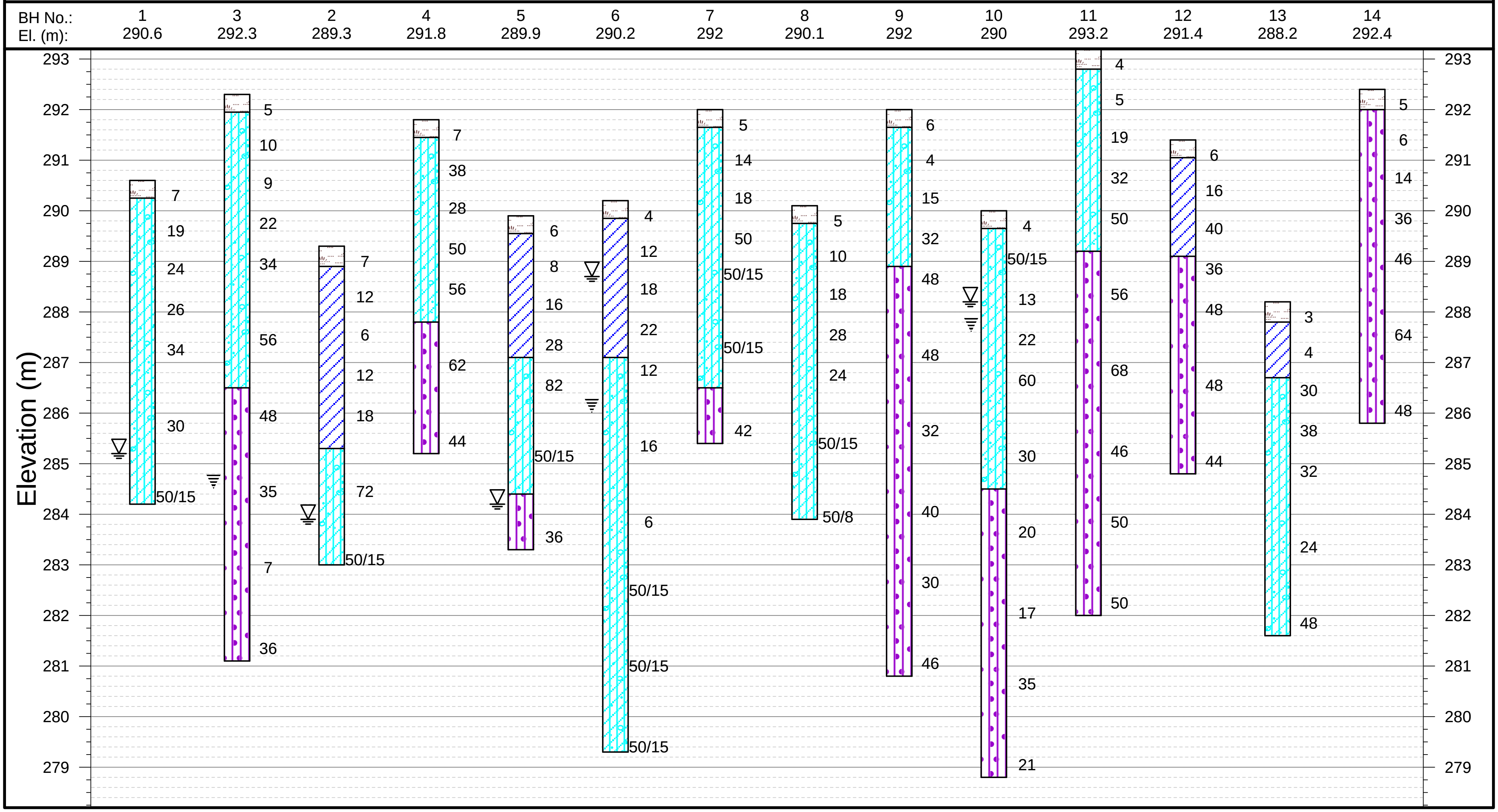
SUBSURFACE PROFILE
DRAWING NO. 2
SCALE: AS SHOWN

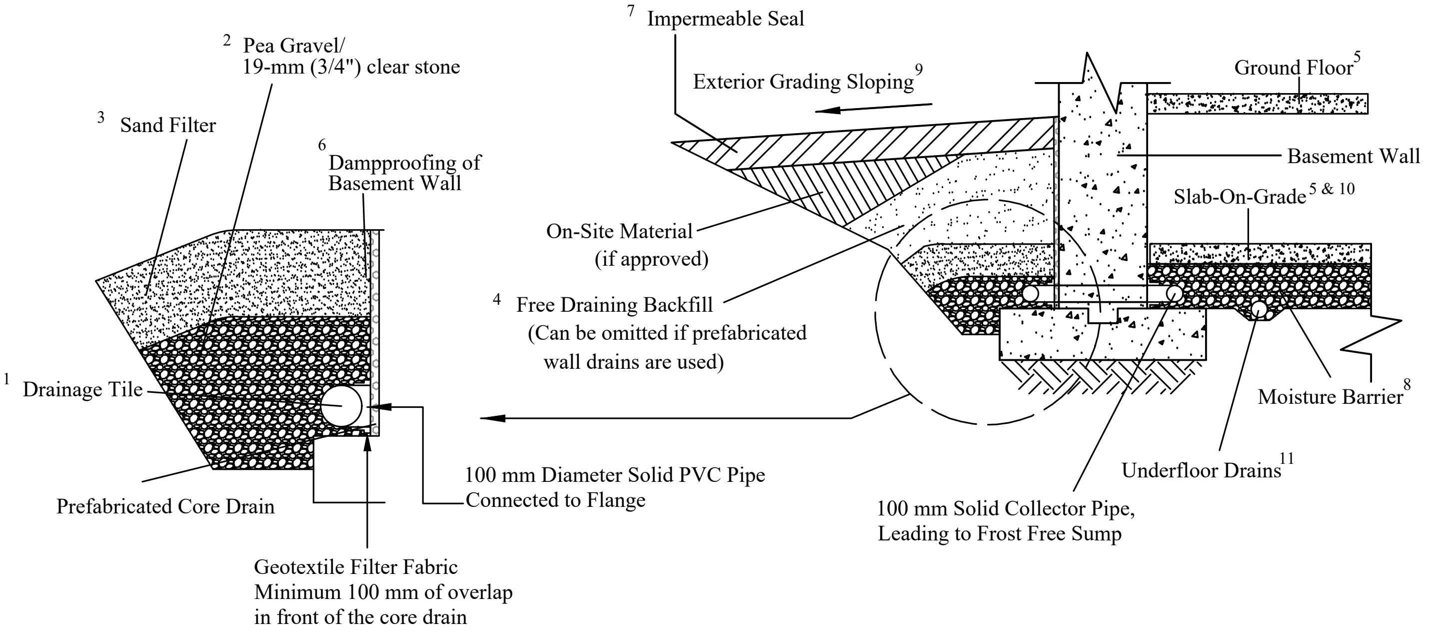
JOB NO.: 2103-S118
REPORT DATE: May 2021
PROJECT DESCRIPTION: Proposed Residential Development
PROJECT LOCATION: 12749 Tenth Line, Town of Whitchurch-Stouffville

LEGEND

▨ SILTY CLAY ▨ SILTY CLAY TILL ▨ SILTY SAND ▨ TOPSOIL

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





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 slab.

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 19-mm (3/4") 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 adequate 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**: 19-mm (3/4") clear stone. 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 spacing should be at least 300 mm (12") between the underside of the floor slab and the top of the pipe. The drains should be connected to positive sumps or outlets. Do not connect the underfloor drains to the perimeter drains.

* Underfloor drains can be omitted where not required.

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PERMANENT PERIMETER DRAINAGE SYSTEM
(OPEN EXCAVATION FOR PART 9 BUILDINGS)

SITE: 12749 Tenth Line, Town of Whitchurch-Stouffville

DESIGNED BY: K.L. **CHECKED BY:** B.L. **DWG NO.:** 3

SCALE: N.T.S. **REF. NO.:** 2103-S118 **DATE:** April 2026 **REV** -

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

APPENDIX

MONITORING WELL RECORDS
2103-W118

REFERENCE NO. 2103-S118

BH/MW	Ground Level Elevation (masl)	Units	28/Apr/21	28/May/21	29/Jun/21	27/Jul/21	31/Aug/21	30/Sep/21	30/Oct/21	30/Nov/21	23/Dec/21	21/Jul/23	23/Nov/23	28/Dec/23	24/Jan/24	28/Feb/24	12/Mar/24	1/Apr/24	22/May/24	25/Jun/24	25/Jul/24	28/Aug/24	25/Sep/24	23/Oct/24	27/Nov/24	23/Dec/25	6/Jan/26
1	290.56	mbgs	1.66	2.23	2.51	2.24	3.00	1.83	1.21	1.56	1.29	1.59	2.13	0.69	0.47	0.73	0.74	1.20	1.37	1.32	1.71	1.52	2.37	2.88	2.24	1.22	1.43
		masl	288.90	288.33	288.05	288.32	287.56	288.73	289.35	289.00	289.27	288.97	288.43	289.87	290.09	289.83	289.82	289.36	289.19	289.24	288.85	289.04	288.19	287.68	288.32	289.34	289.13
5	289.88	mbgs	3.52	3.61	3.95	4.02	4.27	4.30	3.71	3.48	2.65	2.85	3.85	2.79	3.06	2.59	2.41	2.55	2.48	2.88	2.86	2.79	3.41	3.71	3.95	3.73	3.72
		masl	286.36	286.27	285.93	285.86	285.61	285.58	286.17	286.40	287.23	287.03	286.03	287.09	286.82	287.29	287.47	287.33	287.40	287.00	287.02	287.09	286.47	286.17	285.93	286.15	286.16
9	292.02	mbgs	6.43	6.53	6.77	6.85	7.01	7.06	6.78	6.51	6.15	6.24	6.69	6.65	6.41	6.04	6.02	5.91	5.65	5.96	6.10	6.19	6.36	6.56	6.71	7.07	7.04
		masl	285.59	285.49	285.25	285.17	285.01	284.96	285.24	285.51	285.87	285.78	285.33	285.37	285.61	285.98	286.00	286.11	286.37	286.06	285.92	285.83	285.66	285.46	285.31	284.95	284.98
11	293.16	mbgs	6.52	6.61	6.84	6.91	7.07	7.13	6.94	6.76	6.44	6.14	6.67	6.63	6.44	6.05	6.02	5.92	5.74	6.04	6.08	6.22	6.41	6.62	6.76	7.00	7.10
		masl	286.64	286.55	286.32	286.25	286.09	286.03	286.22	286.40	286.72	287.02	286.49	286.53	286.72	287.11	287.14	287.24	287.42	287.12	287.08	286.94	286.75	286.54	286.40	286.16	286.06
15	291.40	mbgs	4.55	4.76	4.98	5.07	5.17	5.21	4.98	4.79	4.54	NA	4.74	4.42	4.36	3.98	3.93	3.95	3.79	3.95	4.08	4.22	4.39	4.65	4.78	4.56	4.22
		masl	286.85	286.64	286.42	286.33	286.23	286.19	286.42	286.61	286.86	NA	286.66	286.98	287.04	287.42	287.47	287.45	287.61	287.45	287.32	287.18	287.01	286.75	286.62	286.84	287.18
16	291.30	mbgs	3.74	3.91	4.19	4.27	4.45	4.52	4.32	4.18	3.74	3.44	5.03	3.89	3.51	3.19	2.98	3.09	2.97	3.25	3.25	3.25	3.72	3.93	3.93	3.80	4.59
		masl	287.56	287.39	287.11	287.03	286.85	286.78	286.98	287.12	287.56	287.86	286.27	287.41	287.79	288.11	288.32	288.21	288.33	288.05	288.05	288.05	287.58	287.37	287.37	287.50	286.71