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A REVISED REPORT TO
WYCLIFFE THORNRIDGE SHARON LIMITED

A GEOTECHNICAL INVESTIGATION FOR PROPOSED RESIDENTIAL DEVELOPMENT

MOUNT ALBERT ROAD AND LESLIE STREET EAST

TOWN OF EAST GWILLIMBURY

REFERENCE NO. 1704-S065

MARCH 2019
(REVISION OF REPORT DATED NOVEMBER 2017)

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1.0 INTRODUCTION

In accordance with written authorization dated April 11, 2017, from Mr. Gary Bensky of Wycliffe Thornridge Sharon Limited., a geotechnical investigation was carried out on a parcel of land located on the north side of Mount Albert Road, west of Leslie Street, in the Town of East Gwillimbury.

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 a Residential Development. The geotechnical findings and resulting recommendations are presented in this Report.

Our records indicate that a previous geotechnical investigation was completed for the development to the north and west in 2007/08 (our Reference No. 0710-S131). Three of the previous boreholes, located within the property of the proposed development, are being used as reference for the preparation of this report.

2.0 SITE AND PROJECT DESCRIPTION

The Town of East Gwillimbury is situated in a rolling and hilly area which contains ice-contact stratified drift sediments associated with the Oak Ridges Moraine. The drift mainly consists of sand, silt and minor gravel.

The subject property, encompasses an area of approximately 3 hectares, is located on the north side of Mount Albert Road and west of Leslie Street in the Town of East Gwillimbury. It is currently occupied by multiple residential dwellings with sheds, garages and grass lawns. The existing site gradient drops slightly towards the northwest.

It is understood that the property will be developed with a 7-storey retirement home, a 7-storey apartment building, mixed-use building and multiple townhouse blocks, all serviced with on-grading parking and municipal services.

3.0 FIELD WORK

The field work of the current investigation, consisting of ten (10) boreholes to depths ranging from 6.6 to 22.5 m, was performed between May 6 and 19, 2017. These boreholes were labeled under the 200-series to distinguish from the previous boreholes completed in 2007/08. The locations of the current and the previous boreholes are shown on the Borehole Location Plan, Drawing No. 1.

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

Dynamic cone penetration tests (DCPT) were also performed beyond the sampling depths of 12.6 to 17.2 m in Boreholes 202, 205, 206 and 207, in order to determine the approximate depth of the hard stratum.

The field work was supervised and the findings were recorded by a Geotechnical Technician. The ground elevation at each of the borehole locations was determined using a hand held Global Navigation Satellite System surveying equipment (Trimble Geoexplorer 6000), or interpolated from the Topographic Survey Plan, prepared by Rady-Pentek & Edward Surveying Ltd. dated August 25, 2016.

4.0 SUBSURFACE CONDITIONS

Detailed descriptions of the encountered subsurface conditions are presented on the Borehole Logs, comprising Figures 1 to 10, inclusive. The logs of the previous Boreholes are attached in the Appendix for reference. The revealed stratigraphy is plotted on the Subsurface Profile, Drawing No. 2.

The investigation revealed that beneath a veneer of topsoil or pavement structure, with a layer of earth fill in places, the site is generally underlain by silty clay and silty clay till, with layers of silt and sandy silt till in the lower stratigraphy. The engineering properties of the disclosed soils are discussed herein.

4.1 **Topsoil** (Boreholes 12, 13, 101, 202, 204 to 207)

The existing ground surface was mostly covered with topsoil, in variable thickness of 15 to 51 cm at the borehole locations. Topsoil thicker than that found in the boreholes is expected to occur in places, particularly in the treed area or in low-lying areas where topsoil deposited by erosion from higher areas will likely occur. The topsoil identified in the previous borehole locations (Boreholes 12, 13 and 101) could have been changed since earthwork has been taken place in the area.

The topsoil is dark brown in colour and permeated with roots and humus, which is unstable and compressible under loads. It is considered to be void of engineering value and can be used for general landscaping purposes only. Due to the humus content, it will generate an offensive odour under anaerobic conditions and may produce volatile gases; therefore, the topsoil must not be buried within the building envelope, or deeper than 1.2 m below the finished grade, as it may have an adverse impact on the environmental well-being of the development.

4.2 **Pavement** (Boreholes 203, 208 and 209)

The asphalt pavement on the existing driveways consists of 50 to 80 mm of asphalt, overlying a granular fill of 250 to 380 mm in thickness.

4.3 **Earth Fill** (Boreholes 209 and 210)

The earth fill, consisting of silty clay with sand and gravel, was contacted in the area of Boreholes 209 and 210. It extends to a depth of 1.5 m and 0.3 m from the prevailing ground surface, respectively. Earth fill can also be found in the vicinity of Boreholes 12 and 101, due to the previous earth work in these areas.

The obtained ‘N’ values of the earth fill are 7 to 18 blows per 30 cm of penetration. The water content of the soil samples ranged from 20% to 22%.

The earth fill is not suitable for supporting any structure sensitive to movement. To reuse the earth fill in structural applications, it must be sub-excavated, segregated and removal of the deleterious material before re-compacted in layers.

<u>One must be aware that the samples retrieved from boreholes 10 cm in diameter may not be truly representative of the geotechnical and environmental quality of the fill, and do not indicate whether the topsoil beneath the earth fill was completely stripped. This should be further assessed by laboratory testing and/or test pits.</u>

4.4 **Silty Clay/Silty Clay Till** (All Boreholes, except Borehole 210)

The silty clay deposit was encountered below the topsoil and/or earth fill. It has a varved structure with silt and sand seams or layers. The natural water content of the clay samples range from 16% to 32%, with a median of 23%, indicating a moist condition. The obtained ‘N’ values range from 2 to 26 blows, with a median of 11 blows per 30 cm of penetration, indicating firm to very stiff in consistency, with soft layers due to weathering near the ground surface.

The silty clay till deposit was encountered below the silty clay or silt stratum in some boreholes. It is heterogeneous, with a random mixture of soils having the particle sizes range from clay to gravel, with the clay fraction exerting the dominant influence on its soil properties. The natural water content of the clay till samples range from 9% to 25%, with a median of 13%. The obtained ‘N’ values range from 8 to over 100 blows, with a median of 17 blows per 30 cm of penetration, indicating that the consistency of the silty clay till is stiff to hard, being generally very stiff.

Hard resistance was encountered during augering through the clay till, showing occasional cobbles and boulders. In fact, the high ‘N’ values (over 100 blows) could have been exaggerated by the cobbles or boulders and do not represent the actual consistency of the clay till.

Grain size analysis was performed on a representative sample of the clay till. The results are plotted on Figure 11.

According to the above findings, the engineering properties of the clay and clay till deposits relating to the project are given below:

- Highly frost susceptable, with high soil-adfreezing potential.
- The laminated sand and silt layers are water erodible.
- Low permeability, with an estimated coefficient of permeability of 10^{-7} cm/sec, a percolation rate of more than 80 minutes/cm and runoff coefficients of:

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

- A cohesive-frictional soil, its shear strength is derived from consistency and augmented by the internal friction of the sand and silt. Its shear strength is moisture dependent and the overall shear strength is susceptible to impact disturbance, i.e. the disturbance will induce a build-up of pore pressure within the soil mantle, resulting in soil dilation and a reduction of shear strength.
- The clay and clay till will generally be stable in a relatively steep cut; however, long exposure will allow the soft or weathered layers to become saturated which may lead to localized sloughing.
- A very poor pavement-supportive material, with an estimated California Bearing Ratio (CBR) value of less than 3%.
- Moderately corrosive to buried metal, with an estimated electrical resistivity of 3000 to 3500 ohm.cm.

4.5 **Silt** (All Boreholes, except Boreholes 12 and 201)

The silt deposit was encountered at various depths in the boreholes. It is fine grained, with some clay. Grain size analyses were performed on four representative samples; the results are plotted on Figure 12.

The natural water content of the samples range from 15% to 30%, with a median of 21%, indicating moist to wet, generally wet conditions.

The obtained ‘N’ values range from 1 to 33 blows, with a median of 13 blows per 30 cm of penetration, indicating very loose to dense, being generally compact in relative density. The very loose or loose silt could have been disturbed by weathering near the ground surface or by the hydrostatic pressure during the augering and sampling process. Based on the DCPT readings in Borehole 202, the undisturbed dense silt stratum was probably encountered at 1.5 m below the sampled depth of borehole, or 15.5 m from the prevailing ground surface.

According to the above findings, the engineering properties relating to the project are given below:

- Highly frost susceptible, with high soil-adfreezing potential.
- Highly water erodible; it is susceptible to migration through small openings under seepage pressure.
- It has a high capillarity and water retention capacity.
- Relatively low permeable, with an estimated coefficient of permeability of 10^{-6} cm/sec, a percolation rate of 55 minutes/cm and runoff coefficients of:

Slope	
0% - 2%	0.11
2% - 6%	0.16
6% +	0.23

- A frictional soil, its shear strength is density dependent. Due to its dilatancy, the strength of the wet silt is susceptible to impact disturbance, i.e. the disturbance will induce a build-up of pore pressure within the soil mantle, resulting in soil dilation and a reduction in shear strength.
- In excavation, the silt will slough and run slowly with seepage bleeding from the cut face. It will boil with a piezometric head of 0.3 m.
- A poor pavement-supportive material, with an estimated CBR value of 3%.
- Moderately corrosive to buried metal, with an estimated electrical resistivity of 4500 ohm.cm.

4.6 **Sandy Silt Till** (Boreholes 101, 203, and 205 to 210, inclusive)

The sandy silt till was encountered in the boreholes, below the clay, clay till or silt. In Boreholes 208 and 209, the sandy silt till stratum was interstratified by a silt deposit.

The sandy silt till consists of a random mixture of particle sizes ranging from clay to gravel, with either sand or silt being the dominant fraction. It is amorphous in structure showing the deposit is glacial till, part of which has been reworked by the glacial lake.

The relative density of the silt till, as inferred by the ‘N’ values ranging from 2 to 47, with a median of 15 blows per 30 cm of penetration, is very loose to dense, being generally compact. The very loose to loose sandy silt till can be caused by the disturbance of hydrostatic pressure in sand layers within the till deposit near the bottom of Boreholes 206, 207, 208 and 209. Based on the DCPT readings in Boreholes 205, 206 and 207, the undisturbed dense till stratum was probably encountered 3 to 4 m below the sampled depth of borehole, or 16 m to 21 m from the prevailing ground surface.

Intermittent hard resistance to augering was encountered, indicating the presence of cobbles and boulders in the stratum.

The natural water content values of the silt till samples were determined; the results are plotted on the Borehole Logs. The values range from 8% to 18%, with a median of 12%, confirming the generally moist to wet conditions disclosed by the sample examinations.

According to the above findings, the following engineering properties are deduced:

- Highly frost susceptible and moderate water erodibility.
- Low permeability, with an estimated coefficient of permeability of 10^{-6} cm/sec, a percolation rate of 60 minutes/cm and runoff coefficients of:

Slope	
0% - 2%	0.11
2% - 6%	0.16
6% +	0.23

- A frictional soil, its shear strength is primarily derived from internal friction, and is augmented by cementation. Therefore, its strength is density dependent.
- They will be stable in steep cuts; however, under prolonged exposure, localized sheet collapse will likely occur.
- A fair pavement-supportive material, with an estimated CBR of 8%.
- Moderate corrosivity to buried metal, with an estimated electrical resistivity of 4500 ohm·cm.

4.7 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 +
Earth Fill	20 to 22	14	9 to 18
Silt	15 to 30	12	8 to 15
Silty Clay/Clay Till	9 to 32	17 to 19	14 to 22
Sandy Silt Till	8 to 18	11	8 to 15

Based on the above findings, part of the on-site material is suitable for 95% + Standard Proctor compaction. Wet material, however, will require aeration prior to compaction. Aeration can be achieved by spreading them thinly on the ground during the dry and warm weather.

The tills and clay should be compacted using a heavy-weight, kneading-type roller. The silt can be compacted by a smooth roller with or without vibration, depending on the water content of the soils being compacted. The lifts for compaction should be limited to 20 cm, or to a suitable thickness as assessed by test strips performed by the equipment which will be used at the time of construction.

When compacting the clay and the cemented till on the dry side of the optimum, the compactive energy will frequently bridge over the chunks in the soil and be transmitted laterally into the soil mantle. Therefore, the lifts of these soils must be limited to 20 cm or less (before compaction). It is difficult to monitor the lifts of backfill placed in deep trenches; therefore, it is preferable that the compaction of backfill at depths over 1.0 m below the road subgrade be carried out on the wet side of the optimum. This would allow wider latitude of lift thickness.

One should be aware that with considerable effort, a 90%± Standard Proctor compaction of the wet silt is achievable. Further densification is prevented by the pore pressure induced by the compactive effort; however, large random voids will have been expelled, and with time, the pore pressure will dissipate and the percentage of compaction will increase. There are many cases on record where after a few months of rest, the density of the compacted mantle has increased to over 95% of its maximum Standard Proctor dry density.

If the compaction of the soils is carried out with the water content within the range for 95% Standard Proctor dry density but on the wet side of the optimum, the surface of the compacted soil mantle will roll under the dynamic compactive load. This is unsuitable for road construction since each component of the pavement structure is to be placed under dynamic conditions which will induce the rolling action of the subgrade surface and cause structural failure of the new pavement. The foundations or bedding of the sewer and slab-on-grade will be placed on a subgrade which will not be subjected to impact loads. Therefore, the structurally compacted soil mantle, with the water content on the wet side or dry side of the optimum, will provide an adequate subgrade for the construction.

The presence of boulders will prevent transmission of the compactive energy into the underlying material to be compacted. If an appreciable amount of boulders over 15 cm in size is mixed with the material, it must either be sorted or must not be used for construction of engineered fill and/or structural backfill.

5.0 GROUNDWATER CONDITIONS

The boreholes were checked for the presence of groundwater or the occurrence of cave-in upon completion of the field work. The records are summarized in Table 2.

Table 2 - Groundwater and Cave-In Levels

Borehole No.	**Ground El. (m)**	**Groundwater Levels**		**Cave-In Levels**	
		Depth (m)	**El. (m)**	**Depth (m)**	**El. (m)**
12	261.4	4.6	256.8	-	-
13	257.9	8.2	249.7	-	-
101	260.2	0.0*	260.2*	-	-
201	263.0	4.6	258.4	4.9	258.1
202	262.2	1.8	260.4	2.1	260.1
203	263.4	4.9	258.5	6.1	257.3
204	261.9	1.5	260.4	4.9	257.0
205	260.9	Dry	-	-	-
206	259.0	Dry	-	-	-
207	260.0	15.2	244.8	-	-
208	261.0	4.6	256.4	-	-
209	259.7	4.0	255.7	-	-
210	258.0	1.8	256.2	-	-

* Due to surface water

Upon the completion of borehole drilling, groundwater was recorded in most of the boreholes between El. 244.8 m and E. 260.4 m. It generally represents the groundwater regime at the site and, in some areas, the groundwater from the saturated silt deposit appears to be under an artesian pressure. Perched water also exists in some boreholes at shallower depths. The groundwater level will fluctuate with seasons.

In excavations, groundwater yield from the clay, clay till and silt till will be slow and limited in quantity, whereas the groundwater yield from the saturated silt will be appreciable and likely persistent.

6.0 DISCUSSION AND RECOMMENDATIONS

The investigation revealed that beneath the topsoil or pavement structure, with a layer of earth fill in places, the site is generally underlain by silty clay, silty clay till, sandy silt till and silt deposits.

Upon the completion of borehole drilling, groundwater was recorded in most of the boreholes between El. 244.8 m and El. 260.4 m. It generally represents the groundwater regime at the site and, in some areas, the groundwater from the saturated silt deposit appears to be under an artesian pressure. Perched water also exists in some areas at shallower depths. The groundwater level will fluctuate with seasons.

It is understood that the property will be developed with a 7-storey retirement home, a 7-storey apartment building, a mixed-use building and multiple townhouse blocks. The geotechnical findings which warrant special consideration are presented below:

1. The topsoil is considered to be void of engineering value and can be used for general landscaping purposes only. Due to the humus content, the topsoil will generate an offensive odour under anaerobic conditions and may produce volatile gases; therefore, it must not be buried within the building envelope, or deeper than 1.2 m below the finished grade, as it may have an adverse impact on the environmental well-being of the development.
2. The earth fill and weathered soils are not suitable to support any structure sensitive to movement. They must be subexcavated and sorted free of topsoil inclusions or deleterious materials before it is reused as engineered fill or structural backfill.

3. The sound natural soils are suitable for normal spread and strip footing construction for the proposed buildings. The footing subgrade must be inspected by a geotechnical engineer to ensure that its condition is compatible with the design of the foundations.
4. Where earth fill is required to raise the site, or where extended footings are necessary, it is generally more economical to place engineered fill for normal footing, sewer and road construction.
5. A Class ‘B’ bedding, consisting of compacted 20-mm Crusher-Run Limestone, or equivalent, is recommended for the construction of the underground services. Where saturated soils are present and extensive dewatering is required, a Class ‘A’ bedding will be required.
6. All excavation should be carried out in accordance with Ontario Regulation 213/91.
7. In excavation, groundwater yield from the clay, clay till and silt till will be slow and limited in quantity, whereas the groundwater yield from the saturated silt will be appreciable and likely persistent. It can be collected to sumps and removed by conventional pumping.
8. In view that artesian pressure is evident in some borehole locations, the proposed buildings and the exterior grading around the buildings should be designed to stay above the stabilized groundwater level unless these structures are waterproofed.
9. Due to the presence of adjacent buildings to the east, it is recommended that a pre-construction survey and a monitoring program be carried out in order to verify any future liability claims.

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

6.1 Foundations

It is understood that the property will be developed in multi-phases. Phase 1 of the development consists of a 7-storey retirement home at the southeast corner of the site fronting Mount Albert Road. Phase 2 consists of multiple townhouse blocks, mainly in the northern half of the site and Phase 3 consists of a 7-storey apartment building at the southwest corner of the site. A mixed-use building fronting Leslie Street will be included in a future phase. On-grade surface parking will be provided for the development. The recommended soil bearing pressures for use in the design of footings, together with the corresponding suitable founding levels, are presented in Table 3.

Table 3 - Founding Levels

Borehole No.	**Maximum Allowable Soil Pressure (SLS)/ Factored Ultimate Soil Bearing Pressure (ULS) and Corresponding Founding Level**					
	100 kPa (SLS) 150 kPa (ULS)		**150 kPa (SLS) 250 kPa (ULS)**		**250 kPa (SLS) 400 kPa (ULS)**	
	Depth (m)	**Elevation (m)**	**Depth (m)**	**Elevation (m)**	**Depth (m)**	**Elevation (m)**
Proposed Townhouse Blocks						
12	1.2 or +	260.2 or -	1.8 or +	259.6 or -	-	-
13	-	-	1.5 or +	256.4 or -	3.1 or +	254.8 or -
101	1.5 or +	258.7 or -	3.1 or +	257.1 or -	-	-
201	1.2 or +	261.3 or -	7.6 or +	254.9 or -	-	-
204	1.0 or +	260.2 or -	1.5 or +	259.7 or -	-	-

Table 3 - Founding Levels (cont'd)

Borehole No.	Maximum Allowable Soil Pressure (SLS)/ Factored Ultimate Soil Bearing Pressure (ULS) and Corresponding Founding Level					
	100 kPa (SLS) 150 kPa (ULS)		**150 kPa (SLS) 250 kPa (ULS)**		**250 kPa (SLS) 400 kPa (ULS)**	
	Depth (m)	**Elevation (m)**	**Depth (m)**	**Elevation (m)**	**Depth (m)**	**Elevation (m)**
Proposed Townhouse Blocks						
206	1.5 or + below 9.1	257.0 or - 249.4 or -	3.1 or +	255.4 or -	6.1 to 9.1	252.4 to 249.4
Proposed 7-Storey Apartment Building						
209	1.7 or + below 12	256.7 or 246.4 or -	3.2 to 12.0	255.2 or 246.4	-	-
210	1.0 or +	256.3 or -	2.3 or +	255.0 or -	4.6 or +	252.7 or -
Proposed 7-Storey Retirement Home						
202	1.0 or +	261.2 or -	4.8 or +	257.9 or -	-	-
203	1.0 or +	261.5 or -	4.6 or +	257.9 or -	9.1 or +	253.4 or -
205	1.2 or +	258.8 or -	10.0 or +	250.0 or -	-	-
207	2.3 or + below 9.1	256.9 or - 250.1 or -	4.6 to 9.1	255.6 to 250.1	-	-
208	1.0 or + below 9.1	259.0 or - 253.9 or -	2.3 or +	257.7 or -	6.1 to 9.1	253.9 to 250.9

The total and differential settlements of the footings are estimated to be 25 mm and 15 mm, respectively.

Further detailed borehole investigation should be carried out for the 7-storey apartment building (Phase 3 of the development) and for the future development of the mixed-use building east of the parking lot, fronting Leslie Street.

The 7-storey buildings may be supported on helical piers or driven piles. These piers and piles should be extended to depths of 18 to 21 m with a pile capacity of 500 to 700 kPa (SLS), depending on the size and embedment of piles. The design load supported by helical piers is directly related to the installation torque of the anchor in the underlying competent soil stratum. The optimum loads, the depth of the piers and the cost of the project should be assessed by prospective foundation contractors in these specialties.

Care should be exercised when installing the deep foundation system as it will penetrate through the saturated silt deposits. Artesian pressure can be anticipated in areas. Therefore, the buildings and their exterior grading should be designed to stay above the stabilized groundwater level unless these structures are waterproofed. The stabilized groundwater level should be established through a detailed hydrogeological assessment.

One must be aware that the recommended bearing pressures are given as a guide for foundation design and the soils at the bearing level must be confirmed by inspection performed by a geotechnical engineer at the footing locations, at the time of construction.

If groundwater seepage is encountered in the footing excavations, or where the subgrade of the normal 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.

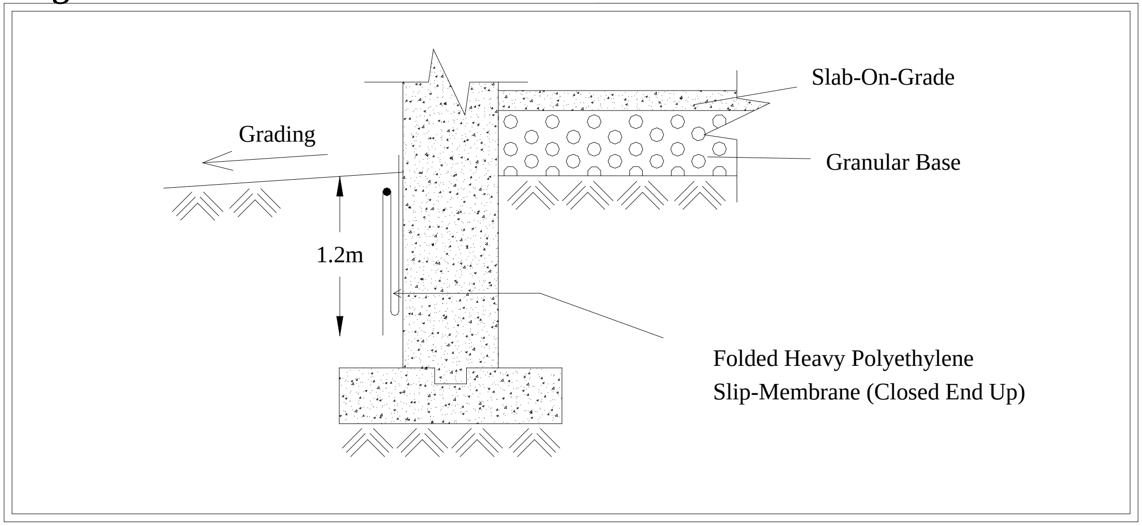
Where earth fill is required to raise the site, or where extended footings are necessary, it is generally more economical to place engineered fill for normal footing construction. The requirements for engineered fill construction are discussed in Section 6.2.

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

The building foundation must meet the requirements specified in the latest Ontario Building Code. As a guide, the structures should be designed to resist an earthquake force using Site Classification ‘D’ (stiff soil). If the apartment buildings will be supported on piles extending into the hard stratum, these building structures can be designed to resist an earthquake force using Site Classification ‘C’ (very dense soil).

The in situ soils have high soil-adfreezing potential. In order to alleviate the risk of frost damage, the foundation walls of the proposed buildings must be constructed of concrete and either the backfill must consist of non-frost-susceptible granular material or the foundation walls must be shielded with a polyethylene slip-membrane between the concrete wall and the backfill. The recommended measures are schematically illustrated in Diagram 1.

Diagram 1 - Frost Protection Measures



6.2 **Engineered Fill**

Where earth fill is required to raise the site, or where extended footings are necessary, it is generally more economical to place engineered fill for normal footing, sewer and road construction. The engineering requirements for a certifiable fill for road construction, municipal services, and footings designed with a Maximum Allowable Soil Pressure (SLS) of 100 kPa and a Factored Ultimate Soil Bearing Pressure (ULS) of 150 kPa are presented below:

1. All of the topsoil and earth fill must be removed, and the subgrade must be inspected and proof-rolled prior to any fill placement.
2. The existing earth fill and weathered soils must be subexcavated, inspected, aerated and properly compacted in layers.
3. Inorganic soils must be used for filling, and they must be uniformly compacted in lifts 20 cm thick to 98% or + of their maximum Standard Proctor dry density up to the proposed finished lot grade and/or road subgrade. The soil moisture must be properly controlled between 1% drier than optimum and 2% wetter

than optimum. This is to prevent the development of excess pore-water pressures in the earth fill, which results in longer duration for pore-water pressure dissipation and ground settlement. If the site services or house foundations are to be built soon after the fill placement, the densification process for the engineered fill must be increased to 100% of the maximum Standard Proctor compaction.

4. If 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.
5. In areas where significant engineered fill (fill more than 3.0 m) is to be placed, settlement plates must be installed and monitored on a weekly basis to assess any consolidation progress in the fill and the underlying strata. No construction of site services or house foundations can commence in these areas until the settlement records have confirmed that the settlement is reduced to a tolerable level and there is no risk of long-term settlement. Where the readings remain the same for a period of 3 consecutive months, no further monitoring will be required and there is no risk for long-term settlement. The settlement of the engineered fill is anticipated to be reduced to a tolerable limit of 25 mm.
6. 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.
7. The engineered fill must extend over the entire graded area; the engineered fill envelope and the finished elevations must be clearly and accurately defined in the field, and must be precisely documented by qualified surveyors.
8. The engineered fill must not be placed during the period from late November to early April, when freezing ambient temperatures occur either persistently or

intermittently. This is to ensure that the fill is free of frozen soils, ice and snow.

9. Where the ground is wet due to subsurface water seepage, an appropriate subdrain scheme must be implemented prior to the fill placement, particularly if it is to be carried out on sloping ground.
10. Where the fill is to be placed on a bank steeper than 1 vertical (V): 3 horizontal (H), the face of the bank must be flattened to 3+ so that it is suitable for safe operation of the compactor and the required compaction can be obtained.
11. The fill operation must be inspected on a full-time basis by a technician under the direction of a geotechnical engineer. In this case, the effect of long-term settlement is expected to be negligible as the fill material will be compacted to achieve an appropriate strength and capacity for structural support.
12. The footing and underground services subgrade must be inspected by the geotechnical consulting firm that inspected the engineered fill placement. This is to ensure that the foundations 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.
13. Once the engineered fill is certified, any excavation carried out in the certified fill area must be reported to the geotechnical consultant who inspected the fill placement, in order to document the locations of excavation and/or to inspect 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 status must be assessed for re-certification.
14. Despite stringent control in the placement of engineered fill, variations in soil type and density may occur in the engineered fill. Therefore, the strip footings and the upper section of the foundation walls constructed on the engineered fill may require continuous reinforcement with steel bars, depending on the

uniformity of the soils in the engineered fill and the thickness of the engineered fill underlying the foundations. Should the footings and/or walls require reinforcement, the required number and size of reinforcing bars must be assessed by considering the uniformity as well as the thickness of the engineered fill beneath the foundations. In sewer construction, the engineered fill is considered to have the same structural proficiency as a natural inorganic soil.

6.3 Slab-On-Grade

The subgrade for slab-on-grade construction should consist of sound natural soils or properly compacted inorganic earth fill. In preparation of the subgrade, any organics, topsoil and deleterious materials detected must be removed.

The subgrade should be inspected and assessed by proof-rolling prior to slab-on-grade construction. Where badly weathered or soft subgrade is detected, it should be subexcavated and replaced with inorganic material, uniformly compacted to 98% or + of its maximum Standard Proctor dry density prior to placement of the granular base.

Any new material for raising the grade should be consist of organic-free soil compacted to at least 98% of its maximum Standard Proctor dry density.

The slabs should be constructed on a granular base, 20 cm thick, consisting of 20-mm Crusher-Run Limestone, or equivalent, compacted to its maximum Standard Proctor dry density. If tolerance for settlement is stringent, the subgrade within 1.2 m to the interface of granular base of the slab must consist of well-compacted clean earth fill.

A modulus of Subgrade Reaction of 20 MPa/m can be used for the slab-on-grade design.

The slab at the entrances into the building should be insulated with 50-mm Styrofoam, or its thermal equivalent, extending 5.0 m internally. This measure is to prevent cold drafts in the winter from inducing frost action in the subgrade, causing damage to the floor slab.

The grading must be designed to slope away from the floor slab in order to prevent water from ponding adjacent to the buildings.

6.4 **Underground Services**

The subgrade for the underground services should consist of natural soils or engineered fill. In areas where the subgrade consists of earth fill and weathered soil, these soils should be subexcavated and replaced with properly compacted inorganic soil and/or bedding material compacted to at least 95% or + of their Standard Proctor compaction.

Where the sewers are to be constructed using the open-cut method, the construction must be carried out in accordance with Ontario Regulation 213/91. In areas where a vertical cut is necessary, the use of a trench box is considered to be appropriate. In the design of the trench box and/or shoring structure, the recommended lateral earth pressure coefficients presented in Table 5, Section 6.8, can be used.

A Class ‘B’ bedding is recommended for construction of the underground services. The bedding material should consist of compacted 20-mm Crusher-Run Limestone, or equivalent, as approved by a geotechnical engineer. Where saturated soils are present or extensive dewatering is required, a Class ‘A’ concrete bedding will likely be required, and the pipe joints should be leak proof or wrapped with a waterproof membrane.

In order to prevent pipe floatation when the sewer trench is deluged with water, a soil cover with a thickness equal to the 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 subgrade soils of the underground services have an electrical resistivity of 3000 to 4500 ohm·cm. These soils are considered corrosive to ductile iron pipes and metal fittings; therefore, the underground services should be protected against soil corrosion. This, however, should be confirmed by testing the soil along the water main alignment at the time of sewer construction.

6.5 Backfilling in Trenches and Excavated Areas

The backfill in service trenches should be compacted to at least 95% of its maximum Standard Proctor dry density. In the zone within 1.0 m below the road subgrade, the material should be compacted with the water content 2% to 3% drier than the optimum; and the compaction should be increased to 98% of the respective maximum Standard Proctor dry density to provide the required stiffness for pavement construction.

Most of the in situ inorganic soils are too wet for a 95% or + Standard Proctor compaction, it can be aerated by spreading it thinly on the ground for drying prior to structural compaction or it can be mixed with drier soils.

In normal construction practice, the problem areas of settlement largely occur adjacent to foundation walls, columns, manholes, catch basins and services crossings. In areas which are inaccessible to a heavy compactor, sand backfill should be used. Unless compaction of the backfill is carefully performed, settlement will occur. Often, the interface of the native soils and sand backfill will have to be flooded for a period of several days.

Narrow trenches for services crossings should be cut at 1V:2H, so that the backfill in the trenches can be effectively compacted. Otherwise, soil arching in the trenches will prevent the achievement of proper compaction. The lift of each backfill layer should be limited to a thickness of 20 cm.

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 soil 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, and repair costs will be incurred prior to final surfacing of the new pavement.
- 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 V:1.5+ H, and the lifts of the fill and its moisture content are stringently controlled; i.e., lifts should be no more than 20 cm (or less if the backfilling conditions dictate) and uniformly compacted to achieve at least 95% of the maximum Standard Proctor dry density, with the moisture content on the wet side of the optimum.
- It is often difficult to achieve uniform compaction of the backfill in the lower vertical section of a trench which is an open cut or is stabilized by a trench box, particularly in the sector close to the trench walls or the sides of the box. These sectors must be backfilled with sand. In a trench stabilized by a trench box, the void left after the removal of the box will be filled by the backfill. It is necessary to backfill this sector with sand, and the compacted backfill must be flooded for 1 day, prior to the placement of the backfill above this sector, i.e., in the upper sloped trench section. This measure is necessary in order to prevent consolidation of inadvertent voids and loose backfill which will compromise the compaction of the backfill in the upper section. In areas where groundwater movement is expected in the sand fill mantle, anti-seepage collars should be provided.

6.6 Sidewalks, Interlocking Stone Pavement, Driveways and Landscaping

Due to high frost susceptibility of the subgrade soils, heaving of the pavement is expected to occur during the cold weather. The driveways at the entrances to the garages must be backfilled with non-frost-susceptible granular material, with a frost taper at a slope flatter than 1 vertical:3 horizontal.

The slab-on-grade in open areas should be designed to tolerate frost heave, and the grading around the slab-on-grade must be such that it directs runoff away from the surface.

Interlocking stone pavement, sidewalks and slab-on-grade to be constructed in areas susceptible to ground movement must be constructed on a free-draining granular base at least 1.2 m thick, with proper drainage to prevent water accumulation in the granular base. Alternatively, the landscaping structures, sidewalks, slab-on-grade and interlocking stone pavement should be properly insulated with 50-mm thick Styrofoam, or equivalent.

6.7 Pavement Design

The pavement design for the project is recommended in Table 4.

Table 4 - Pavement Design

Course	Thickness (mm)	OPS Specifications
Asphalt Surface	40	HL-3
Asphalt Binder		HL-8
Light-Duty Parking	60	
Fire Route and Collector	80	
Granular Base	150	20-mm Crusher-Run Limestone
Granular Sub-base		50-mm Crusher-Run Limestone or equivalent
Light-Duty Parking	250	
Fire Route and Collector	350	

In preparation of the subgrade, the topsoil, weathered soil and earth fill must be removed. Any new fill should consist of organic free material, compacted to 95% or + of its maximum Standard Proctor dry density. In the zone within 1.0 m below the pavement subgrade, the backfill should be compacted to at least 98% of its maximum Standard Proctor dry density, with the water content 2% to 3% drier than the optimum. The final subgrade should be inspected and proof-rolled. Any soft spots should be subexcavated, and replaced by properly compacted inorganic earth fill.

All the granular bases should be compacted to their maximum Standard Proctor dry density.

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 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 pavement should be properly graded to prevent the ponding of large amounts of water during the interim construction period.
- Fabric filter-encased curb subdrains are required to meet the Town’s requirements.
- 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.

6.8 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**
Earth Fill/Silt	21.0	11.0	1.25	1.00
Silty Clay/Clay Till	22.0	12.0	1.30	1.00
Sandy Silt Till	22.5	12.5	1.33	1.03

Lateral Earth Pressure Coefficients	**Active**	**At Rest**	**Passive**
	K_a	K_o	K_p
Compacted Earth Fill/Silty Clay	0.45	0.60	2.20
Silt/Clay Till/Silt Till	0.35	0.50	3.00

Table 5 - Soil Parameters (cont'd)

Coefficients of Friction	
Between Concrete and Granular Base	0.5
Between Concrete and Sound Native Soils	0.4

6.9 Excavation

Excavation should be carried out in accordance with Ontario Regulation 213/91. For excavation purposes, the types of soils are classified in Table 6.

Table 6 - Classification of Soils for Excavation

Material	Type
Sound Tills, Silty Clay	2
Earth Fill, weathered Soils, dewatered Silt	3
Saturated Silt	4

In excavation, the groundwater yield from the clay, clay till and silt till is expected to be slow in rate and limited in quantity. The groundwater yield from the saturated silt will be appreciable and likely persistent. In general, the groundwater yield can be collected to sumps and removed by conventional pumping.

In order to provide a stable subgrade for the services or foundation construction, the groundwater should be depressed to at least 0.5 m below the subgrade. Where excavations for services are to be carried out in the saturated or water-bearing silt, the possibility of flowing sides and bottom boiling dictates that the ground be predrained, either by pumping from closely spaced sump-wells or, if necessary, by the use of a well point dewatering system. The appropriate method of dewatering should be further assessed by test pumping prior to the project construction.

Prospective contractors must be asked to assess the in situ subsurface conditions for soil cuts by digging test pits to at least 0.5 m below the sewer subgrade. These test pits should be allowed to remain open for a period of at least 4 hours to assess the trenching conditions.

7.0 LIMITATIONS OF REPORT

This report was prepared by Soil Engineers Ltd. for the account of Wycliffe Thornridge Sharon Limited, for review by their designated consultants, financial institutions, 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 Kin Fung Li, P.Eng., and Bennett Sun, 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, are 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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CHUN C. B. SUN
March 18, 2019
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

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CONSULTING ENGINEERS
GEOTECHNICAL • ENVIRONMENTAL • HYDROGEOLOGICAL • BUILDING SCIENCE

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 201

FIGURE NO.: 1

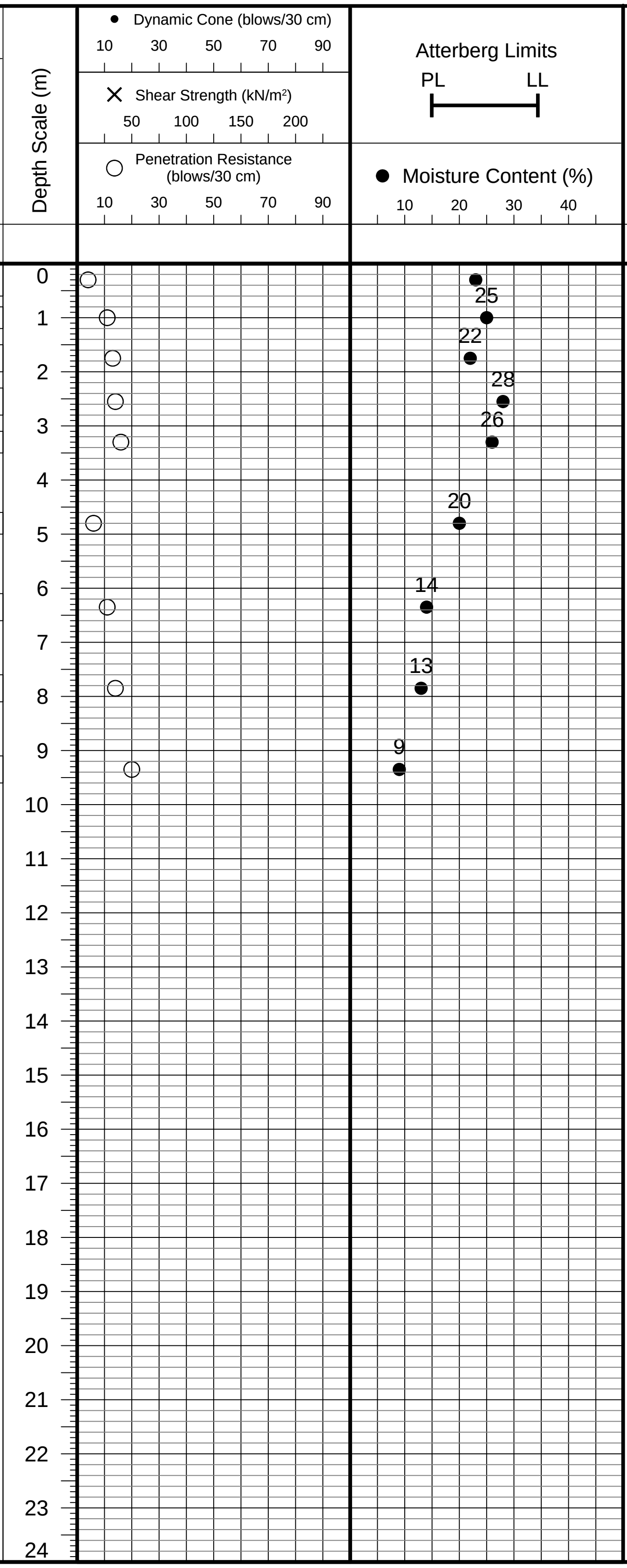
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 6, 2017

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
262.5	Ground Surface			
0.0	Firm to very stiff	1	DO	4
	SILTY CLAY — weathered	2	DO	11
	a trace of sand	3	DO	13
		4	DO	14
		5	DO	16
	— brown / grey	6	DO	6
256.4 6.1	Grey, stiff to very stiff	7	DO	11
	SILTY CLAY TILL			
	some sand to sandy a trace of gravel	8	DO	14
252.9		9	DO	20
9.6	**END OF BOREHOLE**			



WATER LEVEL

W.L. @ El. 258.4 m upon completion
Cave-In @ El. 258.1 m upon completion

Soil Engineers Ltd.

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 202

FIGURE NO.: 2

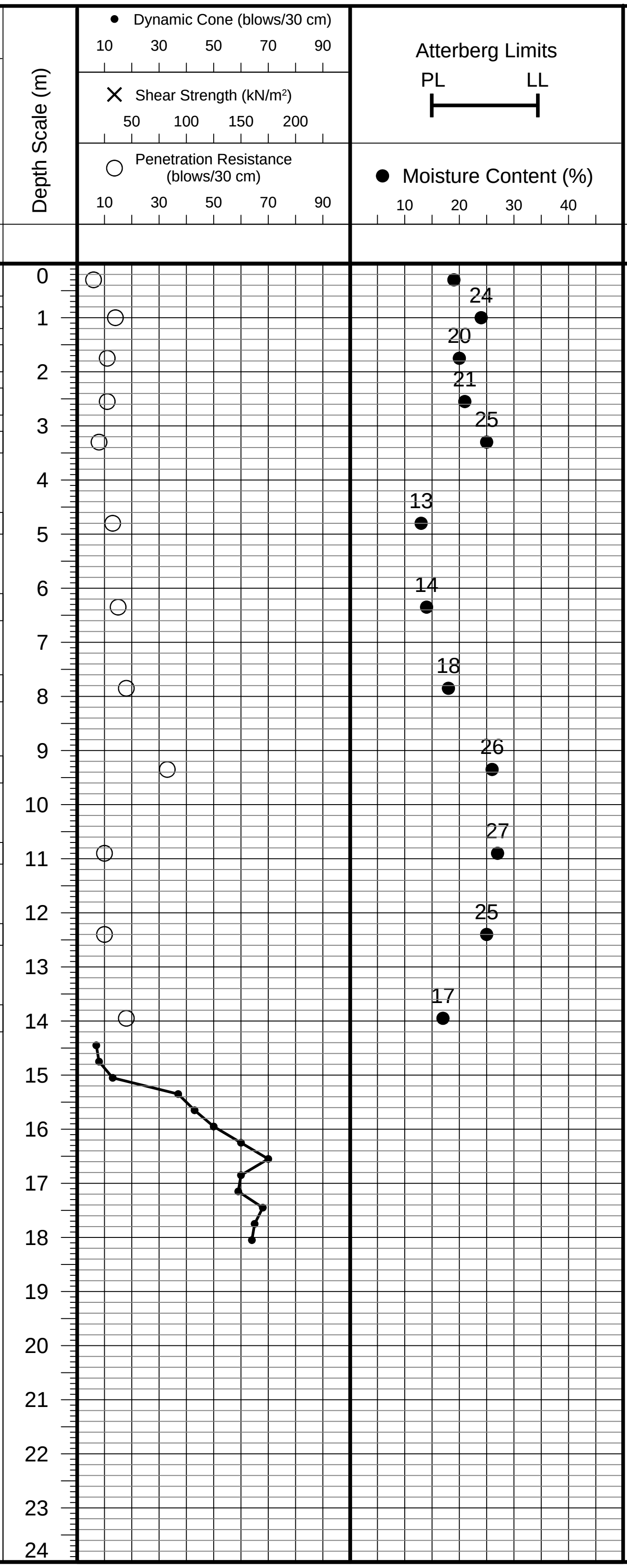
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 10, 2017

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES		
		Number	Type	N-Value
261.7	Ground Surface			
0.0	**15cm TOPSOIL**	1	DO	6
	weathered Brown, firm to stiff	2	DO	14
	SILTY CLAY	3	DO	11
	a trace of sand	4	DO	11
		5	DO	8
257.1 4.6	Grey, stiff to very stiff	6	DO	13
	SILTY CLAY TILL			
	some sand to sandy a trace of gravel	7	DO	15
		8	DO	18
252.6 9.1	Grey, compact to dense, wet	9	DO	33
	SILT			
	some clay to clayey occ. clay layers	10	DO	10
		11	DO	10
		12	DO	18
247.5 14.2	**NO SAMPLING** **DYNAMIC CONE**			
243.5 18.2	**END OF BOREHOLE**			



WATER LEVEL

W.L. @ El. 260.4 m upon completion

Cave-In @ El. 260.1 m upon completion

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 203

FIGURE NO.: 3

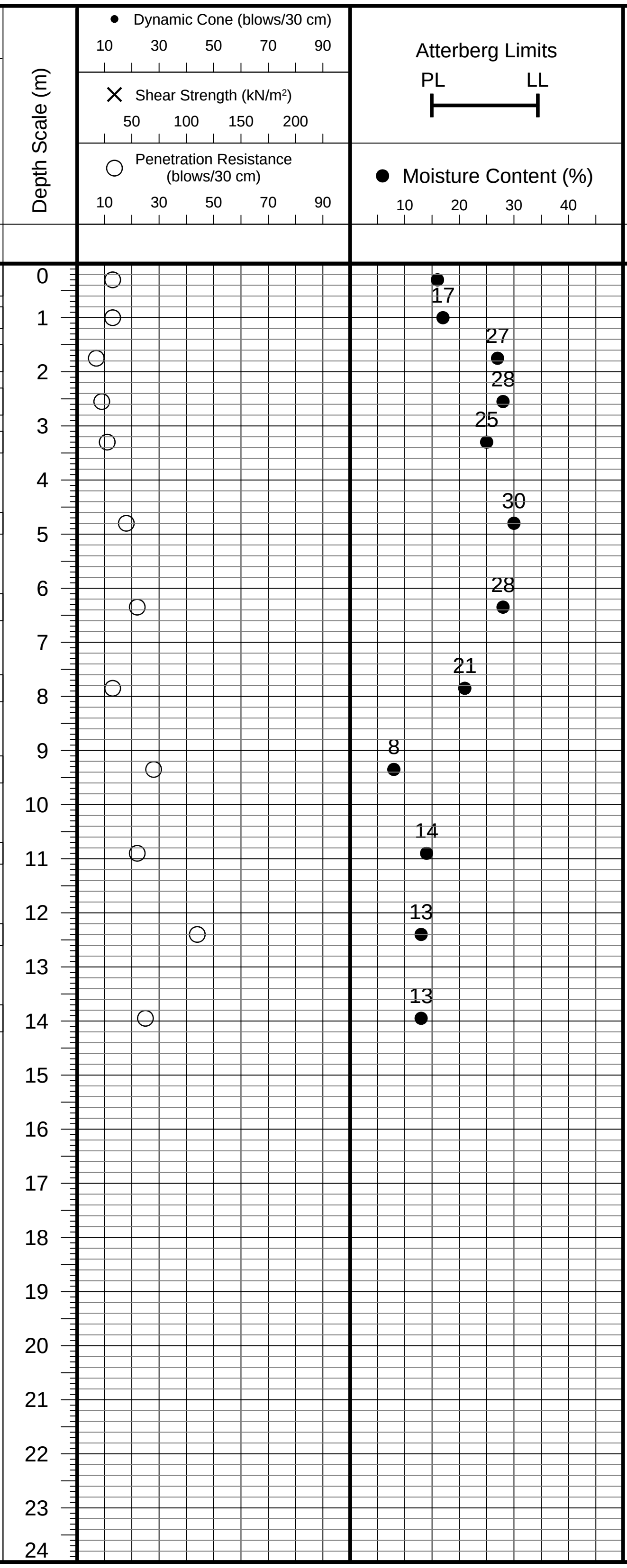
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 8, 2017

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
262.5	Ground Surface			
0.0	**50 mm ASPHALTIC CONCRETE** **300 mm GRANULAR FILL**	1	DO	13
	Brown, firm to stiff **SILTY CLAY** a trace of sand	2	DO	13
		3	DO	7
		4	DO	9
		5	DO	11
258.5 4.0	Compact, wet **SILT** some clay a trace of sand brown / grey	6	DO	18
		7	DO	22
		8	DO	13
253.4 9.1	Grey, compact to dense **SANDY SILT TILL** some clay a trace of gravel occ. cobbles	9	DO	28
		10	DO	22
		11	DO	44
		12	DO	25
248.3 14.2	**END OF BOREHOLE**			



WATER LEVEL

▽ W.L. @ El. 258.5 m upon completion

Cave-In @ El. 257.3 m upon completion

Soil Engineers Ltd.

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 204

FIGURE NO.: 4

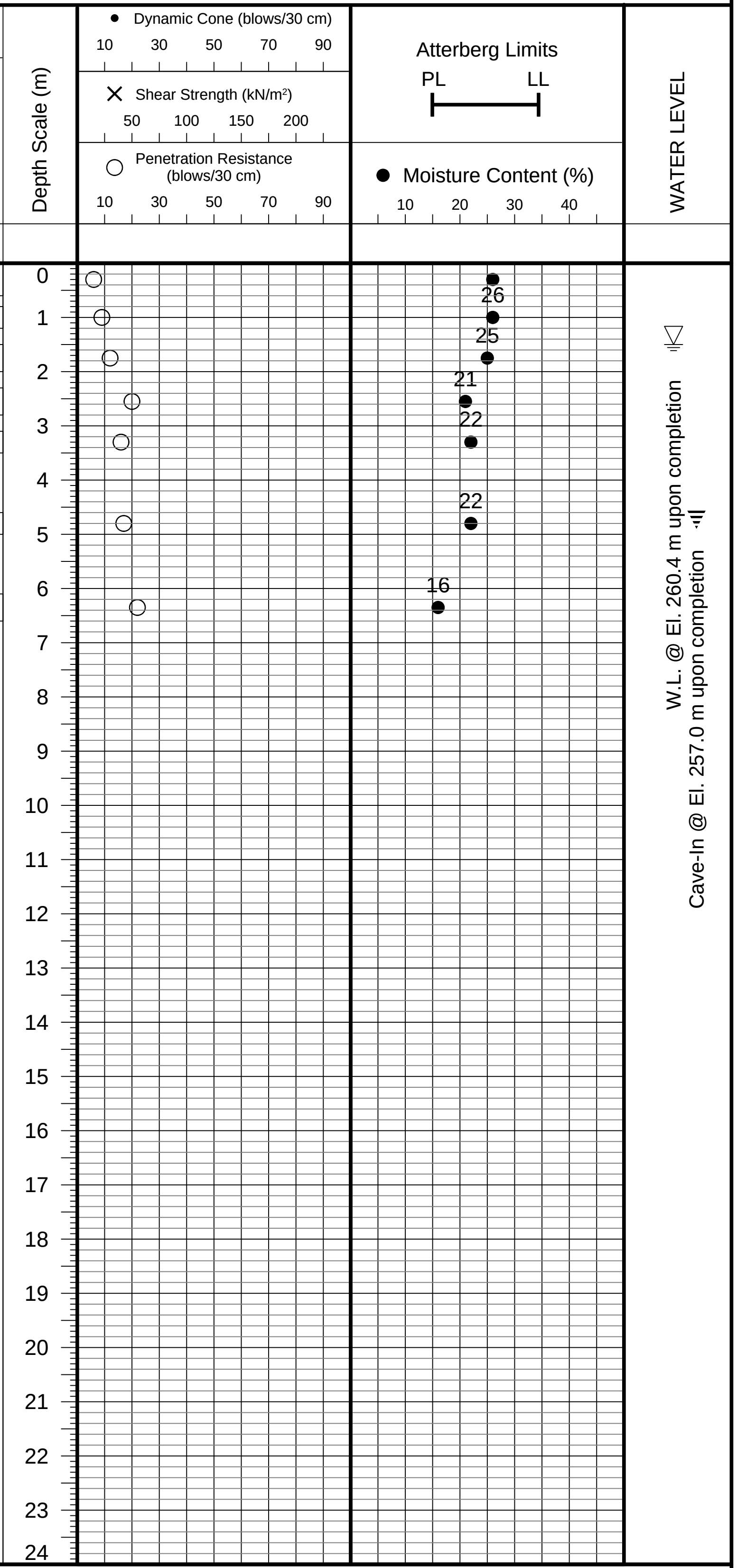
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 10, 2017

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES		
		Number	Type	N-Value
261.2	Ground Surface			
0.0	**18 cm TOPSOIL**	1	DO	6
	Brown, firm to very stiff weathered	2	DO	9
	SILTY CLAY	3	DO	12
	occ. silt layers	4	DO	20
		5	DO	16
257.2 4.0	Grey, compact			
	SILT	6	DO	17
	some clay			
254.6	a trace of sand	7	DO	22
6.6	**END OF BOREHOLE**			



W.L. @ El. 260.4 m upon completion

Cave-In @ El. 257.0 m upon completion

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 205

FIGURE NO.: 5

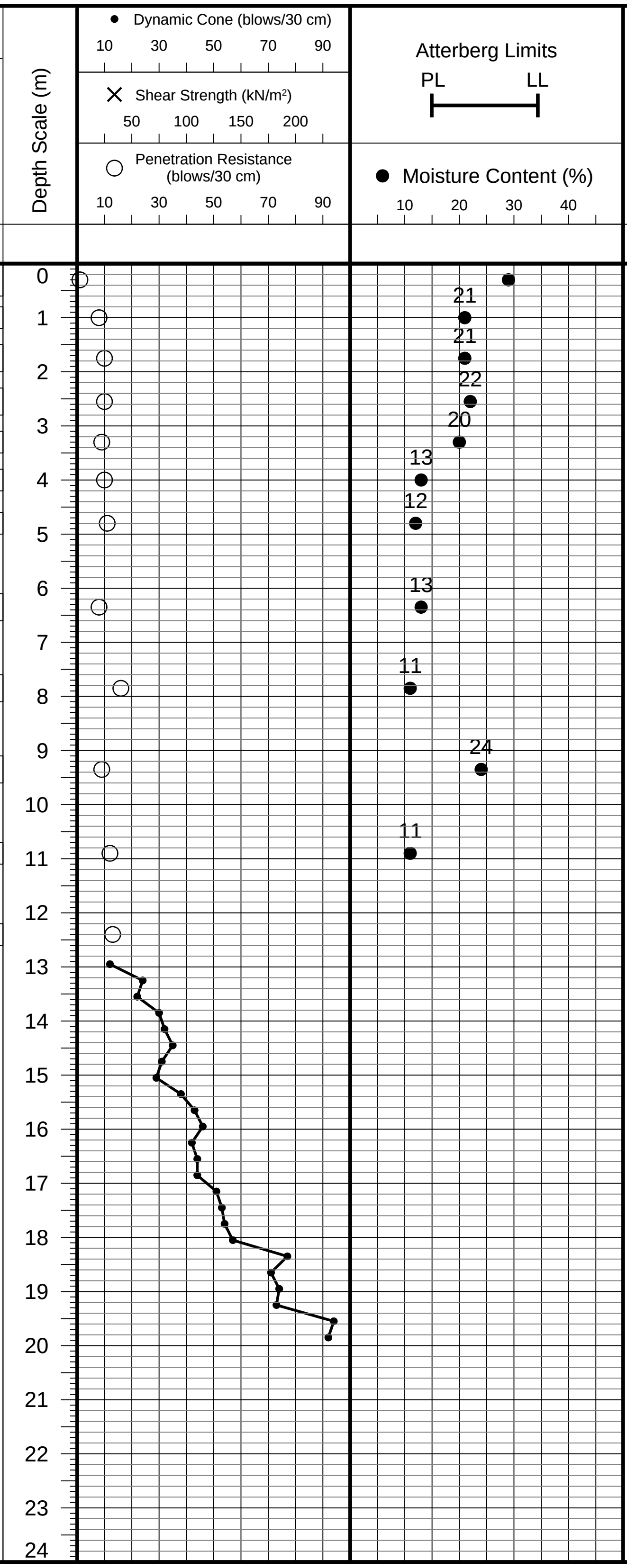
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 19, 2017

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES			WATER LEVEL
		Number	Type	N-Value	
260.0	Ground Surface				
0.0	**15cm TOPSOIL**	1	DO	1	Dry upon completion
	Very loose to compact, wet weathered	2	DO	8	
	SILT	3	DO	10	
	some clay	4	DO	10	
	brown grey	5	DO	9	
256.2 3.8	Grey, stiff to very stiff	6	DO	10	
	SILTY CLAY TILL	7	DO	11	
	some sand to sandy a trace of gravel	8	DO	8	
		9	DO	16	
	wet silt layer	10	DO	9	
250.0 10.0	Grey, compact **SANDY SILT TILL**	11	DO	12	
247.4	some clay to clayey a trace of gravel	12	DO	13	
12.6	**NO SAMPLING** **DYNAMIC CONE**				
240.0 20.0	**END OF BOREHOLE**				



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JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 206

FIGURE NO.: 6

PROJECT DESCRIPTION: Proposed Residential Development

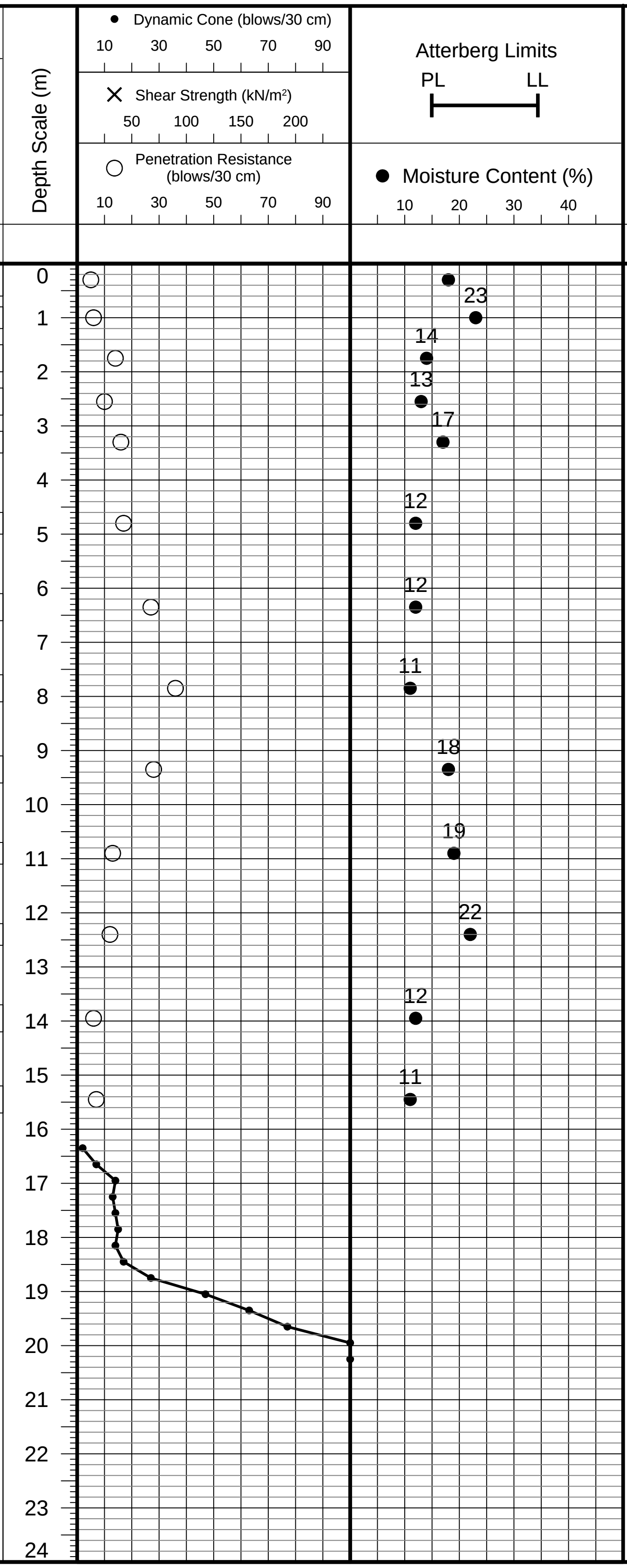
METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 12, 2017

El. (m) Depth (m)	SOIL DESCRIPTION
258.5	Ground Surface
0.0	**23 cm TOPSOIL**
	Brown, firm **SILTY CLAY** a trace of sand weathered
257.0 1.5	Stiff to hard **SILTY CLAY TILL** sandy a trace of gravel occ. cobbles and boulders brown / grey boulders and cobbles
249.4 9.1	Grey, compact, wet **SILT** some clay
245.4 13.1	Grey, loose **SANDY SILT TILL** some clay to clayey a trace of gravel
242.5 16.0	**NO SAMPLING** **DYNAMIC CONE**
238.1 20.4	**END OF BOREHOLE**

Number	Type	N-Value
1	DO	5
2	DO	6
3	DO	14
4	DO	10
5	DO	16
6	DO	17
7	DO	27
8	DO	36
9	DO	28
10	DO	13
11	DO	12
12	DO	6
13	DO	7



WATER LEVEL

Dry upon completion

Soil Engineers Ltd.

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 207

FIGURE NO.: 7

PROJECT DESCRIPTION: Proposed Residential Development

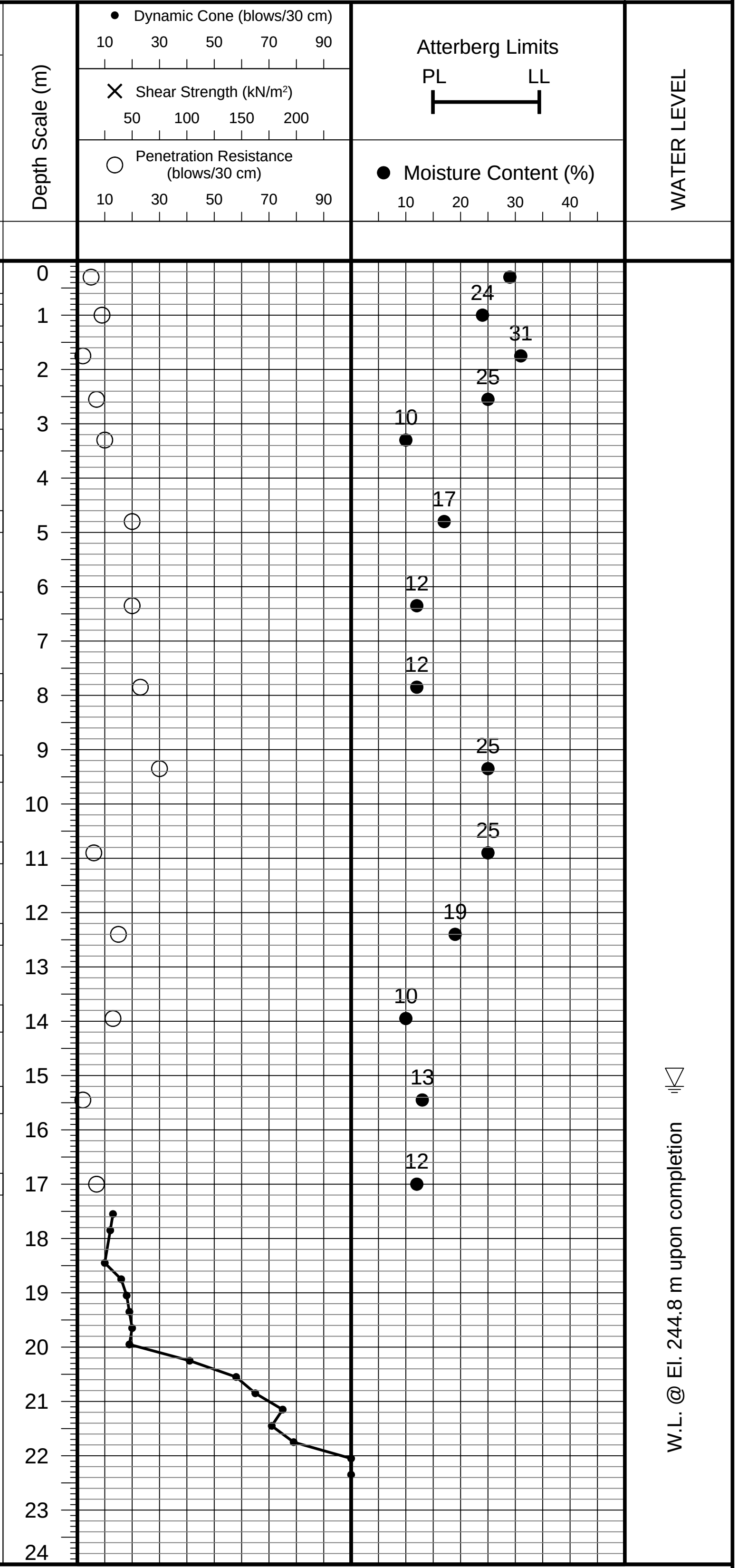
METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 16, 2017

El. (m) Depth (m)	SOIL DESCRIPTION
259.2	Ground Surface
0.0	**20 cm TOPSOIL**
	Brown, firm to stiff **SILTY CLAY** a trace of sand weathered
257.7 1.5	Brown, loose **SILT** some clay a trace of sand
256.1 3.1	Stiff to very stiff **SILTY CLAY TILL** brown grey sandy a trace of gravel occ. sand seams and layers
248.5 10.7	Grey, loose to compact, wet **SILT** some clay
246.1 13.1	Grey, very loose to compact **SANDY SILT TILL** some clay a trace of gravel wet silt layer
242.0 17.2	**NO SAMPLING** **DYNAMIC CONE**
236.7 22.5	**END OF BOREHOLE**

SAMPLES Number	Type	N-Value	Moisture Content (%)
1	DO	5	
2	DO	9	24
3	DO	2	31
4	DO	7	25
5	DO	10	10
6	DO	20	17
7	DO	20	12
8	DO	23	12
9	DO	30	25
10	DO	6	25
11	DO	15	19
12	DO	13	10
13	DO	2	13
14	DO	7	12



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JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 208

FIGURE NO.: 8

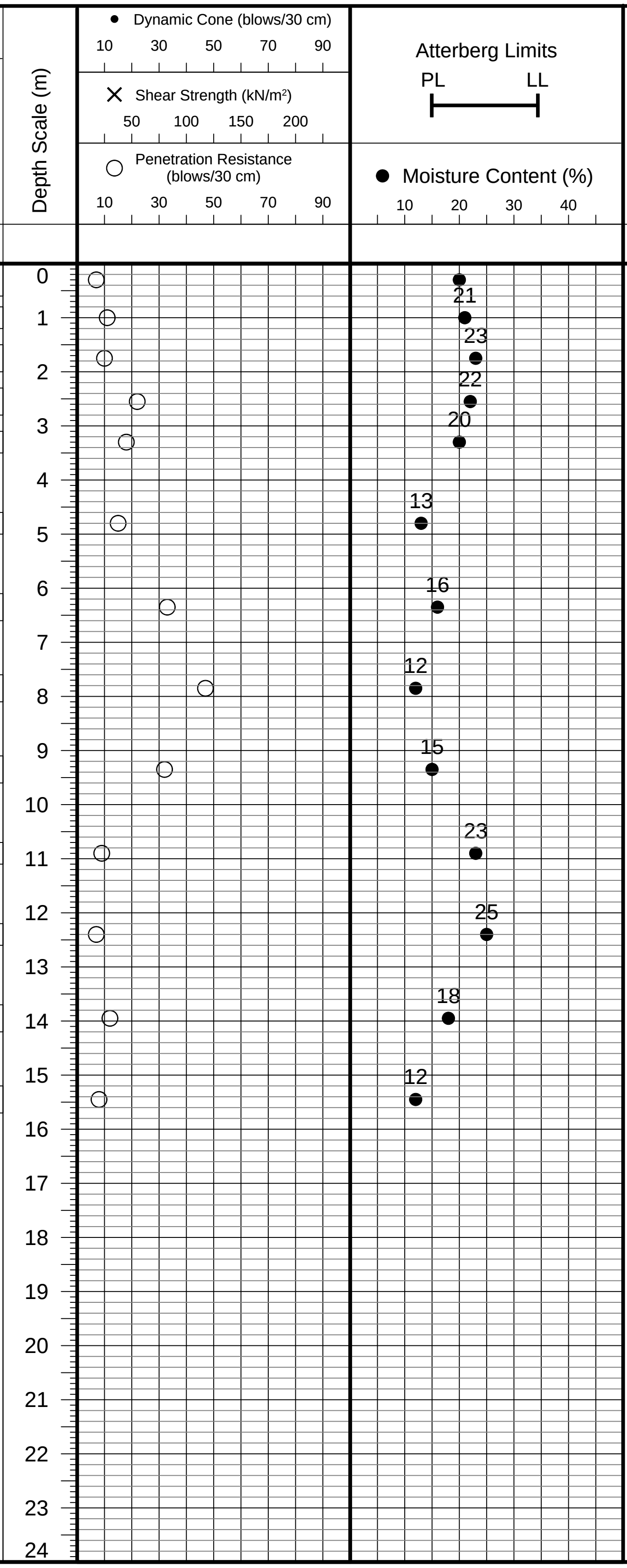
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 8, 2017

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
260.0	Ground Surface			
0.0	**80 mm ASPHALTIC CONCRETE** **250 mm GRANULAR FILL**	1	DO	7
	Brown, firm to very stiff **SILTY CLAY** a trace of sand weathered	2	DO	11
		3	DO	10
		4	DO	22
		5	DO	18
256.7 3.3	Compact to dense **SANDY SILT TILL** some clay a trace of gravel brown grey	6	DO	15
		7	DO	33
		8	DO	47
250.9 9.1	Grey, loose to dense, wet **SILT** some clay a trace of sand	9	DO	32
		10	DO	9
		11	DO	7
246.9 13.1	Grey, loose to compact **SANDY SILT TILL** some clay a trace of gravel	12	DO	12
		13	DO	8
244.3 15.7	**END OF BOREHOLE**			



WATER LEVEL

▽ W.L. @ El. 256.4 m upon completion

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JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 209

FIGURE NO.: 9

PROJECT DESCRIPTION: Proposed Residential Development

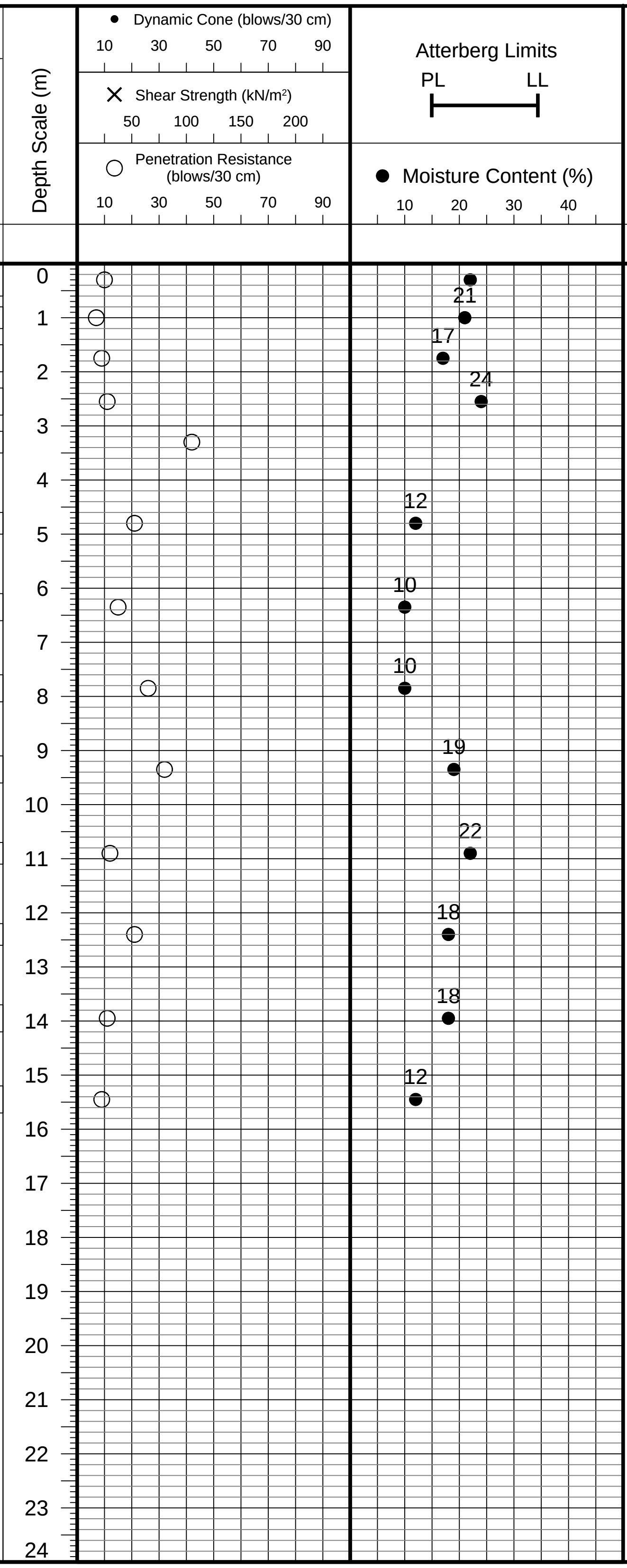
METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 9, 2017

El. (m) Depth (m)	SOIL DESCRIPTION
258.4	Ground Surface
0.0	**50 mm ASPHALTIC CONCRETE** **380 mm GRANULAR FILL** **EARTH FILL** brown silty clay coarse sand layer
256.9 1.5	Brown, stiff **SILTY CLAY** a trace of sand occ. gravel boulder
255.2 3.2	Grey, compact to dense **SANDY SILT TILL** some clay a trace of gravel
249.3 9.1	Grey, compact to dense, wet **SILT** some clay
244.7 13.7	Grey, loose to compact **SANDY SILT TILL** some clay a trace of gravel
242.7 15.7	**END OF BOREHOLE**

SAMPLES Number	Type	N-Value
1	DO	10
2	DO	7
3	DO	9
4	DO	11
5	DO	42
6	DO	21
7	DO	15
8	DO	26
9	DO	32
10	DO	12
11	DO	21
12	DO	11
13	DO	9



WATER LEVEL

W.L. @ El. 255.7 m upon completion

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Page: 1 of 1

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 210

FIGURE NO.: 10

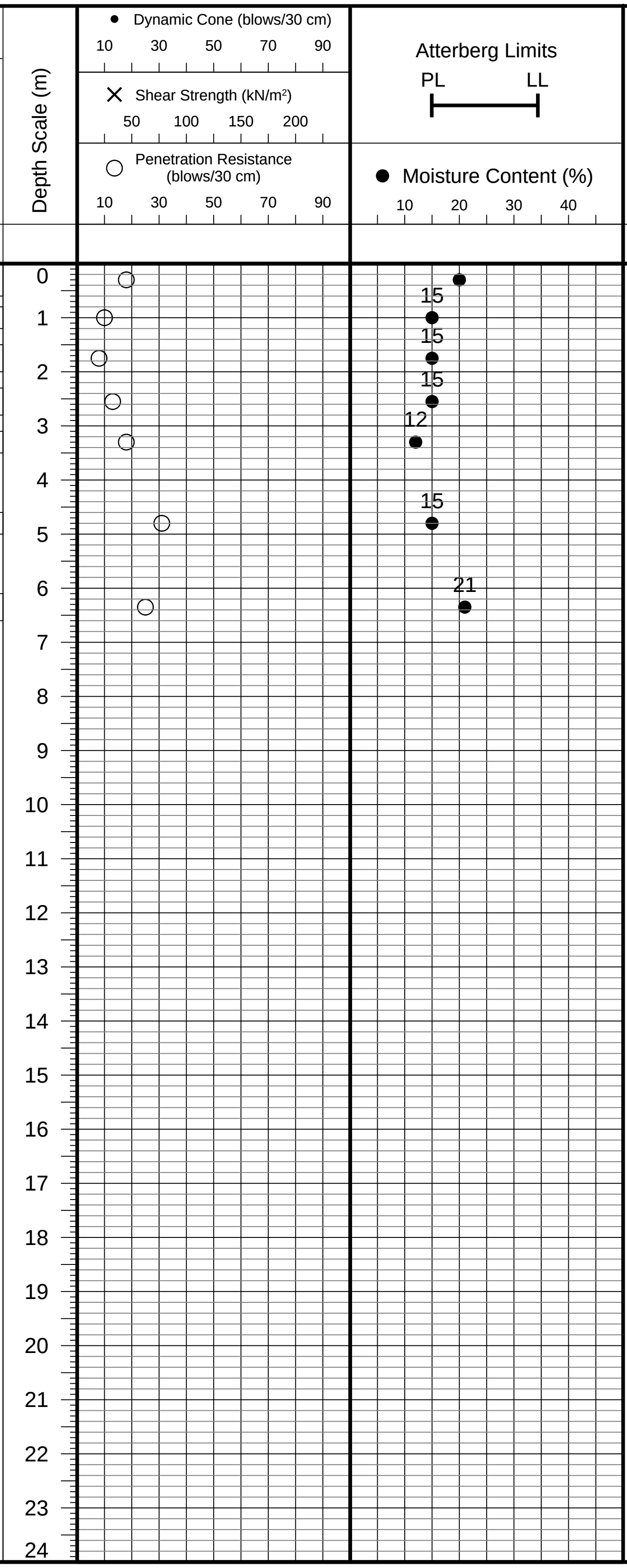
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 9, 2017

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
257.3	Ground Surface			
257.0 0.3	**EARTH FILL** brown silty clay traces of sand and gravel	1	DO	18
		2	DO	10
	Brown, loose to dense **SANDY SILT TILL** some clay a trace of gravel	3	DO	8
		4	DO	13
		5	DO	18
		6	DO	31
251.8 5.5	Grey, compact, wet **SILT** some clay and sand	7	DO	25
250.7 6.6	**END OF BOREHOLE**			



WATER LEVEL

W.L. @ El. 256.2 m upon completion

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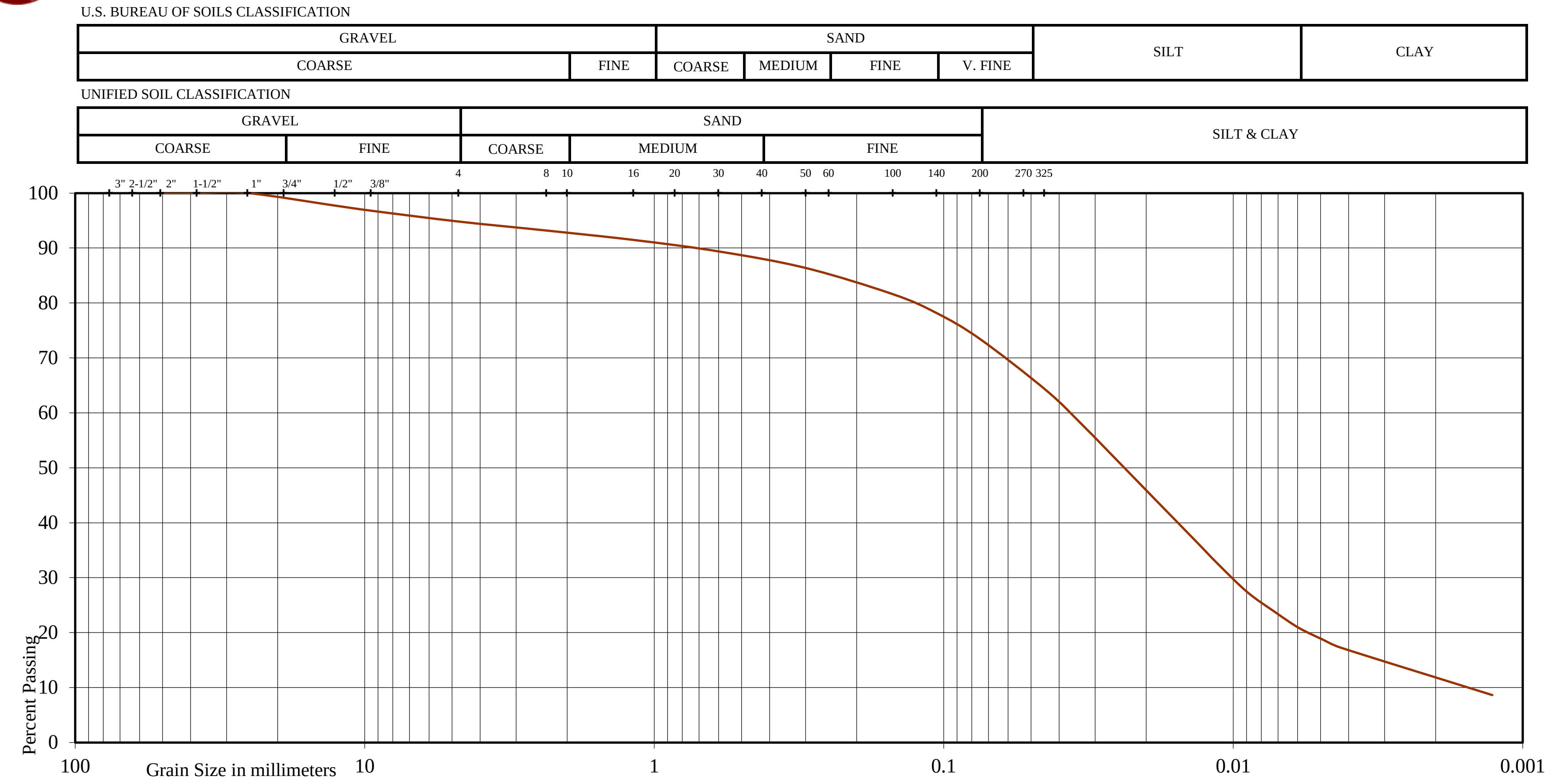
GRAIN SIZE DISTRIBUTION

Reference No: 1704-S065



Project: Proposed Residential Development

Location: Northwest corner of Mount Albert Road and Leslie Street, Town of East Gwillimbury

Liquid Limit (%) = -

Plastic Limit (%) = -

Borehole No: 207

Plasticity Index (%) = -

Sample No: 8

Moisture Content (%) = 12

Depth (m): 7.8

Estimated Permeability

Elevation (m): 252.2

(cm./sec.) = 10^{-7}

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

Figure: 11

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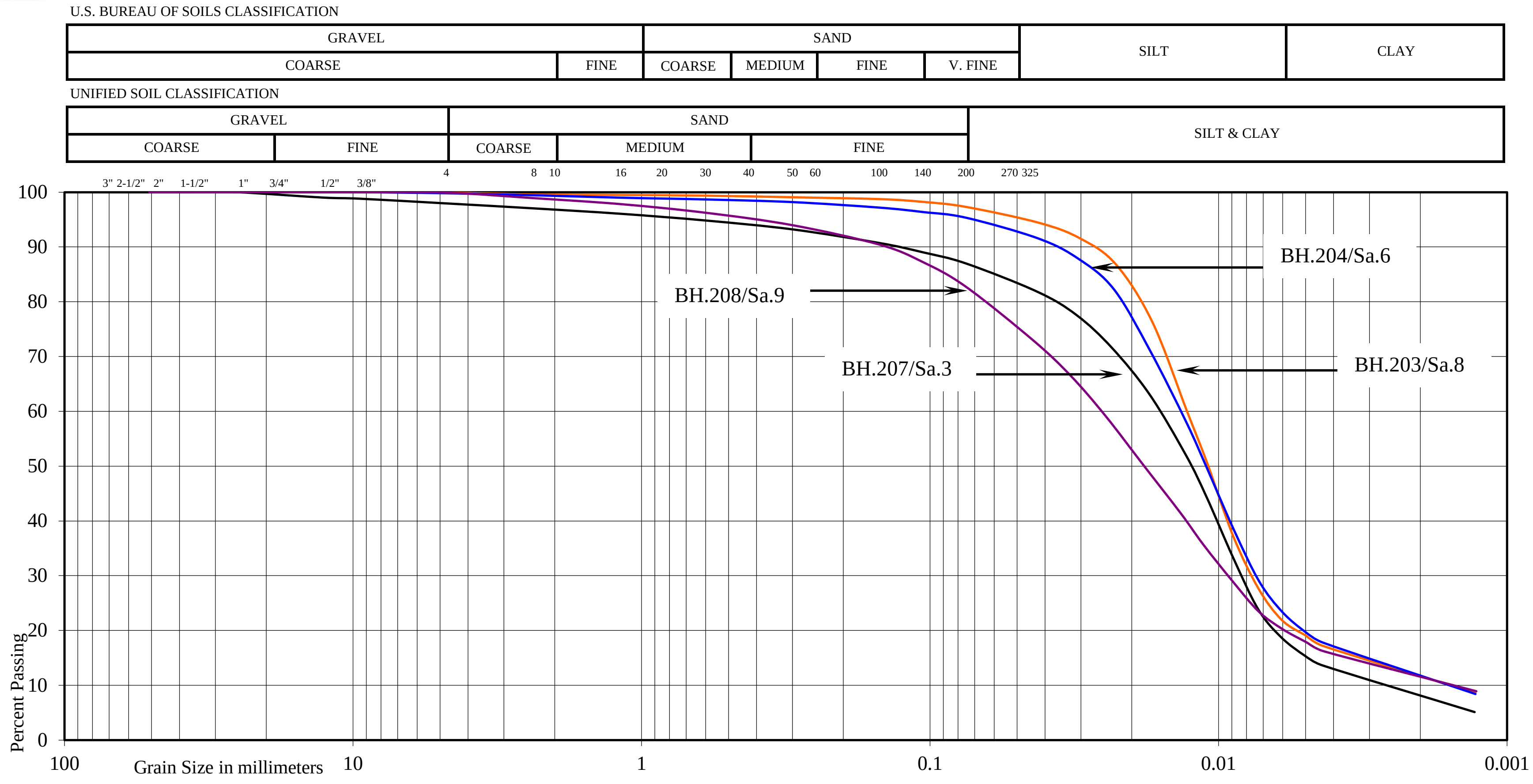
GRAIN SIZE DISTRIBUTION

Reference No: 1704-S065



Project: Proposed Residential Development

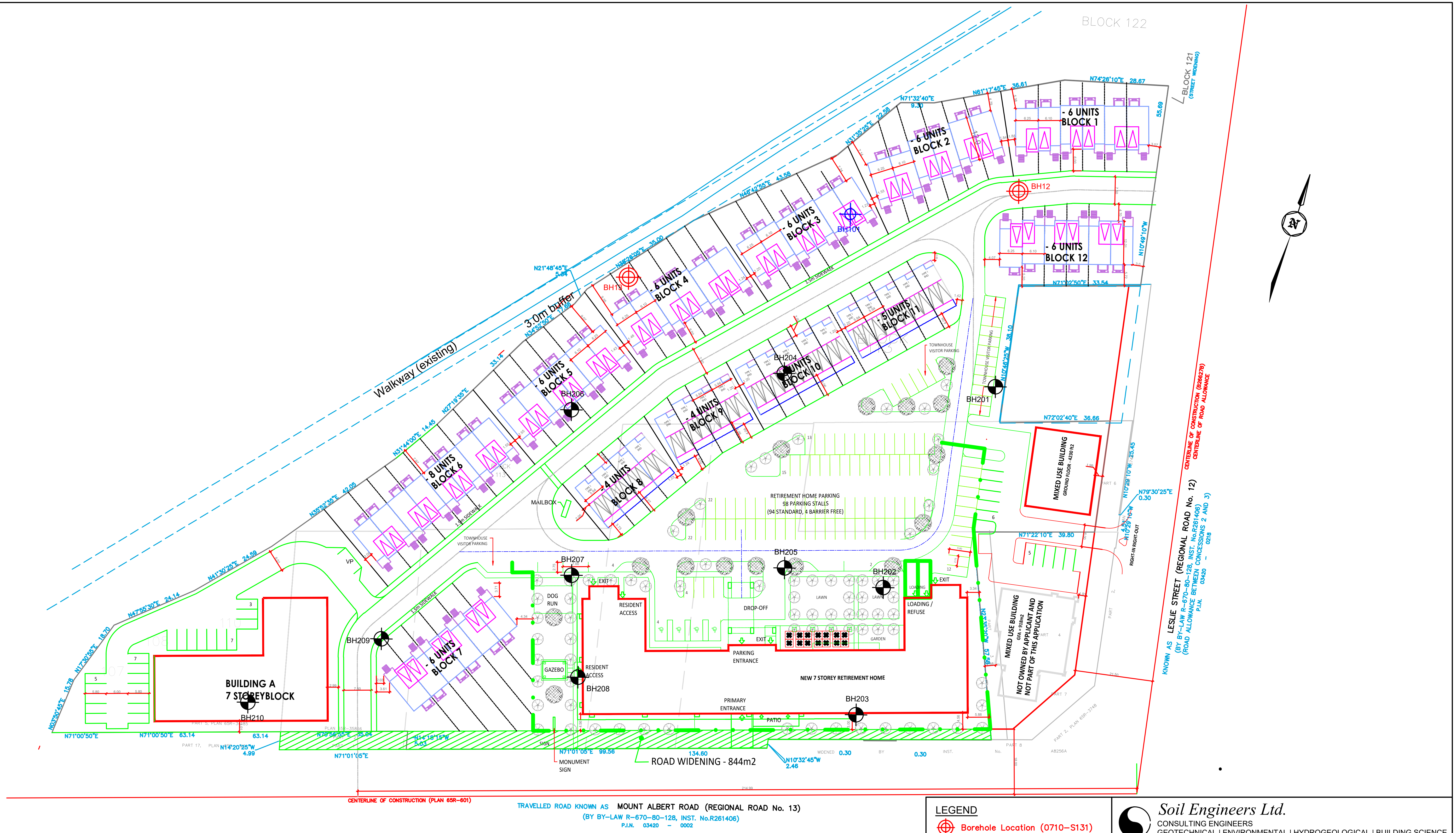
Location: Northwest corner of Mount Albert Road and Leslie Street, Town of East Gwillimbury

Borehole No:	203	204	207	208
Sample No:	8	6	3	9
Depth (m):	7.8	4.8	1.8	9.3
Elevation (m):	254.7	256.4	257.4	200.7

BH./Sa.	203/8	204/6	207/3	208/9
Liquid Limit (%) =	-	-	-	-
Plastic Limit (%) =	-	-	-	-
Plasticity Index (%) =	-	-	-	-
Moisture Content (%) =	21	22	31	15
Estimated Permeability (cm./sec.) =	10^{-6}	10^{-6}	10^{-6}	10^{-6}

Classification of Sample [& Group Symbol]: SILT, some clay and sand, traces of fine sand and gravel

Figure: 12



LEGEND

⊕ Borehole Location (0710–S131)

⊕ Borehole Location (0710–S131) (100 series)

⊕ Borehole Location (1704–S065) (200 series)

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

BOREHOLE LOCATION PLAN

SITE: MOUNT ALBERT ROAD AND LESLIE STREET
TOWN OF EAST GWILLIMBURY

DESIGNED BY:
CHECKED BY:
DWG NO.: 1
SCALE: 1:1000
REF. NO.: 1704-S065
DATE: MARCH 2019
REV 2

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SUBSURFACE PROFILE
DRAWING NO. 2
SCALE: AS SHOWN

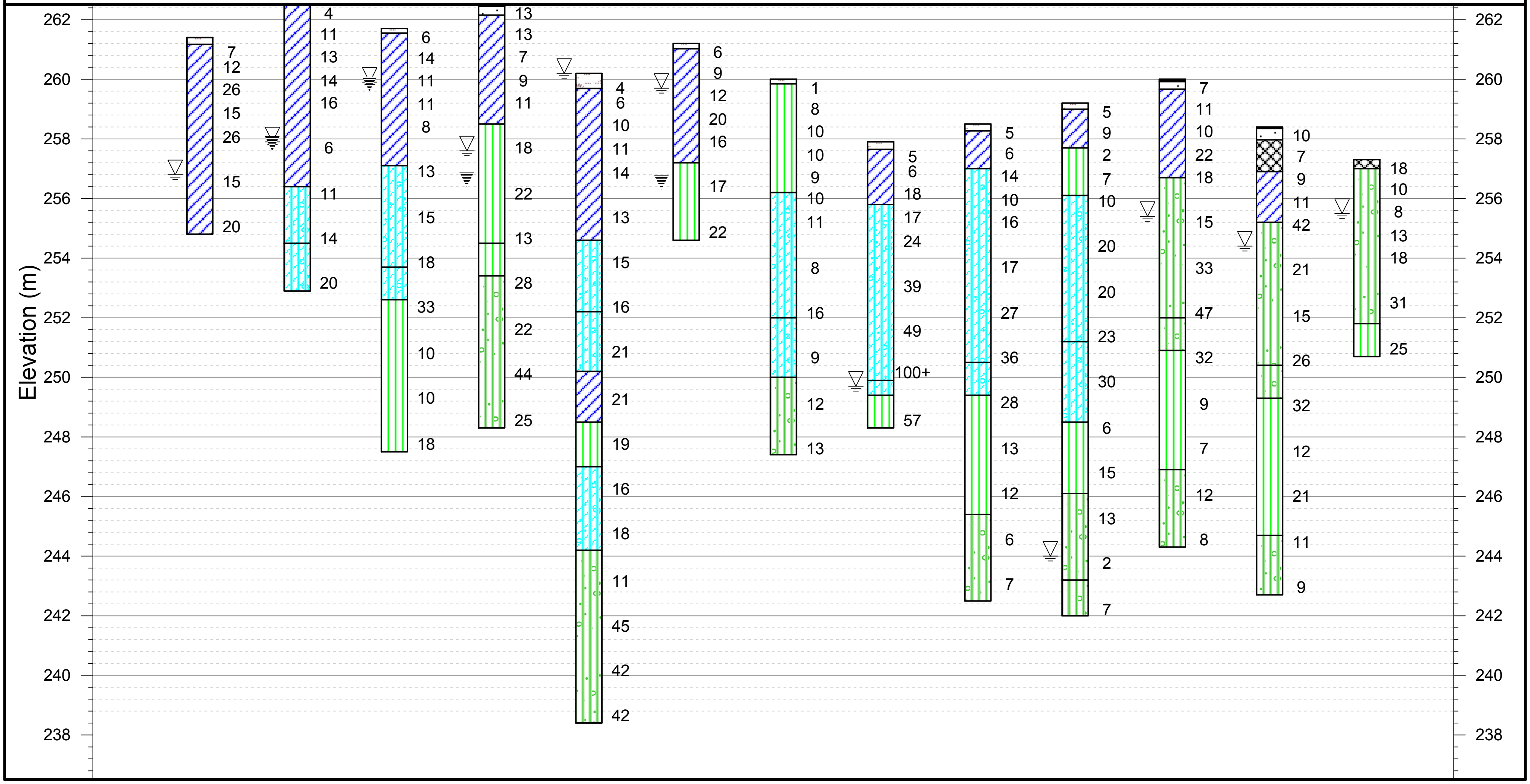
JOB NO.: 1704-S065
REPORT DATE: March 2019
PROJECT DESCRIPTION: Proposed Residential Development
PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

LEGEND

⬚	TOPSOIL	⁛	GRANULAR	▥	SANDY SILT TILL	▨	SILTY CLAY
■	ASPHALT	▩	FILL	▥	SILT	▨	SILTY CLAY TILL

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

BH No.:	12	201	202	203	101	204	205	13	206	207	208	209	210
El. (m):	261.4	262.5	261.7	262.5	260.2	261.2	260	257.9	258.5	259.2	260	258.4	257.3



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TEL: (705) 721-7863	TEL: (905) 542-7605	TEL: (905) 440-2040	TEL: (905) 853-0647	TEL: (705) 684-4242	TEL: (905) 440-2040	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) 725-1315	FAX: (905) 542-2769

APPENDIX

LOGS OF PREVIOUS BOREHOLES

Reference No. 0710-S131

JOB NO.: 0710-S131

LOG OF BOREHOLE NO.: 12

FIGURE NO.: 12

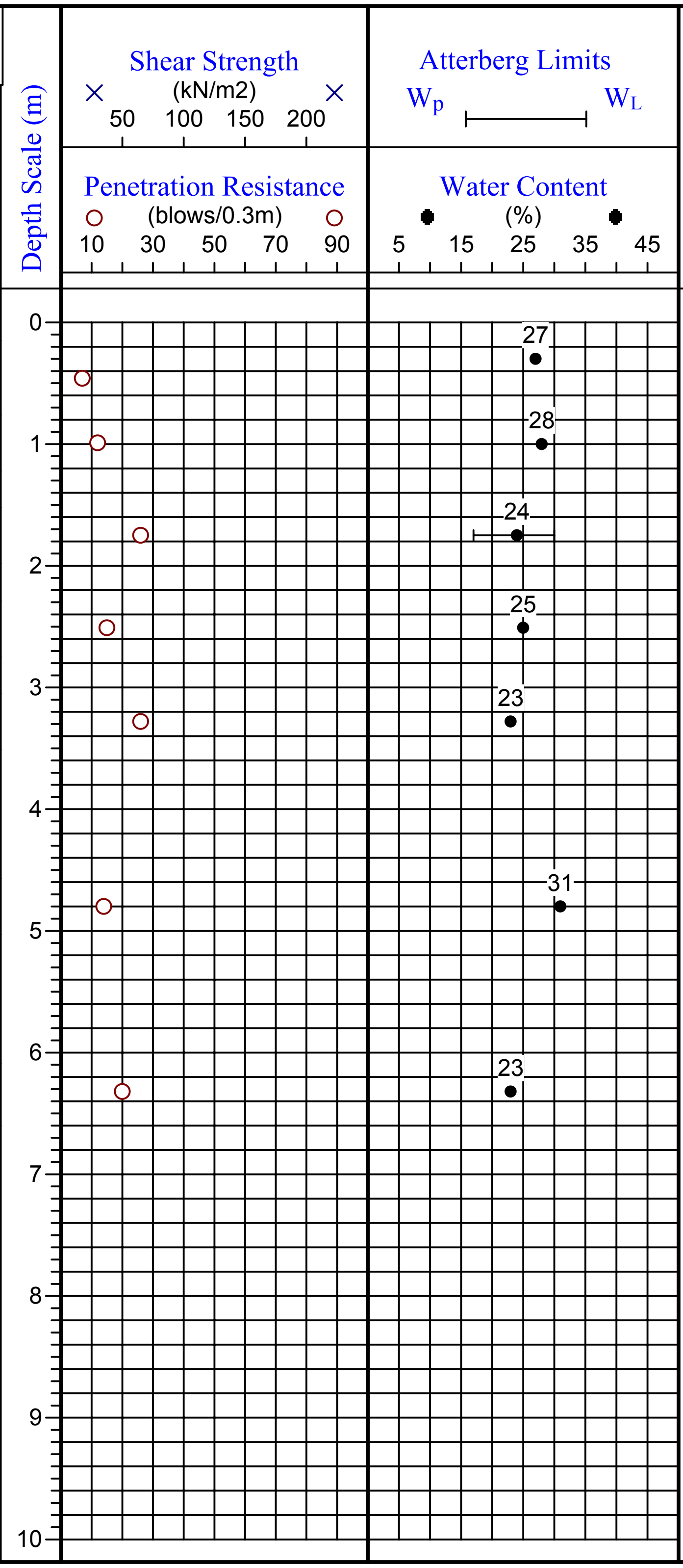
JOB DESCRIPTION: Proposed Residential Subdivision

JOB LOCATION: Leslie St./Mount Albert Rd.
Town of East Gwillimbury

METHOD OF BORING: Flight-Auger

DATE: January 24, 2008

Elev. Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
261.4	Ground Surface			
0.0	**23cm TOPSOIL**			
	Firm to very stiff weathered	1	DO	7
		2	DO	12
	SILTY CLAY	3	DO	26
	a trace of sand occ. wet sand and silt seams and layers	4	DO	15
		5	DO	26
	brown grey			
		6	DO	14
		7	DO	20
254.8 6.6	**END OF BOREHOLE**			



WATER LEVEL

W.L. @ El. 256.8 m on completion

Soil Engineers Ltd.

JOB NO.: 0710-S131

LOG OF BOREHOLE NO.: 13

FIGURE NO.: 13

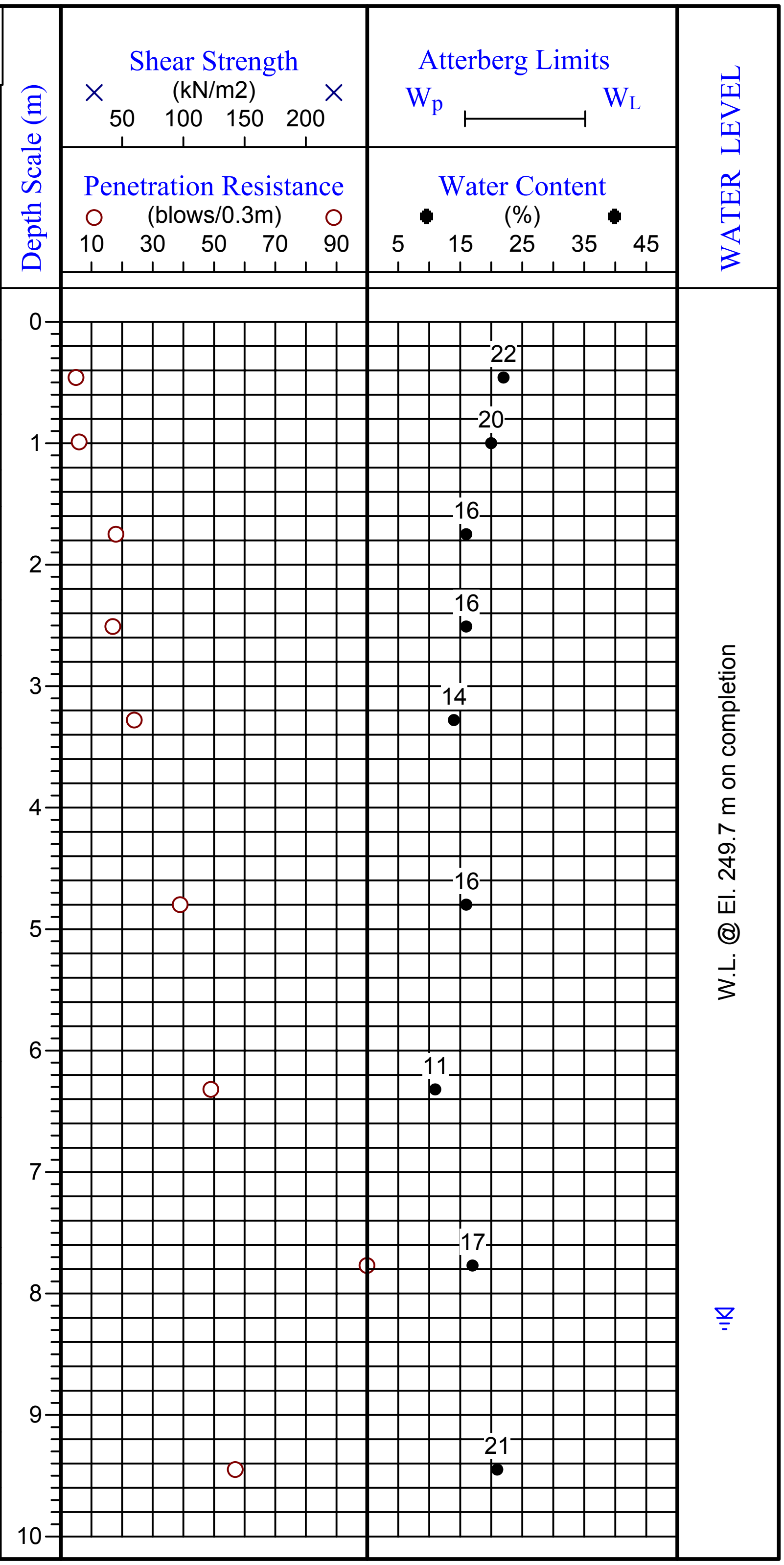
JOB DESCRIPTION: Proposed Residential Subdivision

JOB LOCATION: Leslie St./Mount Albert Rd.
Town of East Gwillimbury

METHOD OF BORING: Flight-Auger

DATE: January 24, 2008

Elev. Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
257.9 0.0	Ground Surface **25cm TOPSOIL**			
	Brown, firm to very stiff **SILTY CLAY** weathered	1	DO	5
		2	DO	6
	a trace of sand occ. wet sand and silt seams and layers	3	DO	18
255.8 2.1	Very stiff to hard brown	4	DO	17
	grey **SILTY CLAY, Till**	5	DO	24
	sandy, a trace of gravel occ. wet sand and silt seams and layers, cobbles and boulders	6	DO	39
		7	DO	49
		8	DO	100+
249.4 8.5	Grey, very dense **SILT** a trace to some sand some clay, a trace of gravel occ. wet sand and clay seams and layers	9	DO	57
248.3 9.6	**END OF BOREHOLE**			



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JOB NO.: 0710-S131

LOG OF BOREHOLE NO.: 101

FIGURE NO.: 1

JOB DESCRIPTION: Proposed Residential Subdivision

JOB LOCATION: Leslie St./Mount Albert Rd.
Town of East Gwillimbury

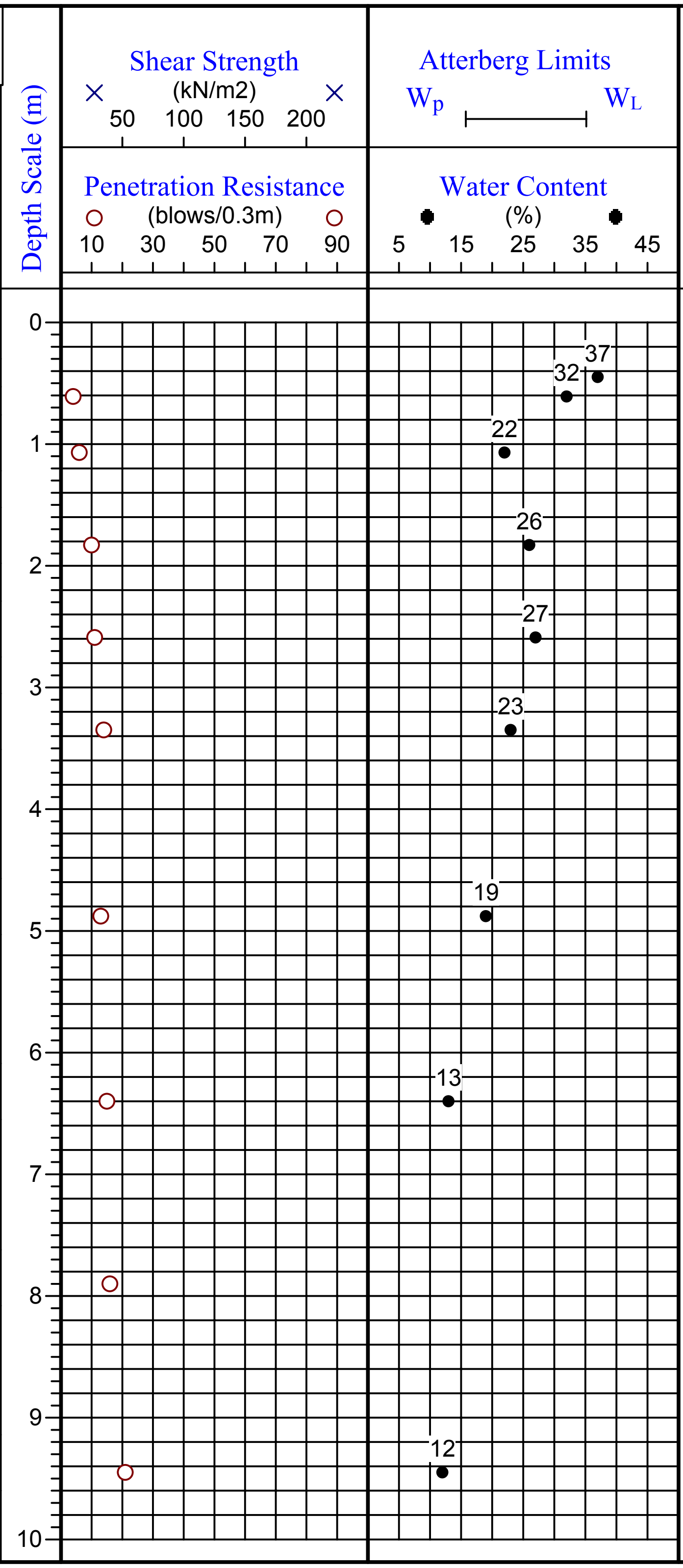
METHOD OF BORING: Flight-Auger

DATE: April 2, 2008

Elev. Depth (m)	SOIL DESCRIPTION
260.2	Ground Surface
0.0	**51cm TOPSOIL**
	Firm to stiff **SILTY CLAY** a trace of sand occ. wet sand and silt seams and layers (varved structure) weathered SILT LAYER brown grey
254.6 5.6	Grey, stiff to very stiff **SILTY CLAY, Till** sandy, a trace of gravel occ. wet sand and silt seams and layers, cobbles and boulders
250.2 10.0	Cont'd on Fig.1A

SAMPLES

Number	Type	N-Value
1A	DO	-
1B	DO	4
2	DO	6
3	DO	10
4	DO	11
5	DO	14
6	DO	13
7	DO	15
8	DO	16
9	DO	21



WATER LEVEL

Surface flooded

Soil Engineers Ltd.

JOB NO.: 0710-S131

LOG OF BOREHOLE NO.: 101

FIGURE NO.: 1 A

JOB DESCRIPTION: Proposed Residential Subdivision

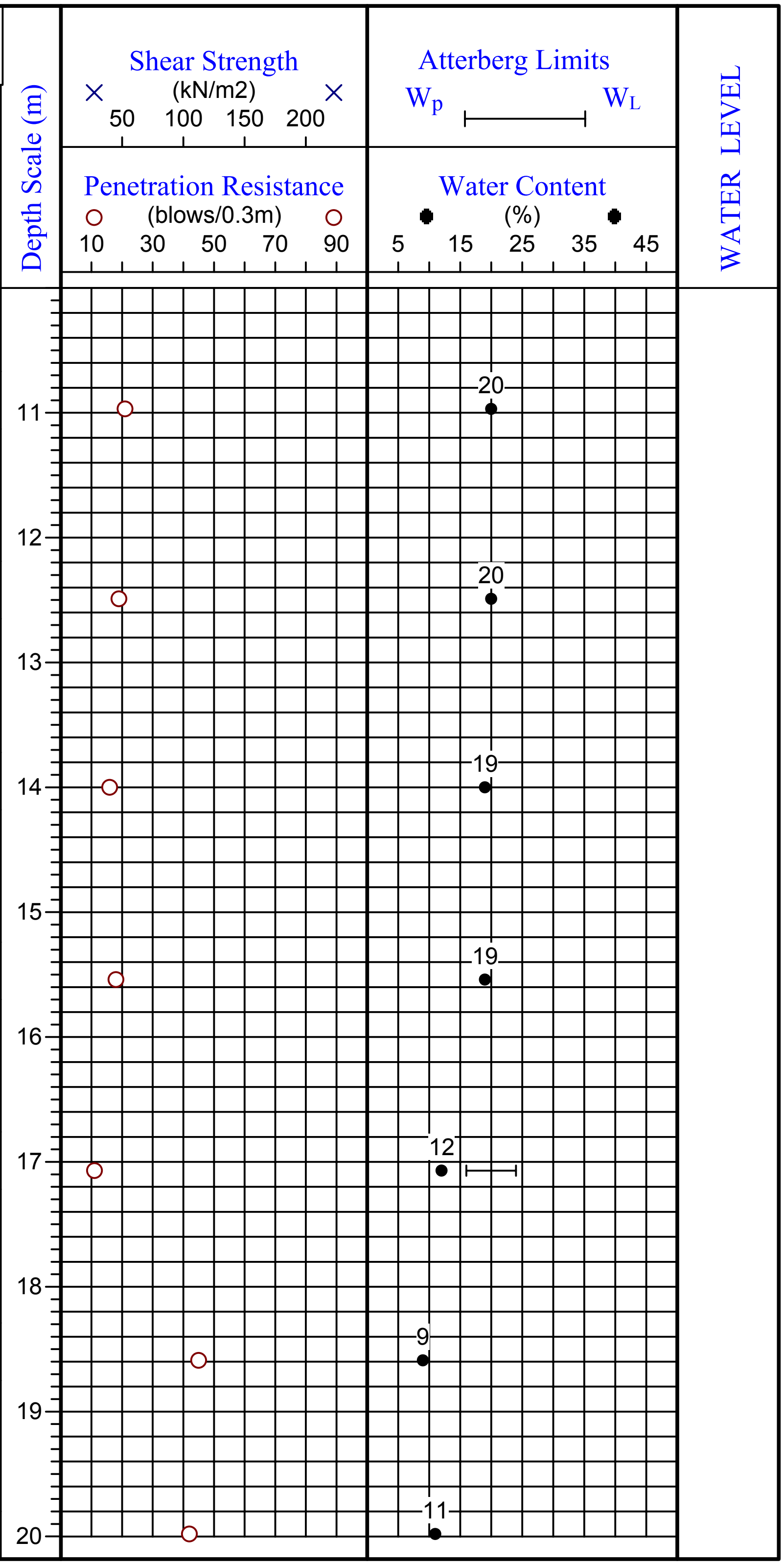
JOB LOCATION: Leslie St./Mount Albert Rd.
Town of East Gwillimbury

METHOD OF BORING: Flight-Auger

DATE: April 2, 2008

Elev. Depth (m)	SOIL DESCRIPTION Cont'd
250.2	
10.0	Grey, very stiff **SILTY CLAY** a trace of sand occ. wet sand and silt seams and layers (varved structure)
248.5 11.7	Grey, compact **SILT** some clay, a trace of sand occ. silty clay layers
247.0 13.2	Grey, very stiff **SILTY CLAY, Till** sandy, a trace of gravel occ. wet sand and silt seams and layers, cobbles and boulders
244.0 16.2	Grey, compact to dense **SANDY SILT, Till** some clay, a trace of gravel occ. wet sand and silt seams and layers, cobbles and boulders
240.2 20.0	Cont'd on Fig. 1B

SAMPLES		
Number	Type	N-Value
10	DO	21
11	DO	19
12	DO	16
13	DO	18
14	DO	11
15	DO	45
16	DO	42



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JOB NO.: 0710-S131

LOG OF BOREHOLE NO.: 101

FIGURE NO.: 1 B

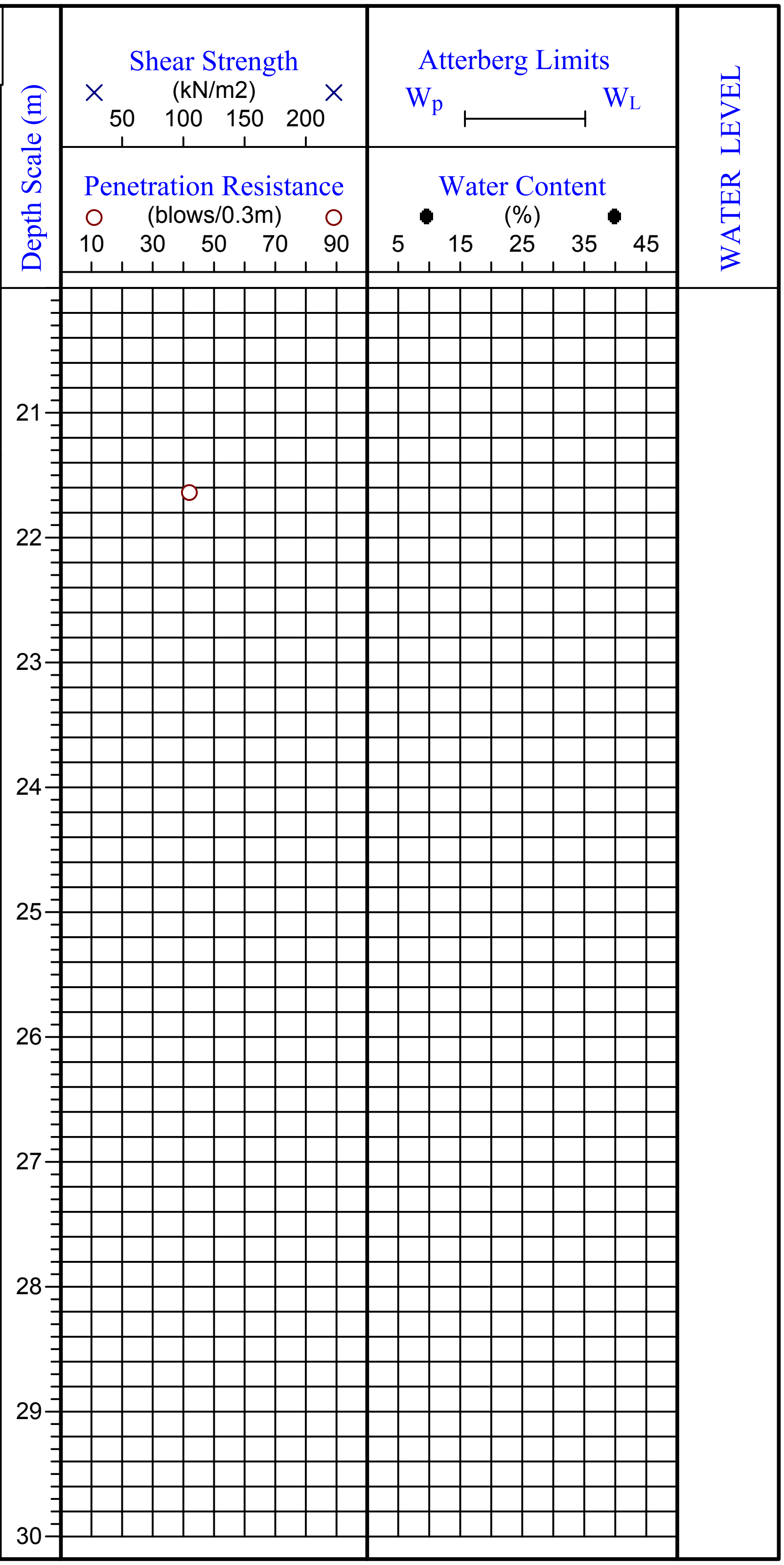
JOB DESCRIPTION: Proposed Residential Subdivision

JOB LOCATION: Leslie St./Mount Albert Rd.
Town of East Gwillimbury

METHOD OF BORING: Flight-Auger

DATE: April 2, 2008

Elev. Depth (m) 240.2	SOIL DESCRIPTION Cont'd	SAMPLES Number	Type	N-Value
20.0	Grey, dense **SANDY SILT, Till** some clay, a trace of gravel occ. wet sand and silt seams and layers, cobbles and boulders	17	DO	42
238.4 21.8	**END OF BOREHOLE**			



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