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February 16, 2018 Reference No. 1711-S047

Bridge Brook Corp.
55 Blue Willow Drive
Woodbridge, Ontario
L4L 9E8

Attention: Mr. John Spina

**Re: A Geotechnical Investigation Report for
Proposed Residential Development
7370 Centre Road
Town of Uxbridge**

Dear Sir:

Enclosed, please find 3 copies of the Geotechnical Investigation Report for the captioned project.

I trust the Report will meet your present requirements as per our proposal.

Should you have any queries concerning the above, or wish to retain us for further services, please feel free to contact the undersigned at your earliest convenience.

Yours truly,
SOIL ENGINEERS LTD.

Kin Fung Li, B.Eng.
KFL:dd

RECEIVED FEB 2 1 2018

Encl.

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A REPORT TO
BRIDGE BROOK CORP.

A GEOTECHNICAL INVESTIGATION FOR PROPOSED RESIDENTIAL DEVELOPMENT

7370 CENTRE ROAD

TOWN OF UXBRIDGE

REFERENCE NO. 1711-S047

FEBRUARY 2018

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1.0 INTRODUCTION

In accordance with written authorization dated November 9, 2017, from Mr. John Spina of Bridge Brook Corp., a geotechnical investigation was carried out on a parcel of land located on 7370 Centre Road, in the Town of Uxbridge.

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 proposed Residential Development.

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

2.0 SITE AND PROJECT DESCRIPTION

The Township of Uxbridge is situated on Peterborough Drumlin Field, where the lacustrine sand, silt, clay and water-laid till (reworked) in Lake Schomberg (glacial lake) has, in places, modified the drumlinized soil stratigraphy.

The subject property, encompasses approximately 40 hectares in area, is located on the west side of Centre Road, approximately 900 m north of Brock Street West in the Town of Uxbridge. It is currently a farm field with wooded areas and some natural drainage channels through the property. The existing site gradient generally drops towards the east direction.

It is understood that the property will be developed into a residential subdivision. Detailed design of the development, however, is not available at the time this report is prepared.

3.0 FIELD WORK

The field work, consisting of fourteen (14) boreholes to various depths ranging from 6.3 to 15.7 m, was performed between November 27 and December 21, 2017. Borehole 1 was cancelled due to accessibility. Borehole 13 was advanced on January 15, 2018 to a depth of 6.6 m. The boreholes locations 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 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 the completion of drilling and sampling, nine (9) 50 mm diameter PVC monitoring wells, including two pairs of nested wells were installed in selected borehole locations to facilitate future groundwater monitoring. The boreholes were backfilled with hole plug (bentonite) and borehole cuttings to the ground level.

The ground elevation at each of the borehole and monitoring well location was interpreted from the topographic survey provided by Stantec Geomatics Ltd.

4.0 SUBSURFACE CONDITIONS

Detailed descriptions of the encountered subsurface conditions are presented on the Borehole Logs, comprising Figures 1 to 15, inclusive.

The investigation revealed that beneath a veneer of topsoil and ploughed soils, the site is generally underlain by a complex stratigraphy consisting of silty clay and tills, with deposits of sand and silts at various depths and locations. The engineering properties of the disclosed soils are discussed herein.

4.1 **Topsoil/Ploughed Soils** (All Boreholes)

The existing ground surface was generally covered with topsoil with variable thickness. In the farm field area, the topsoil was mixed with ploughed soils, extending to depths of 0.6 to 1.5 m from the existing ground level.

The thickness of topsoil may vary randomly across the site. Thicker topsoil layers can occur in the low-lying areas, especially in treed areas and depressed areas beside the watercourses.

The topsoil is dark brown in colour and permeated with roots. This infers that it contains appreciable amounts of roots and humus. Similarly, the ploughed soils contains a composition of topsoil that it is unstable and compressible under loads; therefore, the topsoil and the ploughed soils are considered to be void of engineering value but can be used for general landscaping purposes. A fertility analysis can be carried out to assess their suitability for use as a planting soil or sodding medium. 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.

4.2 Silty Clay/Silty Clay Till (Boreholes 2, 3, 4, 6 to 10, inclusive, 13, 14 and 15)

The clay till consists of a random mixture of soils; the particle sizes range from clay to gravel, with the clay fraction exerting the dominant influence on its soil properties. Its structure is heterogeneous, showing a glacial deposit. The silty clay consists of predominantly clay and silt with occasional sand seams or layers, showing a lacustrine deposit.

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

The consistency of the clay and clay till and their respective 'N' values are summarized below:

	'N' Values	**Consistency**
Silty Clay	12 to 58 (median 28)	Stiff to hard, generally very stiff
Silty Clay Till	6 to over 100 (median 30)	Firm to hard, generally hard

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

	Silty Clay Till	**Silty Clay**
Liquid Limit	28%	35%
Plastic Limit	17%	19%
Natural Water Content	5% to 27% (median 12%)	14% to 26% (median 15%)

The above results show that the clay and clay till are cohesive materials with low plasticity. The natural water content generally lies below the plastic limit or between the plastic and liquid limits, confirming the consistencies of the clay and clay till as determined by the 'N' values.

Grain size analyses were performed on representative samples of silty clay till and silty clay; the results are plotted on Figures 16 and 17, respectively.

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

- Highly frost susceptible and low water erodibility.
- The silty clay has high soil-adfreezing potential.
- Virtually impervious, with an estimated coefficient of permeability of 10^{-7} cm/sec or less, an average percolation rate of 80 min/cm, and runoff coefficients of:

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

- Cohesive soils, their shear strengths are primarily derived from consistency which is inversely related to its moisture content. The clay till also contains sand and gravel; therefore, its shear strength is augmented by internal friction.

- The shear strength of the silty clay and till is moisture dependent and, due to the dilatancy of the silt layers in the clay, the overall shear strength of the silty clay 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, prolonged exposure will allow the weathered layers and the wet sand seams to become saturated which may lead to localized sloughing.
- Very poor pavement-supportive materials, with an estimated California Bearing Ratio (CBR) of 3% to 5%.
- Moderately high corrosivity to buried metal, with an estimated electrical resistivity of 3000 ohm·cm.

4.3 **Silty Sand Till** (Boreholes 2, 5, 6, 7, 10, 11 and 12)

The silty sand till consists of a random mixture of particle sizes ranging from clay to gravel, with sand being the dominant fraction. They are heterogeneous and amorphous in structure showing the deposit is a glacial till, part of which has been reworked by the glacial lake.

Tactile examinations of the soil samples indicated that the till is slightly cemented.

The obtained 'N' values range from 6 to over 100, with a median of 26 blows per 30 cm of penetration. This shows that the relative density of the till is loose to very dense, being generally compact. The loose soil is encountered below the ploughed soil and has been weakened by weathering.

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

The natural water content values of the samples were determined; the results are plotted on the Borehole Logs. The values range from 7% to 13%, with a median of 9%, confirming the generally moist condition disclosed by the sample examinations.

Grain size analyses were performed on two representative samples; the results are plotted on Figure 18.

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

- Highly frost susceptible and moderately water erodible.
- Low soil-adfreezing potential.
- Low permeability, with an estimated coefficient of permeability of 10^{-5} cm/sec, an average percolation rate of 40 min/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, the strength is density dependent.
- It 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 10%.

- Moderately low corrosivity to buried metal, with an estimated electrical resistivity of 5000 ohm·cm.

4.4 **Sandy Silt/Silt** (Boreholes 2, 4, 9, 11, 12 and 15)

The sandy silt and silt deposit was encountered in various depths and locations. It is fine grained, with traces to some sand and clay. The natural water content of the samples range from 10% to 23%, with a median of 17%, indicating a moist to wet condition, being generally wet and likely saturated. The wet silt dilates when shaken by hand. The wet soils are water-bearing.

The obtained 'N' values range from 14 to 72 blows, with a median of 30 blows per 30 cm of penetration, indicating that the relative density of the sandy silt and silt is compact to very dense, being generally compact.

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.
- Low permeability, with an estimated coefficient of permeability of 10^{-5} cm/sec, an average percolation rate of 40 min/cm and runoff coefficients of:

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

- Frictional soils, their shear strength is density dependent. Due to their dilatancy, the strength of the wet silts 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 wet silts will slough and run slowly with seepage bleeding from the cut face. It will boil with a piezometric head of 0.3 m.
- Poor pavement-supportive materials, with an estimated CBR value of 5%.
- Moderately corrosive to buried metal, with an estimated electrical resistivity of 4500 ohm.cm.

4.5 Sand (Boreholes 4, 5, 13 and 15)

The sand deposit is generally fine to medium grained with some silt. Sample examinations show that the deposit is in a very moist to wet condition and is water bearing. This is confirmed by the natural water content of the soil samples, in the range of 5% to 22%, with a median of 17%. Due to the pervious nature of the deposit, some water could have been drained from the samples after they were retrieved or during the packing process. Hence, the actual water content of the deposit can be higher. The wet sand is water-bearing.

The obtained 'N' values of the sand deposit ranged from 9 to over 100, with a median of 27 blows per 30 cm of penetration, indicating the relative density of the sand is loose to very dense, being generally compact.

A grain size analysis was performed on one representative sample of the sand deposit; the result is plotted on Figure 19.

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

- Low frost susceptibility.
- Highly water erodible.
- Susceptible to migration through small openings under seepage pressure.
- Pervious, with an estimated coefficient of permeability of 10^{-3} cm/sec, an average percolation rate of 10 min/cm and runoff coefficients of:

Slope	
0% - 2%	0.04
2% - 6%	0.09
6% +	0.13

- A frictional soil, its shear strength is dependent on its internal friction angle and soil density. Due to its dilatancy, its 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 reduction of shear strength.
- In excavation, the wet sand will slough and run slowly with seepage bleeding from the cut face. It will boil with a piezometric head of 0.3 m.
- A good pavement-supportive material, with an estimated CBR value of 21%.
- Moderately low corrosivity to buried metal, with an estimated electrical resistivity of 6000 ohm·cm.

4.6 Compaction Characteristics of the Revealed Soils

The obtainable degree of compaction is primarily dependent on the soil moisture and, to a lesser extent, on the type of compactor used and the effort applied.

As a general guide, the typical water content values of the revealed soils for Standard Proctor compaction are presented in Table 1.

Table 1 - Estimated Water Content for Compaction

Soil Type	Determined Natural Water Content (%)	Water Content (%) for Standard Proctor Compaction	
		100% (optimum)	Range for 95% or +
Silty Clay and Silty Clay Till	5 to 27 (median 13)	18	14 to 24
Silty Sand Till	7 to 13 (median 9)	13	8 to 16
Sandy Silt and Silt	10 to 23 (median 17)	10	7 to 14
Sand	5 to 22 (median 17)	8	5 to 11

Based on the above findings, the clay and tills are generally suitable for 95% or + Standard Proctor compaction. However, some of the clays, sand and silts are generally too wet and will require aeration prior to compaction. Aeration can be achieved by spreading them thinly on the ground during the dry and warm weather.

The clay and tills should be compacted using a heavy-weight kneading-type roller. The sand and silts can be compacted by a smooth drum roller, with or without vibration, depending on the water content of the soil 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 or tills on the dry side of the optimum, the compactive energy will frequently bridge over the chunks in the soil and be transmitted laterally into the soil mantle. Therefore, the lifts 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 a wider latitude of lift thickness.

One should be aware that with considerable effort, a 90%± Standard Proctor compaction of the wet sand and silts 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 in the tills 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. In addition, the groundwater level in monitoring wells was recorded on January 31, 2018. The records are summarized in Table 2.

Table 2 - Groundwater Level

Borehole No.	**Ground El. (m)**	**Groundwater in Boreholes/Monitoring Wells**			
		Upon Completion		**On January 31, 2018**	
		Depth (m)	**El. (m)**	**Depth (m)**	**El. (m)**
2	295.8	1.2	294.6	No Well	
3	305.0	2.7	302.3	0.4	304.6
4	318.6	0.6	318.0	No Well	
5	332.2	4.8	327.4	No Well	
6	287.9	14.9	273.0	1.3	286.6
7	297.8	4.8	293.0	0.9	296.9
8	307.0	5.4	301.6	No Well	
9	321.9	14.6	307.3	7.4	314.5
10	332.6	3.6	329.0	0.2	332.4
11	291.4	1.2	290.2	1.1	290.3
12	303.0	4.8	298.2	No Well	
13	322.6	3.6	319.0	3.5	319.1
14	322.9	3.6	319.3	No Well	
15	333.6	2.7	330.9	No Well	

Upon the completion of borehole drilling, groundwater was recorded in the boreholes between El. 273.0 m and El. 330.9 m, dropping in the east southeast direction. The stabilized groundwater in the monitoring wells was recorded between El. 286.6 m and El. 332.4 m.

Groundwater within the saturated sand and silts generally represents the permanent groundwater regime at the site. Perched water also exists in certain areas at shallower depths. The groundwater level will fluctuate with seasons.

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

Where groundwater seepage is encountered in the tills and clay, the groundwater can be controlled by pumping from sumps. However, where the excavation extends into the saturated/water bearing soils, dewatering from closely spaced sumps and/or a well-point system will be required.

6.0 DISCUSSION AND RECOMMENDATIONS

The investigation revealed that beneath a veneer of topsoil and ploughed soils, the site is generally underlain by a complex stratigraphy consisting of stiff to hard, generally very stiff silty clay; firm to hard, generally hard silty clay till and loose to very dense, generally compact silty sand till, with layers of loose to very dense, generally compact sand and compact to very dense, generally compact silt deposits at various depths and locations. The wet sand and silts are water-bearing.

Upon the completion of borehole drilling, groundwater was recorded in the boreholes between El. 273.0 m and El. 330.9 m, dropping in the east southeast direction. The stabilized groundwater in the monitoring wells was recorded between El. 286.6 m and El. 332.4 m. The groundwater within the saturated sand and silt generally represents the permanent groundwater regime at the site. Perched water also exists in certain areas at shallower depths. The groundwater level will fluctuate with seasons.

In excavation, groundwater yield from the clay and tills will be slow and limited in quantity, whereas the groundwater yield from the saturated sand and silts below the water level will be appreciable and persistent.

It is understood that the property will be developed into a residential subdivision. Detailed design of the development, however, is not available at the time this report is prepared. The geotechnical findings which warrant special consideration are presented below:

1. The topsoil and ploughed soil must be removed for the development. The thickness of topsoil and ploughed soil may vary or becomes thicker in some areas, especially in the treed areas and depressed areas. In order to prevent

overstripping, a diligent control of the stripping operation will be required. A test pit programme can be carried out prior to or during construction to determine the thickness of the topsoil and ploughed soils.

2. The topsoil is void of engineering value. It must not be buried within the building envelope or deeper than 1.2 m below the exterior finished grade of the development. It can only be used for landscaping and landscape contouring purposes.
3. The 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.
4. The sound natural soils below the topsoil, ploughed soil, and weathered soils, are suitable for normal spread and strip footing construction for the proposed buildings. The footings must be designed in accordance with the recommended bearing pressures in Section 6.1 and the footing subgrade must be inspected by a geotechnical engineer to ensure that its condition is compatible with the design of the foundations.
5. The footings must be maintained at least 0.5 m above the groundwater levels. If groundwater seepage is encountered during excavation, 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. Dewatering may be required prior to and during construction.
6. 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.
7. A Class 'B' bedding, consisting of compacted 20-mm Crusher-Run Limestone, or equivalent, is recommended for the construction of the underground services. The pipe joints should be leak proof or wrapped with a

waterproof membrane. Where saturated soils are present or extensive dewatering is required, a Class 'A' bedding will be required.

8. All excavation should be carried out in accordance with Ontario Regulation 213/91.

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 assumed that the site will be regraded for the proposed development. It is generally more economical to place engineered fill for normal footing, sewer and pavement construction. Soil bearing pressures of 150 kPa (SLS) and 250 kPa (ULS) are recommended for the design of building foundations, consisting of normal spread and strip footings founded on the engineered fill or on the sound native soil stratum. The requirements for engineered fill construction are discussed in Section 6.2.

The appropriate founding levels in the natural soils range from 1.0± to 2.5± m from the prevailing ground surface, depending on the location.

The recommended soil pressures (SLS) incorporate a safety factor of 3. The total and differential settlements of the footings are estimated to be 25 mm and 15 mm, respectively.

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 during 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.

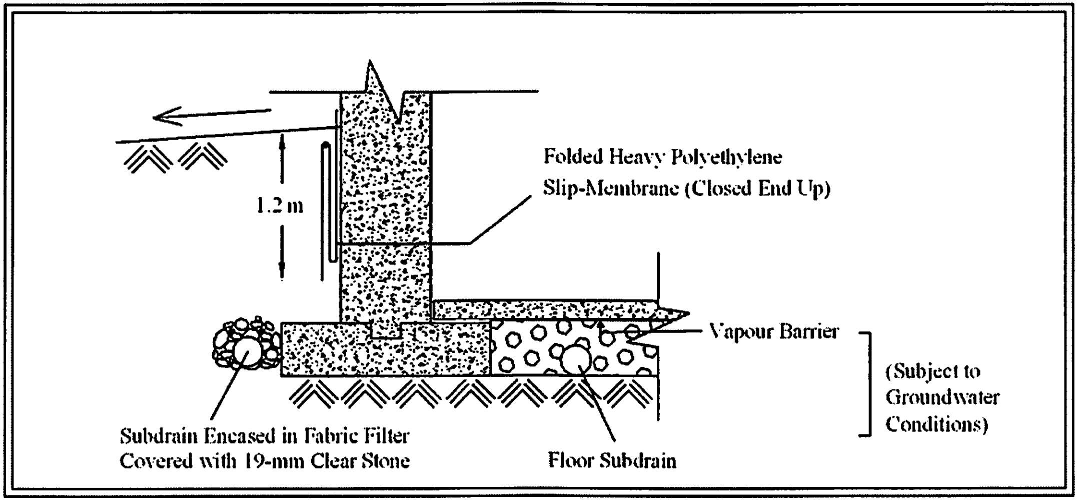
Footings exposed to weathering, or in unheated areas, should have at least 1.2 m of earth cover for protection against frost action.

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

Higher design bearing pressures of 200 to 300 kPa (SLS) and 320 to 480 kPa (ULS) are available in some locations, having the footings extending into the undisturbed sound native soil stratum at deeper levels. The allowable soil bearing pressures can be provided for individual structures, if necessary, at the time the design of the development and the site grading plan are finalized.

Most of 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



Perimeter subdrains and dampproofing of the foundation walls will be required for the project construction. If wet silt or sand is encountered at the basement subgrade, under-floor subdrains and vapour barrier will be required. All subdrains must be encased in a fabric filter to protect them against blockage by silting.

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 150 kPa and a Factored Ultimate Soil Bearing Pressure (ULS) of 250 kPa are presented below:

1. All of the topsoil and the ploughed soils must be removed, and the subgrade must be inspected and proof-rolled prior to any fill placement.

2. The 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 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 being 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 Underground Services

The subgrade for the underground services should consist of natural soils or engineered fill. In areas where the subgrade consists of ploughed and/or 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 4, Section 6.7, 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’ 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 ranging from 3000 to 6000 ohm·cm. These soils are considered corrosive to ductile iron pipes and metal fittings; therefore, the underground services should be protected against soil corrosion. For estimation of anode weight requirements, the estimated electrical resistivity of 3000 ohm·cm can be used. This, however, should be confirmed by testing the soil along the water main alignment at the time of sewer construction.

6.4 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 and increased to 98% or + below the floor slab. 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.

The tills and clay are suitable for 95% or + Standard Proctor compaction. The sands and silts 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 1V:1.5+H, and the lifts of the fill and its moisture content are stringently controlled; i.e., lifts should be no more than 20 cm (or less if the backfilling conditions dictate) and uniformly compacted to achieve at least 95% 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.

6.5 Garages, 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 1V:3H.

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 and slab-on-grade to be constructed in areas susceptible to ground movement must be constructed on a free-draining granular base at least 1.0 m thick, with proper drainage, which will prevent water from ponding in the granular base.

6.6 Pavement Design

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

Table 3 - Pavement Design

Course	Thickness (mm)	OPS Specifications
Asphalt Surface	40	HL-3
Asphalt Binder	50	HL-8
Granular Base	150	Granular 'A' or equivalent
Granular Sub-base		Granular 'B' or equivalent
Local	350	
Collector	450	

In preparation of the subgrade, the topsoil, weathered soils and ploughed soils 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.
- 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.
- Fabric filter-encased curb subdrains are required to meet the Town's requirements.

6.7 Soil Parameters

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

Table 4 - Soil Parameters

Unit Weight and Bulk Factor

	Unit Weight (kN/m^3)		Estimated Bulk Factor	
	Bulk	**Submerged**	**Loose**	**Compacted**
Silty Clay	20.0	10.0	1.33	0.98
Silty Clay Till	22.0	12.0	1.30	1.00
Silty Sand Till	22.5	12.5	1.20	1.00
Sand and Silts	21.0	11.0	1.20	1.00

Lateral Earth Pressure Coefficients

	Active K_a	At Rest K_o	Passive K_p
Silty Clay and Silty Clay Till	0.40	0.55	2.50
Silty Sand Till, Sand and Silts	0.33	0.45	3.00

Coefficients of Friction

Between Concrete and Granular Base	0.5
Between Concrete and Sound Native Soils	0.4

6.8 Excavation

Excavation should be carried out in accordance with Ontario Regulation 213/91. For excavation purposes, the types of soils are classified in Table 5.

Table 5 - Classification of Soils for Excavation

Material	Type
Sound Silty Clay and Tills	2
Weathered Soils, drained Sand and Silts	3
Ploughed soils and saturated Sand and Silts	4

In excavations, groundwater yield from the tills and clay will be slow and limited in quantity, whereas the groundwater yield from the saturated sand and silts layers will be appreciable and likely persistent.

Where groundwater seepage is encountered in the tills and clay, the groundwater can be removed by pumping from sumps. However, where the excavation extends into the saturated/water-bearing soils, dewatering from closely spaced sumps and/or a well-point system will be required.

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 Bridge Brook Corp., for review by its 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, B.Eng., and Daniel Man, 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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Feb 8/18
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 'O'

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.: 1711-S047

LOG OF BOREHOLE NO.: 1

FIGURE NO.: 1

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING:

PROJECT LOCATION: 7370 Centre Road, Town of Uxbridge

DRILLING DATE:

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES			Depth Scale (m)	● Dynamic Cone (blows/30 cm) 10 30 50 70 90 × Shear Strength (kN/m²) 50 100 150 200 ○ Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL ⊢⊣ LL ● Moisture Content (%) 10 20 30 40	WATER LEVEL
		Number	Type	N-Value				
0.0								
	CANCELLED DUE TO ACCESS ISSUE				0			
					1			
					2			
					3			
					4			
					5			
					6			
					7			
					8			
					9			
					10			

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JOB NO.: 1711-S047

LOG OF BOREHOLE NO.: 2

FIGURE NO.: 2

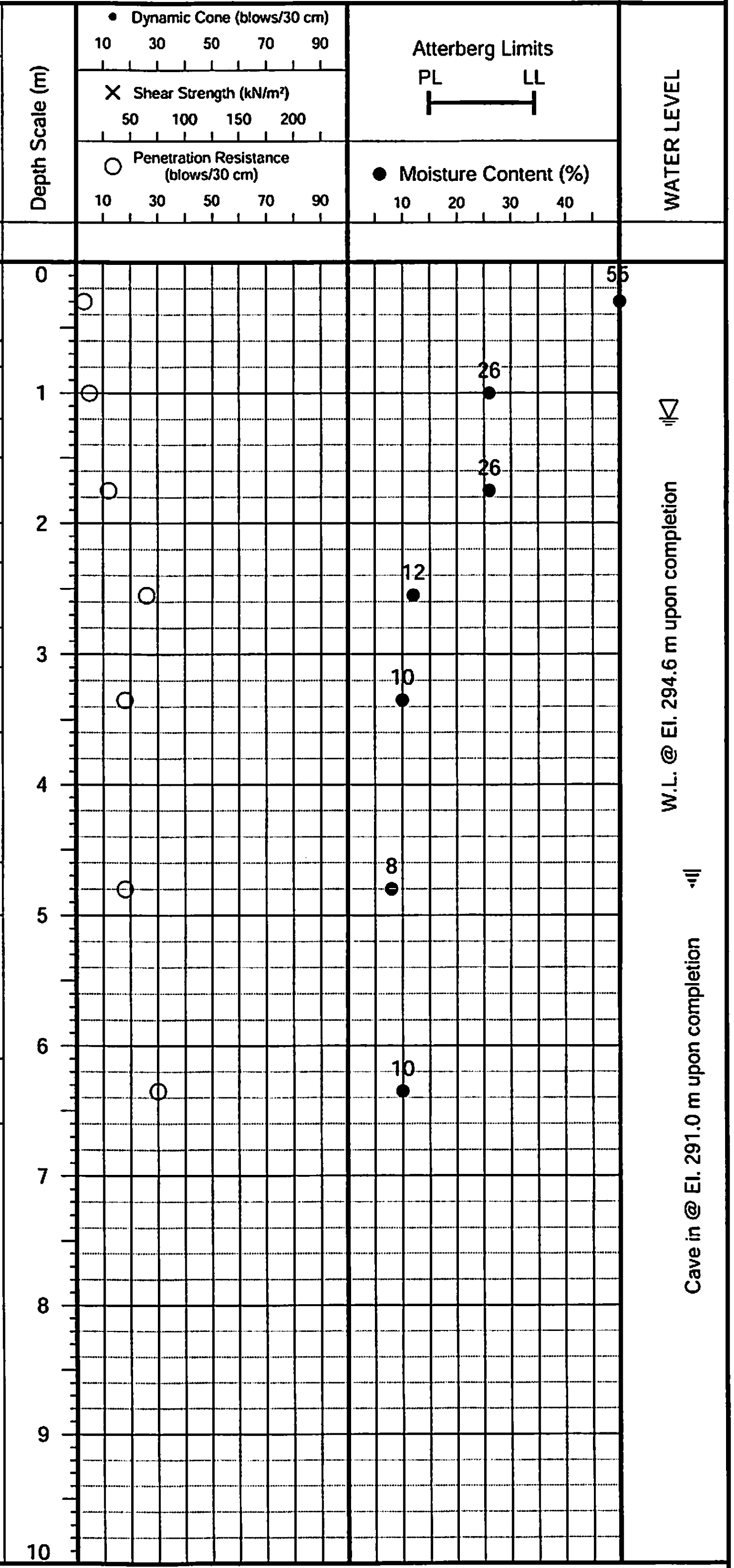
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 7370 Centre Road, Town of Uxbridge

DRILLING DATE: December 20, 2017

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
295.8	Ground Surface			
0.0	**TOPSOIL/PLOUGHED SOIL**	1	DO	3
		2	DO	5
294.6 1.2	Brown, stiff **SILTY CLAY**	3	DO	12
293.5 2.3	Compact **SILTY SAND TILL** some gravel a trace of clay	4	DO	26
		5	DO	18
	brown grey	6	DO	18
290.3 5.5	Grey, dense **SILT** some sand a trace of clay	7	DO	30
289.2 6.6	**END OF BOREHOLE**			



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JOB NO.: 1711-S047

LOG OF BOREHOLE NO.: 3

FIGURE NO.: 3

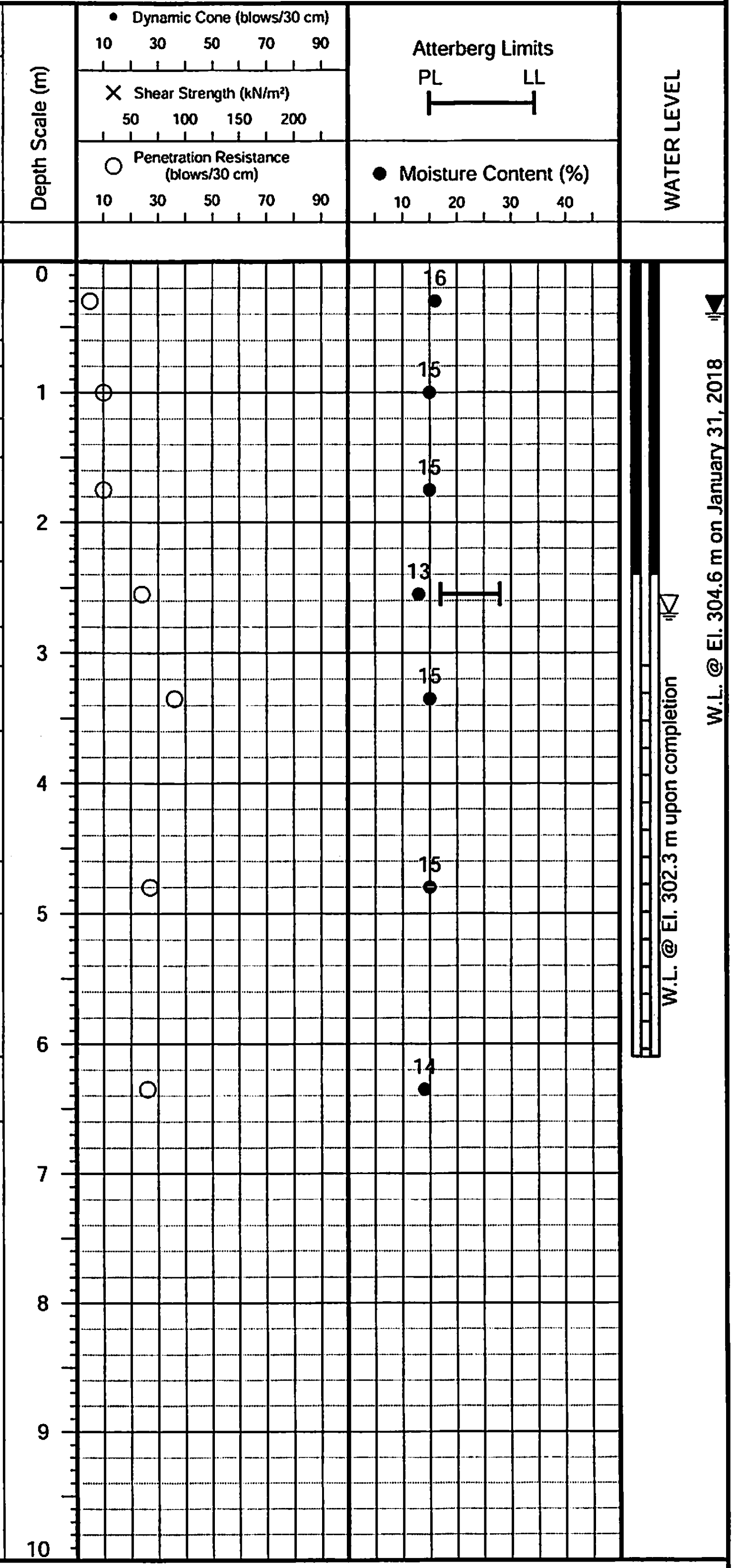
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 7370 Centre Road, Town of Uxbridge

DRILLING DATE: December 15, 2017

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
305.0	Ground Surface			
0.0	**TOPSOIL/PLOUGHED SOIL**	1	DO	5
304.0 1.0	Stiff to hard	2	DO	10
	SILTY CLAY TILL sandy a trace of gravel	3	DO	10
		4	DO	24
		5	DO	36
	brown grey	6	DO	27
		7	DO	26
298.4 6.6	**END OF BOREHOLE**			



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Page: 1 of 1

JOB NO.: 1711-S047

LOG OF BOREHOLE NO.: 4

FIGURE NO.: 4

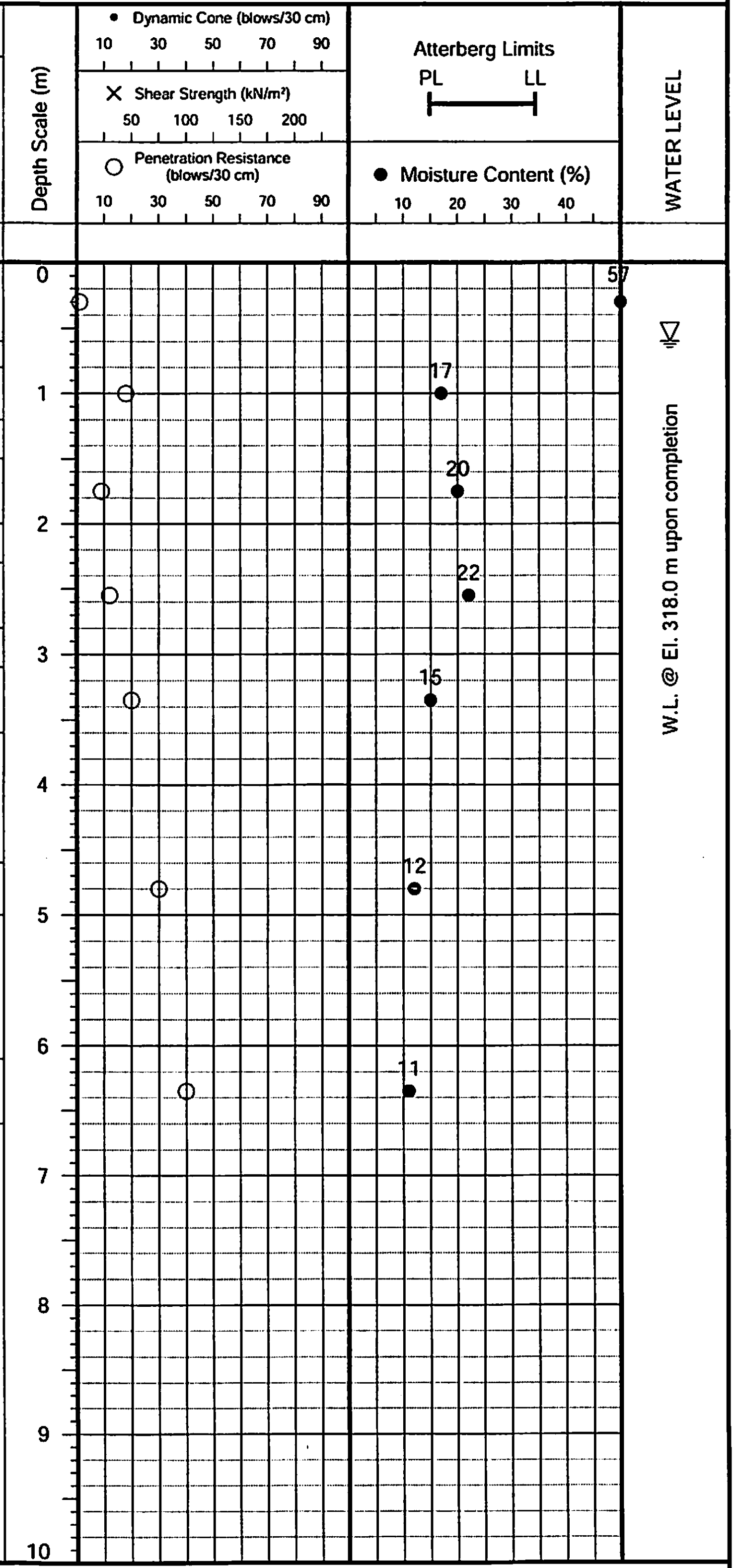
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 7370 Centre Road, Town of Uxbridge

DRILLING DATE: December 21, 2017

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
318.6	Ground Surface			
0.0	**TOPSOIL/PLOUGHED SOIL**	1	DO	1
317.8 0.8	Brown, compact **SANDY SILT** occ. topsoil inclusion	2	DO	18
317.1 1.5	Brown, loose to compact **SAND** fine to medium grained	3	DO	9
		4	DO	12
315.5 3.1	Very stiff to hard **SILTY CLAY TILL** some sand a trace of gravel	5	DO	20
	brown grey	6	DO	30
		7	DO	40
312.0 6.6	**END OF BOREHOLE**			



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JOB NO.: 1711-S047

LOG OF BOREHOLE NO.: 5

FIGURE NO.: 5

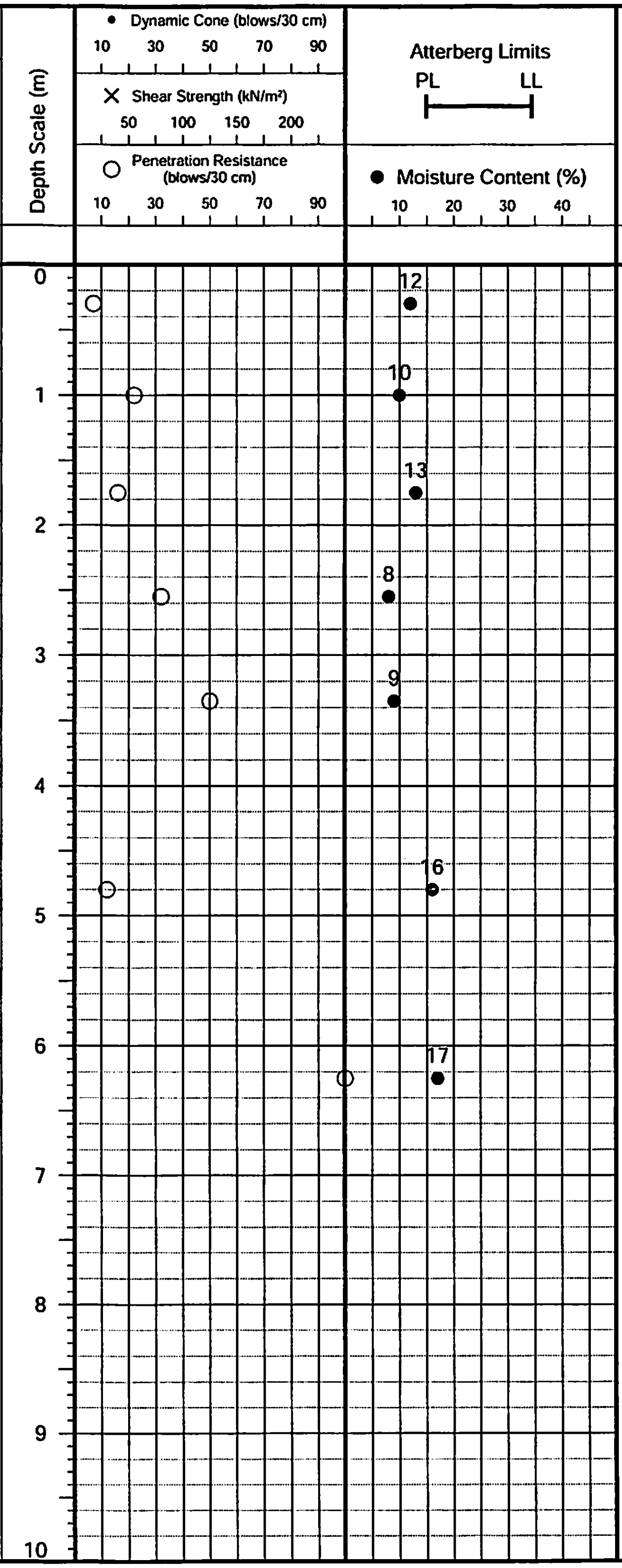
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 7370 Centre Road, Town of Uxbridge

DRILLING DATE: December 21, 2017

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
332.2	Ground Surface			
0.0	**TOPSOIL/PLOUGHED SOIL**	1	DO	7
331.4 0.8	Brown, compact to very dense **SILTY SAND TILL** some clay a trace of gravel	2	DO	22
	sandy silt layer	3	DO	16
		4	DO	32
		5	DO	50
328.2 4.0	Brown, compact to very dense **SAND** fine to medium grained	6	DO	12
		7	DO	50/15
325.8 6.4	**END OF BOREHOLE**			



WATER LEVEL

∇ W.L. @ El. 327.4 m upon completion

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JOB NO.: 1711-S047

LOG OF BOREHOLE NO.: 6

FIGURE NO.: 6

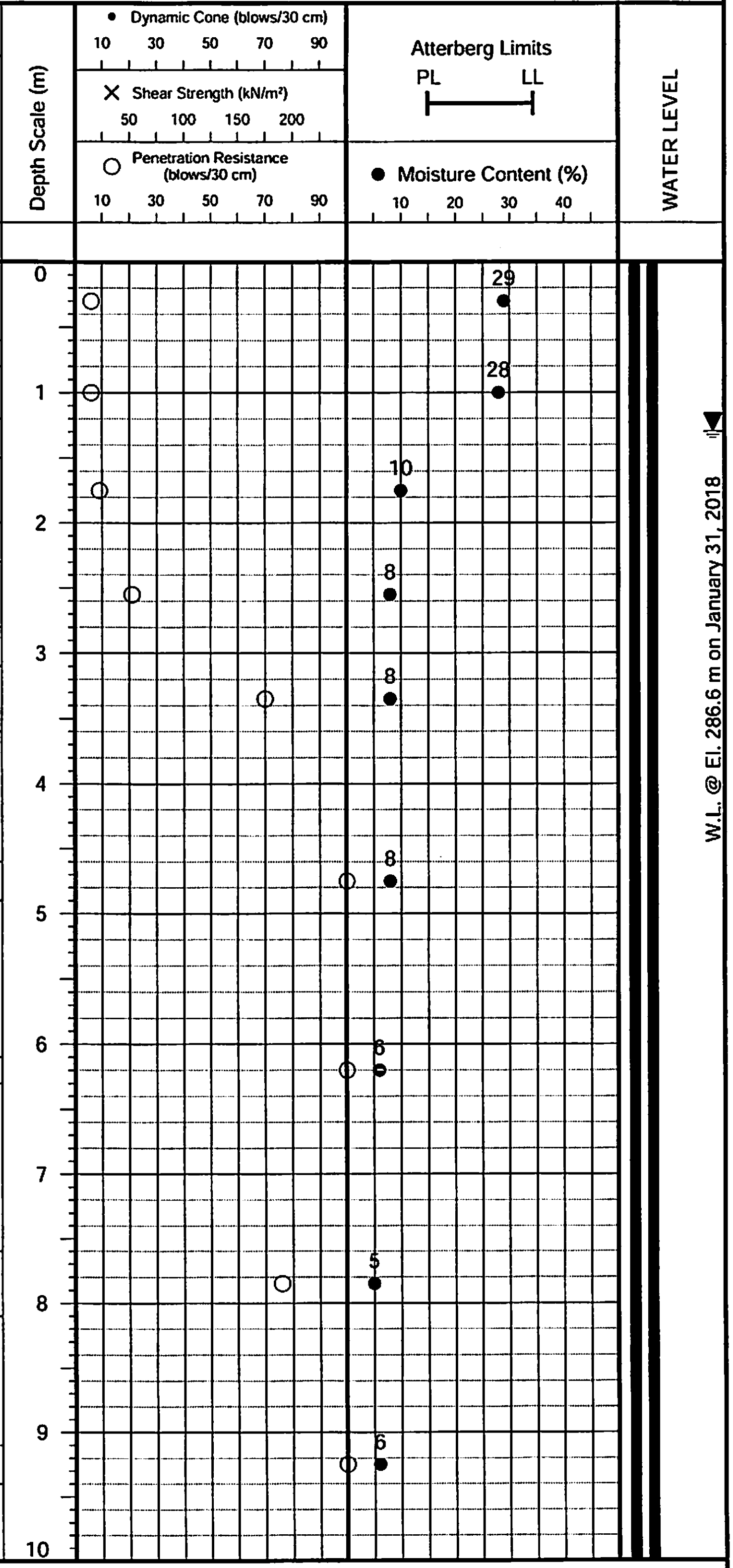
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 7370 Centre Road, Town of Uxbridge

DRILLING DATE: December 12, 2017

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
287.9	Ground Surface			
0.0	**TOPSOIL/PLOUGHED SOIL**	1	DO	6
		2	DO	6
286.4 1.5	Brown, loose to very dense **SILTY SAND TILL** some gravel a trace of clay	3	DO	9
		4	DO	21
	occ. cobbles and boulders	5	DO	70
283.9 4.0	Grey, hard **SILTY CLAY TILL** sandy some gravel occ. cobbles and boulders	6	DO	50/15
		7	DO	50/15
		8	DO	76
		9	DO	50/10
277.9				



Soil Engineers Ltd.

JOB NO.: 1711-S047

LOG OF BOREHOLE NO.: 6

FIGURE NO.: 6

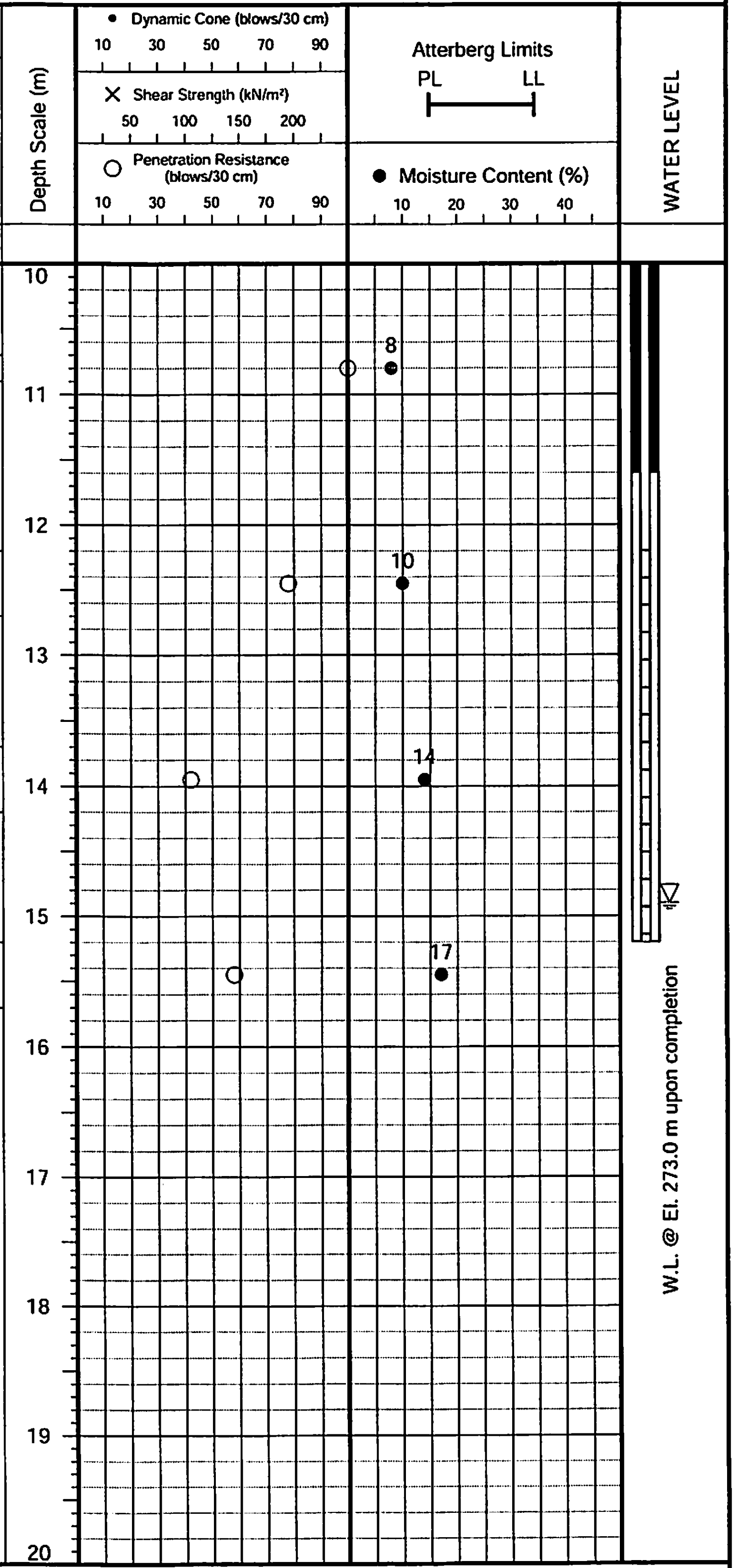
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 7370 Centre Road, Town of Uxbridge

DRILLING DATE: December 12, 2017

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
10.0	Grey, hard **SILTY CLAY TILL** sandy some gravel occ. cobbles and boulders	10	DO	50/15
		11	DO	78
		12	DO	42
		13	DO	58
272.2 15.7	**END OF BOREHOLE**			



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JOB NO.: 1711-S047

LOG OF BOREHOLE NO.: 7

FIGURE NO.: 7

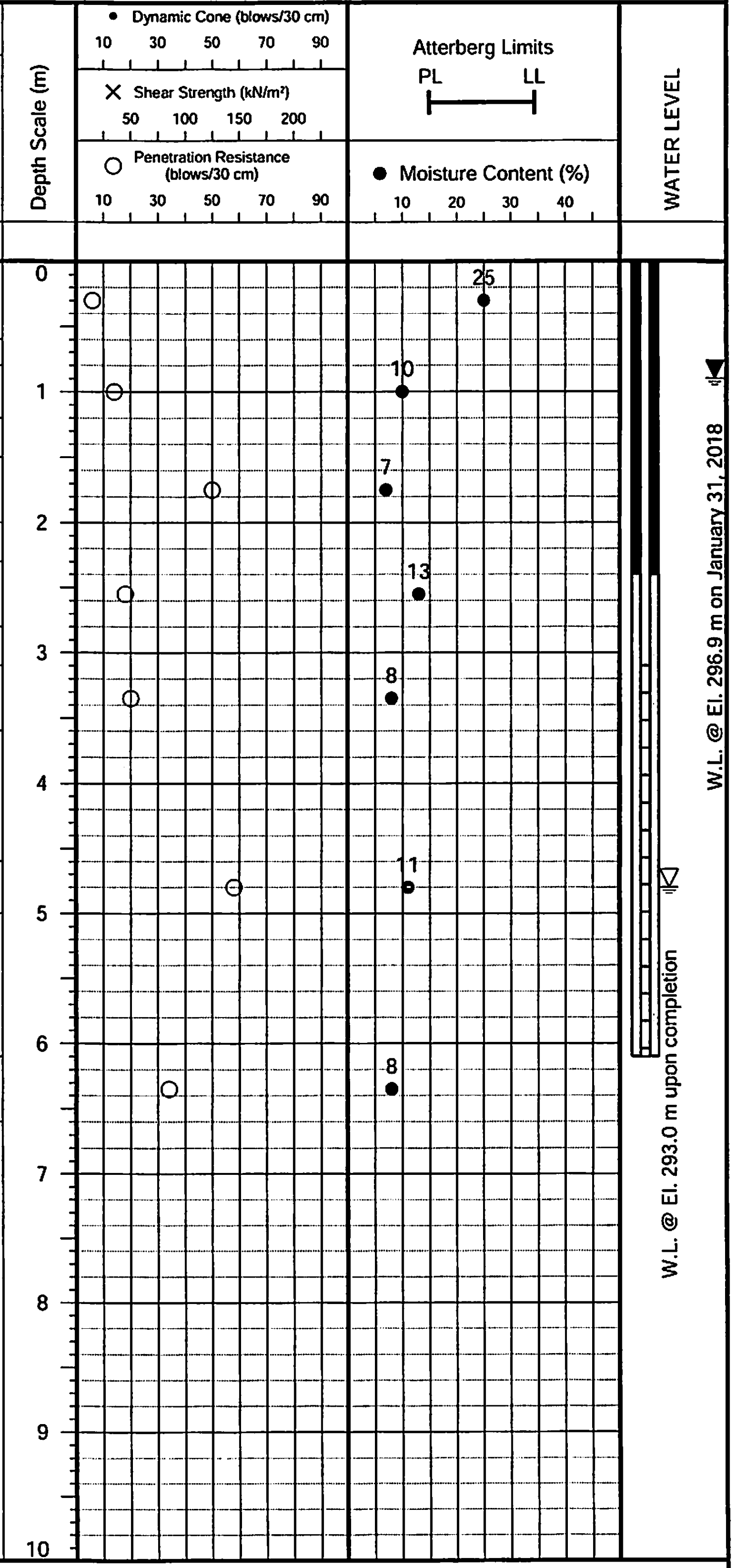
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 7370 Centre Road, Town of Uxbridge

DRILLING DATE: December 15, 2017

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
297.8	Ground Surface			
0.0	**TOPSOIL/PLOUGHED SOIL**	1	DO	6
297.0 0.8	Brown, stiff to hard **SILTY CLAY TILL** sandy some gravel occ. cobbles and sand layer	2	DO	14
		3	DO	50
295.5 2.3	Brown, compact to very dense **SILTY SAND TILL** some gravel a trace of clay	4	DO	18
		5	DO	20
		6	DO	58
		7	DO	34
291.2 6.6	**END OF BOREHOLE**			



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JOB NO.: 1711-S047

LOG OF BOREHOLE NO.: 8

FIGURE NO.: 8

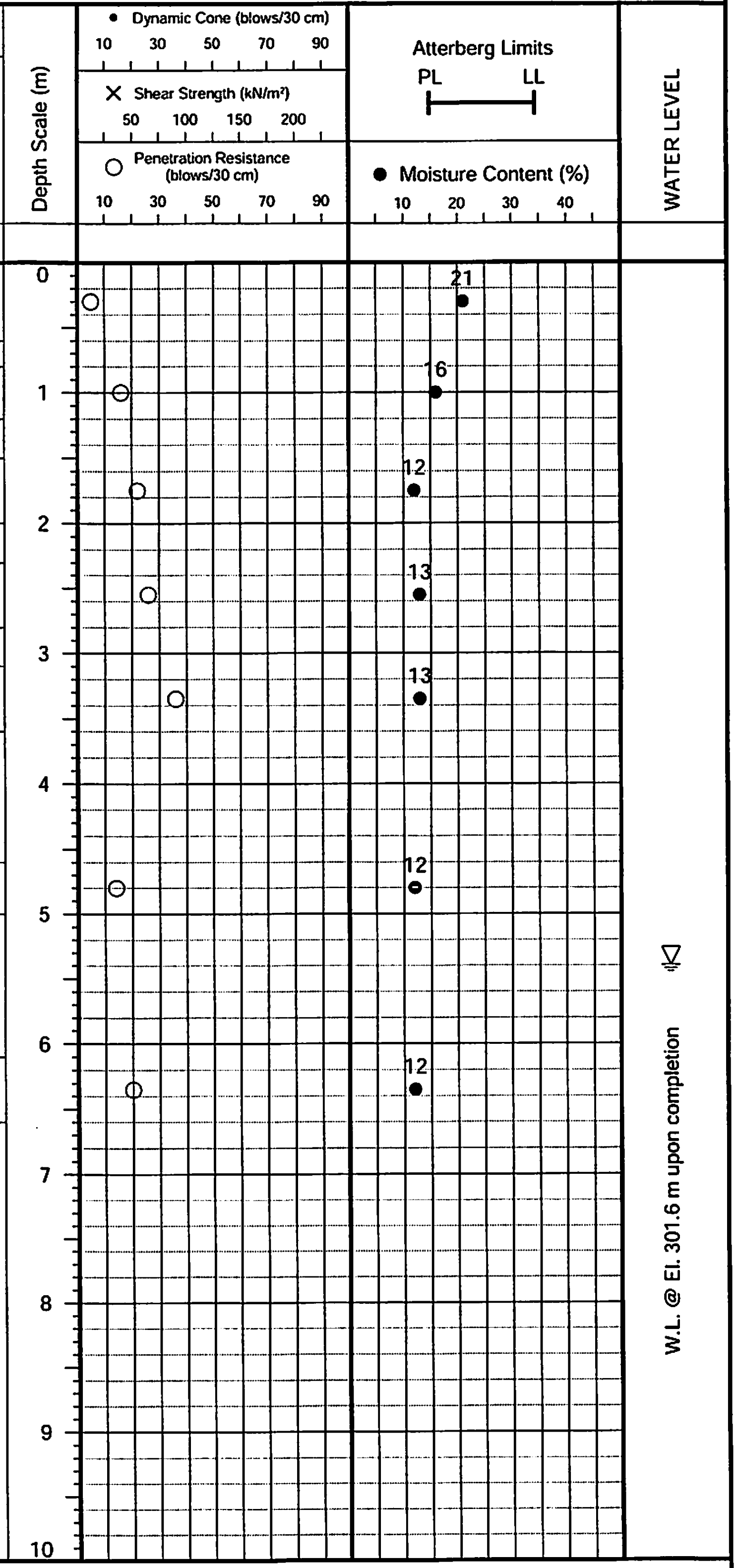
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 7370 Centre Road, Town of Uxbridge

DRILLING DATE: December 15, 2017

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
307.0	Ground Surface			
0.0	**TOPSOIL/PLOUGHED SOIL**	1	DO	5
306.0 1.0	Stiff to hard **SILTY CLAY TILL** sandy a trace of gravel	2	DO	16
		3	DO	22
		4	DO	26
		5	DO	36
	brown grey	6	DO	14
		7	DO	20
300.4 6.6	**END OF BOREHOLE**			



W.L. @ El. 301.6 m upon completion

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JOB NO.: 1711-S047

LOG OF BOREHOLE NO.: 9

FIGURE NO.: 9

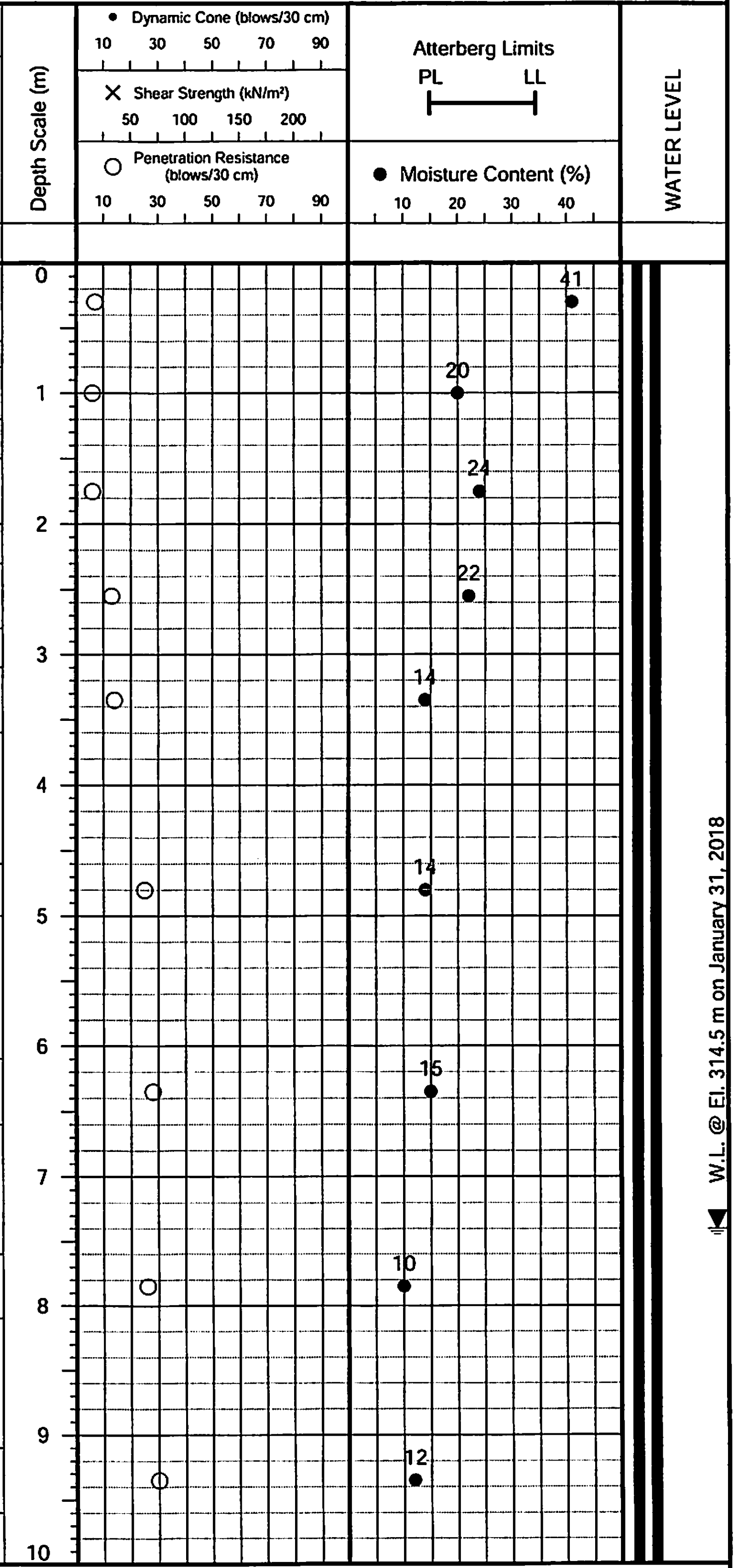
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 7370 Centre Road, Town of Uxbridge

DRILLING DATE: December 20, 2017

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Moisture Content (%)
321.9	Ground Surface				
0.0	**TOPSOIL/PLOUGHED SOIL**	1	DO	7	41
321.3 0.6	Brown, firm to stiff **SILTY CLAY TILL** traces of sand and gravel	2	DO	6	20
	weathered	3	DO	6	24
		4	DO	13	22
318.8 3.1	Stiff to very stiff **SILTY CLAY**	5	DO	14	14
		6	DO	25	14
	brown grey	7	DO	28	15
314.3 7.6	Grey, very stiff to hard **SILTY CLAY TILL** some sand a trace of gravel occ. cobbles and boulders	8	DO	26	10
		9	DO	30	12
311.9					



W.L. @ El. 314.5 m on January 31, 2018

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JOB NO.: 1711-S047

LOG OF BOREHOLE NO.: 9

FIGURE NO.: 9

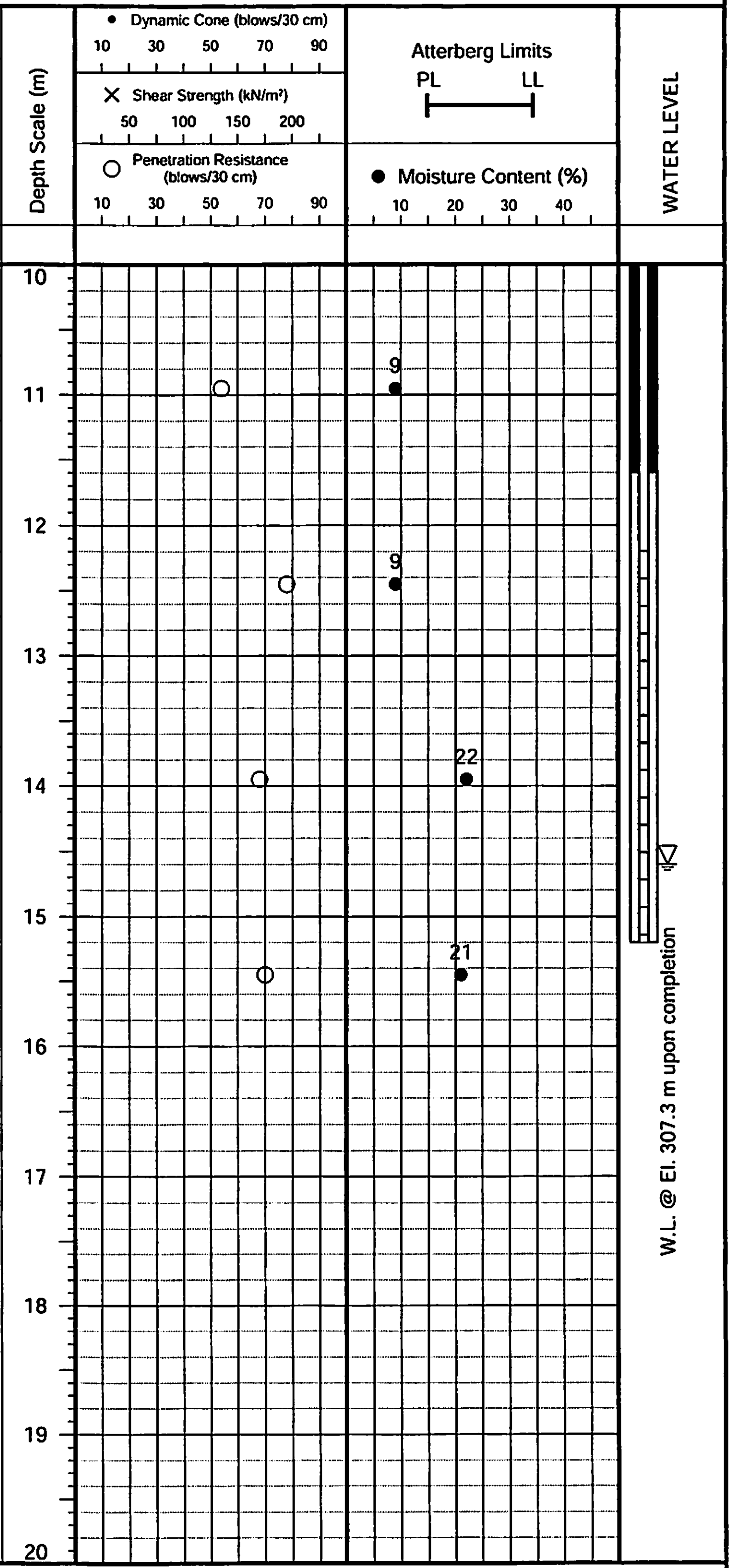
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 7370 Centre Road, Town of Uxbridge

DRILLING DATE: December 20, 2017

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
10.0	Grey, very stiff to hard **SILTY CLAY TILL** some sand a trace of gravel occ. cobbles and boulders	10	DO	54
		11	DO	78
308.9 13.0	Grey, very dense **SILT**	12	DO	68
		13	DO	70
306.2 15.7	**END OF BOREHOLE**			



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JOB NO.: 1711-S047

LOG OF BOREHOLE NO.: 10

FIGURE NO.: 10

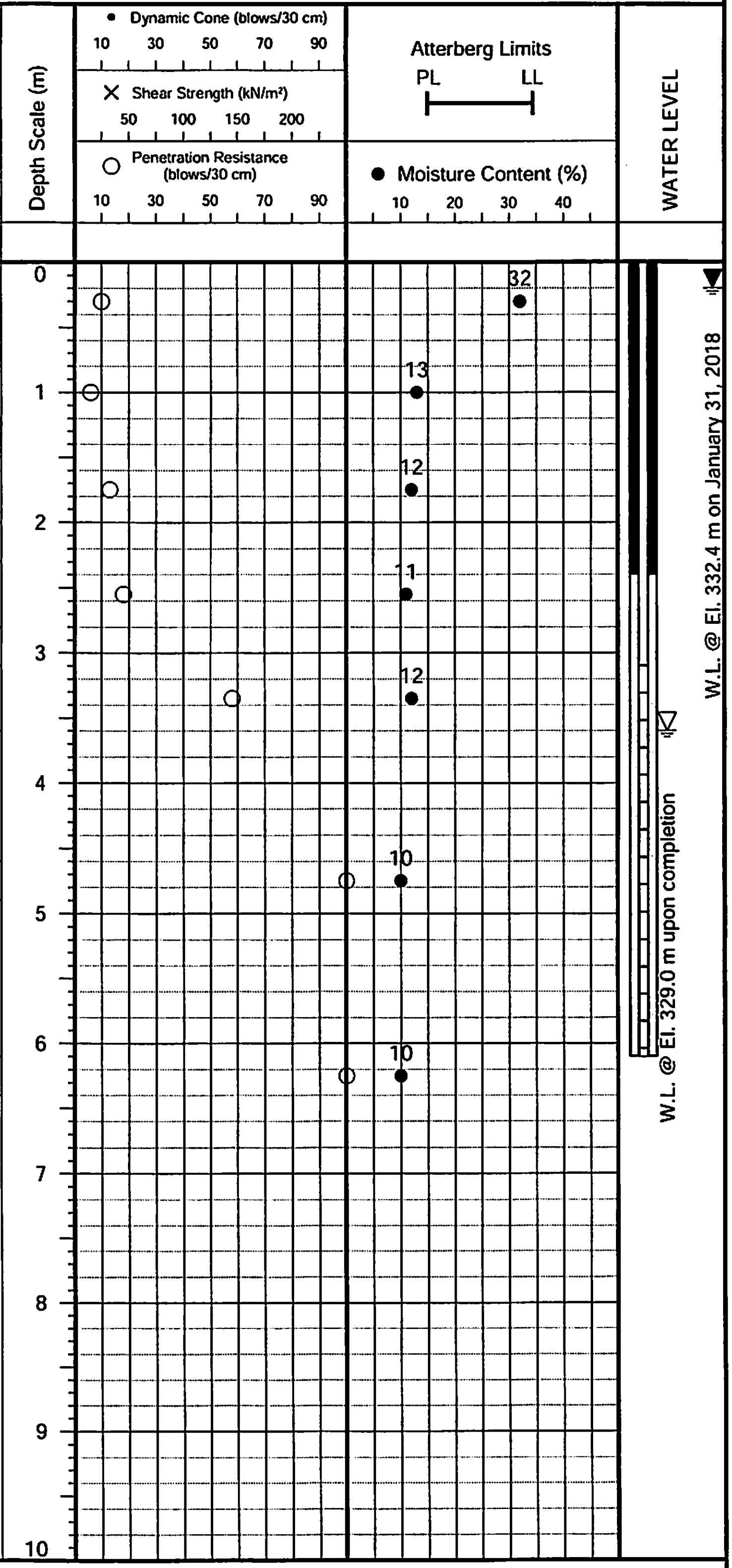
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 7370 Centre Road, Town of Uxbridge

DRILLING DATE: December 21, 2017

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
332.6	Ground Surface			
0.0	**TOPSOIL/PLOUGHED SOIL**	1	DO	10
331.8 0.8	Brown, loose to compact **SILTY SAND TILL** weathered some gravel a trace of clay	2	DO	6
		3	DO	13
330.1 2.5	Hard **SILTY CLAY TILL** some sand a trace of gravel occ. cobbles and boulders	4	DO	18
		5	DO	58
	brown grey	6	DO	50/15
		7	DO	50/15
326.2 6.4	**END OF BOREHOLE**			



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JOB NO.: 1711-S047

LOG OF BOREHOLE NO.: 11

FIGURE NO.: 11

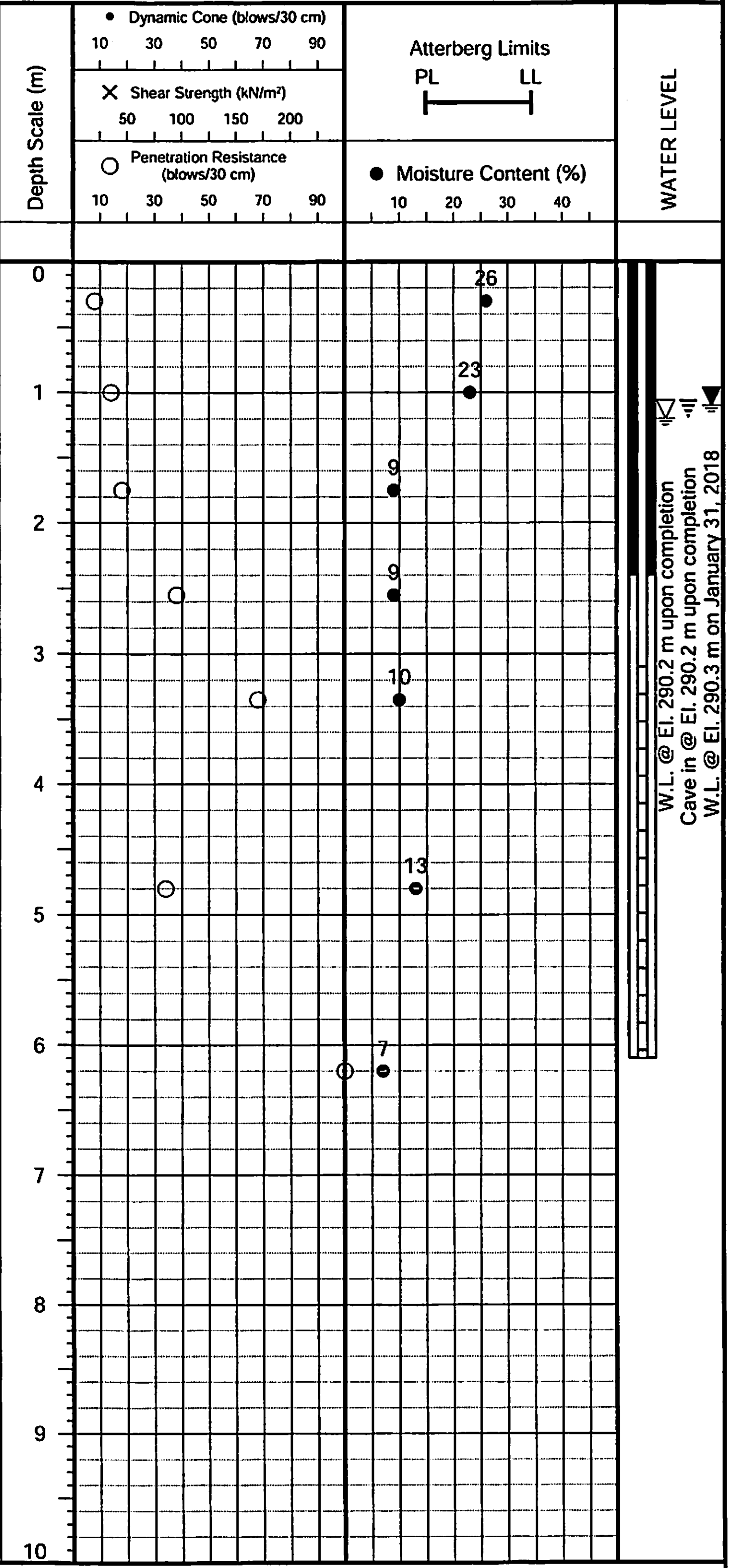
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 7370 Centre Road, Town of Uxbridge

DRILLING DATE: November 27, 2017

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
291.4	Ground Surface			
0.0	**TOPSOIL/PLOUGHED SOIL**	1	DO	8
290.6 0.8	Brown, compact **SILT**	2	DO	14
289.9 1.5	Brown, compact to very dense **SILTY SAND TILL** some gravel a trace of clay occ. cobbles	3	DO	18
		4	DO	38
		5	DO	68
		6	DO	34
		7	DO	50/5
285.1 6.3	**END OF BOREHOLE**			



W.L. @ El. 290.2 m upon completion

Cave in @ El. 290.2 m upon completion

W.L. @ El. 290.3 m on January 31, 2018

Soil Engineers Ltd.

JOB NO.: 1711-S047

LOG OF BOREHOLE NO.: 12

FIGURE NO.: 12

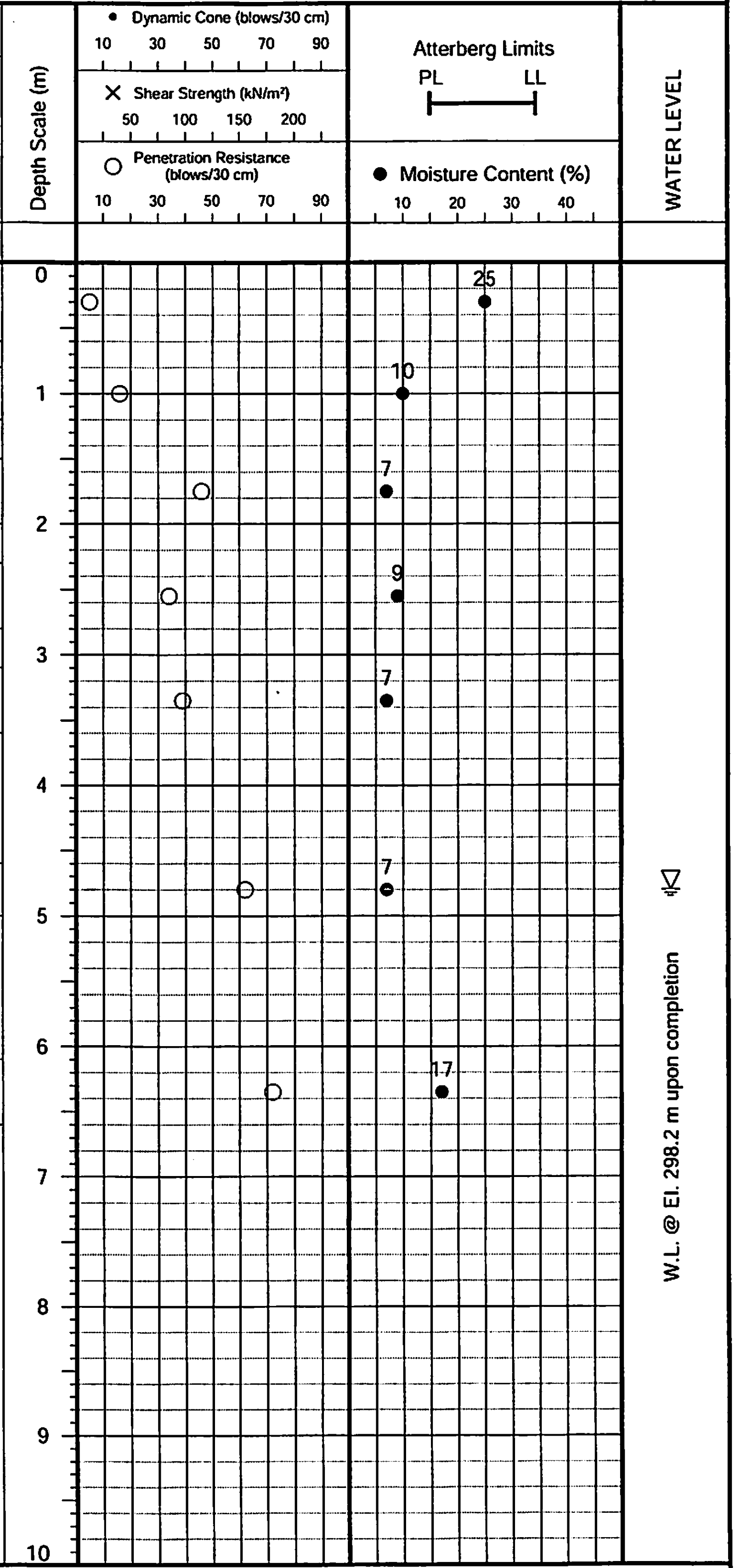
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 7370 Centre Road, Town of Uxbridge

DRILLING DATE: November 27, 2017

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
303.0	Ground Surface			
0.0	**TOPSOIL/PLOUGHED SOIL**	1	DO	5
302.0 1.0	Brown, compact to very dense **SILTY SAND TILL** some gravel a trace of clay occ. cobbles	2	DO	16
		3	DO	46
		4	DO	34
		5	DO	39
		6	DO	62
297.5 5.5	Brown, very dense **SILT**	7	DO	72
296.4 6.6	**END OF BOREHOLE**			



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JOB NO.: 1711-S047

LOG OF BOREHOLE NO.: 13

FIGURE NO.: 13

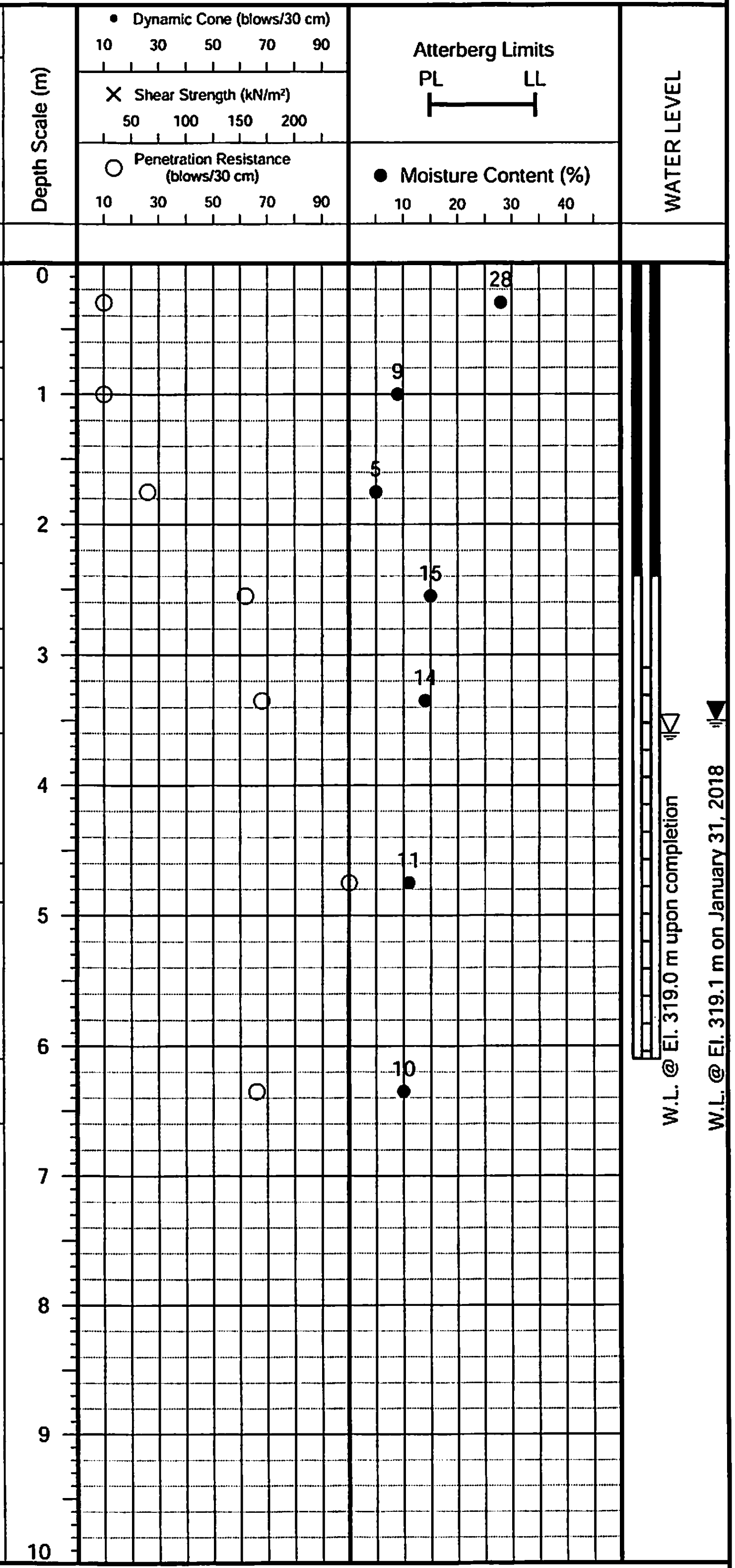
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 7370 Centre Road, Town of Uxbridge

DRILLING DATE: January 15, 2018

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
322.6	Ground Surface			
0.0	**TOPSOIL/PLOUGHED SOIL**	1	DO	10
321.8 0.8	Brown, compact to very dense — — silty **SAND** fine to coarse grained a trace to some silt a trace of gravel	2	DO	10
		3	DO	26
		4	DO	62
		5	DO	68
318.0 4.6	Brown, hard **SILTY CLAY TILL** sandy some gravel — brown/grey	6	DO	50/15
		7	DO	66
316.0 6.6				



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JOB NO.: 1711-S047

LOG OF BOREHOLE NO.: 14

FIGURE NO.: 14

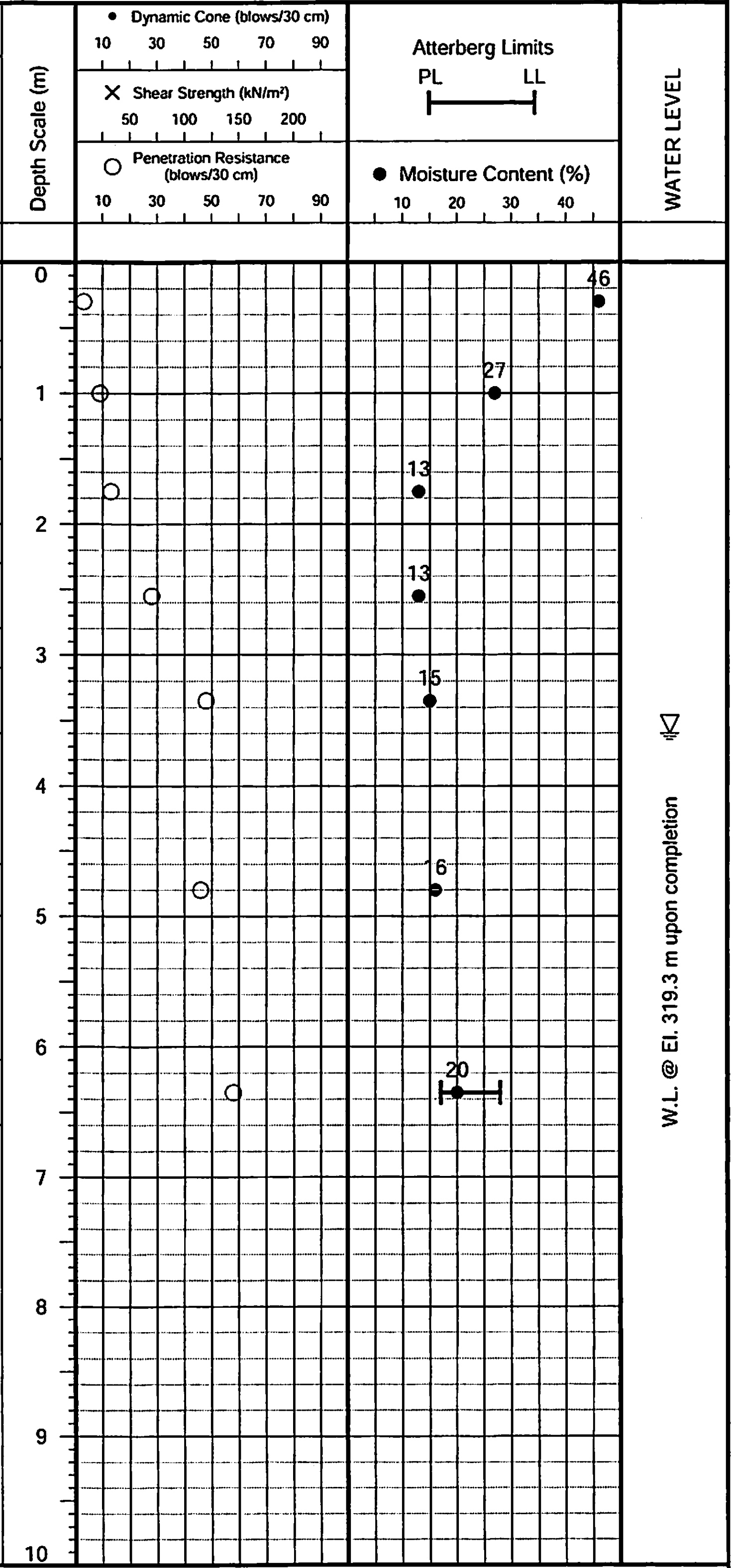
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 7370 Centre Road, Town of Uxbridge

DRILLING DATE: December 21, 2017

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
322.9	Ground Surface			
0.0	**TOPSOIL/PLOUGHED SOIL**	1	DO	3
322.1 0.8	Brown, stiff to very stiff **SILTY CLAY TILL**	2	DO	9
	weathered traces of sand and gravel	3	DO	13
		4	DO	28
319.8 3.1	Hard **SILTY CLAY**	5	DO	48
	brown grey	6	DO	46
316.3		7	DO	58
6.6	**END OF BOREHOLE**			



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JOB NO.: 1711-S047

LOG OF BOREHOLE NO.: 15

FIGURE NO.: 15

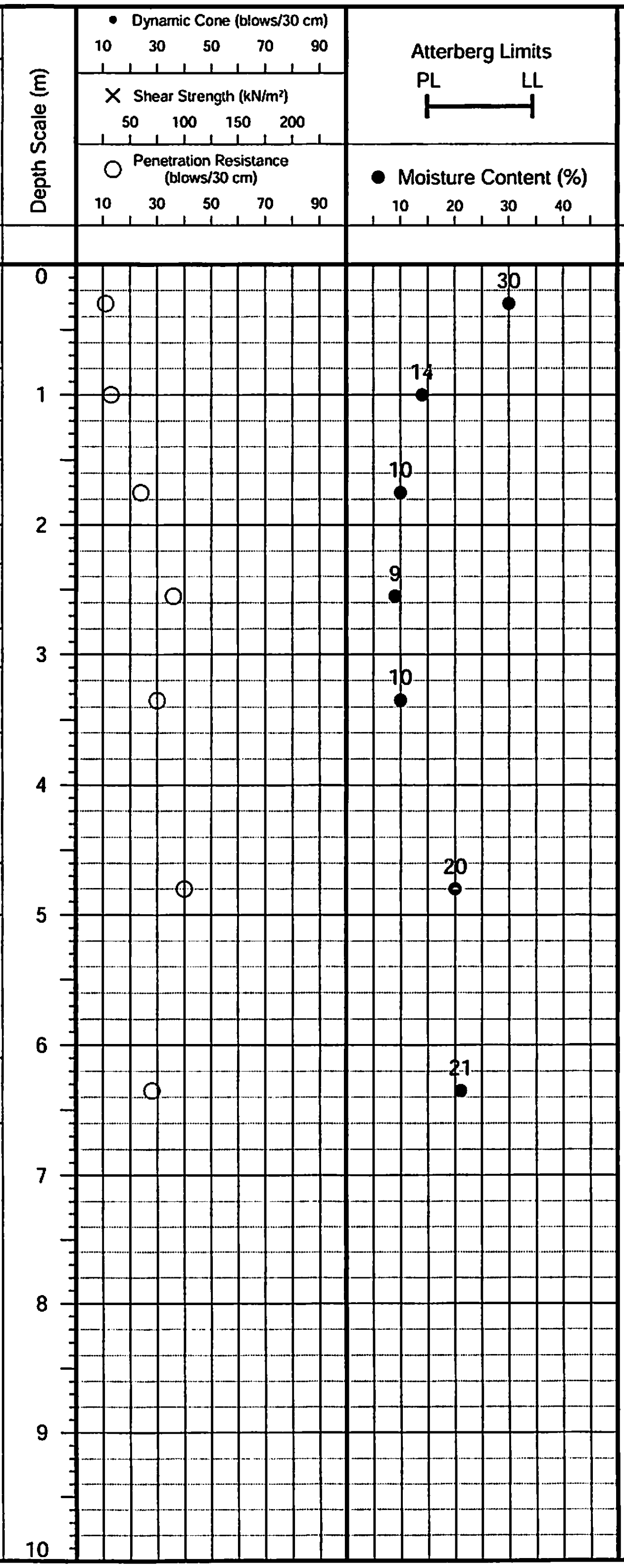
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: 7370 Centre Road, Town of Uxbridge

DRILLING DATE: December 21, 2017

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
333.6	Ground Surface			
0.0	**TOPSOIL/PLOUGHED SOIL**	1	DO	11
332.8 0.8	Brown, stiff to hard **SILTY CLAY TILL** sandy some gravel	2	DO	13
		3	DO	24
		4	DO	36
330.5 3.1	Brown, dense **SANDY SILT** a trace of clay	5	DO	30
329.6 4.0	Brown, compact to dense **SAND** fine grained some silt	6	DO	40
		7	DO	28
327.0 6.6	**END OF BOREHOLE**			



WATER LEVEL

W.L. @ El. 330.9 m upon completion

Cave in @ El. 329.4 m upon completion

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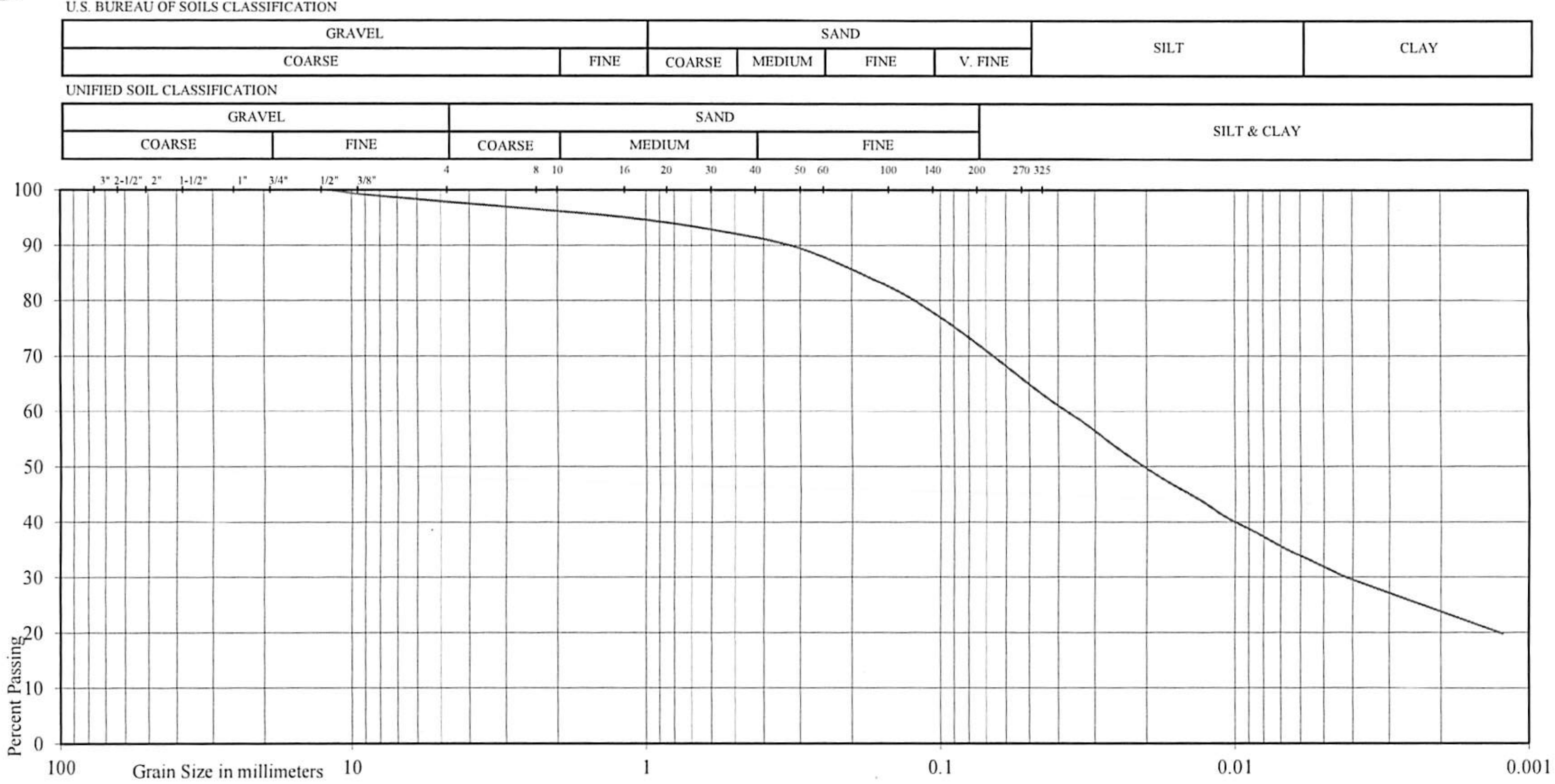
GRAIN SIZE DISTRIBUTION

Reference No: 1711-S047



Project: Proposed Residential Development

Location: 7370 Centre Road, Town of Uxbridge

Liquid Limit (%) = 28

Plastic Limit (%) = 17

Plasticity Index (%) = 11

Moisture Content (%) = 13

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

Borehole No: 3

Sample No: 4

Depth (m): 2.5

Elevation (m): 302.5

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

Figure: 16

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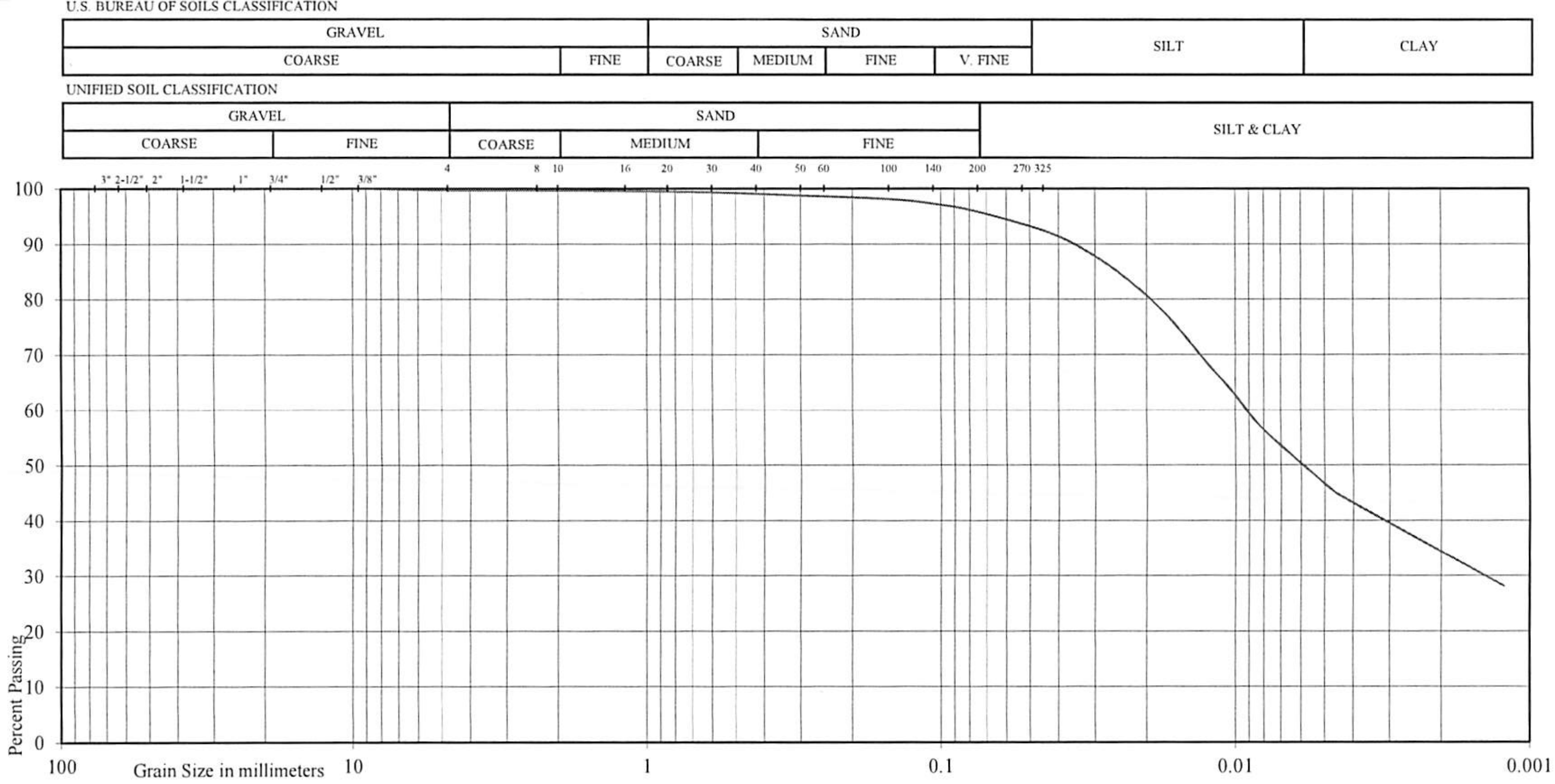
GRAIN SIZE DISTRIBUTION

Reference No: 1711-S047



Project: Proposed Residential Development

Location: 7370 Centre Road, Town of Uxbridge

Borehole No: 14

Sample No: 7

Depth (m): 6.3

Elevation (m): 316.6

Liquid Limit (%) = 35

Plastic Limit (%) = 19

Plasticity Index (%) = 16

Moisture Content (%) = 20

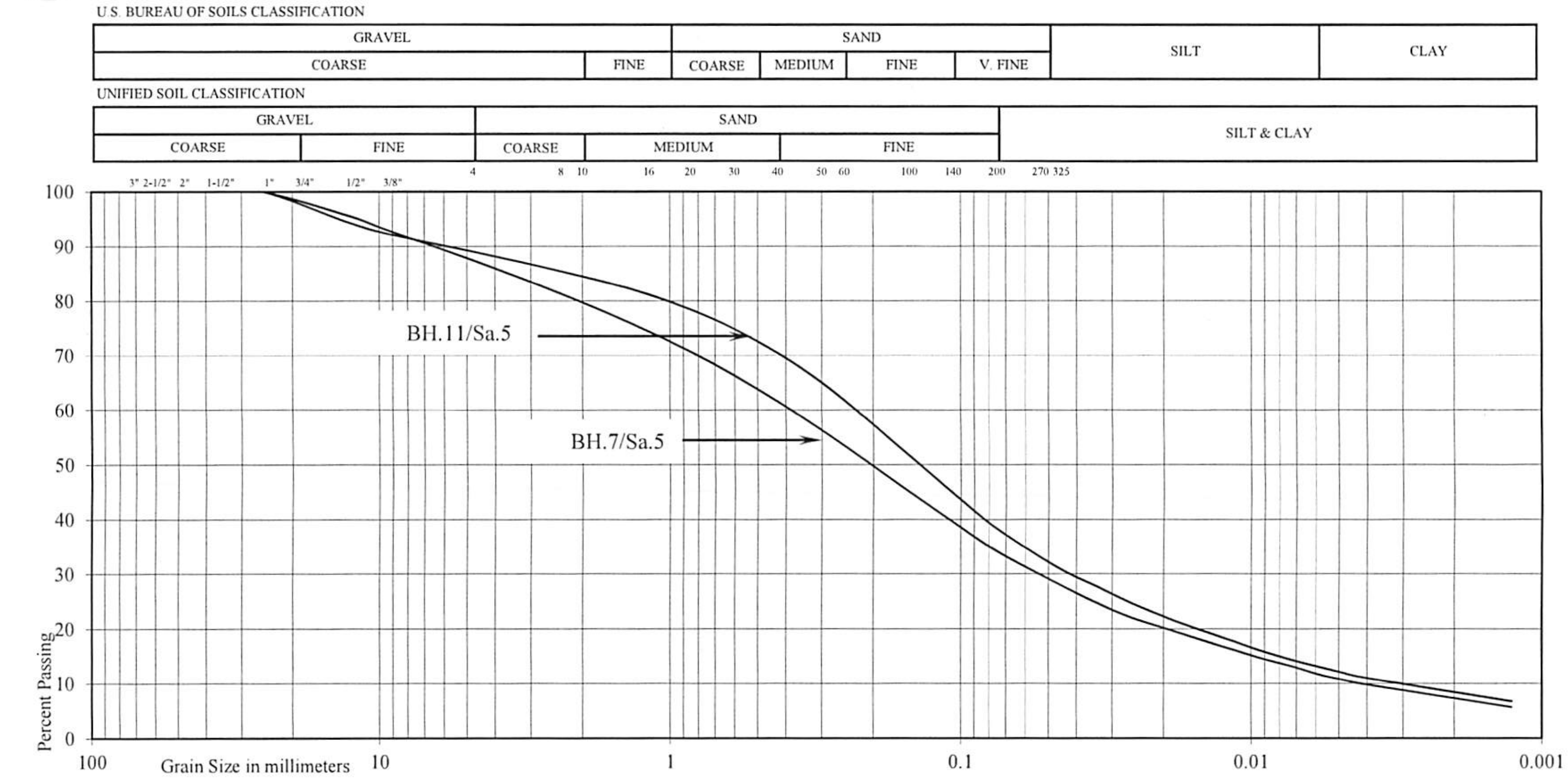
Estimated Permeability (cm./sec.) = 10^{-7}

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

Figure: 17

GRAIN SIZE DISTRIBUTION

Reference No: 1711-S047



Project:	Proposed Residential Development	
Location:	7370 Centre Road, Town of Uxbridge	
Borehole No:	7	11
Sample No:	5	5
Depth (m):	3.3	3.3
Elevation (m):	294.5	288.1

BH./Sa.	7/5	1/5
Liquid Limit (%) =	-	-
Plastic Limit (%) =	-	-
Plasticity Index (%) =	-	-
Moisture Content (%) =	8	10
Estimated Permeability (cm./sec.) =	10^{-5}	10^{-5}

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

Figure: 18

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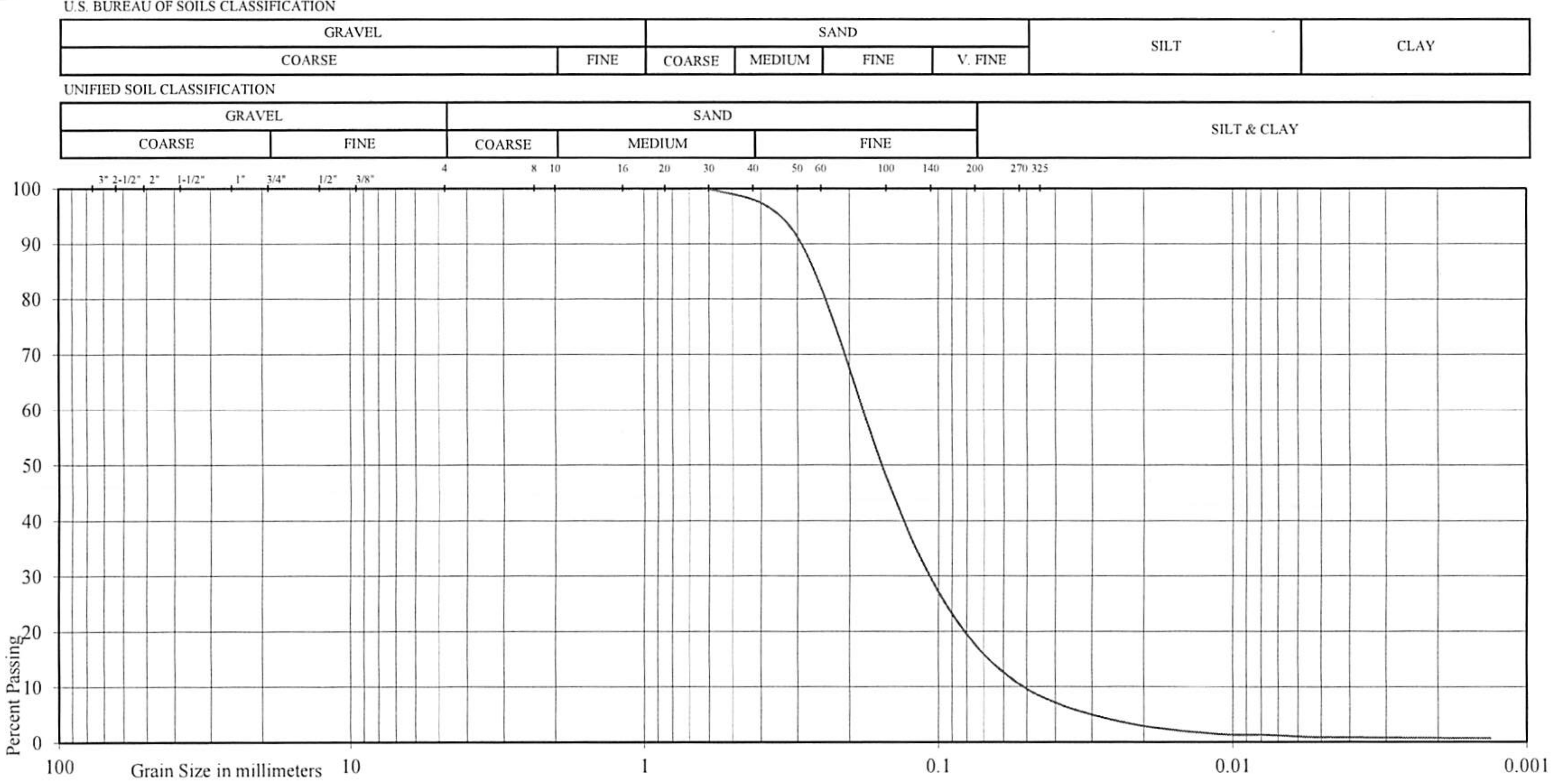
GRAIN SIZE DISTRIBUTION

Reference No: 1711-S047



Project: Proposed Residential Development

Location: 7370 Centre Road, Town of Uxbridge

Borehole No: 15

Sample No: 7

Depth (m): 6.3

Elevation (m): 327.3

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

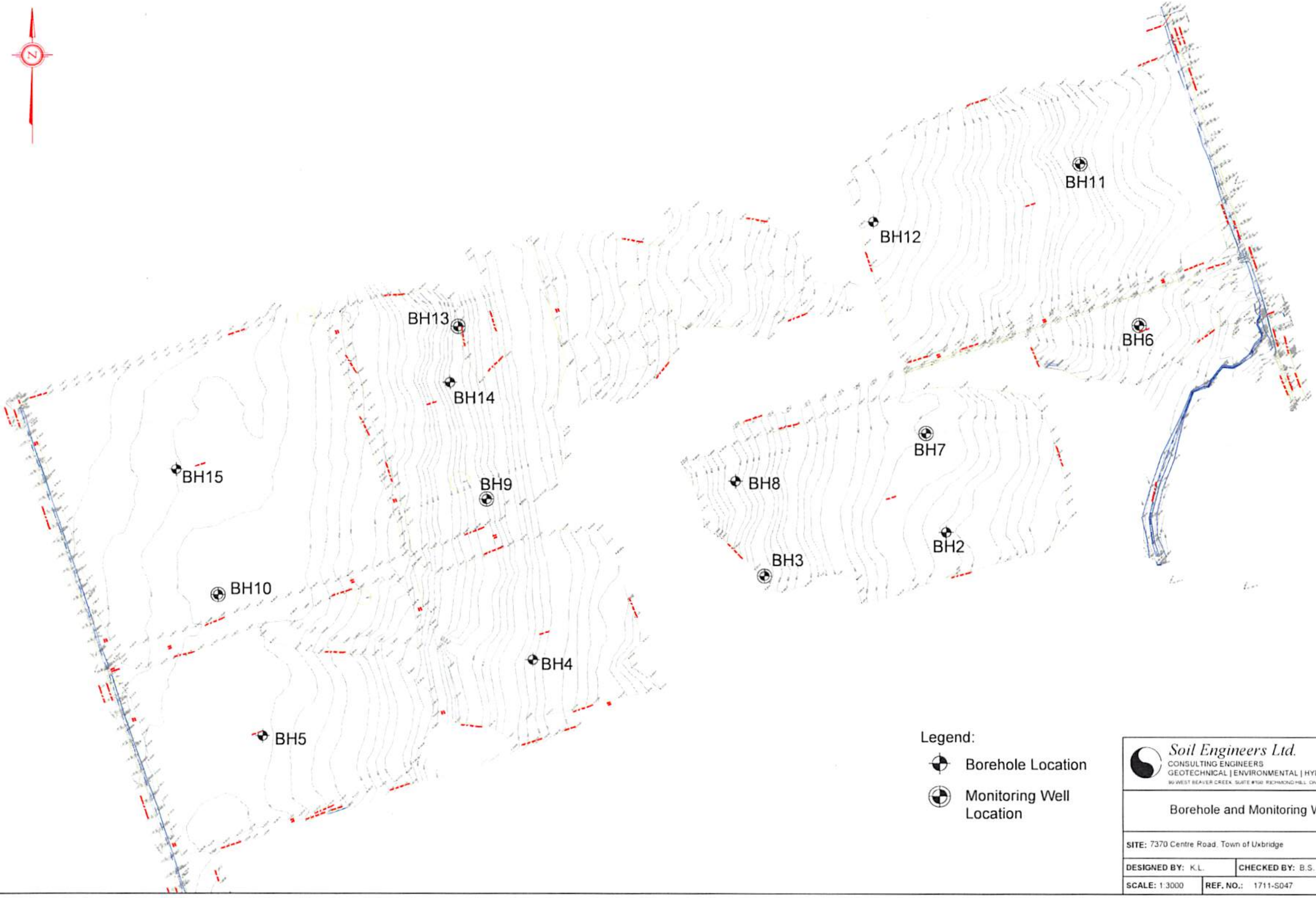
Moisture Content (%) = 21

Estimated Permeability

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

Classification of Sample [& Group Symbol]: FINE SAND, some silt, a trace of clay

Figure: 19



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

Borehole and Monitoring Well Location Plan

SITE: 7370 Centre Road, Town of Uxbridge

DESIGNED BY: K.L.	**CHECKED BY:** B.S.	**DWG NO.:** 1	
SCALE: 1:3000	**REF. NO.:** 1711-S047	**DATE:** February 2018	**REV** -