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A REPORT TO
BEACHCROFT INVESTMENTS INC.

A GEOTECHNICAL INVESTIGATION FOR PROPOSED RESIDENTIAL DEVELOPMENT

63 AND 63A TRAFALGAR ROAD

TOWN OF ERIN

REFERENCE NO. 2206-S054

JANUARY 2024

DISTRIBUTION

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ENCLOSURES

1.0 INTRODUCTION

In accordance with the written authorization dated July 21, 2022, from Ms. Uzo Rossouw of Beachcroft Investments Inc., a geotechnical investigation was carried out at the captioned property at 63 and 63A Trafalgar Road in the Town of Erin.

The purpose of the investigation was to reveal the subsurface conditions and to determine the engineering properties of the disclosed soils for the design and construction of a proposed residential development.

2.0 SITE AND PROJECT DESCRIPTION

The Town of Erin is located in a physiographical region known as Hillsburgh Sandhills where the topography is rough with flat-bottomed swampy valleys running through sandy knolls. Lacustrine sands, silts, reworked till, and glaciolacutrine sediments were deposited on drift and ground moraines which had been partly eroded by the past glaciations.

The subject site is located on the east side of Trafalgar Road and about 500 m north of Wellington 22 in the Town of Erin. At the time of investigation, the site is a farm field, consisting of soy bean crops. The existing site gradient is undulating with a grade difference of more than 10 m.

Based on a conceptual plan provided, it is understood that the site will be re-graded for the development of a residential subdivision, with municipal services and paved roadways meeting urban standards. In addition, there will be reserved blocks for mixed-use areas and stormwater management (SWM) pond in designated areas.

3.0 FIELD WORK

The field work, consisting of eleven (11) sampled boreholes with monitoring wells, extending to a depth of 4.7 to 6.7 m, was completed at the site between November 18 and 25, 2022. 50-mm diameter monitoring wells were installed in the boreholes to facilitate the hydrogeological study, which is presented under a separate cover. The depths and details of the monitoring wells are shown on the Borehole Logs. The borehole and monitoring well locations are shown on Drawing No. 1, enclosed.

The boreholes were advanced at intervals to the sampling depths by a track-mounted machine equipped with solid-stem augers for soil sampling. Split-spoon samples were recovered for soil classification and laboratory testing. Standard Penetration Tests using the procedures described on the enclosed “List of Abbreviations and Terms” were performed at the sampling depths. The relative density of the non-cohesive strata is inferred from the ‘N’ values. The field work was supervised and the findings were recorded by a geotechnical technician.

The ground elevation at the borehole locations was obtained using handheld Global Navigation Satellite System equipment.

4.0 SUBSURFACE CONDITIONS

Beneath the topsoil and ploughed soil layer, the subsoil profile consists of strata of predominantly gravelly sand and fine to medium sand deposits. Sandy silt till and silt deposits were contacted in the lower stratigraphy at various locations.

Detailed descriptions of the encountered subsurface conditions are presented on the enclosed Borehole Logs comprising Figures 1 to 11, inclusive. The revealed stratigraphy is plotted on the Subsurface Profile, Drawing No. 2.

4.1 Topsoil/Ploughed Soil

The thickness of the revealed topsoil is approximately 36 cm with the ploughed soil extending to a depth of 0.5 to 0.9 m below the prevailing ground surface. Thicker topsoil may be encountered in areas beyond the borehole locations, especially in local low-lying areas.

4.2 Gravelly Sand

The gravelly sand deposit was generally contacted beneath the ploughed soil and sand layer in majority of the boreholes. The deposit extends to depths of 3.7 m to its terminated depth of 6.7 m below the prevailing ground surface. It contains some silt. Hard resistance to augering was contacted during borehole drilling, indicating the presence of cobbles and boulders in the deposit. Grain size analysis was performed on a representative gravelly sand sample; the results are plotted on Figure 12.

The obtained ‘N’ values range from 22 to more than 100 blows, with a median of 60 blows per 30 cm penetration, indicating that the relative density of the gravelly sand is compact to very dense, being generally very dense.

The water content values of the sand range from 2% to 12%, with a median of 4%, indicating that the gravelly sand is dry to wet, generally in a dry condition. Sample examination revealed that the wet gravelly sand was generally contacted in the lower stratigraphy and likely water bearing.

The engineering properties of the gravelly sand are listed below:

- Low to medium frost susceptibility, depending on the silt content.
- Moderate to high water erodibility.
- In excavation, the gravelly sand will slough to its angle of repose.

4.3 Sand

The sand deposit was contacted beneath the ploughed soil in majority of the boreholes. The deposit extends to depths of 1.0 m to its terminated depth of 6.6 m below the prevailing ground surface. It is fine to medium grained with some silt and gravel. Grain size analysis was performed on a representative sand sample; the result is plotted on Figure 13.

The obtained 'N' values range from 3 to more than 100 blows, with a median of 21 blows per 30 cm penetration, indicating that the relative density of the sand is very loose to very dense, being generally compact. The very loose to loose sand is generally restricted near the interface between the ploughed soil and native sand, where the soil has been disturbed by farming activities and/or has been weakened by the weathering process.

The water content values of the sand range from 2% to 15%, with a median of 6%, indicating that the sand is dry to wet, generally in a moist condition. The higher water content values is generally restricted near the interface between the ploughed soil and native sand, where the soil may have been contaminated with pockets of topsoil indicating unusually higher water content values.

The engineering properties of the sand are listed below:

- Low to medium frost susceptibility, depending on the silt content.
- High water erodibility; its fine particles are susceptible to migration through small openings, particularly under seepage pressure.
- In excavation, the sand will slough readily, run with seepage and boil under a piezometric head of 0.3 m.

4.4 **Sandy Silt Till** and **Silty Sand Till**

The sandy silt till and silty sand till deposits were contacted in the lower stratigraphy in the boreholes at various locations. The till is cemented with a trace of clay and contains some gravel to being gravelly. Hard resistance to augering was contacted during borehole drilling, indicating the presence of cobbles and boulders in the till mantle.

The obtained 'N' values range from 35 to 66 blows, with a median of 40 blows per 30 cm penetration, indicating that the relative density of the tills are dense to very dense, being generally dense.

The natural water content values of the till range from 6% to 8%, indicating that the tills are generally in moist conditions.

The engineering properties of the tills are listed below:

- High frost susceptibility and moderately low water erodibility.
- The till will be relatively stable in steep excavation; however, the till may slough after prolonged exposure.

4.5 **Silt**

The silt deposit was generally contacted beneath the gravelly sand and fine to medium sand deposits. The silt is fine grained with occasional clay layers.

The obtained 'N' values are 38 and 100 blows, with a median of 47 blows per 30 cm penetration, indicating that the relative density of the silt is dense to very dense, being generally dense.

The natural water content values of the silt are 19% to 25%, indicating generally wet conditions and likely water bearing.

The engineering properties of the silt are listed below:

- High frost susceptibility, with high soil-adfreezing potential.
- High water erodibility; they are susceptible to migration through small openings, particularly under seepage pressure.
- The shear strength is derived from internal friction and is soil 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 silts will slowly slump, run with groundwater seepage, and boil under a piezometric head of 0.4 m.

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 +
Gravelly Sand	2 to 12 (median 4)	6	4 to 8
Sand (Fine to Medium)	2 to 15 (median 6)	8	6 to 10
Sandy Silt Till/ Silty Sand Till	6 to 8 (median 8)	10	8 to 12
Silt	19 to 25(median 21)	15	12 t o18

The above values show that the on-site soils are generally suitable for compaction. The addition of water may be required prior to structural compaction for the gravelly sand and fine to medium sand, particularly in the dry, warm weather and in areas where compaction is best performed on the wet side of the optimum. The wet gravelly sand, fine to medium sand and silt can be stockpiled to drain the excess water prior to structural compaction.

The lifts for compaction should be limited to 20 cm, or to a suitable thickness assessed by test strips performed by the compaction equipment. Boulders larger than 15cm in size must be sorted and removed from the backfill.

5.0 GROUNDWATER CONDITIONS

All boreholes were checked for the presence of groundwater upon completion of borehole drilling. Groundwater was recorded in Boreholes 3 and 5 at a depth of 5.5 m below grade or at El. 428.4 m and 428.7 m, respectively. The remaining boreholes were dry on completion.

Detailed groundwater condition with in the investigated area will be discussed in the hydrogeological report, under separate cover.

6.0 DISCUSSION AND RECOMMENDATIONS

Beneath the topsoil and ploughed soil layer, the subsoil profile consists of strata of predominantly gravelly sand and fine to medium sand deposits. Sandy silt till and silt deposits were contacted in the lower stratigraphy at various locations.

Groundwater was recorded in Boreholes 3 and 5 at a depth of 5.5 m below grade or at El. 428.4 m and 428.7 m, respectively, on completion. The remaining boreholes were dry.

Based on a conceptual plan provided, it is understood that the site will be re-graded for the development of a residential subdivision, with municipal services and paved roadways meeting urban standards. In addition, there will be reserved blocks for mixed-use areas and SWM pond in designated areas. The following geotechnical considerations warrant special attention:

1. The topsoil and ploughed soil must be removed for development; it can be reused for general landscaping purposes only.
2. The weathered soil should be inspected prior to any placement of earth fill for site grading purpose. The weathered soil should be subexcavated, sorted free of any organic, topsoil, and/or other deleterious material, before reusing for structural backfill.
3. Where cut and fill is required for the development, the earth fill should be constructed in an engineered manner for foundations, underground services and pavement construction.
4. The proposed structures can be supported on conventional spread and strip footings, founded on engineered fill or sound native soils. The foundation subgrade must be inspected to assess its suitability for bearing the designed foundations.
5. Any basement structure should be damp-proofed and provided with a perimeter subdrain system at wall base, connecting to a positive outlet.
6. A Class ‘B’ bedding, consisting of compacted 19-mm Crusher-Run Limestone (CRL), is recommended for the construction of underground services. Where services installation extends into the saturated soils, or where dewatering is required, a Class ‘A’ concrete bedding should be considered for pipe support.

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, and the assessment given herein is general in nature based on the borehole findings. Should this become apparent during construction, a geotechnical engineer must be consulted to determine whether the following recommendations require revision.

6.1 Site Preparation

The topsoil and vegetation at the ground surface must be removed for development. Where additional fill is required for site grading, the earth fill can be placed in an engineered manner for conventional footing construction, site services support and road construction. The engineering requirements for a certifiable fill are presented below:

1. All the existing topsoil must be removed, and the subgrade must be inspected and proof-rolled prior to any fill placement. Badly weathered/ploughed soils should be subexcavated, sorted free of topsoil inclusions and deleterious materials, if any, aerated and properly compacted in layers.
2. Inorganic soils must be used for engineered fill construction. They must be uniformly compacted in 20 cm thick lifts to at least 98% Standard Proctor dry density (SPDD) up to the proposed finished grade with their moisture properly controlled near the optimum. If the foundations are to be built soon after the fill placement, the densification process for the engineered fill must be increased to 100% SPDD.
3. If the engineered fill is compacted with the moisture content on the wet side of the optimum, the underground services and pavement construction should not begin until the pore pressure within the fill mantle has completely dissipated. This must be further assessed at the time of the engineered fill construction.
4. If imported fill is to be used, it 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 it is hauled to the site.
5. The engineered fill must extend over the entire graded area; the engineered fill envelope and finished elevations must be clearly and accurately defined in the field, and they must be precisely documented by qualified surveyors.
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. Placement of engineered fill and backfill material shall be free of any frozen material.
7. Where the ground is wet due to subsurface water seepage, an appropriate subdrain scheme must be implemented prior to the fill placement.
8. Where the fill is to be placed on sloping ground steeper than 1 vertical (V): 3 horizontal (H), the face of the sloping ground must be benched or flattened to 3+ so

that it is suitable for safe operation of the compactor and the required compaction can be obtained.

9. The fill operation must be inspected on a full-time basis by a technician under the direction of a geotechnical engineer.
10. 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.
11. Any excavation carried out in certified engineered fill must be reported to the geotechnical consultant who supervised the fill placement in order to document the locations of the excavation and/or to supervise reinstatement of the excavated areas to engineered fill status. If construction on the engineered fill does not commence within a period of 2 years from the date of certification, the condition of the engineered fill must be assessed for re-certification.
12. Despite stringent control in the placement of the engineered fill, variations in soil type and density may occur in the engineered fill. Therefore, the foundations constructed fully or partially on the engineered fill should be reinforced and designed by a structural engineer.
13. In sewer construction, the engineered fill is considered to have the same structural proficiency as a natural inorganic soil.

6.2 **Foundation**

At the time of report preparation, detailed design of the development is not available for review: Based on the borehole information, the following bearing pressures are recommended for structures supported on conventional strip and spread footings founded onto engineered fill or sound native soils:

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

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

The footing subgrade must be inspected by a geotechnical engineer, or a senior geotechnical technician, under the supervision of a geotechnical engineer, to ensure that the revealed conditions are compatible with the design of the foundation.

Footings exposed to weathering, or in unheated areas, should have at least 1.4 m of earth cover for protection against frost action.

Where the footing excavation consists of wet soils or the footing subgrade is saturated, a concrete mud-slab of lean mix concrete should be poured immediately after subgrade preparation and inspection to prevent construction disturbance and costly rectification of the bearing subsoil.

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

6.3 **Basement and Structure**

The perimeter walls of the basement should be designed to sustain a lateral earth pressure calculated using the soil parameters stated in Section 6.8. Any applicable surcharge loads adjacent to the basement must also be considered in the wall design.

In conventional design, the perimeter walls of the basement structure should be provided with drainage board and subdrain system at the wall base as illustrated in Drawing No. 3. The subdrains should be encased in fabric filter to protect them against blockage by silting and discharge into the municipal sewer.

The basement subgrade and should consist of sound native soil or properly compacted inorganic earth fill. The subgrade should be proof-rolled and inspected. Any weak or wet subgrade identified must be properly rectified prior to the placement of the granular base. The concrete slab should be constructed on a granular base, at least 15 cm thick, consisting of 19-mm Crusher-Run Limestone (CRL) or equivalent, compacted to 100% SPDD.

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

6.4 **Underground Services**

The subgrade for underground services should consist of sound native soils or engineered fill. Where earth fill, badly weathered or soft/loose soil is encountered, it should be subexcavated and replaced with the bedding material, compacted to at least 98% SPDD.

A Class ‘B’ bedding, consisting of compacted 19-mm CRL or equivalent, is recommended for the construction of the underground services within the glacial tills and clay. In areas where water bearing soils are encountered or where dewatering is necessary, a Class ‘A’ bedding should be used.

The pipe joints connecting to manholes and catch basins must be leak-proofed, or the joints must be wrapped with a waterproof membrane. This is to prevent the migration of fine particles due to leakage, leading to a loss of subgrade support and subsequent sewer collapse. Any opening to subdrains and catch basins should be shielded by a fabric filter to prevent blockage by silting.

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

The on-site soil is corrosive to ductile iron pipes and metal fittings; therefore, they should be protected against soil corrosion. For estimation for the anode weight requirements, the electrical resistivities of the disclosed soils can be used. The proposed anode weight must meet the minimum requirements as specified by the Town standard.

6.5 Backfilling Trenches and Excavated Areas

The on-site inorganic soils are mostly suitable for trench backfill. The soils used for backfilling must be sorted free of organics and/or oversized rock and boulders (over 15 cm in size). The backfill should be compacted in 20 cm layers, or the lift thickness should be determined by test strips, to at least 95% SPDD. In the zone within 1.0 m below the pavement subgrade, the material should be compacted to at least 98% SPDD with the water content at 2% to 3% drier than the optimum. This is to provide the required stiffness for floor and pavement construction.

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

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

- When construction is carried out in freezing winter weather, allowance should be made for these following conditions. Despite stringent backfill monitoring, frozen soil layers may inadvertently be mixed with the structural trench backfill. Should the in-situ soils have a water content on the dry side of the optimum, it would be impossible to wet the soils due to the freezing condition, rendering difficulties in obtaining uniform and proper compaction. 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 the winter months, prolonged exposure of the trench walls will result in frost heave within the soil mantle of the walls. This may result in some settlement as the frost recedes, and repair costs will be incurred prior to 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% SPDD, with the moisture content on the wet side of the optimum.
- It is often difficult to achieve uniform compaction of the backfill in the lower vertical section of a trench which is an open cut or is stabilized by a trench box, particularly in the sector close to the trench walls or the sides of the box. These sectors must be backfilled with sand. In a trench stabilized by a trench box, the void left after the removal of the box will be filled by the backfill. It is necessary to backfill this sector with sand, and the compacted backfill must be flooded for 1 day, prior to the placement of the backfill above this sector, i.e., in the upper sloped trench section. This measure is necessary in order to prevent consolidation of inadvertent voids and loose backfill which will compromise the compaction of the backfill in the upper section.
- In areas where groundwater movement is expected in the sand fill mantle, anti-seepage collars should be provided.

6.6 **Pavement Design**

The recommended pavement design for residential local and collector roads is provided in Table 2.

Table 2 - Pavement Design

Course	Thickness (mm)	OPS Specifications
Asphalt Surface	40	HL3
Asphalt Binder		HL8
Local Residential	50	
Collector Residential	60	
Granular Base	150	Granular ‘A’ or equivalent
Granular Sub-base		Granular ‘B’ or equivalent
Local Residential	300	
Collector Residential	400	

After fine grading, the pavement subgrade should be inspected and proof-rolled. Any soft spots as identified should be subexcavated and replaced with selected on-site material, free of organics, compacted to 98% SPDD, with the water content at 2% to 3% drier than the optimum. All the granular bases should be compacted to 100% SPDD.

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

- If the pavement construction does not immediately follow the trench backfilling, the subgrade should be properly crowned and smooth-rolled to allow interim precipitation to be properly drained.
- Lot areas adjacent to the pavement should be properly graded to prevent ponding of large amounts of water. Otherwise, the water will seep into the subgrade mantle and induce a regression of the subgrade strength with costly consequences for the pavement construction.
- Fabric filter-encased curb subdrains should be provided on both sides of roadways, as required by the Town.
- If the pavement is to be constructed during wet seasons and extensively soft subgrade occurs, the granular sub-base should be thickened in order to compensate for the inadequate strength of the subgrade. This can be assessed during construction.

6.7 Stormwater Management Ponds

The proposed development will include two (2) SWM ponds at the northwest and southwest portion of the site (Blocks 425 and 426). Detailed design of the ponds was not available at the time of report preparation; however, it is understood that they will be used for water retention purpose.

Pond Liner

Based on the borehole findings in the vicinity of the SWM ponds (Boreholes 4 and 8), the subsoil consists of predominantly pervious sand deposits having estimated coefficients of permeability of 10^{-1} to 10^{-3} cm/sec. In Borehole 4, a silty sand till deposit was contacted in the lower stratigraphy, having an estimated coefficient of permeability ranging from 10^{-5} to 10^{-6} cm/sec.

Given the pervious soil within the vicinity of the ponds, a clay liner will be required for water retention purpose. The clay liner should be constructed with inorganic soil, composing of at least 30% clay content, compacted to 98% SPDD in lift of no more than 20 cm thick. The liner thickness should be further evaluated once the SWM pond designs are available for review.

Where the source of clay is not available, geosynthetic clay liner (GCL) should be considered. A ballast, having the same thickness as the clay liner should be used to secure the GCL in place. The construction of the GCL and the ballast should be carried out in accordance with the manufacturer’s specifications.

Earth Berm Construction

Where earth berm is proposed around the SWM ponds, any topsoil and vegetation must be removed prior to construction. The subgrade must be proof-rolled before placement of earth fill for the berm. Selected on site material, free organics, can used for the berm compacted to 98% SPDD in 20 cm layers. The side slope gradient flatter than 4H:1V is considered geotechnically stable, with clay liner. The side slopes must be vegetated and/or sodded to prevent surface erosion.

Control Structures

Where inlet, outlet and control structures are proposed, they should be designed according to the recommendations in Sections 6.1 and 6.2. In addition, the inlet and outlet should be lined with gabion stone or rip-rap for erosion protection from scouring.

6.8 Soil Parameters

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

Table 3 - Soil Parameters

Unit Weight and Bulk Factor	**Unit Weight (kN/m^3)**		**Estimated Bulk Factor**	
	Bulk	**Submerged**	**Loose**	**Compacted**
Sand	20.0	10.0	1.20	1.00
Gravelly Sand	21.5	11.5	1.20	1.00
Sandy Silt Till/Silty Sand Till	22.0	12.0	1.30	1.03
Silt	20.5	10.5	1.25	1.00
Lateral Earth Pressure Coefficients		**Active K_a**	**At Rest K_o**	**Passive K_p**
Sand		0.29	0.46	3.39
Gravelly Sand		0.25	0.40	4.02
Sandy Silt Till, Silty Sand Till and Silt		0.33	0.46	3.39
Estimated Coefficient of Permeability (K) and Percolation Time (T)			**K (cm/sec)**	**T (min/cm)**
Sandy Silt Till/Silty Sand Till/Silt			10^{-5} to 10^{-6}	20 to 50
Sand and Gravelly Sand			10^{-1} to 10^{-3}	2 to 8
Estimated Electrical Resistivity				**(ohm·cm)**
Sandy Silt Till/Silty Sand Till/Silt				4500
Sand and Gravelly Sand				5500 to 6000
Coefficients of Friction				
Between Concrete and Granular Base				0.50
Between Concrete and Native Soils or Compacted Earth Fill				0.35

6.9 Excavation

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

Table 4 - Classification of Soils for Excavation

Material	**Type**
Sandy Silt Till/Silty Sand Till	2
Weathered Soils, Drained Sands and Silts	3
Saturated Soils	4

Proper sloping gradients should be achieved for a safe open excavation unless the excavation is properly supported. For Type 2 soil, the bottom 1.2 m can remain vertical and sloped at a gradient of 1H:1V or flatter above the bottom 1.2 m; for Type 3 soil, the excavation should be sloped at a gradient of 1H:1V or flatter from the bottom of excavation; for Type 4 soil, the excavation should be sloped at a gradient of 3H:1V or flatter.

For excavation into the wet soil or below the groundwater, the groundwater yield is expected to be appreciable and persistent. Dewatering from closely spaced sumps and sump wells will likely be required prior to excavation. The dewatering requirement will be discussed in the hydrogeological report.

Prospective contractors may be asked to assess the in-situ subsurface conditions for soil cuts by digging test pits to at least 0.5 m below the intended bottom of excavation. These test pits should be allowed to remain open for a few hours to assess the trenching conditions.

7.0 LIMITATIONS OF REPORT

This report was prepared by Soil Engineers Ltd. for the account of Beachcroft Investments Inc. or review by its designated consultants, contractors and government agencies. The material in the report reflects the judgement of Cedric Ramos, B.A.Sc., EIT and Kin Fung Li, P.Eng., in light of the information available to it at the time of preparation.

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

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LIST OF ABBREVIATIONS AND DESCRIPTION OF TERMS

The abbreviations and terms commonly employed on the borehole logs and figures, and in the text of the report, are as follows:

SAMPLE TYPES

AS	Auger sample
CS	Chunk sample
DO	Drive open (split spoon)
DS	Denison type sample
FS	Foil sample
RC	Rock core (with size and percentage recovery)
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

PENETRATION RESISTANCE

Dynamic Cone Penetration Resistance:

A continuous profile showing the number of blows per each 30 cm of penetration of a 51 mm diameter, 90° point cone driven by a 63.5 kg hammer falling from a height of 76 cm.

Plotted as '—•—'

Standard Penetration Resistance or 'N' Value:

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

Plotted as '○'

WH	Sampler advanced by static weight
PH	Sampler advanced by hydraulic pressure
PM	Sampler advanced by manual pressure
NP	No penetration

SOIL DESCRIPTION

Cohesionless Soils:

'N' (blows/30 cm)	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 (kPa)	'N' (blows/30 cm)	Consistency
less than 12	less than 2	very soft
12 to 25	2 to 4	soft
25 to 50	4 to 8	firm
50 to 100	8 to 15	stiff
100 to 200	15 to 30	very stiff
over 200	over 30	hard

Method of Determination of Undrained Shear Strength of Cohesive Soils:

x 0.0	Field vane test in borehole; the number denotes the sensitivity to remoulding
△	Laboratory vane test

METRIC CONVERSION FACTORS

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

JOB NO.: 2206-S054

LOG OF BOREHOLE: BH/MW 1

FIGURE NO.: 1

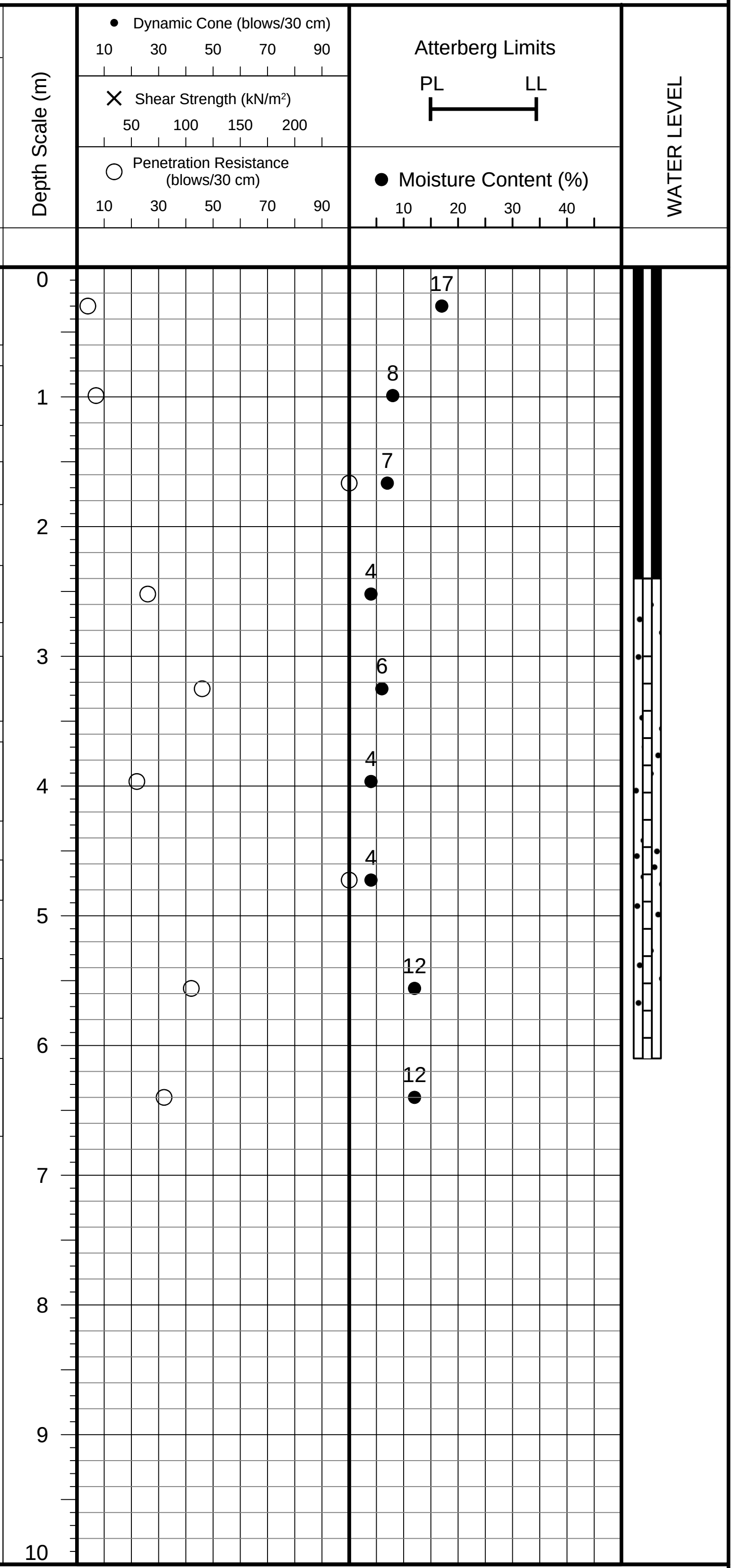
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Solid Stem

PROJECT LOCATION: 63 and 63A Trafalgar Road, Town of Erin

DRILLING DATE: November 23, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
439.7	Ground Surface			
0.0	**36 cm Topsoil** **PLOUGHED SOIL** Dark brown sand, occ. rootlets	1	DO	4
439.0 0.7	Brown, compact **SAND** fine to medium grained some silt and gravel	2	DO	7
438.2 1.5	Brown, dense to very dense **GRAVELLY SAND** some silt occ. cobbles and boulders wet below 5.1 m	3	DO	50/28
		4	DO	26
		5	DO	46
		6	DO	22
		7	DO	50/15
		8	DO	42
		9	DO	32
433.0 6.7	**END OF BOREHOLE** Installed 50 mm Ø monitoring well to 6.1 m completed with 3.1 m screen Sand backfill from 2.4 to 6.1 m Bentonite seal from 0.0 m to 2.4 m Provided with a monument casing			



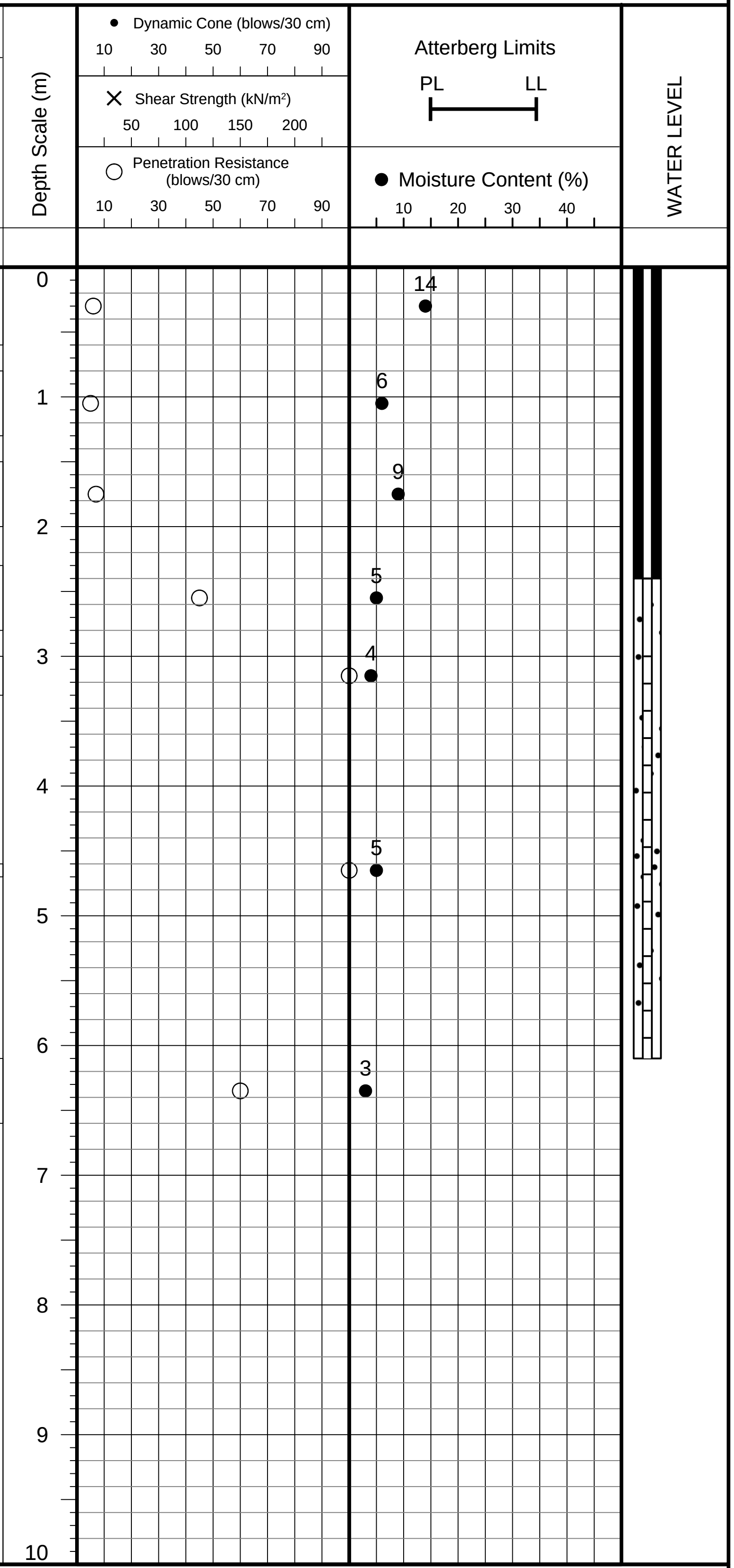
Soil Engineers Ltd.

JOB NO.: 2206-S054
LOG OF BOREHOLE: BH/MW 2
FIGURE NO.: 2

PROJECT DESCRIPTION: Proposed Residential Development
METHOD OF BORING: Solid Stem

PROJECT LOCATION: 63 and 63A Trafalgar Road, Town of Erin
DRILLING DATE: November 22, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
436.3	Ground Surface			
0.0	**36 cm Topsoil** **PLOUGHED SOIL** Dark brown sand, occ. rootlets	1	DO	6
435.6 0.7	Brown, loose **SAND** fine to medium grained some silt and gravel	2	DO	5
		3	DO	7
433.9 2.4	Brown, dense to very dense **GRAVELLY SAND** some silt occ. cobbles and boulders	4	DO	45
		5	DO	50/15
		6	DO	50/15
		7	DO	60
429.7 6.6	**END OF BOREHOLE** Installed 50 mm Ø monitoring well to 6.1 m completed with 3.1 m screen Sand backfill from 2.4 to 6.1 m Bentonite seal from 0.0 m to 2.4 m Provided with a monument casing			



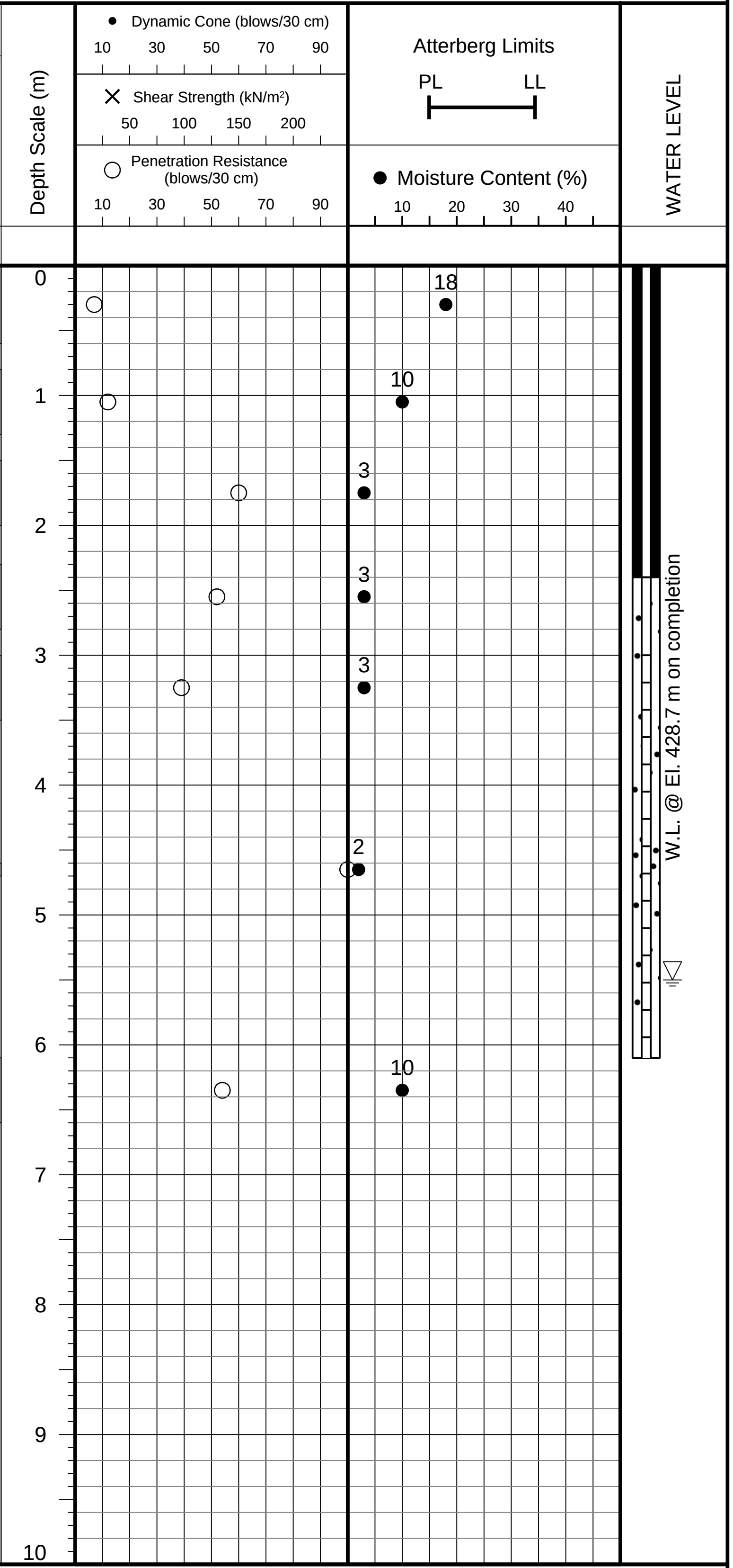
Soil Engineers Ltd.

JOB NO.: 2206-S054 **LOG OF BOREHOLE: BH/MW 3** **FIGURE NO.:** 3

PROJECT DESCRIPTION: Proposed Residential Development **METHOD OF BORING:** Solid Stem

PROJECT LOCATION: 63 and 63A Trafalgar Road, Town of Erin **DRILLING DATE:** November 24, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
434.2	Ground Surface			
0.0	**36 cm Topsoil** **PLOUGHED SOIL** Dark brown sand, occ. rootlets	1	DO	7
433.5 0.7	Brown, compact **SAND** fine to medium grained some silt and gravel	2	DO	12
432.8 1.4	Brown, dense to very dense **GRAVELLY SAND** some silt occ. cobbles and boulders wet below 5.5 m	3 4 5 6 7	DO DO DO DO DO	60 52 39 50/15 54
427.6 6.6	**END OF BOREHOLE** Installed 50 mm Ø monitoring well to 6.1 m completed with 3.1 m screen Sand backfill from 2.4 to 6.1 m Bentonite seal from 0.0 m to 2.4 m Provided with a monument casing			



Soil Engineers Ltd.

JOB NO.: 2206-S054

LOG OF BOREHOLE: BH/MW 4

FIGURE NO.: 4

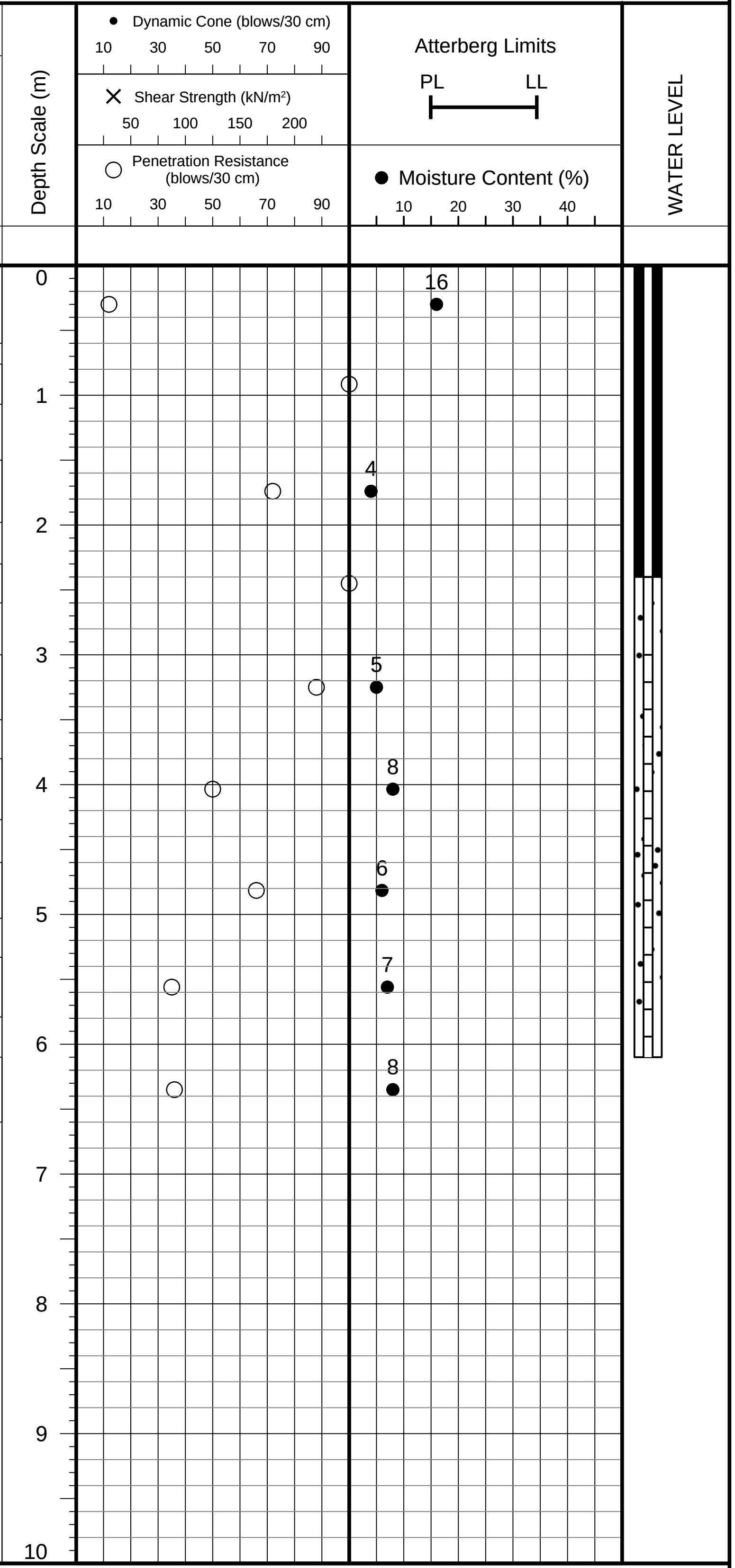
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Solid Stem

PROJECT LOCATION: 63 and 63A Trafalgar Road, Town of Erin

DRILLING DATE: November 18, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
427.7	Ground Surface			
0.0	**36 cm Topsoil** **PLOUGHED SOIL** Dark brown sand, occ. rootlets	1	DO	12
427.2 0.5	Brown, compact **SAND** fine to medium grained, some silt	2	DO	50/15
426.7 1.0	Brown, very dense **GRAVELLY SAND** some silt occ. cobbles and boulders	3 4 5	DO DO DO	72 50/10 88
424.0 3.7	Very dense to dense **SILTY SAND TILL** some gravel to gravelly a trace of clay occ. cobbles and boulders — — brown / grey	6 7 8 9	DO DO DO DO	50 66 35 36
421.1 6.6	**END OF BOREHOLE** Installed 50 mm Ø monitoring well to 6.1 m completed with 3.1 m screen Sand backfill from 2.4 to 6.1 m Bentonite seal from 0.0 m to 2.4 m Provided with a monument casing			



Soil Engineers Ltd.

JOB NO.: 2206-S054

LOG OF BOREHOLE: BH/MW 5

FIGURE NO.: 5

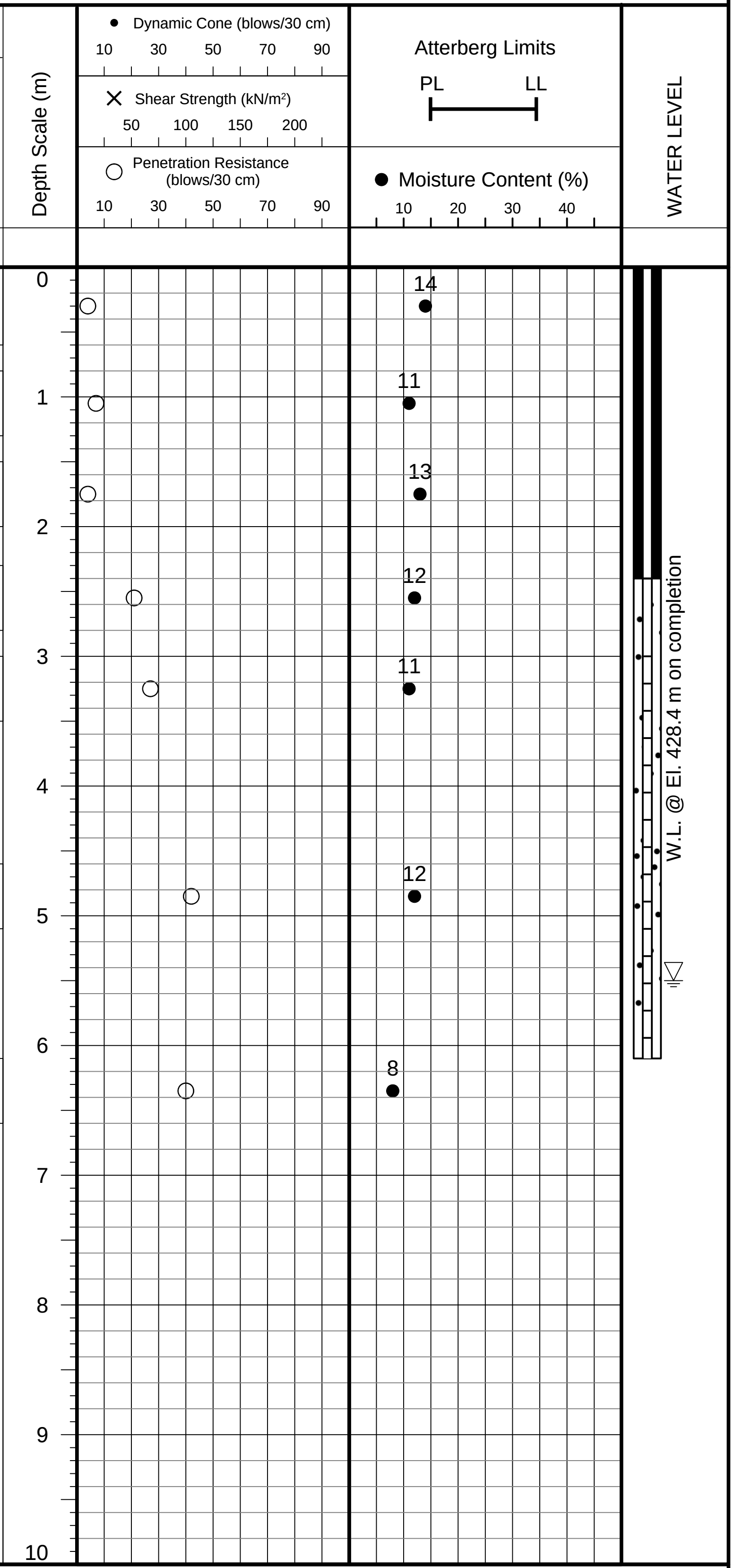
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Solid Stem

PROJECT LOCATION: 63 and 63A Trafalgar Road, Town of Erin

DRILLING DATE: November 24, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
433.9	Ground Surface			
0.0	**36 cm Topsoil** **PLOUGHED SOIL** Dark brown sand, occ. rootlets	1	DO	4
433.2 0.7	Brown, compact **SAND** fine grained some silt and gravel	2	DO	7
		3	DO	4
		4	DO	21
		5	DO	27
429.8 4.1	Brown, dense, wet **GRAVELLY SAND** some silt occ. cobbles and boulders	6	DO	42
428.3 5.6	Brown, dense **SANDY SILT TILL** traces of gravel and clay occ. cobbles and boulders	7	DO	40
427.3 6.6	**END OF BOREHOLE** Installed 50 mm Ø monitoring well to 6.1 m completed with 3.1 m screen Sand backfill from 2.4 to 6.1 m Bentonite seal from 0.0 m to 2.4 m Provided with a monument casing			



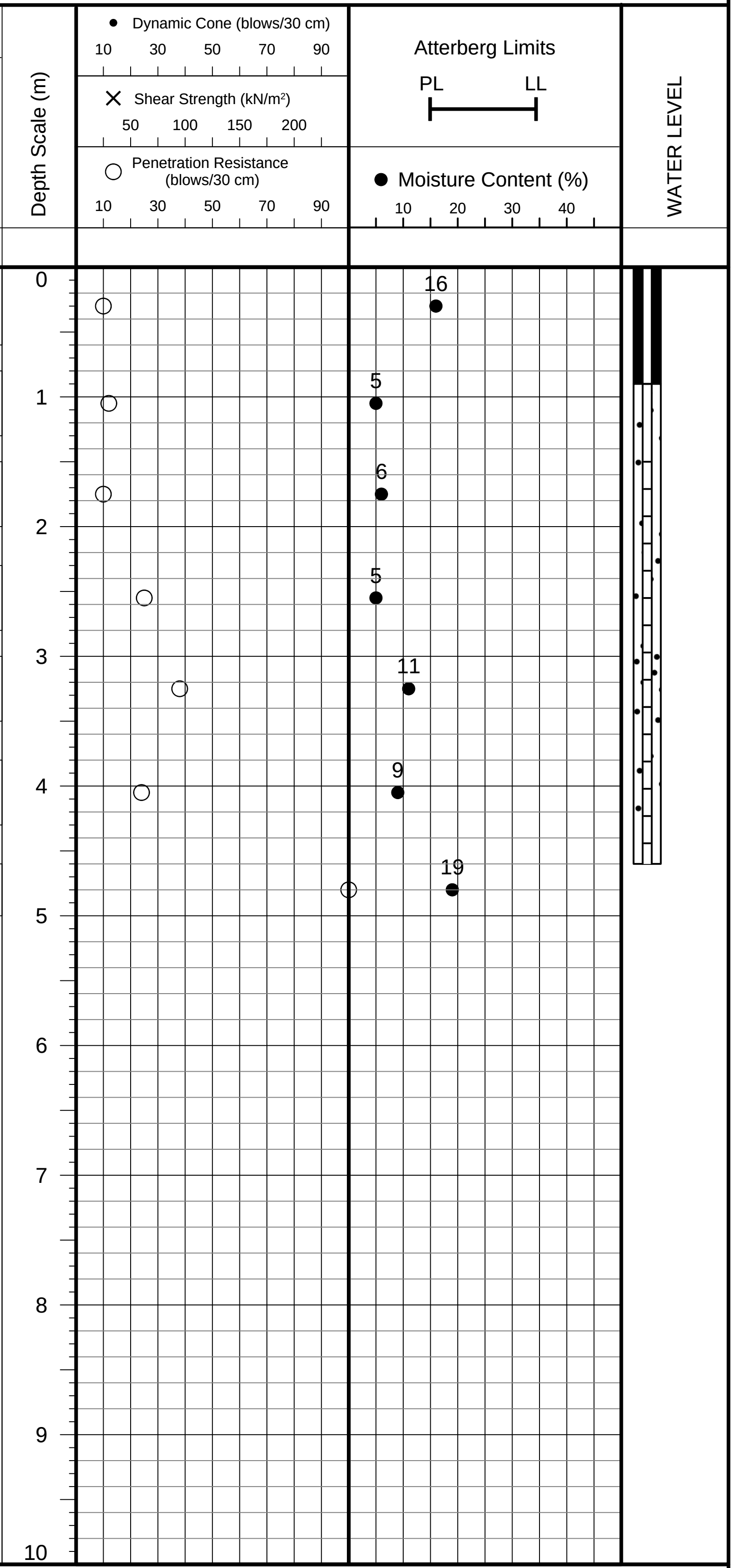
Soil Engineers Ltd.

JOB NO.: 2206-S054 **LOG OF BOREHOLE:** **BH/MW 6** **FIGURE NO.:** 6

PROJECT DESCRIPTION: Proposed Residential Development **METHOD OF BORING:** Solid Stem

PROJECT LOCATION: 63 and 63A Trafalgar Road, Town of Erin **DRILLING DATE:** November 21, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES		
		Number	Type	N-Value
443.5	Ground Surface			
0.0	**36 cm Topsoil** **PLOUGHED SOIL** Dark brown sand, occ. rootlets	1	DO	10
442.8 0.7	Brown, compact **SAND** fine grained some silt and gravel	2	DO	12
		3	DO	10
441.3 2.2	Brown, compact to dense **GRAVELLY SAND** some silt occ. cobbles and boulders wet below 3.0 m	4	DO	25
		5	DO	38
		6	DO	24
438.5 4.4	Brown, very dense, wet **SILT** fine grained, occ. clay seams and layers	7	DO	50/28
5.0	**END OF BOREHOLE** Installed 50 mm Ø monitoring well to 4.6 m completed with 3.1 m screen Sand backfill from 0.9 to 4.6 m Bentonite seal from 0.0 m to 0.9 m Provided with a monument casing			



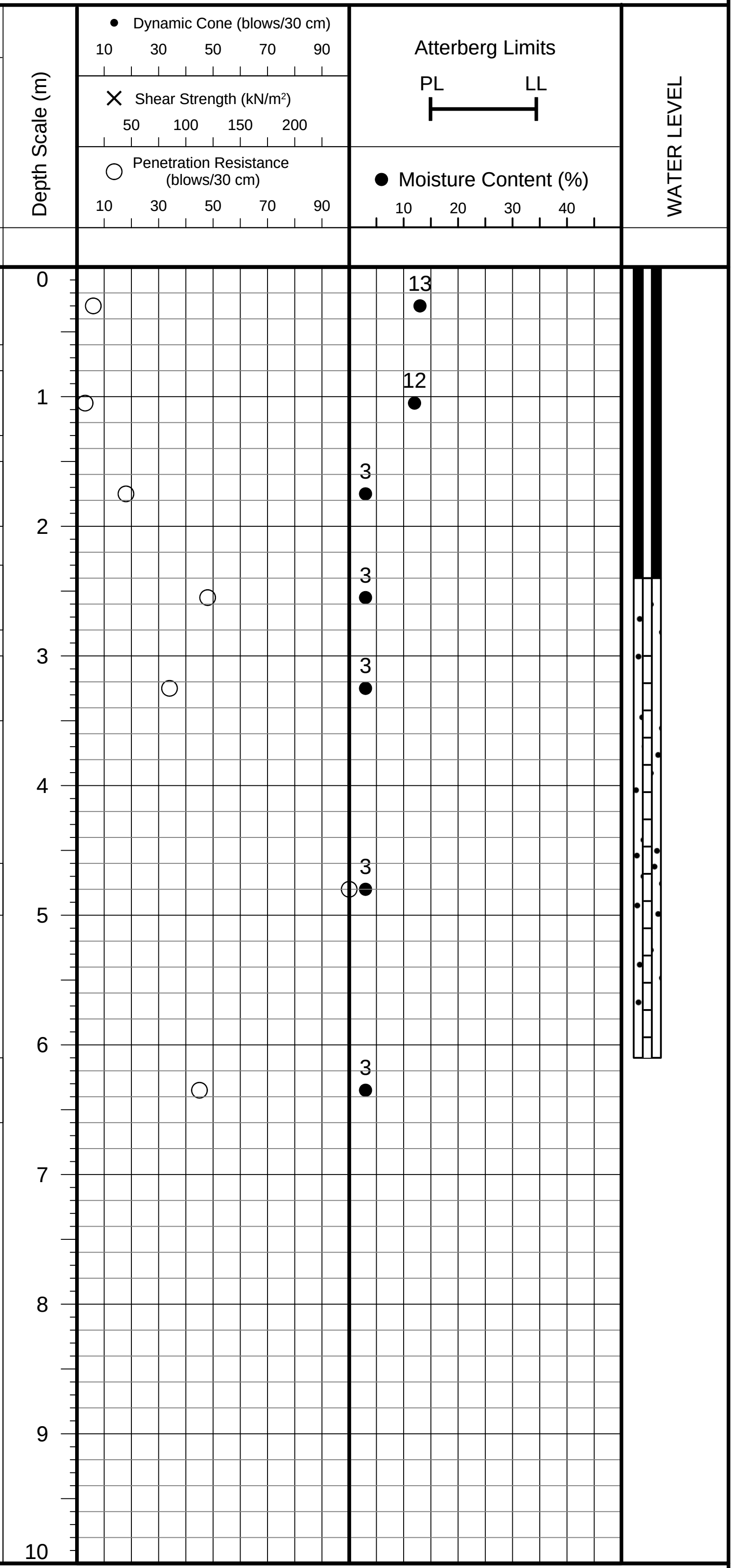
Soil Engineers Ltd.

JOB NO.: 2206-S054 **LOG OF BOREHOLE:** **BH/MW 7** **FIGURE NO.:** 7

PROJECT DESCRIPTION: Proposed Residential Development **METHOD OF BORING:** Solid Stem

PROJECT LOCATION: 63 and 63A Trafalgar Road, Town of Erin **DRILLING DATE:** November 23, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
442.4	Ground Surface			
0.0	**36 cm Topsoil** **PLOUGHED SOIL** Dark brown sand, occ. rootlets	1	DO	6
441.7 0.7	Brown, very loose to very dense **SAND** fine to medium grained a trace to some gravel	2	DO	3
		3	DO	18
		4	DO	48
		5	DO	34
		6	DO	50/23
		7	DO	45
435.8 6.6	**END OF BOREHOLE** Installed 50 mm Ø monitoring well to 6.1 m completed with 3.1 m screen Sand backfill from 2.4 to 6.1 m Bentonite seal from 0.0 m to 2.4 m Provided with a monument casing			



Soil Engineers Ltd.

JOB NO.: 2206-S054

LOG OF BOREHOLE: BH/MW 8

FIGURE NO.: 8

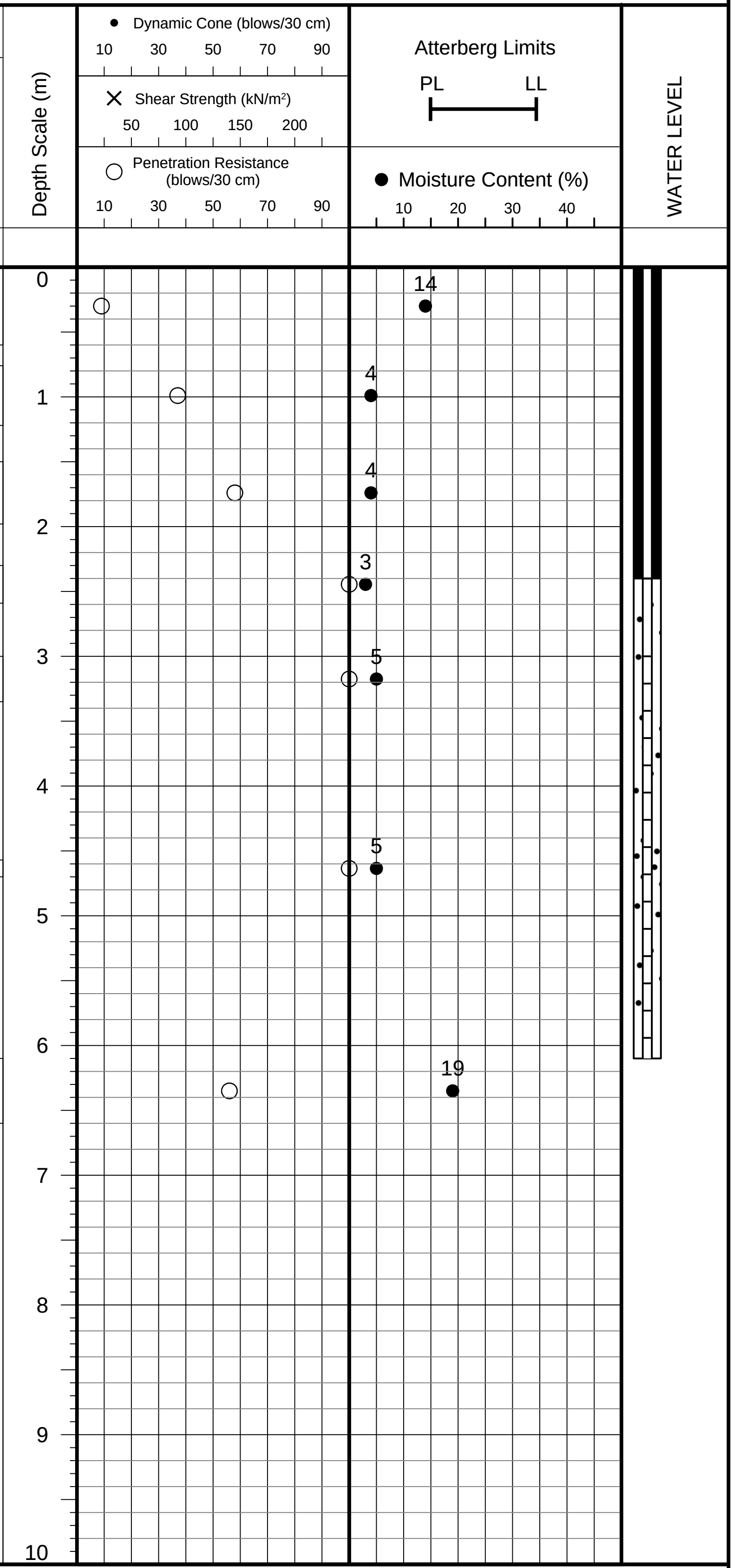
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Solid Stem

PROJECT LOCATION: 63 and 63A Trafalgar Road, Town of Erin

DRILLING DATE: November 22, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
434.3	Ground Surface			
0.0	**36 cm Topsoil**			
433.8 0.5	**PLOUGHED SOIL** Dark brown sand, occ. rootlets	1	DO	9
	Brown, dense to very dense **GRAVELLY SAND** some silt and gravel occ. cobbles and boulders	2	DO	37
		3	DO	58
		4	DO	50/10
		5	DO	50/15
		6	DO	50/15
428.8 5.5	Brown, very dense **SILT** fine grained occ. clay seams and layers	7	DO	56
427.7 6.6	**END OF BOREHOLE** Installed 50 mm Ø monitoring well to 6.1 m completed with 3.1 m screen Sand backfill from 2.4 to 6.1 m Bentonite seal from 0.0 m to 2.4 m Provided with a monument casing			



Soil Engineers Ltd.

JOB NO.: 2206-S054

LOG OF BOREHOLE: BH/MW 9

FIGURE NO.: 9

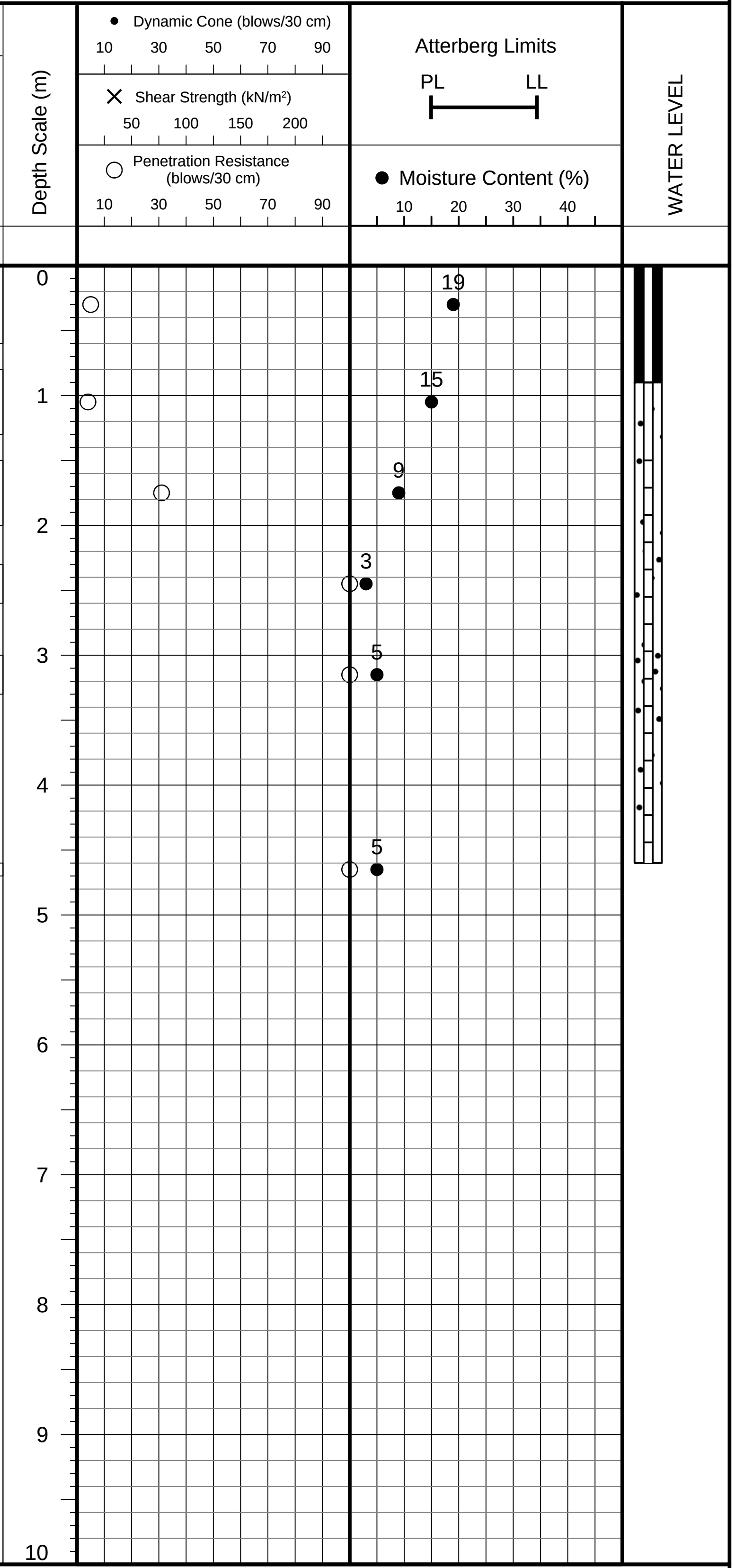
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Solid Stem

PROJECT LOCATION: 63 and 63A Trafalgar Road, Town of Erin

DRILLING DATE: November 24, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
437.7	Ground Surface			
0.0	**36 cm Topsoil** **PLOUGHED SOIL** Dark brown sand, occ. rootlets	1	DO	5
437.0 0.7	Brown, compact **SAND** fine to medium grained some silt and gravel	2	DO	4
		3	DO	31
435.9 1.8	Brown, dense to very dense **GRAVELLY SAND** some silt and gravel occ. cobbles and boulders	4	DO	50/15
		5	DO	50/10
		6	DO	50/3
433.0 4.7	**END OF BOREHOLE** Installed 50 mm Ø monitoring well to 4.6 m completed with 3.1 m screen Sand backfill from 0.9 to 4.6 m Bentonite seal from 0.0 m to 0.9 m Provided with a monument casing			



JOB NO.: 2206-S054

LOG OF BOREHOLE: BH/MW 10

FIGURE NO.: 10

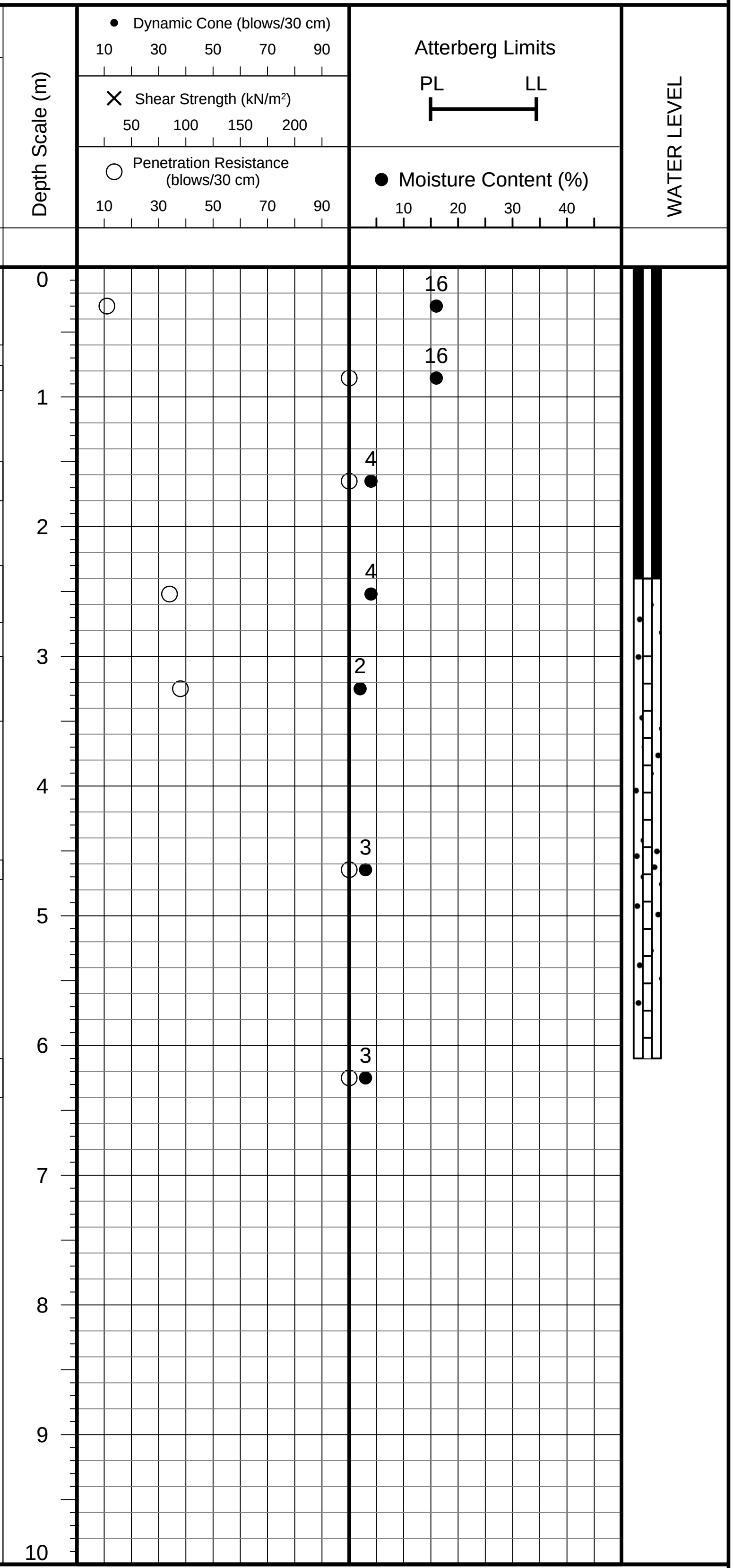
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Solid Stem

PROJECT LOCATION: 63 and 63A Trafalgar Road, Town of Erin

DRILLING DATE: November 25, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
437.9	Ground Surface			
0.0	**36 cm Topsoil** **PLOUGHED SOIL** Dark brown sand, occ. rootlets	1	DO	11
		2	DO	50/5
437.0 0.9	Brown, dense to very dense **GRAVELLY SAND** some silt and gravel occ. cobbles and boulders	3	DO	50/15
		4	DO	34
		5	DO	38
		6	DO	50/15
431.5		7	DO	50/10
6.4	**END OF BOREHOLE** Installed 50 mm Ø monitoring well to 6.1 m completed with 3.1 m screen Sand backfill from 2.4 to 6.1 m Bentonite seal from 0.0 m to 2.4 m Provided with a monument casing			



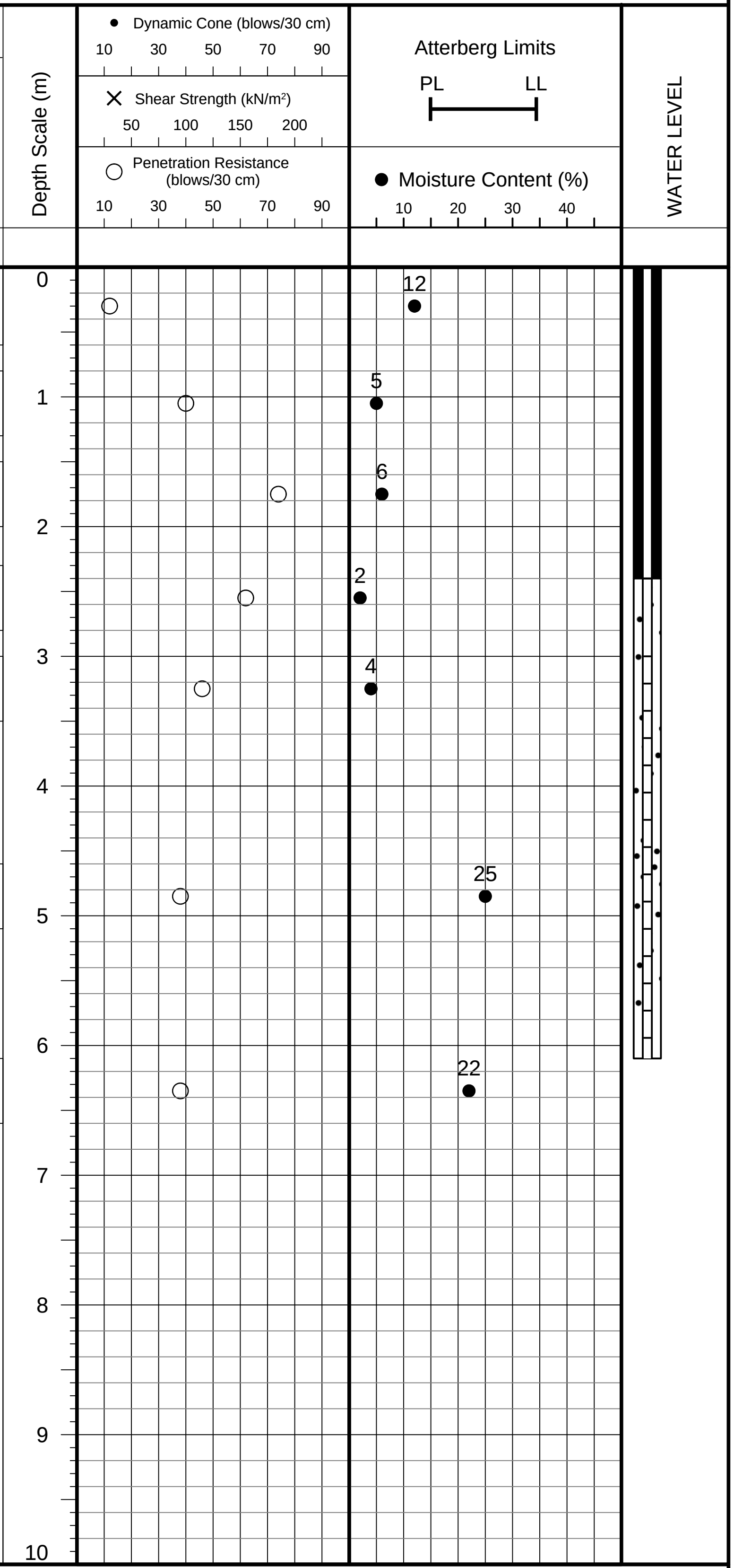
Soil Engineers Ltd.

JOB NO.: 2206-S054 **LOG OF BOREHOLE:** **BH/MW 11** **FIGURE NO.:** 11

PROJECT DESCRIPTION: Proposed Residential Development **METHOD OF BORING:** Solid Stem

PROJECT LOCATION: 63 and 63A Trafalgar Road, Town of Erin **DRILLING DATE:** November 25, 2022

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES		
		Number	Type	N-Value
435.6	Ground Surface			
0.0	**36 cm Topsoil** **PLOUGHED SOIL** Dark brown sand, occ. rootlets	1	DO	12
434.9 0.7	Brown, dense to very dense **SAND** fine to medium grained some gravel and silt	2	DO	40
		3	DO	74
		4	DO	62
		5	DO	46
431.5 4.1	Dense,wet **SILT** fine grained occ. clay seams and layers	6	DO	38
	— — brown grey	7	DO	38
429.0 6.6	**END OF BOREHOLE** Installed 50 mm Ø monitoring well to 6.1 m completed with 3.1 m screen Sand backfill from 2.4 to 6.1 m Bentonite seal from 0.0 m to 2.4 m Provided with a monument casing			



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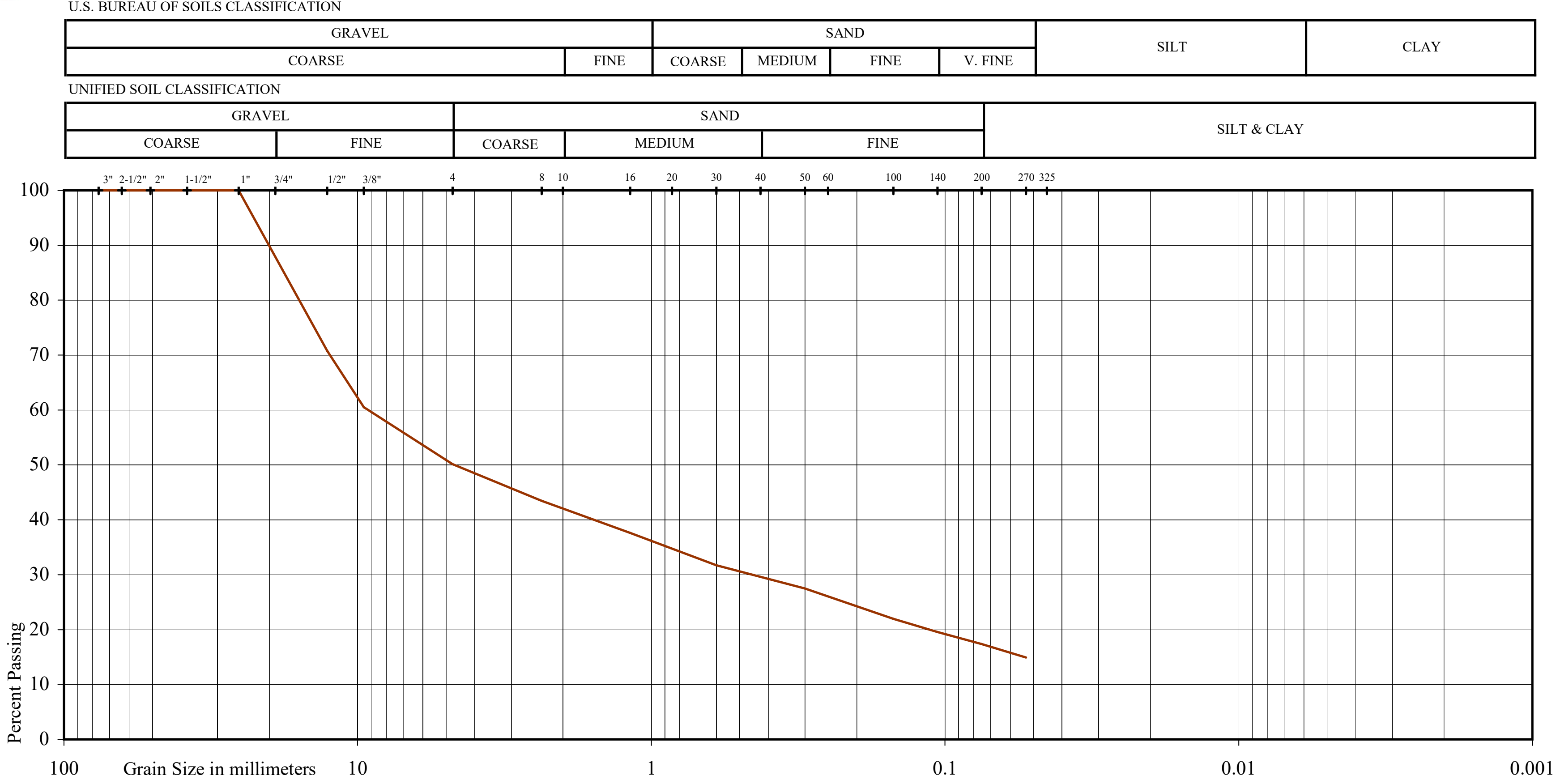
GRAIN SIZE DISTRIBUTION

Reference No: 2206-S054



Project:	Proposed Residential Development	BH./Sa.	1/5
Location:	63 and 63A Trafalgar Road, Town of Erin	Liquid Limit (%) =	-
		Plastic Limit (%) =	-
Borehole No:	1	Plasticity Index (%) =	-
Sample No:	5	Moisture Content (%) =	6
Depth (m):	3.0	Estimated Permeability	
Elevation (m):	430.9	(cm./sec.) =	10^{-3}

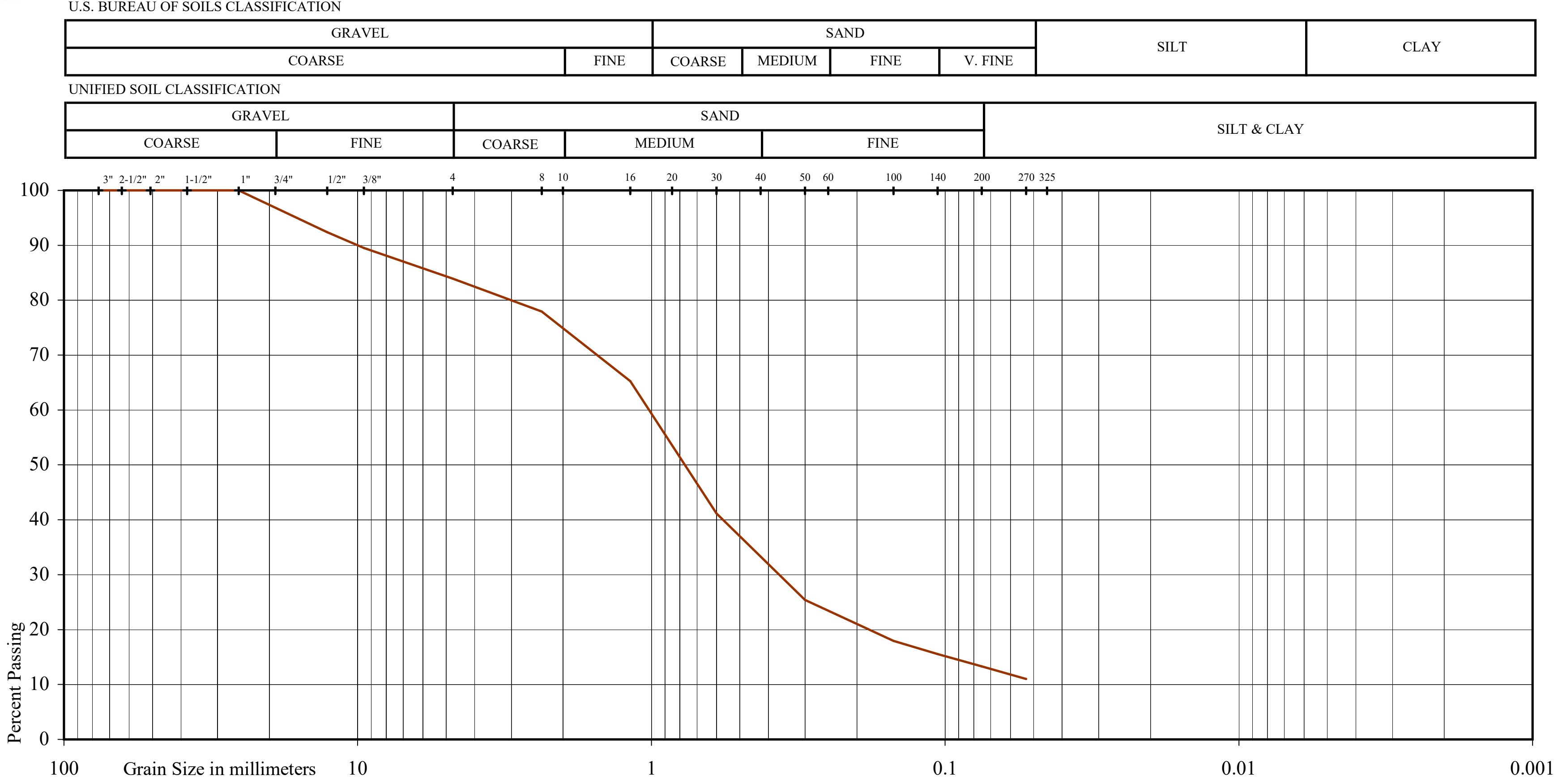
Classification of Sample [& Group Symbol]: GRAVELLY SAND
some silt

Figure: 12

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 2206-S054



Project: Proposed Residential Development

Location: 63 and 63A Trafalgar Road, Town of Erin

Borehole No: 7

Sample No: 6

Depth (m): 4.6

Elevation (m): 437.8

BH./Sa. 7/6

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

Moisture Content (%) = 3

Estimated Permeability

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

Classification of Sample [& Group Symbol]: FINE TO MEDIUM SAND
some gravel and silt

Figure: 13

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CONSULTING ENGINEERS
GEOTECHNICAL | ENVIRONMENTAL | HYDROGEOLOGICAL | BUILDING SCIENCE
90 WEST BEAVER CREEK ROAD, SUITE #100, RICHMOND HILL, ONTARIO L4B 1E7 · TEL: (416) 754-8515 · FAX: (905) 881-8335

Borehole and Monitoring Well Location Plan

SITE: 63 and 63A Trafalgar Road, Town of Erin

DESIGNED BY: C.R.
CHECKED BY: K.F.L.
DWG NO.: 1
SCALE: 1:5000
REF. NO.: 2206-S054
DATE: January 2024
REV -

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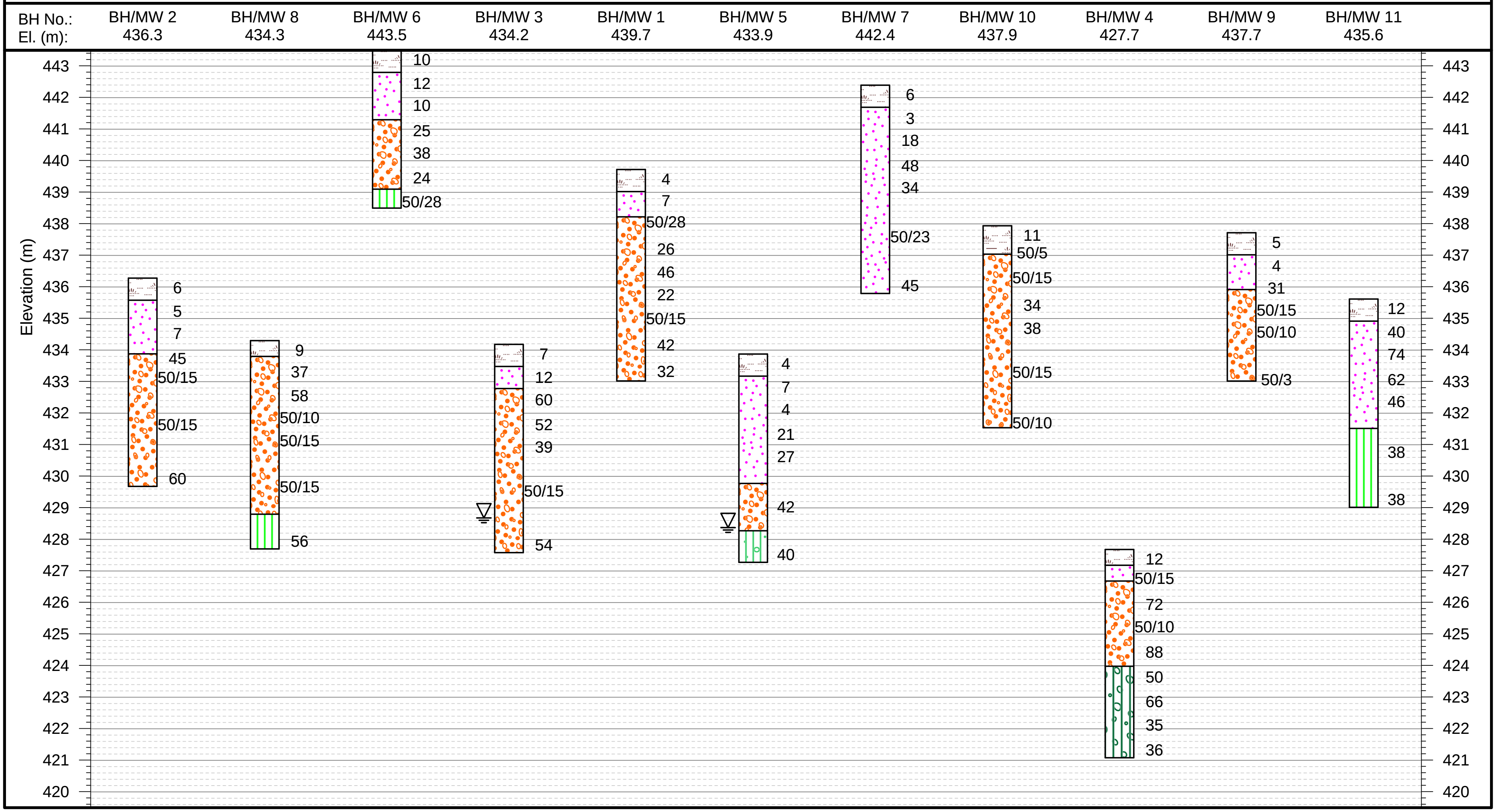
SUBSURFACE PROFILE
DRAWING NO. 2
SCALE: AS SHOWN

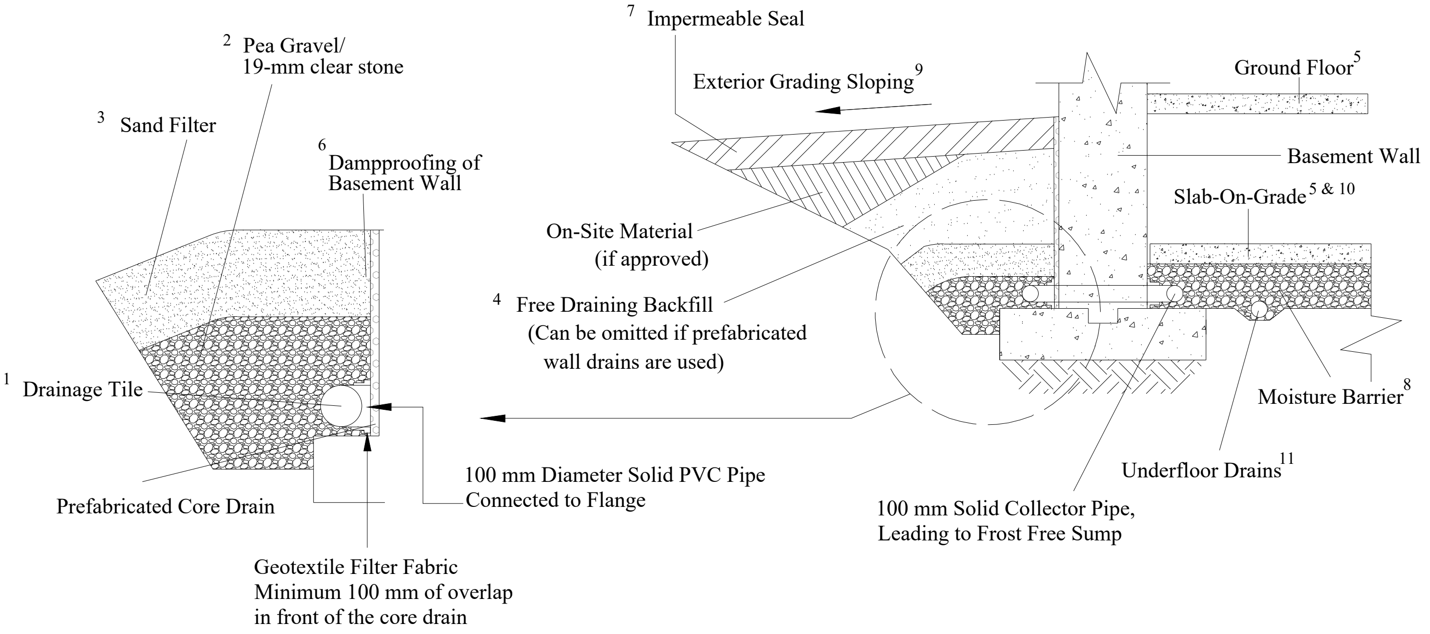
JOB NO.: 2206-S054
REPORT DATE: January 2024
PROJECT DESCRIPTION: Proposed Residential Development
PROJECT LOCATION: 63 and 63A Trafalgar Road, Town of Erin

LEGEND

GRAVELLY SAND
SANDY SILT TILL
SILTY SAND TILL
PLOUGHED SOIL
SAND
SILT

WATER LEVEL (END OF DRILLING)





NOTES:

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

2. **Pea gravel**: at 150 mm (6") on the top and sides of drain. If drain is not placed on concrete footing, provide 100 mm (4") of pea gravel below drain. The pea gravel may be replaced by 19-mm clear stone provided that the drain is covered by a porous geotextile membrane of Terrafix 270R or equivalent.

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

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

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

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

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

8. **Moisture barrier**: 19-mm CRL or equivalent. The thickness of this layer should be 150 mm (6") minimum.

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

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

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

[*] Underfloor drains can be deleted where not required.

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

Permanent Perimeter Drainage System

SITE: 63 and 63A Trafalgar Road, Town of Erin

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

SCALE: N.T.S. **REF. NO.:** 2206-S054 **DATE:** January 2024 **REV** -