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A REPORT TO
LANAROSE MIDLAND LTD.

A GEOTECHNICAL INVESTIGATION
FOR PROPOSED HOTEL

BAYPORT VILLAGE - BLOCK 76

MARINA PARK AVENUE AND HARBOURVIEW DRIVE

TOWN OF MIDLAND

REFERENCE NO. 1911-S109

MARCH 2020

DISTRIBUTION

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1.0 INTRODUCTION

In accordance with a written authorization dated November 20, 2019, from Mr. Enzo Bertucci of Lanarose Midland Ltd., a geotechnical investigation was carried out at a parcel of property located at the northeast intersection of Marina Park Avenue and Harbourview Drive in the Town of Midland. 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 hotel complex.

It should be noted that previous investigations have been completed within the parcel block by Soil Engineers Ltd. in 2007 (our Reference No. 0705-S060) and 2010 (our Reference No. 1010-S027). The geotechnical findings and resulting recommendations with reference to the current investigation and the available information are presented in this Report.

2.0 SITE AND PROJECT DESCRIPTION

The Town of Midland is situated on the Penetang Peninsula within the physiographic region known as Simcoe Upland which is comprised of a series of broad rolling till plains. The tills are generally sandy in composition and have been partly eroded by glacial Lake Algonquin, filled with glaciofluvial and lacustrine sand, silt and clay in places.

The subject property, approximately 1.36 hectares (3.36 acres) in area, is “Block 76 in Bayport Village Development”, located at the northeast intersection of Harbourview Drive and Marina Park Avenue in the Town of Midland. It is situated to the west of the Bay Port Yachting Centre and in close proximity of the shoreline of Lake Huron.

A review of the aerial photos between 2002 and 2018 indicates that earthwork or site grading has been carried out at the north and south portions of the property, in 2013. At present, boats and trailers are parked on part of the site. The remaining areas are weed covered, with trees and bushes. The existing site gradient is relatively flat, descending slightly to the waterfront towards the southeast.

It is understood that the proposed development will consist of a 6-storey hotel with an in-ground swimming pool and a tennis court. Accessible driveways and paved parking lot will be provided on site at street level.

3.0 FIELD WORK

The field work of the current investigation, consisting of six (6) sampled boreholes extending to depths of 8.7 to 20.8 m from the prevailing ground surface, was performed between January 8 and 16, 2020, at the locations shown on the Location Plan, Drawing No. 1. These boreholes are numbered in the 200-series to distinguish from the previous borehole investigations.

The logs of six (6) relevant boreholes, completed at the site in 2007 and 2010, are attached in Appendices 'A' and 'B' for reference:

- Boreholes 1 to 4, inclusive, extending to depths of 6.6 to 19.8 m, completed in October 2007.
- Boreholes 101 and 102, extending to 19.8 m and 19.9 m, completed in November 2010.

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

Weak and soft clay was contacted in the borehole locations. In situ vane shear tests were performed in the weak clay stratum to determine the shear strength and sensitivity.

Dynamic cone penetration tests (DCPT) were also conducted beyond the sampling depth of 20.4 m at Borehole 201. Virtual refusal to cone penetration, having a blow count of over 100 blows per 30 cm of penetration, was contacted at a depth of 20.8 m from grade.

Upon completion of borehole drilling and sampling, a monitoring well, 50 mm in diameter, was installed at Borehole 205 to facilitate a hydrogeological assessment by others. The depth and details of the monitoring well are shown on the corresponding Borehole Log.

The ground elevation at each borehole location was determined with reference to a temporary bench mark, "Top of Catch Basin" located on the east side of Harbourview Drive. It has a geodetic elevation of El. 179.09 m, as shown on the Topographical Survey Plan provided by WMI & Associates Limited.

4.0 SUBSURFACE CONDITIONS

The current investigation has disclosed that beneath a localized topsoil and a layer of earth fill, an alluvial deposit was contacted in a majority of the borehole locations, overlying the native silty clay and sand deposits. A stratum of silty sand till was contacted below 14.7 to 19.4 m in the deeper boreholes.

Detailed descriptions of the subsurface conditions are presented on the Borehole Logs, comprising Figures 1 to 6, inclusive. The relevant borehole logs completed at the site in 2007 and 2010 are enclosed in Appendices 'A' and 'B', respectively. The revealed subsurface soil stratigraphy is plotted on the Subsurface Profile, Drawing Nos. 2 and 3.

Due to an indication of previous earthwork or site grading in the 2013 aerial photo, the surficial soil conditions presented on the previous borehole logs will not be considered in this report.

4.1 **Topsoil** (Borehole 204)

Topsoil is present in the weed-covered area. A topsoil veneer of 18 cm in thickness was contacted at the ground surface of Borehole 204. Thicker topsoil can be anticipated in the other area beyond the borehole location. It must be removed for site development.

The topsoil can be reused for landscaping purpose only. It must not be buried below 1.0 m from grade, otherwise, it will have an adverse impact on the environmental well-being in the development.

4.2 **Earth Fill** (All Boreholes)

A layer of earth fill, extending to a depth of 2.1 to 4.1 m from grade, was contacted at the borehole locations. In the previous boreholes, the earth fill was also recorded to a depth of 2.1 to 4.9 m from grade. The earth fill consists of sand or silty clay, with topsoil, wood debris and slag. The slag is a by-product of iron foundry.

Grain size analytical results on the representative samples from the previous boreholes are presented in Appendix 'A' for reference.

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

4.3 **Peat and/or Alluvium** (All Boreholes, except Boreholes 101, 102 and 203)

An alluvial deposit of sand and silt with plant debris and organic peat layers was contacted in a majority of the boreholes, below the earth fill at a depth of 2.1 to 4.6 m from grade. It extends to a depth of 2.9 to 5.3 from the prevailing ground surface.

The alluvium was formed by the progressive accumulation of incompletely decomposed plants and sediments in a wet environment. It is mostly saturated, highly compressible, and is very weak in compressive strength. In addition, the organics in the peat and alluvium will decompose, generating methane gas under an anaerobic condition.

4.4 **Silty Clay** (All Boreholes)

The silty clay is laminated with silt and occasional sand layers. Grain size analysis was performed on a representative sample; the result is plotted on Figure 7. The grain size distribution curve of a clay sample from a relevant previous borehole, Borehole 1, is attached in Appendix ‘A’.

The obtained ‘N’ values range from 0 (i.e., weight of hammer) to 7, with a median of 1 blow per 30 cm of penetration, indicating the consistency of the clay deposit is generally very soft. The in situ vane shear test results are plotted on the Borehole Logs, having the undrained shear strength values between 11 kPa and 96 kPa, with a median of 33 kPa. The sensitivity values range from 1.8 to 10.0, showing the clay is sensitive to remoulding.

The Atterberg Limits of 3 representative samples and the natural water content values of all the clay samples were determined. The results are plotted on the Borehole Logs and summarized below:

Liquid Limit	36%, 41%, 42%
Plastic Limit	23%, 24%, 24%
Natural Water Content	19% to 68% (median 42%)

The excessively high water content values, associated with the low ‘N’ values, confirm that the clay is normally consolidated under the lake. It is medium in plasticity and the natural water content is generally above the plastic limit or liquid limit.

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

- High frost susceptibility and high soil-adfreezing potential.

- Relatively low water erodibility.
- It is low permeable, with an estimated coefficient of permeability of 10^{-7} cm/sec. The runoff coefficients are:

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

- The soft clay is normally consolidated; it will undergo long-term settlement if it is subject to a higher loading.
- The shear strength is derived from the consistency and is inversely dependent on soil moisture. It will be susceptible to reduction in shear strength if remoulded.
- In excavation, the soft stratum may be subject to base heaving.
- Very poor pavement-supportive material, with an estimated California Bearing Ratio (CBR) value of less than 3%.
- Moderately high corrosivity to buried metal, an estimated electrical resistivity of 2500 ohm·cm.

4.5 **Sand/Silt** (Boreholes 2, 4, 101, 102, 201, 202, 203 and 204)

The sand or silt deposit was contacted beneath the silty clay at a depth of 10.0 to 13.2 m from grade and also under a peat layer in Borehole 4 at a depth of 4.7 m. The sand deposit is fine or well graded, with occasional silt seams or layers. Grain size analyses were performed on 2 representative samples; the results are plotted on Figure 8. The grain size distribution curves of some sand and silt samples from the previous boreholes are attached in Appendices ‘A’ and ‘B’.

The obtained ‘N’ values range from 0 to 37, with a median of 16 blows per 30 cm of penetration, indicating the deposit is very loose to dense, being generally compact in relative density. It is saturated; the natural water content values of the soil samples range from 11% to 29%, with a median of 18%. The low ‘N’ values are likely caused by the disturbance of the hydrostatic pressure in the saturated soils during the augering and sampling operation.

The engineering properties of the sand and silt deposits are deduced:

- Moderate to high frost susceptibility.
- High water erodibility.
- Pervious to semi-permeable, with the estimated coefficient of permeability of 10^{-2} to 10^{-5} cm/sec. The runoff coefficients are:

Slope	
0% - 2%	0.04 to 0.11
2% - 6%	0.09 to 0.16
6% +	0.13 to 0.23

- The shear strength is derived from internal friction and is density dependent.
- In excavation, the sand and silt will slough and run with seepage. It will boil under a piezometric head of 0.3 m.
- Moderately low corrosivity to buried metal, with an estimated electrical resistivity of 5500 ohm·cm.

4.6 **Glacial Till** (Boreholes 2, 4, 101, 102, 201, 202, 203, and 204)

The glacial till deposit was contacted in the lower stratigraphy, below depths of 13.7 to 19.4 m at the deeper borehole locations. The till deposit is heterogeneous and amorphous in structure, consisting of a random mixture of particle sizes ranging from clay to gravel. Tactile examinations of the soil samples indicated that the till is slightly cemented. Hard resistance was encountered occasionally during augering and sampling, indicating the presence of cobbles and boulders in the deposit.

Grain size analysis was performed on a representative sample; the result is plotted on Figure 9. The grain size distribution curves of three samples from the previous boreholes are attached in Appendices ‘A’ and ‘B’.

The obtained ‘N’ values range from 18 to over 100 blows per 30 cm of penetration, indicating the till deposit is compact to very dense in relative density or very stiff to hard in consistency. The natural water content values of the soil samples range from 9% to 16%, with a median of 11%, indicating moist to very moist conditions.

The engineering properties of the till deposit are deduced:

- Moderately high frost susceptibility and soil-adfreezing potential.
- Moderately low water erodibility.
- Low permeability, with an estimated coefficient of permeability of 10^{-4} to 10^{-7} cm/sec, and runoff coefficients of:

Slope	
0% - 2%	0.07 to 0.15
2% - 6%	0.12 to 0.20
6% +	0.18 to 0.28

- The shear strength is primarily derived from internal friction, and is augmented by cementation. The soil strength is density dependent.
- Moderate corrosivity to buried metal, with an estimated electrical resistivity of 4500 ohm·cm.

4.7 **Interpretation of Refusal to Augering/Cone Penetration** (Boreholes 2, 201 and 202)

Virtual refusal to augering or cone penetration was encountered at a depth of 17.8 m, 20.8 m and 20.5 m in Boreholes 2, 201 and 202, respectively. The depth may represent boulders or inferred bedrock in the area. It was not proven by rock coring.

4.8 **Compaction Characteristics of the Revealed Soils**

The obtainable degree of compaction is primarily dependent on the soil moisture and, to a lesser extent, on the type of compactor used and the effort applied. As a general guide, the typical water content values of the revealed soils for Standard Proctor compaction are presented in Table 1.

Table 1 - Estimated Water Content for Compaction

Soil Type	Determined Natural Water Content (%)	Water Content (%) for Standard Proctor Compaction	
		100% (optimum)	Range for 95% or +
Earth Fill	5 to 45 (median 14)	11 to 13	7 to 16
Silty Clay	22 to 68 (median 42)	22	18 to 25
Sand/Silt	11 to 29 (median 18)	10 to 12	6 to 15

Excavation into the clay is unlikely, due to the depth and the groundwater conditions. The earth fill must be sorted free of topsoil inclusions and deleterious materials prior to its use as structural backfill.

Organic peat and alluvium should be removed and not be reused for backfilling due to the compressibility and organic content.

The on site organic-free material can be too wet for 95% or + Standard Proctor compaction. It will require aeration prior to structural compaction. Aeration of the wet soils can be effectively carried out by spreading them thinly on the ground in dry and warm weather.

5.0 GROUNDWATER CONDITIONS

The boreholes were checked for the presence of groundwater and the occurrence of cave-in upon the completion of drilling and sampling. The data are plotted on the Borehole Logs and summarized in Table 2.

Table 2 - Groundwater Levels

Borehole No.	**Ground Elevation (m)**	**Seepage Encountered During Augering**		**Recorded Groundwater/ Cave-in* Level Upon Completion**		
		Depth (m)	**Amount**	**Depth (m)**	**Elevation (m)**	**Record Date**
1	No Record	1.8	Moderate	1.8	-	10/31/2007
2	No Record	2.3	Moderate	0.9*	-	10/31/2007
3	No Record	3.4	Moderate	3.4/4.6*	-	10/30/2007
4	No Record	3.4	Appreciable	3.4/4.9*	-	10/31/2007
101	179.2	1.5	Appreciable	1.2/11.3*	178.0/167.9*	11/03/2010
102	181.6	3.8	Appreciable	4.0	177.6	11/03/2010
201	179.8	0.6	Moderate	2.1/10.1*	177.7/169.7*	01/09/2020
202	179.8	3.8	Appreciable	1.7/11.6*	178.1/168.2*	01/10/2020
203	179.7	3.8	Moderate	2.1	177.6	01/14/2020
204	179.5	3.0	Moderate	1.7	177.8	01/15/2020
205(MW)	180.7	3.8	Moderate	3.1	177.6	01/28/2020
206	180.7	3.0	Moderate	2.7	178.0	01/15/2020

Groundwater seepage was detected in the boreholes below 0.6 to 3.8 m from grade. Upon the completion of drilling, free groundwater was recorded in the boreholes at a depth of 1.2 m to 4.0 m, or between El. 178.1 m and El. 177.6 m. It represents the groundwater regime in the area. It will be subject to seasonal fluctuation and is affected by the water level in Lake Huron. The current water level in Georgian Bay is at approximate El. 177.5 m.

The groundwater yield from any excavation extending below the saturation level will be moderate to persistent, due to the close proximity of the water front. The excavation will require isolation with cofferdams or sheet piling extending into the low permeable clay stratum, in association with a dewatering system in the excavation.

6.0 DISCUSSION AND RECOMMENDATIONS

The investigation has disclosed that beneath a localized topsoil and a layer of earth fill, an alluvial deposit was contacted in a majority of the borehole locations, overlying the native silty clay of soft to firm in consistency, and sand or silt deposit of loose to dense in relative density. A stratum of silty sand till was contacted below 14.7 to 19.4 m in the deeper boreholes. The inferred bedrock may exist at a depth of 17.8 to 20.8 m. It was not proven by rock coring.

Groundwater seepage was detected in the boreholes below 0.6 to 3.8 m from grade. Upon the completion of drilling, free groundwater was recorded in the boreholes at a depth of 1.2 to 4.0 m, or between El. 178.1 m and El. 177.6 m. It represents the groundwater regime in the area. It will be subject to seasonal fluctuation and affected by the water level in Georgian Bay. The current water level in Lake Huron is at approximate El. 177.5 m.

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

1. The topsoil must be removed for site development.
2. The existing earth fill is not suitable for supporting any structure sensitive to settlement.
3. The peat, alluvium and the soft clay stratum will undergo long-term settlement under additional loading.
4. The peat and alluvium are compressible and they will generate methane gas under an anaerobic condition.
5. If the site will be regraded with additional earth filling for development, the compressible peat and alluvium must be removed before filling. The existing earth fill can be subexcavated, inspected, sorted free of topsoil inclusions and deleterious materials, and properly compacted in layers. The anticipated settlement in the soft clay should be monitored before the construction of site services, building and pavement.
6. To speed up the settlement in the soft clay stratum, the pregrading area can be rough graded with an engineered fill and preloaded with an earth embankment. The earth embankment can be removed for construction after the ground settlement is complete.
7. After the clay is preloaded, only limited bearing pressures are recommended for the design of conventional footings founded on the engineered fill. Alternatively, the proposed building can be supported on deep foundations of helical piers, micropiles or drilled concrete piers (caissons).
8. In case the construction schedule does not allow the consolidation of clay to complete or in case the compressible peat and alluvium will be left in place, beneath the service trenches or on-grade structures, Geopiers or Menard’s controlled modulus column

(CMC) can be installed for soil improvement of the slab-on-grade and along the services to prevent long-term settlement.

9. Groundwater seepage in excavations can be collected into sump pits and removed by conventional pumping. If the alluvium and peat is to be removed for the engineered fill construction, the excavation will require dewatering and the use of sheet piling to isolate the excavation to prevent continuous groundwater moving into the excavation. Additional test pits can be completed to assess the excavation condition.
10. Bottom heaving may occur in deep excavation extending into the soft clay. Any excavation extending below 3 m must be cut at 1 vertical:2 horizontal or flatter and the spoil must be placed at a distance at least 2 times the depth of the excavation. In sheet piled excavation, the sheet piles should extend sufficiently to a cut-off depth to prevent bottom heaving.

The recommendations appropriate for the project 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 **Site Preparation**

The site grading plan of the development has not been finalized at the time of report preparation. A review of the site grading plan is necessary for the assessment of pregrading and/or preloading requirement for construction.

If the site will be regraded with additional earth fill, the existing topsoil, the compressible peat and alluvium must be removed. The existing earth fill must be subexcavated, inspected, sorted free of topsoil inclusions and deleterious materials, and properly compacted in layers. Long-term ground settlement in the soft clay is anticipated. It should be monitored for confirmation of completion before the construction of site services, building, underground structures and pavement. The settlement can be sped up by preloading the area with an earth embankment above the final grade level and the installation of wick drains. A review of the site grading plan is necessary for the assessment of pregrading or preloading requirement.

According to the borehole findings, the excavation of earth fill, peat and alluvium will extend into the clay stratum at the approximate depths of 2.3 to 5.6 m from grade. Dewatering and the use of sheet piling will be necessary for the excavation.

The engineering requirements for a certifiable fill for construction of municipal services, pavement and lightly loaded structures are presented below:

1. The existing topsoil must be removed. All the existing peat, alluvium and earth fill must also be removed. The subgrade must be inspected to be free of organic soils prior to any fill placement.
2. Inorganic soils must be used for the fill and they must be uniformly compacted in lifts of 20 cm thick to 98% or + of their maximum Standard Proctor dry density up to the proposed finished grade. The soil moisture must be 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% of the maximum Standard Proctor compaction.
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 any deleterious material with environmental issue (contamination). Any potential imported earth fill from off-site must be reviewed for geotechnical and environmental quality by the appropriate personnel as authorized by the developer or agency, before it is hauled to the site.
5. If the engineered fill is to be left over the winter months, adequate earth cover or equivalent must be provided for protection against frost action.
6. The 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 they must be precisely documented by qualified surveyors.
7. Foundations partially on engineered fill must be reinforced in the footings and the foundation walls, designed by a structural engineer, to properly distribute the stress induced by the abrupt differential settlement between the natural soils and the engineered fill.
8. The engineered fill must not be placed during the period from late November to early April, when freezing ambient temperatures occur. 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 1V:3H, 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.
12. The footings 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. Any excavation carried out in certified engineered fill 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.
14. 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.

6.2 Foundations

The following options can be considered for the foundations of the proposed hotel:

Option 1 - Engineered Fill

If the existing subsoil is modified with an engineered fill, as described in Section 6.1, a raft foundation with structural slab-on-grade can be considered on the engineered fill. As a general guide, the recommended soil bearing pressures of 50 to 60 kPa (Serviceability Limit State) and 100 kPa (Ultimate Limit State) can be used for the design of the raft foundation, having the Modulus of Subgrade Reaction of 10 MPa/m. The total and differential settlements of the raft are estimated within 30 mm and 20 mm, respectively.

The foundation subgrade must be inspected by a geotechnical engineer, or a geotechnical technician under the supervision of a geotechnical engineer, to assess its suitability for bearing the designed foundations. A concrete mud-slab should be placed on the bearing surface to prevent construction disturbance and costly rectification during the construction of the raft foundation.

The ground floor slab can be supported on a granular bedding above the raft foundation. The bedding may consist of 20-mm Crusher-Run Limestone, or equivalent, where the underground service pipes will be laid, compacted to its maximum Standard Proctor dry density.

Option 2 - Deep Foundation

If the earth fill, slag fill, peat and alluvium are to be left in place, ground settlement can be anticipated under the building structure. Deep foundations of Helical piers, micropiles or drilled concrete piers (caissons) can be considered for supporting the proposed building structure.

The piles will extend into the very dense or hard till deposit at a depth ranging from 17 to 20 m from grade, or El. 159 to 163 m. The design load of Helical Piers and micropiles can be assessed by the prospective foundation contractor in these specialties. Full scale load test in the field must be conducted to confirm the load carrying characteristics of piles.

The capacity of caissons extending into the very dense or hard stratum can be determined using the recommended end bearing pressures:

- Maximum Axial End Bearing Pressure (Serviceability Limit State) = 800 kPa
- Factored End Bearing Capacity (Ultimate Limit State) = 1200 kPa

Prospective contractor of deep foundation must assess the subsoil conditions for the suitability of construction into the ground. Steel liners will be necessary for construction in order to prevent any groundwater from entering or soil caving into the shaft.

The piles must be supervised and inspected by either a geotechnical engineer, or a geotechnical technician under the supervision of a geotechnical engineer, to ensure that the construction of piles are compatible with the foundation design requirements.

Where the peat and alluvium are to be left in place, a passive venting system will be required beneath the building structure to prevent any gas migration into the structure. Structural slab and grade beams will also be required for supporting the ground floor slab.

Option 3 - Soil Improvement

Geopiers or Menard’s controlled modulus column (CMC) can be considered for the building foundation. Once completed, the proposed structures can be constructed with conventional footings and slab-on-grade at the desired elevation. A specialist contractor can be consulted for this alternative.

Where the organic layers are to be left in place, a passive venting system will be required beneath the building structure to prevent any gas migration into the structure.

Other Recommendations

In unheated areas, the perimeter footings and grade beams should have at least 1.8 m of earth cover for protection against frost action, unless they are properly insulated. In order to alleviate the risk of frost damage, the foundation walls must be constructed of concrete and either backfilled with non-frost susceptible granular material, or shielded with a polyethylene slip-membrane. The membrane will allow vertical movement of the heaving soil (due to frost) without imposing structural distress on the foundation.

The building foundation must meet the requirements specified in the latest Ontario Building Code. As a guide, the structures should be designed to resist an earthquake force using the following Site Classifications:

- Site Classification 'C' for deep foundations
- Site Classification 'D' for footings on Geopiers or CMC, with soil improvement.
- Site Classification 'E' for raft foundations on engineered fill

An accurate Site Classification can be determined by Shear Wave Velocity Test to be performed by a Geophysical specialist.

Concrete sidewalk at the entrances into the building should be insulated with 50-mm Styrofoam, or equivalent. This measure is to prevent cold drafts in the winter from inducing frost action in the subgrade and causing damage to the sidewalk.

The ground adjacent to the building and sidewalk must be graded to direct water away from the structure to minimize the frost heave phenomenon generally associated with the disclosed soils.

6.3 **Underground Services**

Under additional earth fill for site grading, the soft clay stratum will undergo long-term settlement; therefore, the site must be pregraded to the finished grade and the ground settlement must be monitored by settlement plates such that the long-term settlement will be reduced to a tolerable level.

When the monitoring of ground settlement is complete, showing the settlement becomes insignificant, the underground service pipes can be installed on competent ground below the existing earth fill, compressible peat and alluvium. Any incompetent soil below the pipe invert must be subexcavated and replaced with compacted earth fill or bedding material.

A Class 'B' bedding, consisting of compacted 20-mm Crusher-Run Limestone, or equivalent, is recommended for the service pipes. In water-bearing soils or where the subgrade needs to be stabilized, a Class 'A' concrete bedding will be required. Alternatively, the wet subgrade should be lined with a geofabric filter to prevent the migration of finer particles into the granular bedding.

In case the construction schedule does not allow monitoring or consolidation of the clay stratum, or the service pipes will be founded above the compressible peat or alluvium, geopiers can be installed for soil improvement along the service trenches to prevent long-term settlement in the service pipes, manholes and connections.

Openings to subdrains and catch basins should be shielded with geofabric filter to prevent blockage by silting. Sewer joints in water-bearing sands and silt should be leak-proof or wrapped with waterproof membrane to prevent subgrade migration.

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.

For estimation purposes for the anode weight requirements, the estimated electrical resistivities given for the disclosed soils can be used. The proposed anode weight must meet the minimum requirements as specified by the Town of Midland and the County of Simcoe.

6.4 **Backfilling in Trenches and Excavated Areas**

Only inorganic soils can be used for service trench and structural backfill.

The on site soils are generally too wet for compaction and they will require aeration by spreading them thinly on the ground in dry and warm weather conditions. Saturated sand may be stockpiled to drain the excessive water before placement and compaction.

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 pavement subgrade, the material should be compacted with the water content 2% to 3% drier than the optimum, and the compaction should be increased to at least 98% of the respective maximum Standard Proctor dry density. This is to provide the required stiffness for pavement construction. In the lower zone, the compaction should be carried out on the wet side of the optimum; this allows a wider latitude of lift thickness.

The narrow trenches for services crossing should be cut at 1 vertical:2 or + horizontal so that the backfill can be effectively compacted. Otherwise, soil arching will prevent the achievement of proper compaction. The lift of each backfill layer should either be limited to a thickness of 20 cm, or the thickness should be determined by test strips.

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. Furthermore, the freezing condition will prevent flooding of the backfill when it is required, such as in a narrow vertical trench section, or when the trench box is removed. The above will invariably cause backfill settlement that may become evident within 1 to several years, depending on the depth of the trench which has been backfilled.
- In areas where 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 for the pavement and slab repairs.
- 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.

6.5 **Swimming Pool and Tennis Court**

An in-ground swimming pool and a tennis court are proposed on site. Due to the presence of peat, alluvium, earth fill and unsuitable material, ground settlement is anticipated in the proposed structures unless the compressible material is removed, backfilled with engineered fill and allowed for settlement with monitoring from the settlement plates.

If the alluvium, earth fill and unsuitable material can be removed and replaced with an engineered fill to the finished grade, the swimming pool and tennis court can be constructed on the engineered fill after rough grading and/or preloading, as described in Section 6.1.

Alternatively, the swimming pool can be constructed on piles or piers as described in Section 6.2.

If the area of the tennis court is not rectified by replacing the unsuitable material with an engineered fill, non-uniform ground settlement can be anticipated. Future maintenance and repairs will be necessary with time to rectify the cracks developed due to the ground movement.

The light poles and fence posts should extend to the sufficient depth to ensure lateral stability and uplift resistance. The coefficient of shaft resistance of 10 kPa can be used between the concrete pier and the subsoil.

It should be noted that, due to the seasonal effects of freezing and thawing, the soil resistance within the frost penetration depth of 1.8 m must be neglected. The recommended earth pressure coefficients for the estimation of soil pressures and soil resistance are provided in Section 6.7, Table 4.

For the construction of drilled piers, a temporary steel liner will be required to prevent groundwater and soil caving into the shaft at the time of drilling. The liner can be removed after the pier is filled with concrete.

6.6 Pavement Design

The existing peat and alluvium will be subject to settlement unless it is removed and replaced with an engineered fill. Following the completion of site grading and settlement monitoring, the recommended pavement structure for the parking lot and the access driveway is given in Table 3.

Table 3 - Pavement Design

Course	Thickness (mm)	OPS Specifications
Asphalt Surface	40	HL-4
Asphalt Binder Light-Duty Parking Heavy-Duty and Fire Route	 45 65	HL-8
Granular Base	150	OPSS Granular 'A' or equivalent
Granular Sub-base Light-Duty Parking Heavy-Duty and Fire Route	 300 400	OPSS Granular 'B' or equivalent

After fine grading, the pavement subgrade must be proof-rolled. Any soft spot as identified must be rectified by subexcavation and replaced with dry inorganic material, compacted to the specified density. In the zone within 1.0 m below the pavement, the fill must be compacted to

98% or + of its maximum Standard Proctor dry density, with the moisture content 2% to 3% drier than the optimum.

The granular bases should be compacted to 100% of their maximum Standard Proctor dry density.

In order to prevent infiltrated precipitation from seeping into the granular bases, since this may inflict frost damage on the pavement, swales or an intercept subdrain system should be installed along the perimeter where surface runoff may drain onto the pavement. In paved areas, catch basins with stub drains in all four directions should be provided.

The stub drains and subdrains should drain into the catch basin through filter-sleeved weepers. The invert of the subdrains should be at least 0.4 m beneath the underside of the granular sub-base and should be backfilled with free-draining granular material.

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/m³)**		**Estimated Bulk Factor**	
	Bulk	**Submerged**	**Loose**	**Compacted**
Earth Fill	20.5	10.5	1.20	0.98
Silty Clay, Sand and Silt	21.0	11.0	1.25	1.00
Sound Tills	22.5	12.5	1.30	1.03

Lateral Earth Pressure Coefficients	**Active K_a**	**At Rest K_o**	**Passive K_p**
Silty Clay	0.44	0.60	2.20
Compacted Earth Fill, Sand and Silt	0.40	0.60	2.50
Sound Tills	0.35	0.50	3.00

Coefficients of Friction	
Between Concrete and compacted Earth Fill or native Soil	0.30
Between Concrete and Granular Base	0.50

Maximum Allowable Soil Pressure (SLS) For Thrust Block Design	
Sound native Soils or Engineered Fill	25 kPa

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 Tills	2
Firm to stiff Silty Clay, dewatered Earth Fill, Silt and Sand	3
Saturated Soils and very soft to soft Silty Clay	4

Groundwater seepage in excavations can be collected into sump pits and removed by conventional pumping. The groundwater yield from any excavation extending below the saturation level will be moderate to persistent, due to the close proximity of the water front. The excavation will require isolation with cofferdams or sheet piling extending into the low permeable clay stratum, in associated with a dewatering system in the excavation. Additional test pits can be completed to assess the excavation condition. The appropriate dewatering method should be assessed by test pumping at the site.

Bottom heaving may occur in deep excavation extending into the soft clay. Any excavation extending below 3 m must be cut at 1V:2H or flatter and the spoil must be placed at a distance at least 2 times the depth of the excavation. In sheet piled excavation, the sheet piles should extend sufficiently to a cut-off depth to prevent bottom heaving.

6.9 Field Monitoring of Performance

It is recommended that close monitoring of vertical and lateral movement of the shoring walls should be carried out and frequent site inspections be conducted to ensure that the excavation does not adversely affect the structural stability of the adjacent buildings and the existing underground utilities. Extra bracing or support may be required if any movement is found excessive. The contractor should maintain the shoring to ensure any movement is within the design limit.

Vibration control and pre-construction survey is strongly recommended for the adjacent properties and structures prior to any excavation activities at the site. The survey will provide baseline data for assessing any future claims for damages. Our office can provide further advice or undertake the vibration control and pre-construction survey, as necessary.

7.0 LIMITATIONS OF REPORT

This report was prepared by Soil Engineers Ltd. for the account of Lanarose Midland Ltd., for review by the designated agents, consultants, financial institutions, and government agencies. Use of the report is subject to the conditions and limitations of the contractual agreement. The material in the report reflects the judgment of Kelvin Hung, P.Eng., and Bennett Sun, P.Eng., in light of the information available to it at the time of preparation. Any use which a Third Party makes of this report, and/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.

LICENSED PROFESSIONAL ENGINEER
03/31/2020
K. W. K. HUNG
100124295
PROVINCE OF ONTARIO

SOIL ENGINEERS LTD.

Kelvin Hung, P.Eng.

P.l. Bennett Sun, P.Eng.
KH/BS

LIST OF ABBREVIATIONS AND DESCRIPTION OF TERMS

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

SAMPLE TYPES

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

PENETRATION RESISTANCE

Dynamic Cone Penetration Resistance:

A continuous profile showing the number of blows for each foot of penetration of a 2-inch diameter, 90° point cone driven by a 140-pound hammer falling 30 inches.

Plotted as '—•—'

Standard Penetration Resistance or 'N' Value:

The number of blows of a 140-pound hammer falling 30 inches required to advance a 2-inch O.D. drive open sampler one foot into undisturbed soil.

Plotted as '○'

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

SOIL DESCRIPTION

Cohesionless Soils:

'N' (blows/ft)	Relative Density
0 to 4	very loose
4 to 10	loose
10 to 30	compact
30 to 50	dense
over 50	very dense

Cohesive Soils:

Undrained Shear Strength (ksf)	'N' (blows/ft)	Consistency
less than 0.25	0 to 2	very soft
0.25 to 0.50	2 to 4	soft
0.50 to 1.0	4 to 8	firm
1.0 to 2.0	8 to 16	stiff
2.0 to 4.0	16 to 32	very stiff
over 4.0	over 32	hard

Method of Determination of Undrained Shear Strength of Cohesive Soils:

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

For a saturated cohesive soil, the undrained shear strength is taken as one half of the undrained compressive strength

METRIC CONVERSION FACTORS

1 ft = 0.3048 metres

1lb = 0.454 kg

1 inch = 25.4 mm

1ksf = 47.88 kPa

Soil Engineers Ltd.
CONSULTING ENGINEERS
GEOTECHNICAL • ENVIRONMENTAL • HYDROGEOLOGICAL • BUILDING SCIENCE

JOB NO.: 1911-S109

LOG OF BOREHOLE NO.: 201

FIGURE NO.: 1

PROJECT DESCRIPTION: Proposed Hotel

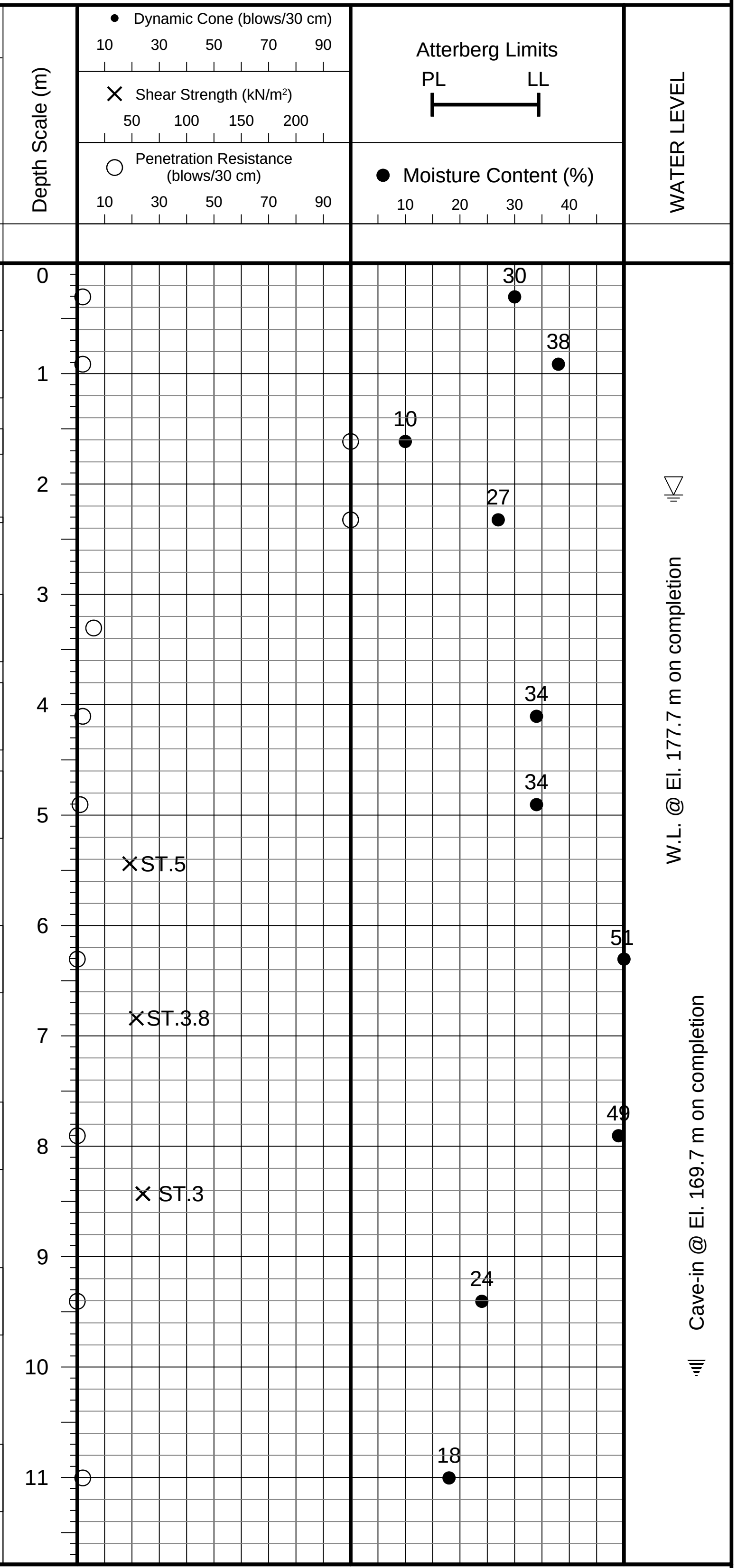
METHOD OF BORING: Hollow-Stem

PROJECT LOCATION: Block 76 - Bayport Village, Town of Midland

DRILLING DATE: January 8 & 9, 2020

El. (m) Depth (m)	SOIL DESCRIPTION
179.8	Ground Surface
0.0	Brown **EARTH FILL** silty clay
178.4 1.4	**SLAG FILL**
176.8 3.0	Brown **ALLUVIUM** (Inferred - No recovery)
176.1 3.7	Grey, soft to very soft **SILTY CLAY** low to medium plasticity a trace of sand occ. sand seams and layers
169.7 10.1	Brown, very loose, disturbed **SAND** saturated,fine- to fine-to-medium grained some silt to silty, a trace of gravel *Cont'd on next page*
168.1	

SAMPLES		
Number	Type	N-Value
1	DO	2
2	AS	2
3	DO	100+
4	DO	100+
5	DO	6
6	DO	2
7	DO	1
8	DO	0
9	DO	0
10	DO	0
11	DO	2



JOB NO.: 1911-S109

LOG OF BOREHOLE NO.: 201

FIGURE NO.: 1

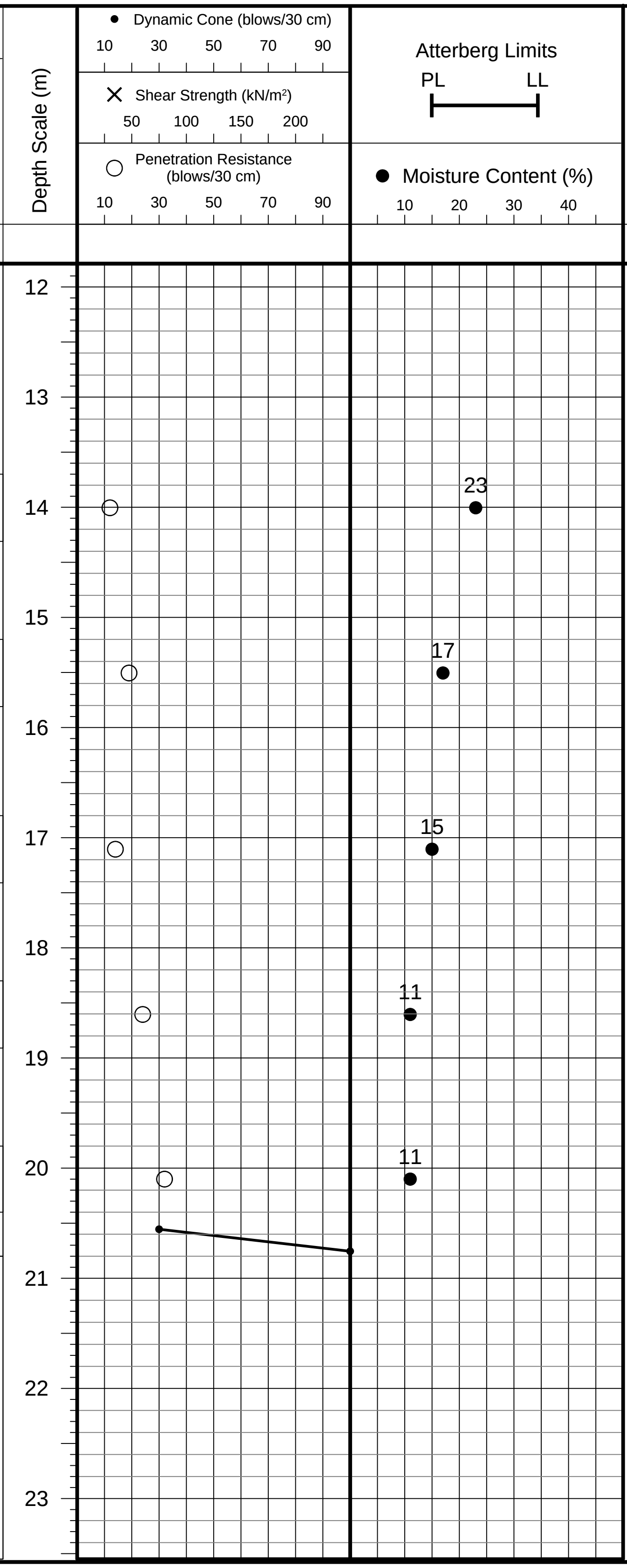
PROJECT DESCRIPTION: Proposed Hotel

METHOD OF BORING: Hollow-Stem

PROJECT LOCATION: Block 76 - Bayport Village, Town of Midland

DRILLING DATE: January 8 & 9, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
11.7	Brown, compact, saturated sand backed up to 6.0 m during augering at 12.2 m **SAND** fine- to fine-to-medium grained some silt to silty, a trace of gravel	12	DO	12
		13	DO	19
		14	DO	14
		15	DO	24
160.4 19.4	Grey, dense **SILTY SAND TILL** with frequent cobbles and boulders	16	DO	32
159.4 20.4	**END OF BOREHOLE**			
159.0 20.8	**END OF CONE PENETRATION TESTS**			



WATER LEVEL

Soil Engineers Ltd.

JOB NO.: 1911-S109

LOG OF BOREHOLE NO.: 202

FIGURE NO.: 2

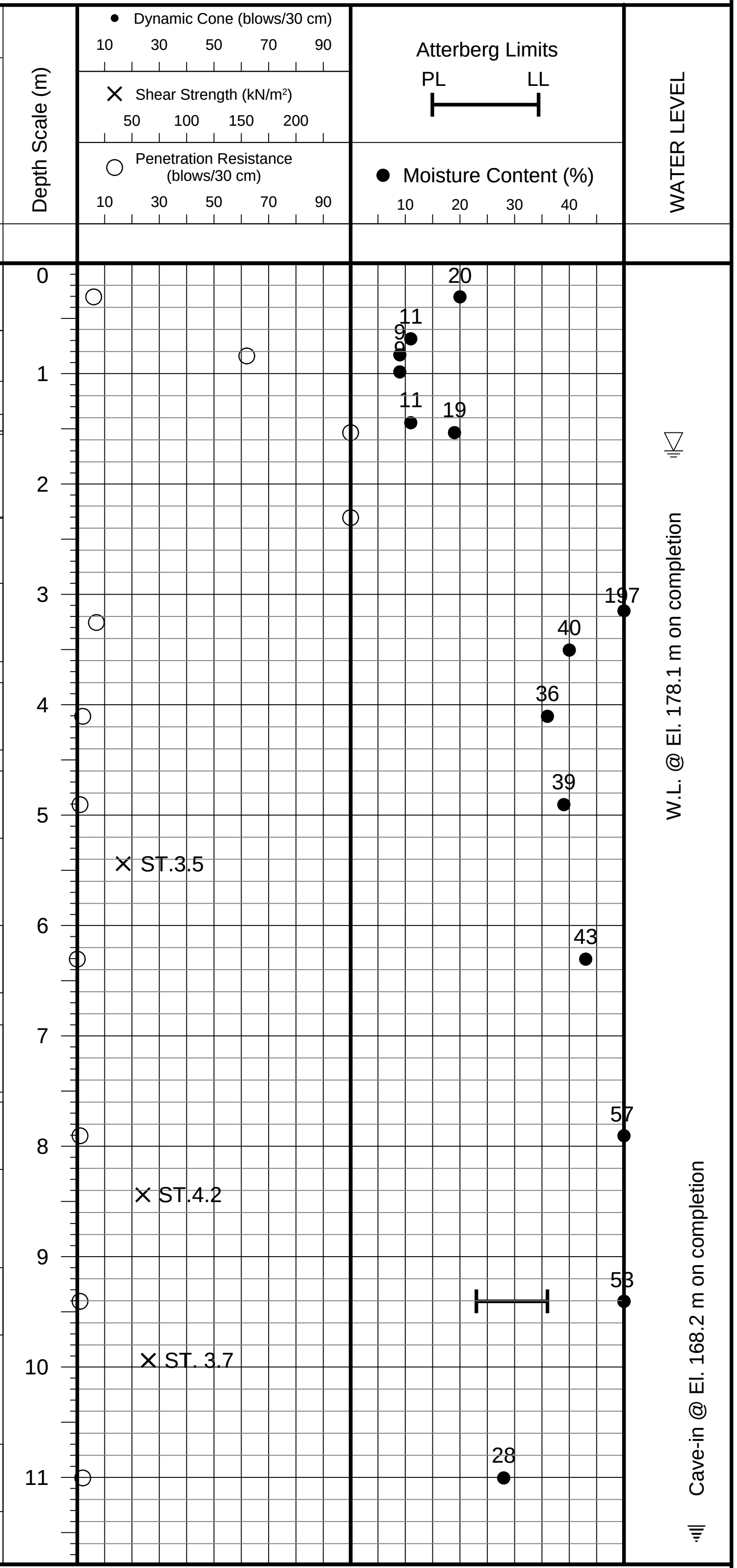
PROJECT DESCRIPTION: Proposed Hotel

METHOD OF BORING: Hollow-Stem

PROJECT LOCATION: Block 76 - Bayport Village, Town of Midland

DRILLING DATE: January 10, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES		
		Number	Type	N-Value
179.8	Ground Surface			
0.0	Brown **EARTH FILL** sand with clay pockets	1	DO	6
178.9 0.9	topsoil layer	2A 2B 2C	DO	62
	SLAG FILL	3	AS	-
		4	DO	100+
		5	DO	100+
176.9 2.9	**PEAT LAYER**	6A	DO	7
176.4 3.4	Brown **ALLUVIUM** sandy silt with peat seams and plant debris	6B		
176.0 3.8	Grey, soft to very soft **SILTY CLAY** low to medium plasticity a trace of sand occ. sand seams and layers	7	DO	2
		8	DO	1
		9	DO	0
		10	TO	-
		11	DO	1
		12	DO	1
		13	DO	2
168.1	*Cont'd on next page*			



JOB NO.: 1911-S109

LOG OF BOREHOLE NO.: 202

FIGURE NO.: 2

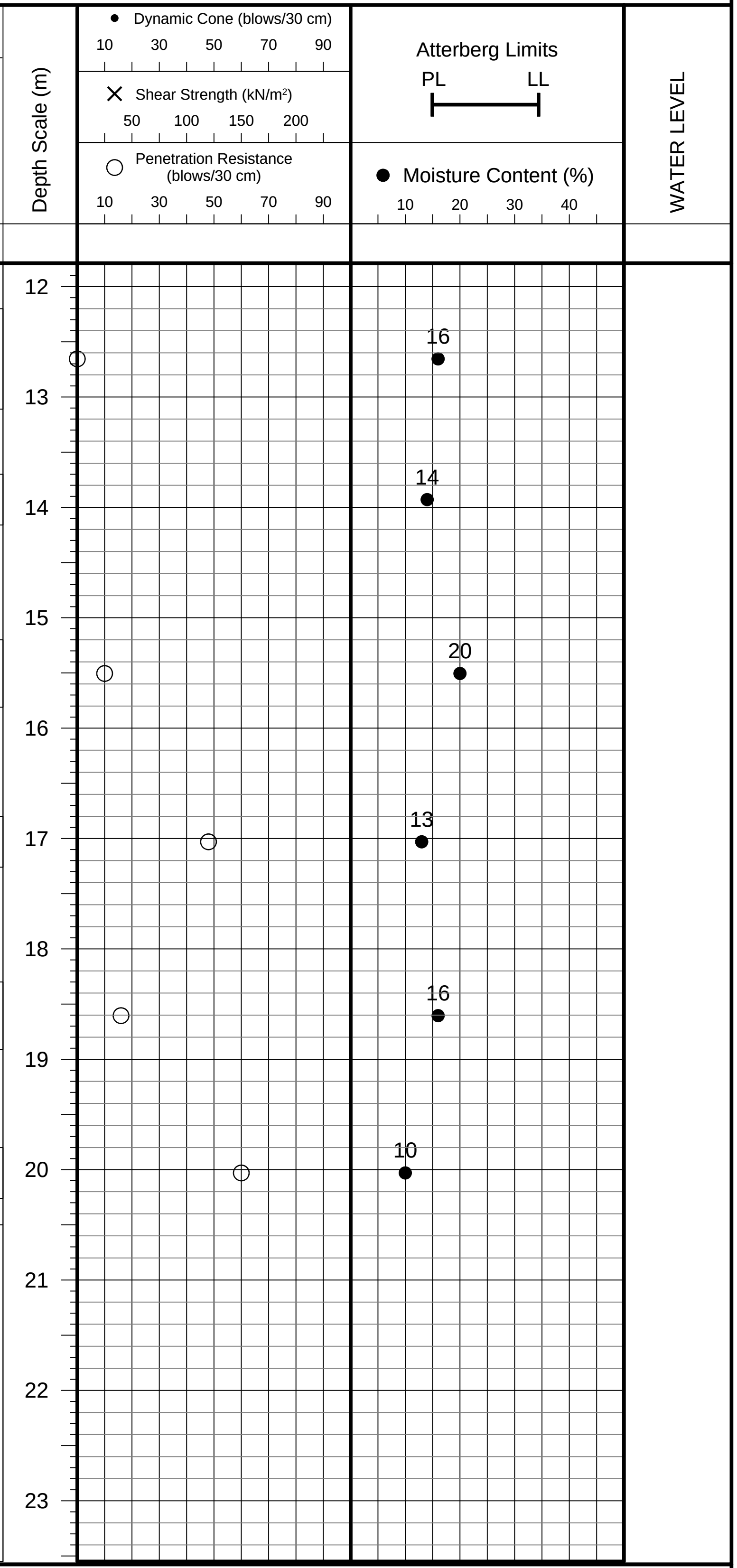
PROJECT DESCRIPTION: Proposed Hotel

METHOD OF BORING: Hollow-Stem

PROJECT LOCATION: Block 76 - Bayport Village, Town of Midland

DRILLING DATE: January 10, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
11.7	Grey, very loose to dense, saturated			
	sand backed up to 6.0 m during augering at 13.7 m	14	DO	0
	SAND	15	DO	-
	fine- to fine-to-medium grained some silt to silty, a trace of gravel	16	DO	10
		17	DO	48
		18	DO	16
160.4 19.4	Grey, very dense **SILTY SAND TILL** with frequent cobbles and boulders	19	DO	60
159.3 20.5	**END OF BOREHOLE** Refusal to augering, probable bedrock			



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JOB NO.: 1911-S109

LOG OF BOREHOLE NO.: 203

FIGURE NO.: 3

PROJECT DESCRIPTION: Proposed Hotel

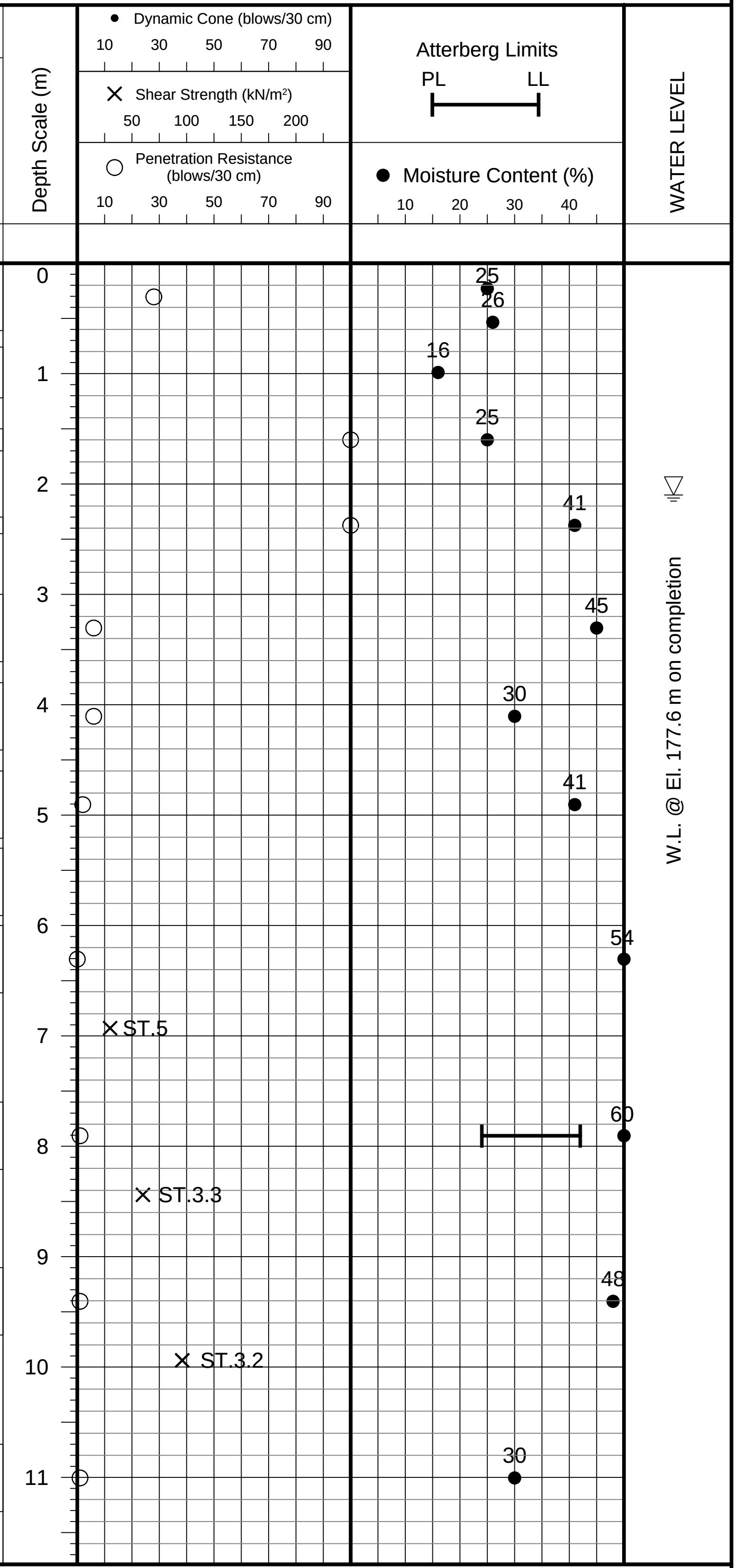
METHOD OF BORING: Hollow-Stem/
Tri-Cone

PROJECT LOCATION: Block 76 - Bayport Village, Town of Midland

DRILLING DATE: January 13 & 14, 2020

El. (m) Depth (m)	SOIL DESCRIPTION
179.7	Ground Surface
0.0	Brown **EARTH FILL** silty clay with rootlets, wood debris, slag and topsoil pockets
179.2 0.5	**SLAG FILL**
177.0 2.7	Dark brown **EARTH FILL** sand with wood debris
176.0 3.7	Grey, firm to very soft **SILTY CLAY** low to medium plasticity a trace of sand occ. silt seams and layers
168.0	*Cont'd on next page*

SAMPLES		
Number	Type	N-Value
1A	DO	28
1B		
2	AS	-
3	DO	100+
4	DO	100+
5	DO	6
6	DO	6
7	DO	2
8	TO	-
9	DO	0
10	DO	1
11	DO	1
12	DO	1



JOB NO.: 1911-S109

LOG OF BOREHOLE NO.: 203

FIGURE NO.: 3

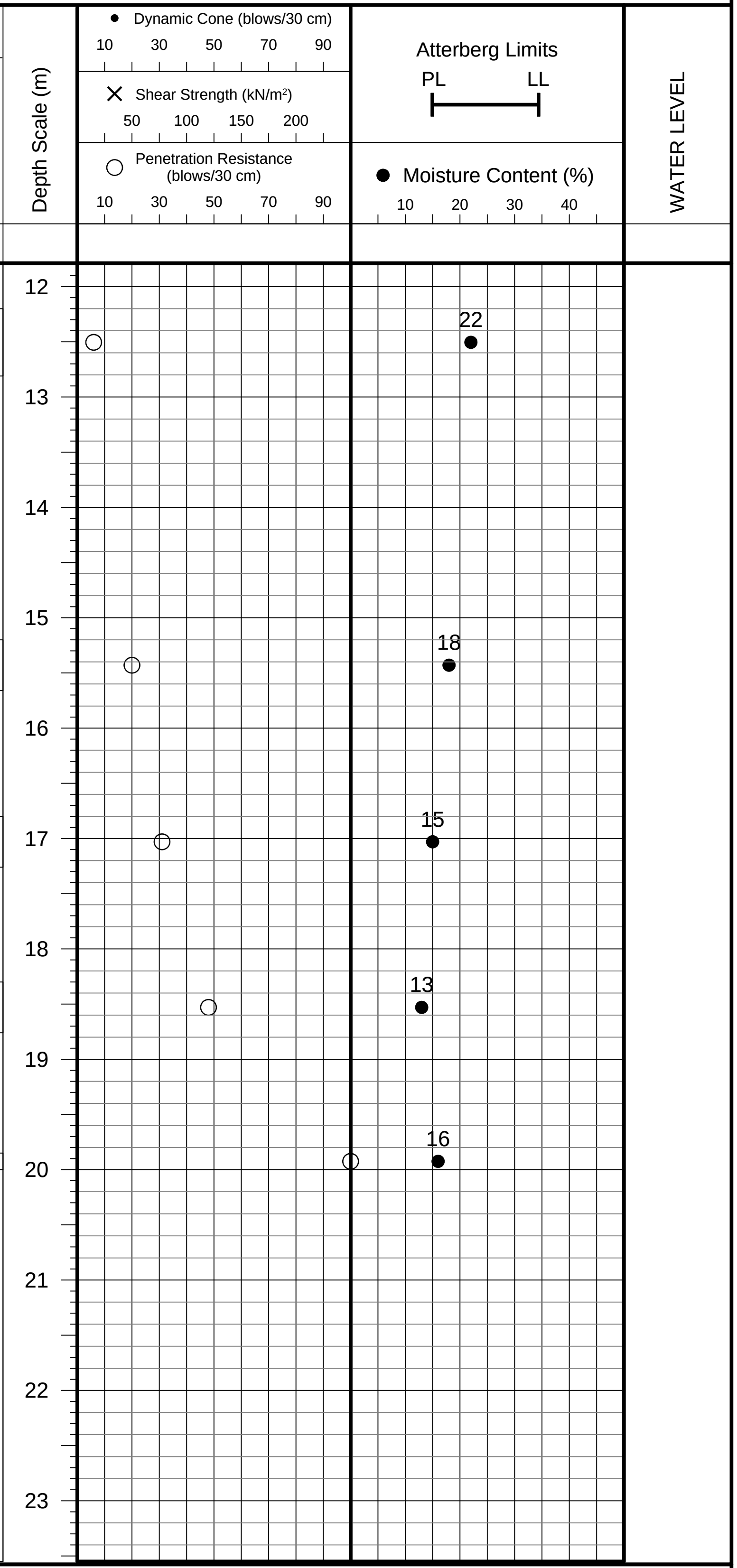
PROJECT DESCRIPTION: Proposed Hotel

METHOD OF BORING: Hollow-Stem/
Tri-Cone

PROJECT LOCATION: Block 76 - Bayport Village, Town of Midland

DRILLING DATE: January 13 & 14, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES		
		Number	Type	N-Value
11.7	Brown, loose to compact, saturated			
	sand backed up to 0.9 m during augering at 13.7 m	13	DO	6
	SAND			
	fine- to fine-to-medium grained some silt to silty, a trace of gravel			
		14	DO	20
163.5 16.2	Grey, dense to very dense			
		15	DO	31
	SILTY SAND TILL			
	with frequent cobbles and boulders	16	DO	48
		17	DO	100+
159.7 20.0	**END OF BOREHOLE**			



JOB NO.: 1911-S109

LOG OF BOREHOLE NO.: 204

FIGURE NO.: 4

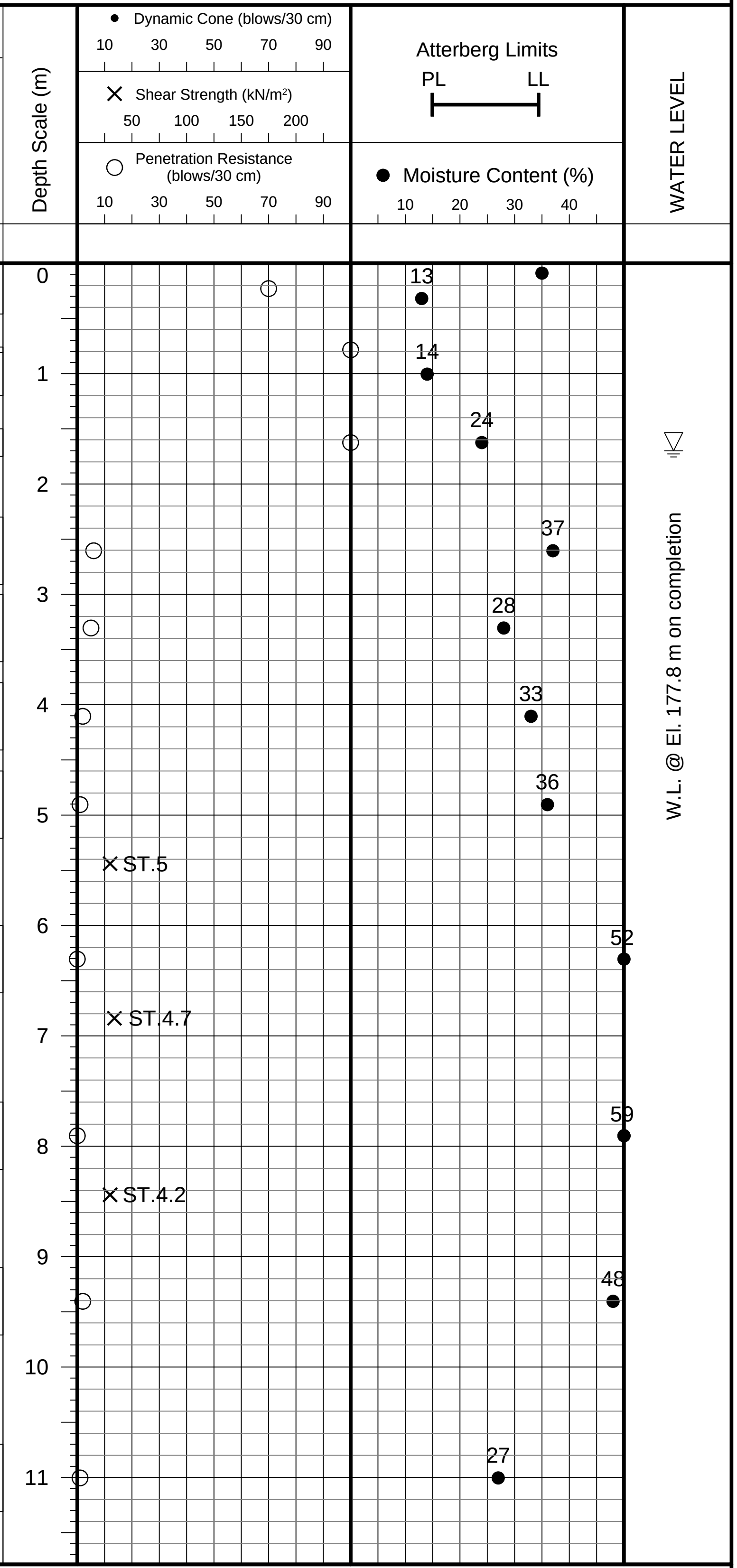
PROJECT DESCRIPTION: Proposed Hotel

METHOD OF BORING: Hollow-Stem/ Tri-Cone

PROJECT LOCATION: Block 76 - Bayport Village, Town of Midland

DRILLING DATE: January 14 & 15, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
179.5	Ground Surface			
0.0	**18 cm TOPSOIL**	1A 1B	DO	70
	SLAG FILL	2	DO	100+
		2A	AS	-
		3	DO	100+
		4	DO	6
176.5 3.0	Brown **ALLUVIUM** sandy silt with peat seams, rootlets and plan debris	5	DO	5
175.7 3.8	Grey, soft to very soft **SILTY CLAY** low to medium plasticity a trace of sand occ. silt seams and layers	6	DO	2
		7	DO	1
		8	DO	0
		9	DO	0
		10	DO	2
		11	DO	1
167.8	*Cont'd on next page*			



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JOB NO.: 1911-S109

LOG OF BOREHOLE NO.: 204

FIGURE NO.: 4

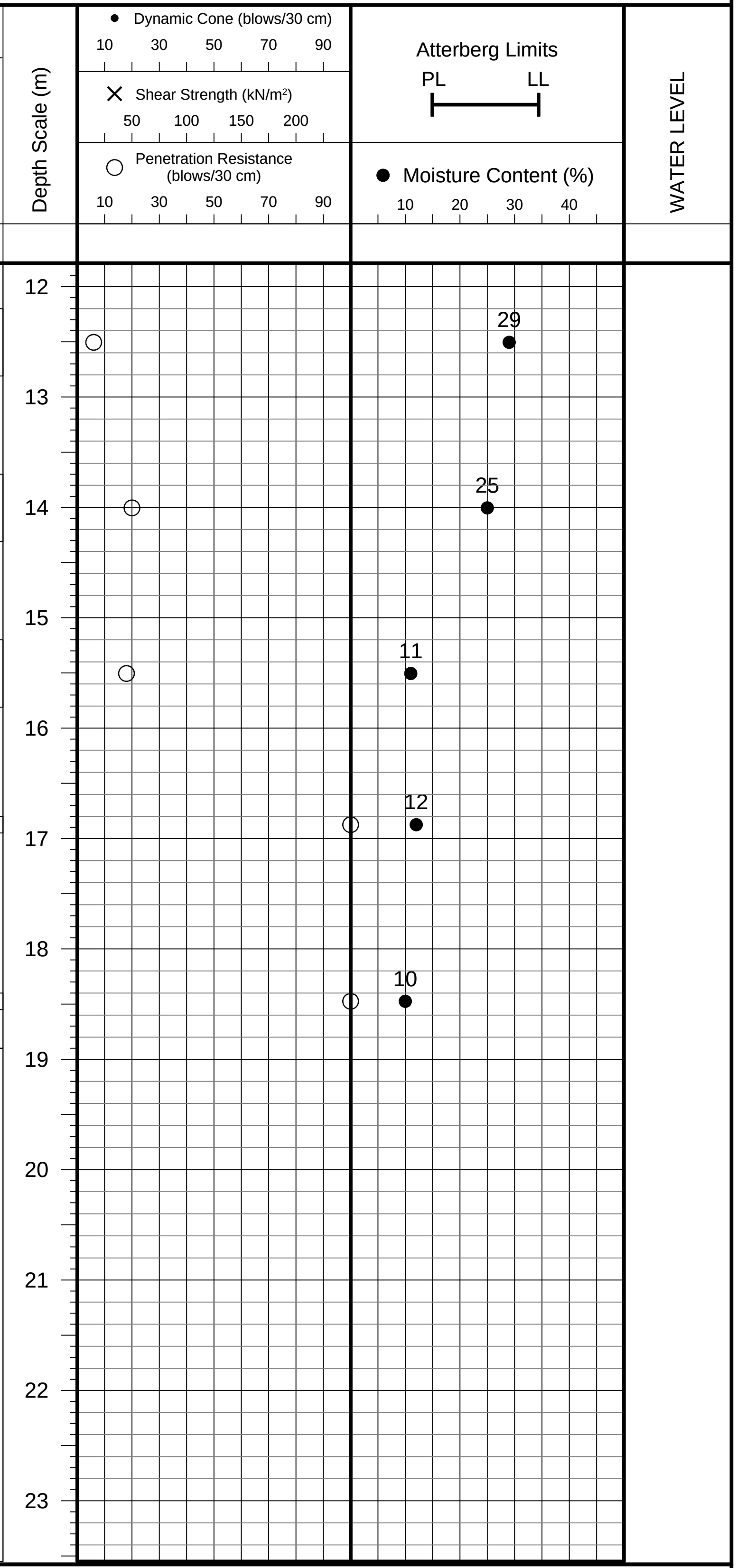
PROJECT DESCRIPTION: Proposed Hotel

METHOD OF BORING: Hollow-Stem/ Tri-Cone

PROJECT LOCATION: Block 76 - Bayport Village, Town of Midland

DRILLING DATE: January 14 & 15, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES		
		Number	Type	N-Value
11.7	Brown, loose to compact, saturated			
		12	DO	6
	SAND			
	fine- to fine-to-medium grained some silt to silty, a trace of gravel	13	DO	20
164.7 14.8	Brown, compact to very dense			
		14	DO	18
	SILTY SAND TILL	15	DO	100+
	with frequent cobbles and boulders			
		16	DO	100+
160.6 18.9	**END OF BOREHOLE**			



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JOB NO.: 1911-S109

LOG OF BOREHOLE NO.: 205

FIGURE NO.: 5

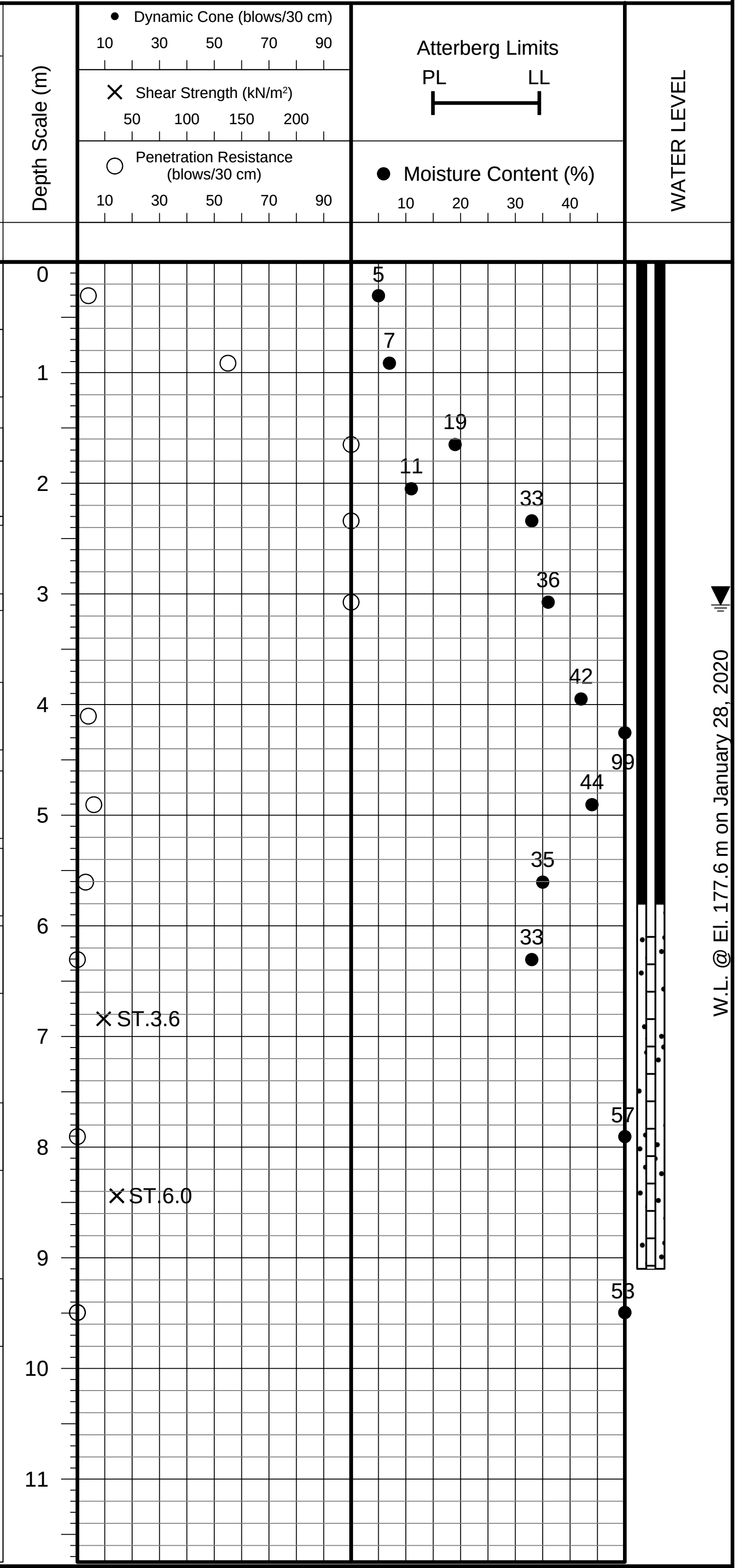
PROJECT DESCRIPTION: Proposed Hotel

METHOD OF BORING: Hollow-Stem

PROJECT LOCATION: Block 76 - Bayport Village, Town of Midland

DRILLING DATE: January 16, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
180.7	Ground Surface			
0.0	Brown to dark brown **EARTH FILL** sand with slag inclusions and rootlets	1	DO	4
		2	AS	55
		3	DO	100+
		4	AS	-
178.4 2.3	**SLAG FILL**	5	DO	100+
		6	DO	100+
177.0 3.7	Grey **EARTH FILL** sand, saturated	7A	DO	4
176.6 4.1	**PEAT LAYER**	7B		
176.2 4.5	Brown **ALLUVIUM** sandy silt with rootlets and plant debris	8	DO	6
175.4 5.3	Very soft to soft **SILTY CLAY** low to medium plasticity a trace of sand occ. silt seams and layers brown grey	9	DO	3
		10	DO	0
		11	DO	0
		12	DO	0
170.9 9.8	**END OF BOREHOLE** Installed 50 mm Ø monitoring well to 9.1 m completed with 3.0 m screen Sand backfill from 5.8 m to 9.1 m Bentonite seal from 0.0 m to 5.8 m Provided with a protective steel casing.			



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JOB NO.: 1911-S109

LOG OF BOREHOLE NO.: 206

FIGURE NO.: 6

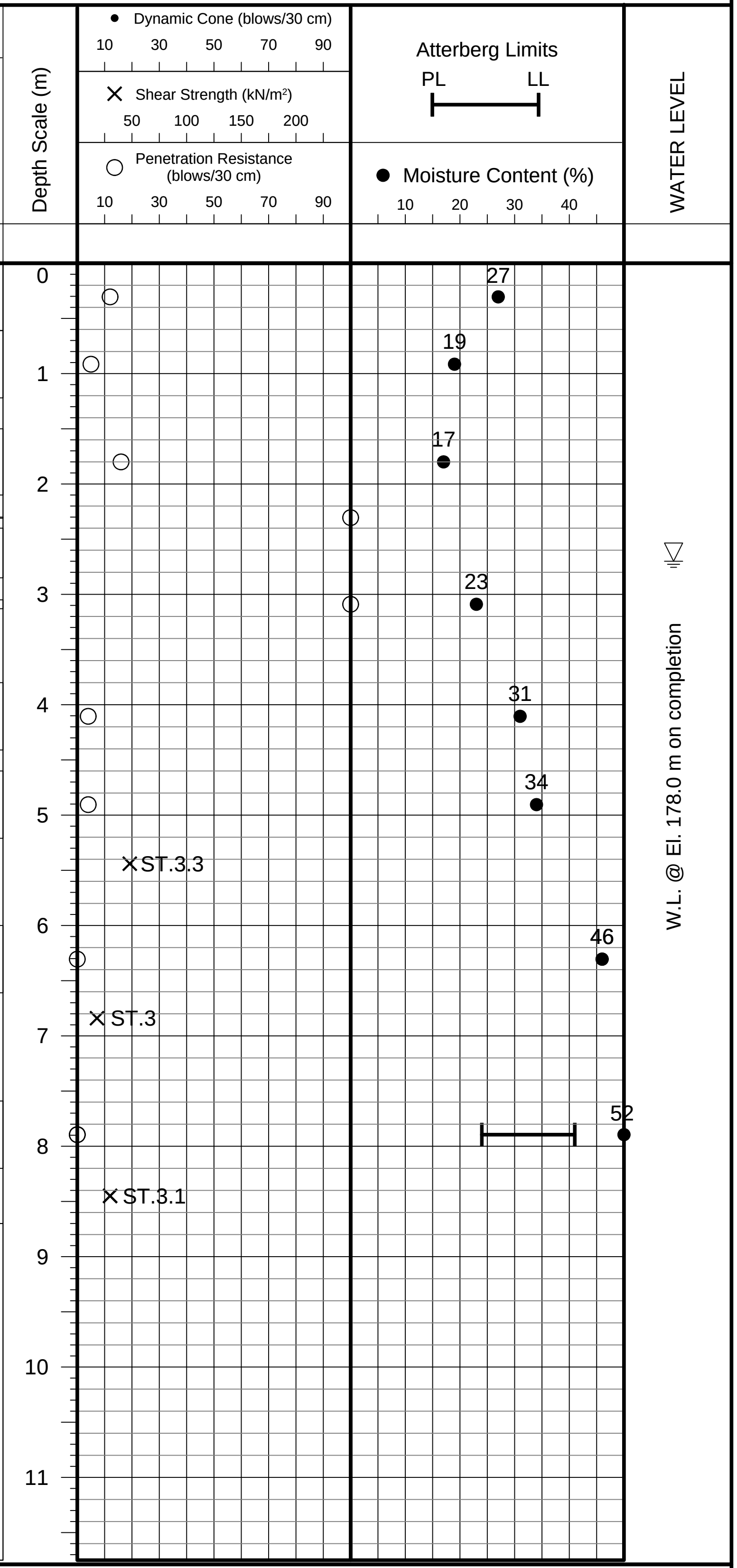
PROJECT DESCRIPTION: Proposed Hotel

METHOD OF BORING: Hollow-Stem

PROJECT LOCATION: Block 76 - Bayport Village, Town of Midland

DRILLING DATE: January 15, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
180.7	Ground Surface			
0.0	Brown to dark brown **EARTH FILL** silty clay with cobbles, slag, rootlets and wood debris	1	DO	12
		2	DO	5
		3	DO	16
178.6 2.1	**SLAG FILL** mixed with topsoil and sand	~~4~~	~~DO~~	~~100+~~
		4A	AS	-
		~~5~~	~~DO~~	~~100+~~
177.2 3.5	Brown **ALLUVIUM** silty sand to sandy silt with wood debris, rootlets and topsoil pockets	6	DO	4
176.2 4.5	Grey, firm to very soft **SILTY CLAY** low to medium plasticity a trace of sand occ. silt seams and layers	7	DO	4
		8	DO	0
		9	DO	0
172.0 8.7	**END OF BOREHOLE**			



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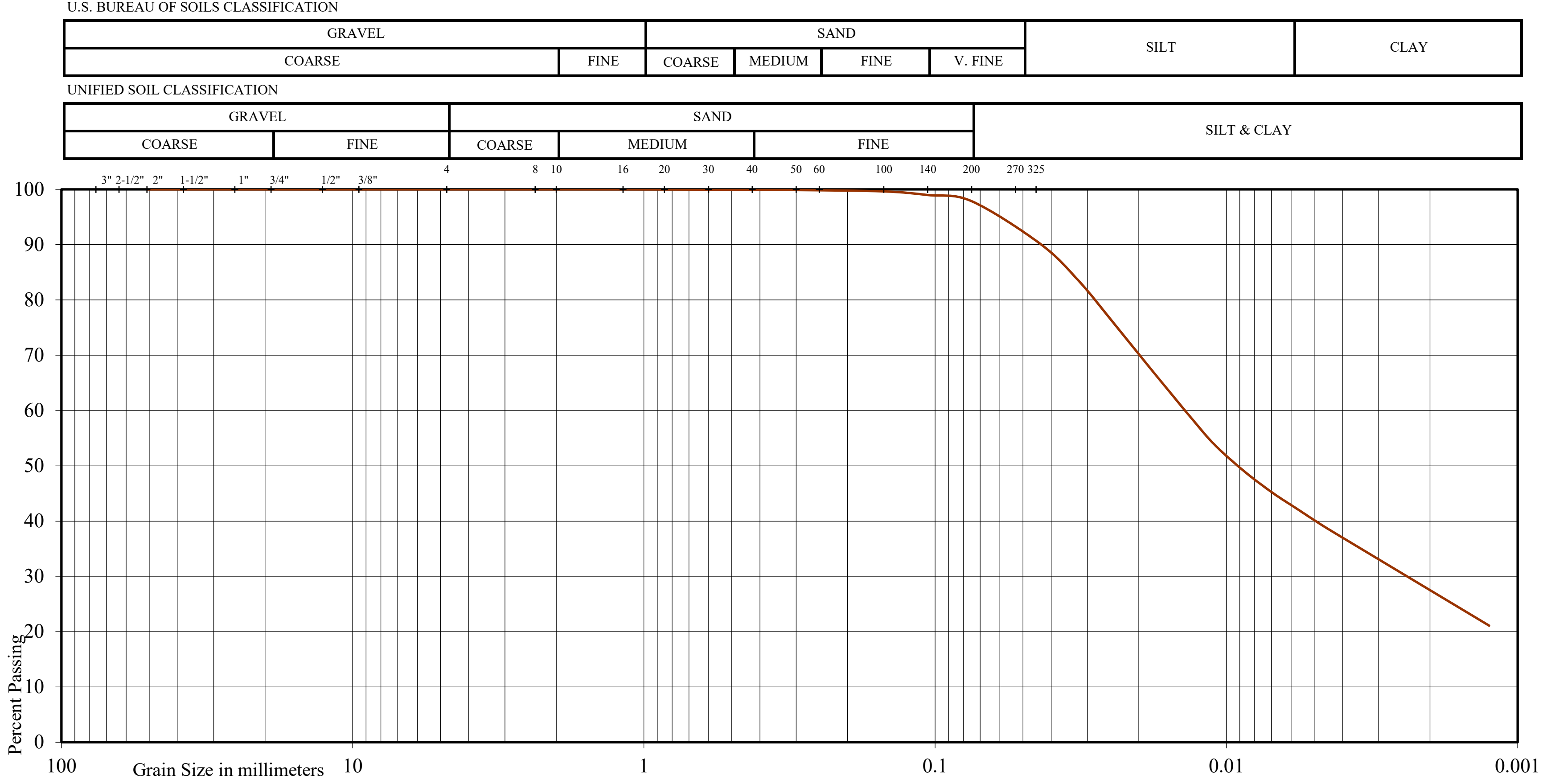
GRAIN SIZE DISTRIBUTION

Reference No: 1911-S109



Project: Proposed Hotel

Location: Block 76 - Bayport Village, Town of Midland

Borehole No: 202

Sample No: 12

Depth (m): 9.4

Elevation (m): 170.4

Liquid Limit (%) = 36

Plastic Limit (%) = 23

Plasticity Index (%) = 13

Moisture Content (%) = 53

Estimated Permeability

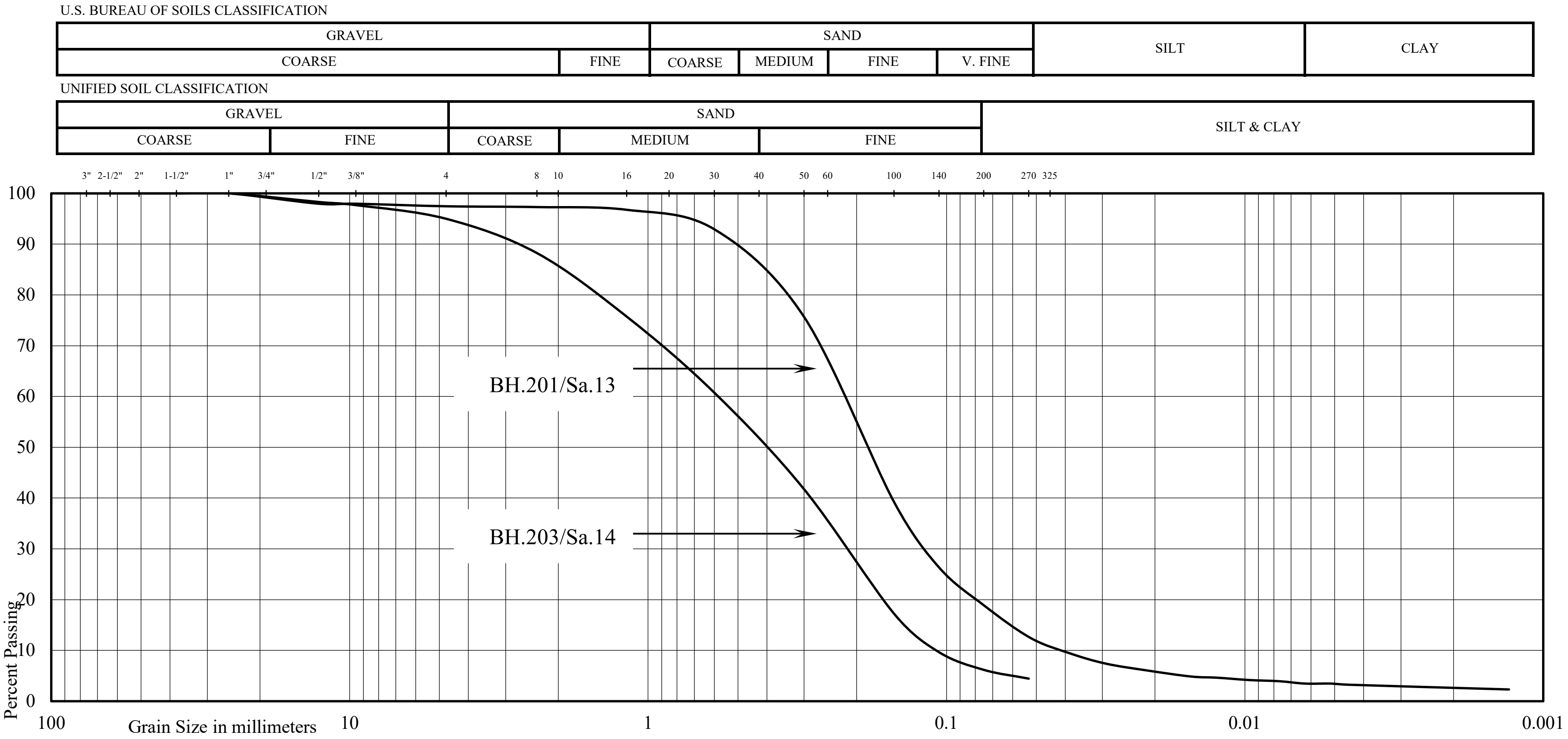
(cm./sec.) = 10^{-7}

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

Figure: 7

GRAIN SIZE DISTRIBUTION

Reference No: 1911-S109



Project: Proposed Hotel

Location: Block 76 - Bayport Village, Town of Midland

Borehole No:	201	203
Sample No:	13	14
Depth (m):	15.5	15.4
Elevation (m):	164.3	164.3

BH./Sa.	201/13	203/14
Liquid Limit (%) =	-	-
Plastic Limit (%) =	-	-
Plasticity Index (%) =	-	-
Moisture Content (%) =	17	18
Estimated Permeability (cm./sec.) =	10^{-3}	10^{-2}

Classification of Sample [& Group Symbol]: SAND, well graded, traces of silt and fine gravel

Figure: 8

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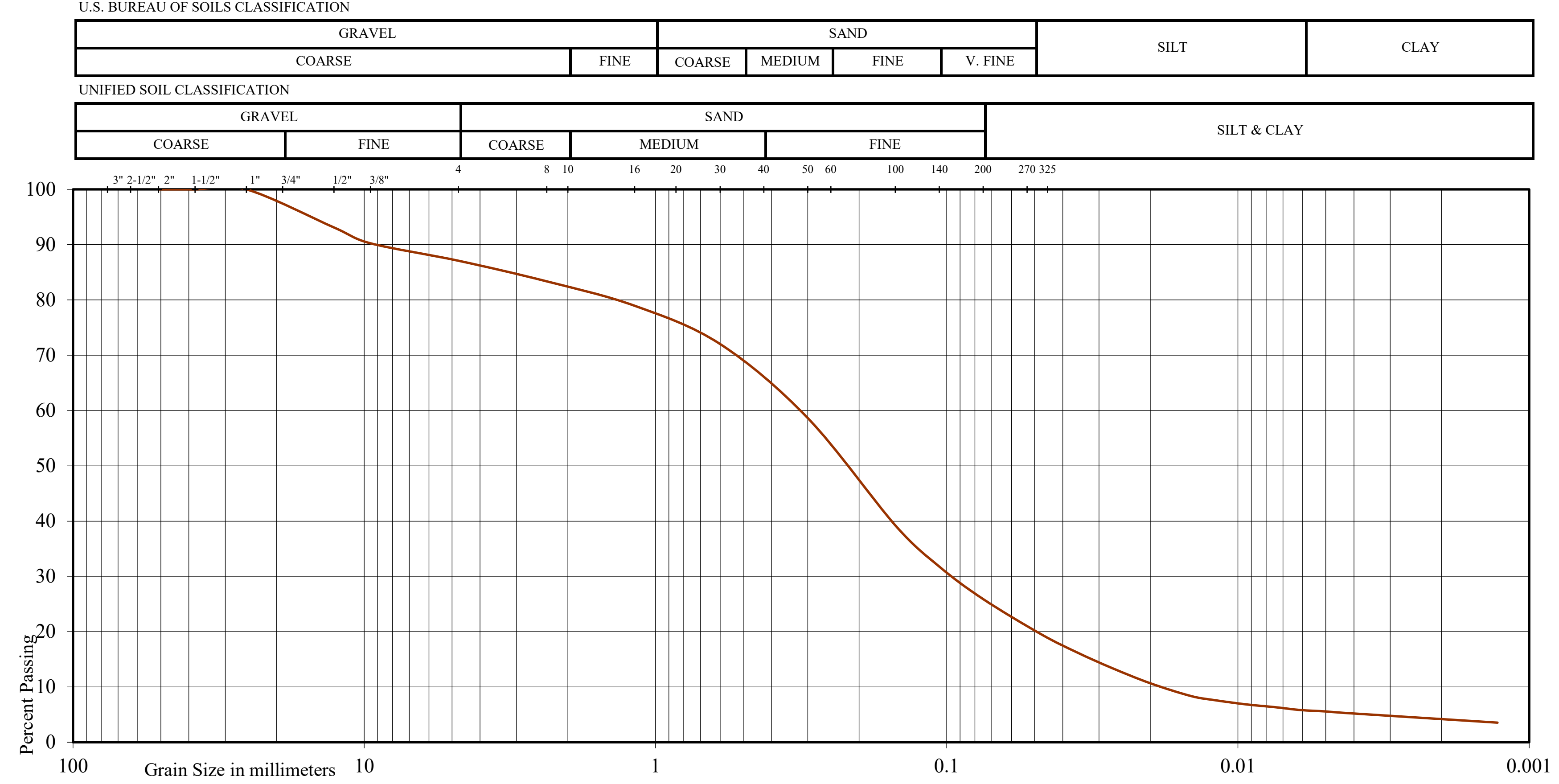
GRAIN SIZE DISTRIBUTION

Reference No: 1911-S109



Project: Proposed Hotel

Location: Block 76 - Bayport Village, Town of Midland

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

Moisture Content (%) = 11

Estimated Permeability

(cm./sec.) = 10^{-4}

Borehole No: 201

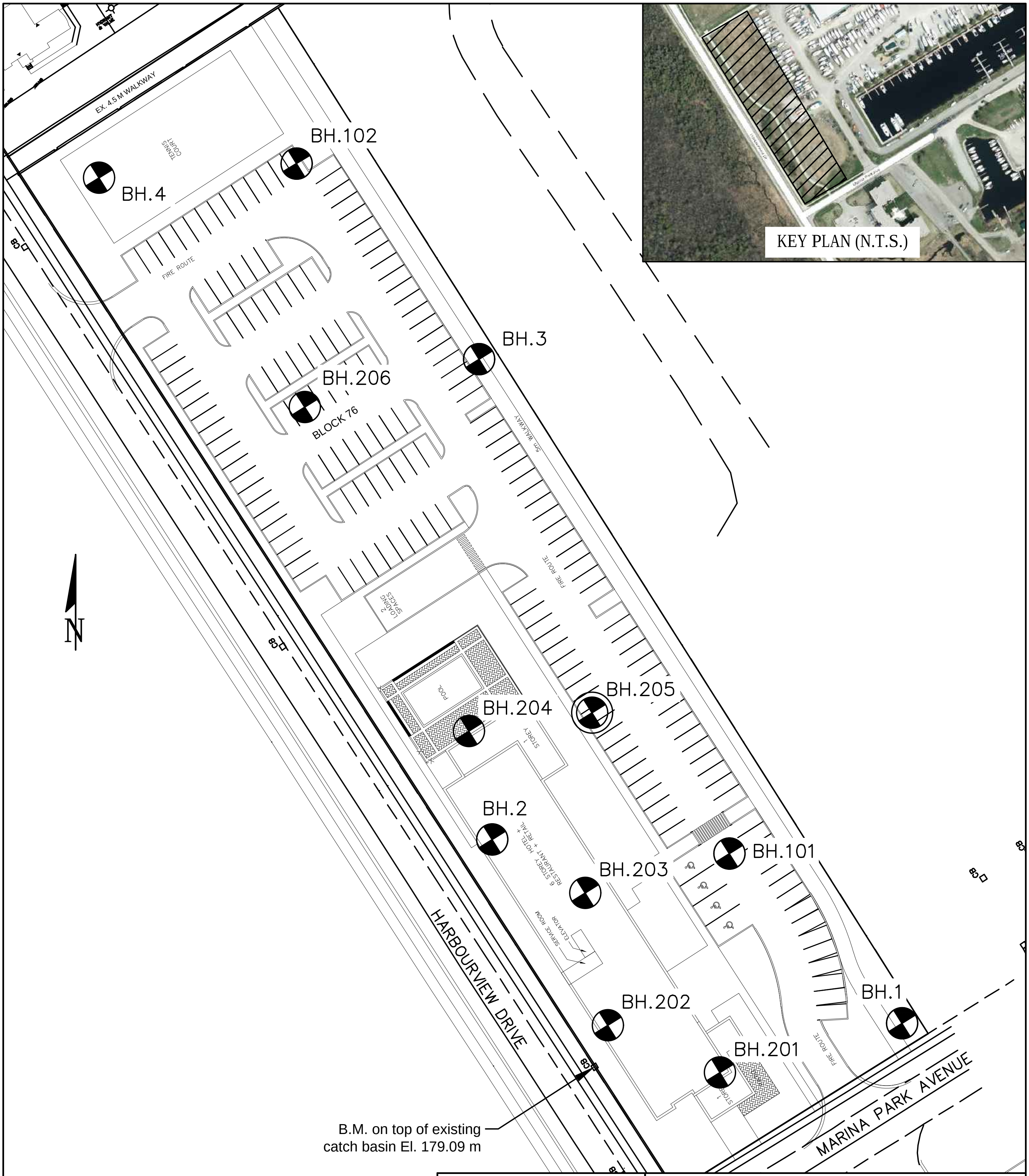
Sample No: 16

Depth (m): 20.1

Elevation (m): 159.7

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

Figure: 9



LEGEND

◉ – Borehole with monitoring well

● – Borehole

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BOREHOLE AND MONITORING WELL LOCATION PLAN

SITE: **Block 76 – Bayport Village, Town of Midland**

DESIGNED BY: –	CHECKED BY: –	DWG NO.: 1	
SCALE: 1:1000	REF. NO.: 1911–S109	DATE: March 2020	REV –

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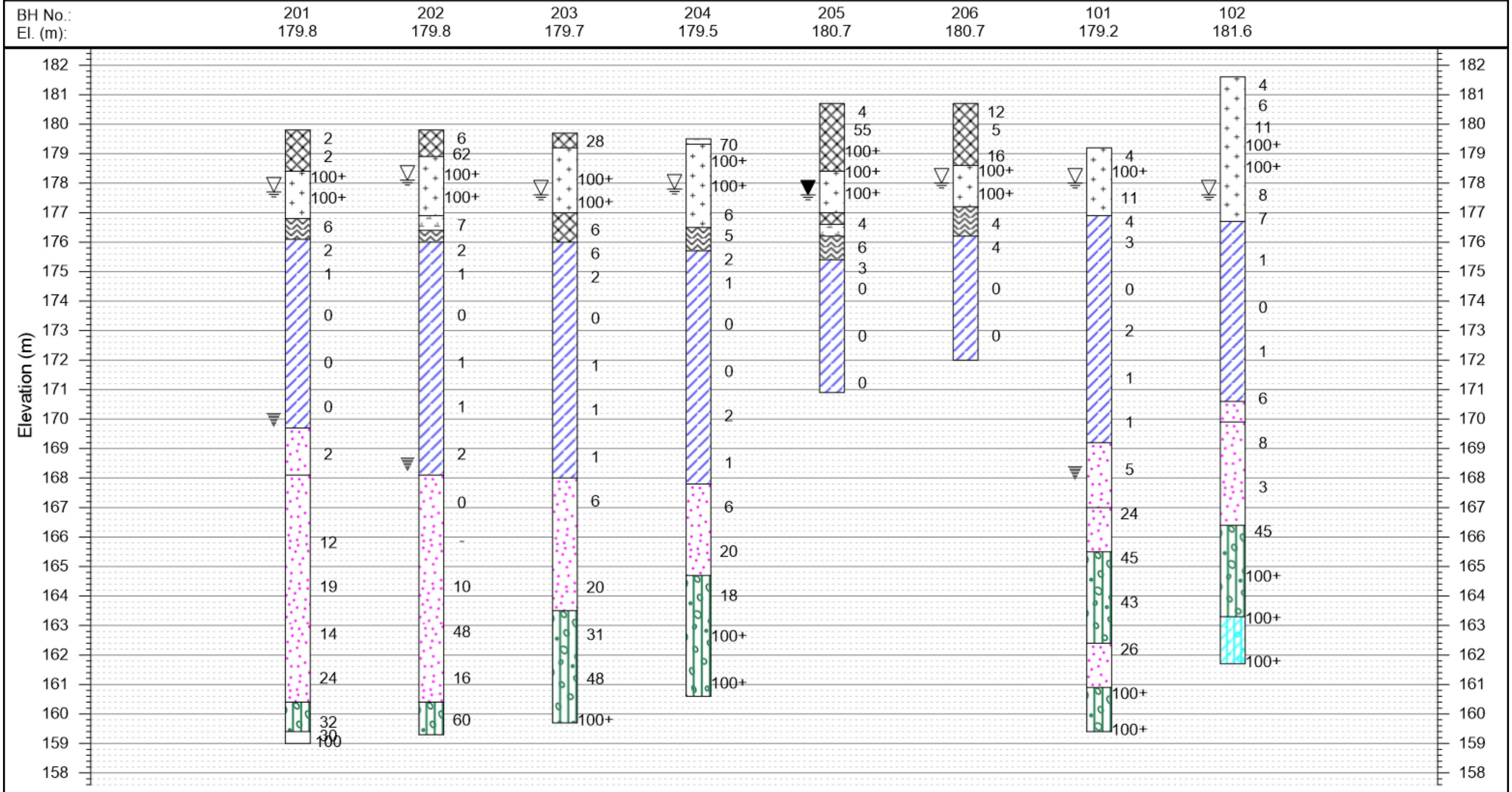
SUBSURFACE PROFILE
DRAWING NO. 2
SCALE: AS SHOWN

JOB NO.: 1911-S109
REPORT DATE: March 2020
PROJECT DESCRIPTION: Proposed Hotel
PROJECT LOCATION: Block 76 - Bayport Village, Town of Midland

LEGEND

▨	TOPSOIL	▨	SAND	▨	SILTY CLAY TILL	▨	SLAG
☐	DCPT	▨	SILTY SAND TILL	▨	PEAT	▨	ALLUVIUM
▨	FILL	▨	SILTY CLAY				

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



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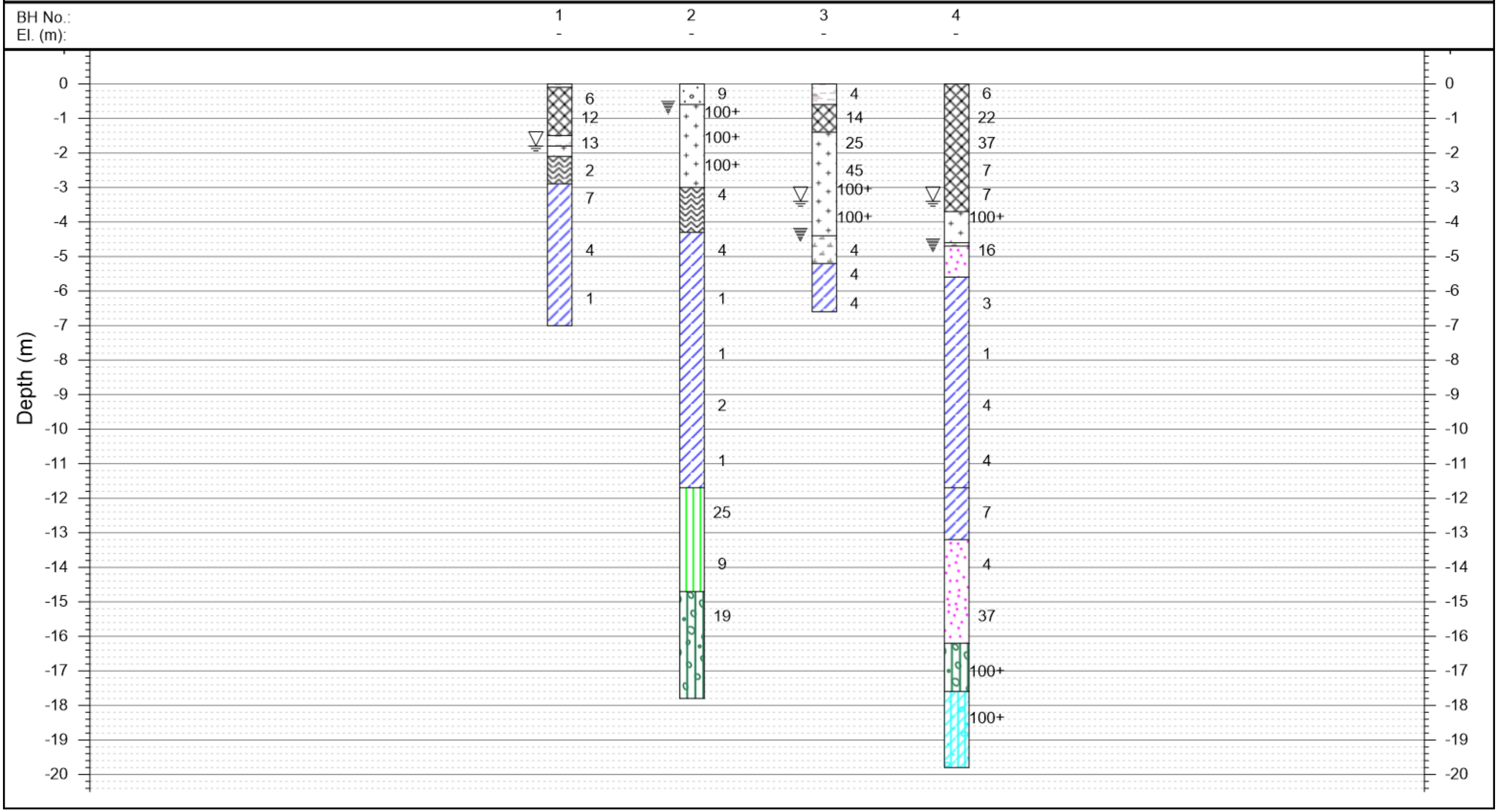
SUBSURFACE PROFILE
DRAWING NO. 3
SCALE: AS SHOWN

JOB NO.:	1911-S109
REPORT DATE:	March 2020
PROJECT DESCRIPTION:	Proposed Hotel
PROJECT LOCATION:	Block 76 - Bayport Village, Town of Midland

LEGEND

TOPSOIL	SAND	SILTY CLAY	SLAG
GRANULAR	SILTY SAND TILL	SILTY CLAY TILL	ALLUVIUM
FILL	SILT	PEAT	

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



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FAX: (705) 721-7864	FAX: (905) 542-2769	FAX: (905) 725-1315	FAX: (905) 881-8335	FAX: (705) 684-8522	FAX: (905) 542-2769

APPENDIX ‘A’

RELEVANT BOREHOLE LOGS AND GRAIN SIZE DISTRIBUTION FROM REFERENCE NO. 0705-S060

REFERENCE NO. 1911-S109

JOB NO.: 0705-S060

LOG OF BOREHOLE NO.: 1

FIGURE NO.: 1

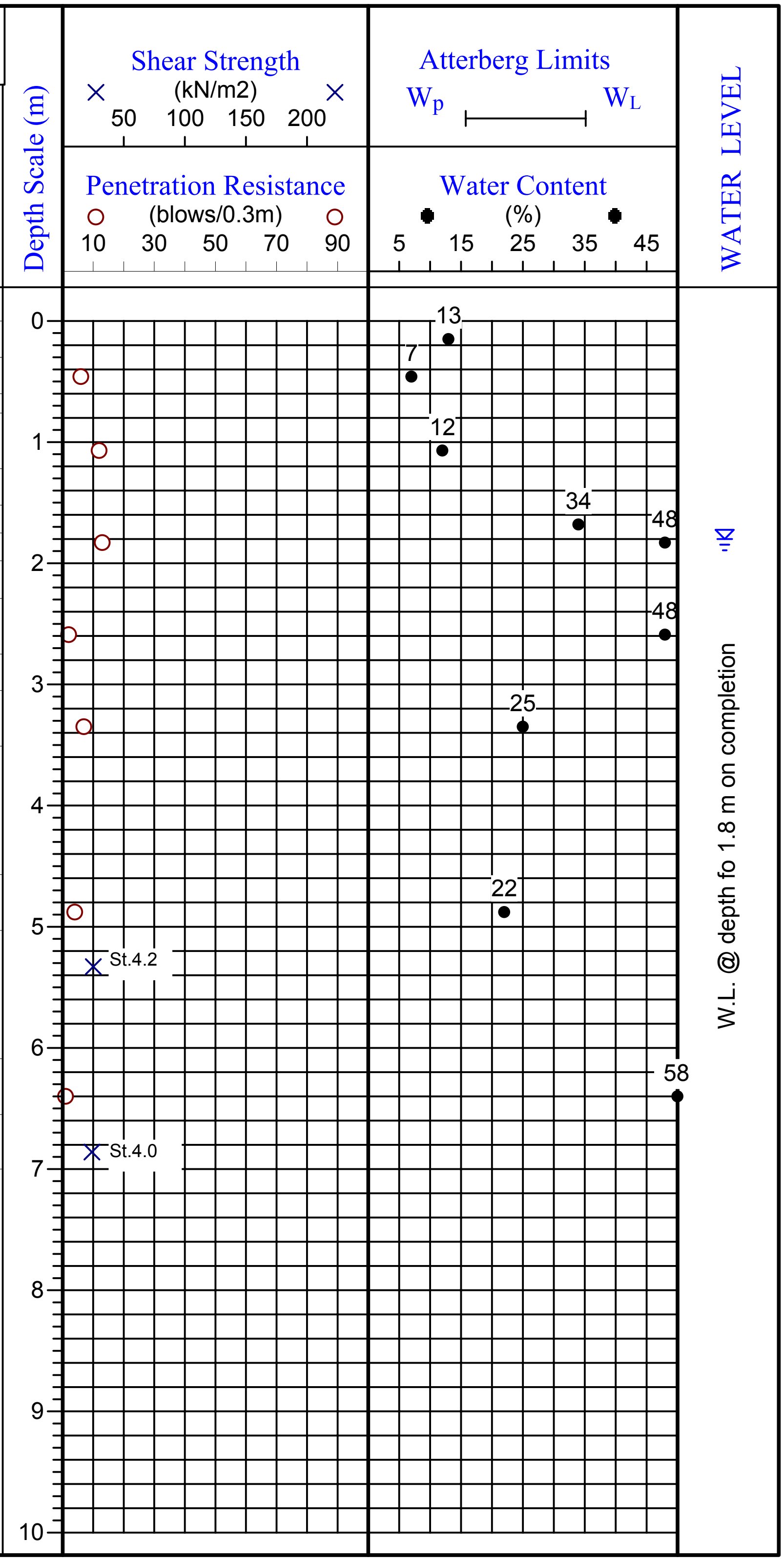
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: Sunnyside Dr./Harbourview Dr., Town of Midland

METHOD OF BORING: Flight-Auger

DATE: October 31, 2007

Elev. Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
	Ground Surface			
0.0	**10cm TOPSOIL, Fill**	1A	DO	-
	Dark brown **SAND, Fill** occ. peat seams	1B	DO	6
		2	DO	12
1.5	**30cm TOPSOIL, Fill**	3A	DO	-
	Black **SLAG, Fill**	3B	DO	13
2.1	Dark brown to black **ALLUVIAL DEPOSIT**	4	DO	2
2.9	Very soft to firm grey ---- brown **SILTY CLAY** brown ---- grey a tr. of sand occ. wet sand and silt seams and layers	5	DO	7
		6	DO	4
		7	DO	1
7.0	**END OF BOREHOLE**			



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JOB NO.: 0705-S060

LOG OF BOREHOLE NO.: 2

FIGURE NO.: 2

JOB DESCRIPTION: Proposed Residential Development

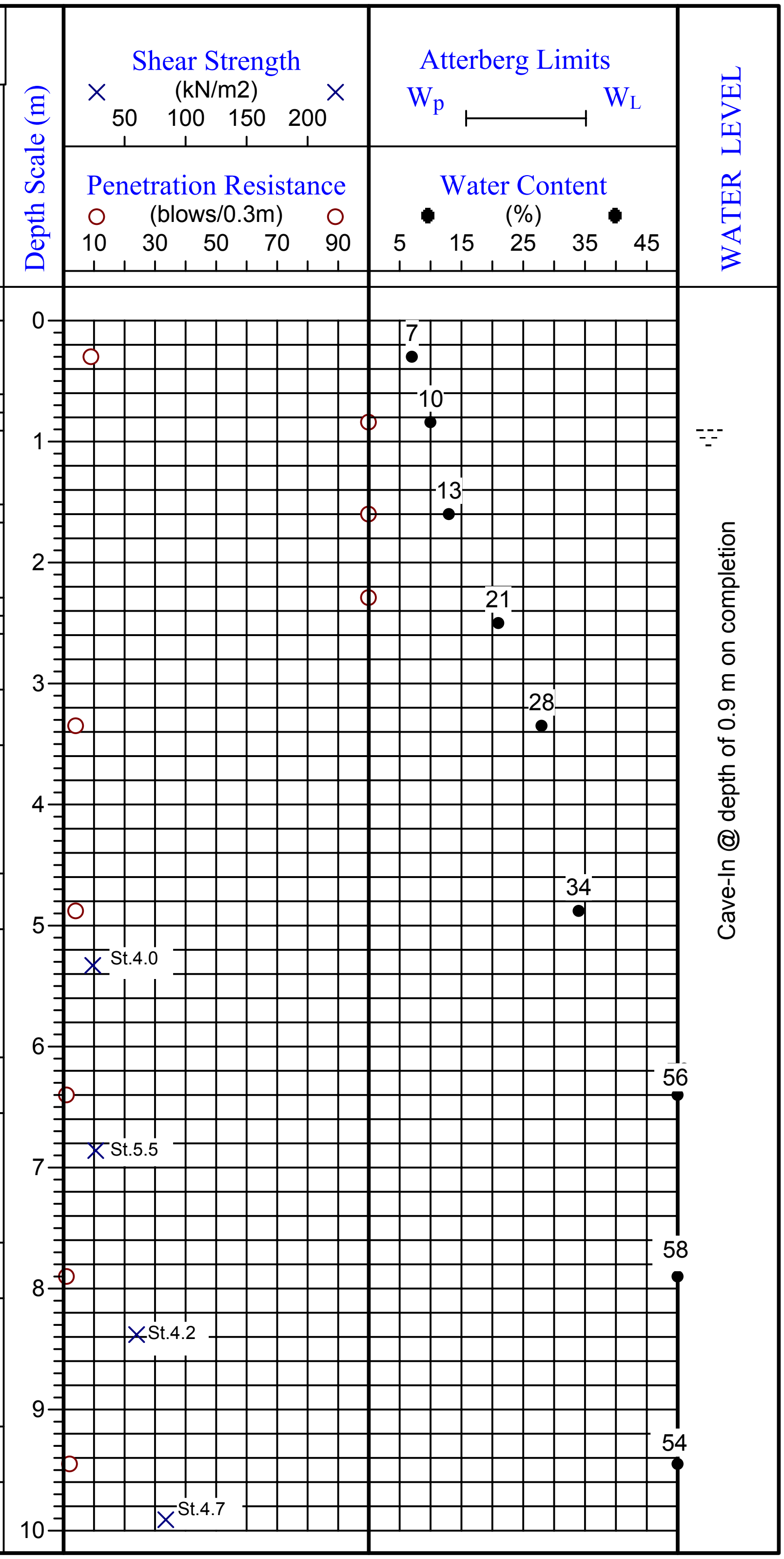
JOB LOCATION: Sunnyside Dr./Harbourview Dr., Town of Midland

METHOD OF BORING: Flight-Auger

DATE: October 31, 2007

Elev. Depth (m)	SOIL DESCRIPTION
	Ground Surface
0.0	**GRANULAR, Fill**
0.6	Dark brown and grey **SLAG, Fill**
3.0	Dark brown to black **ALLUVIAL DEPOSIT**
4.3	Very soft to firm brown grey **SILTY CLAY** a tr. of sand occ. wet sand and silt seams and layers
10.0	Cont'd on Fig. 2A

SAMPLES		
Number	Type	N-Value
1A	DO	9
2	DO	100+
3A	DO	100+
4	DO	100+
4A	AS	-
5	DO	4
6	DO	4
7	DO	1
8	DO	1
9	DO	2



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JOB NO.: 0705-S060

LOG OF BOREHOLE NO.: 2

FIGURE NO.: 2 A

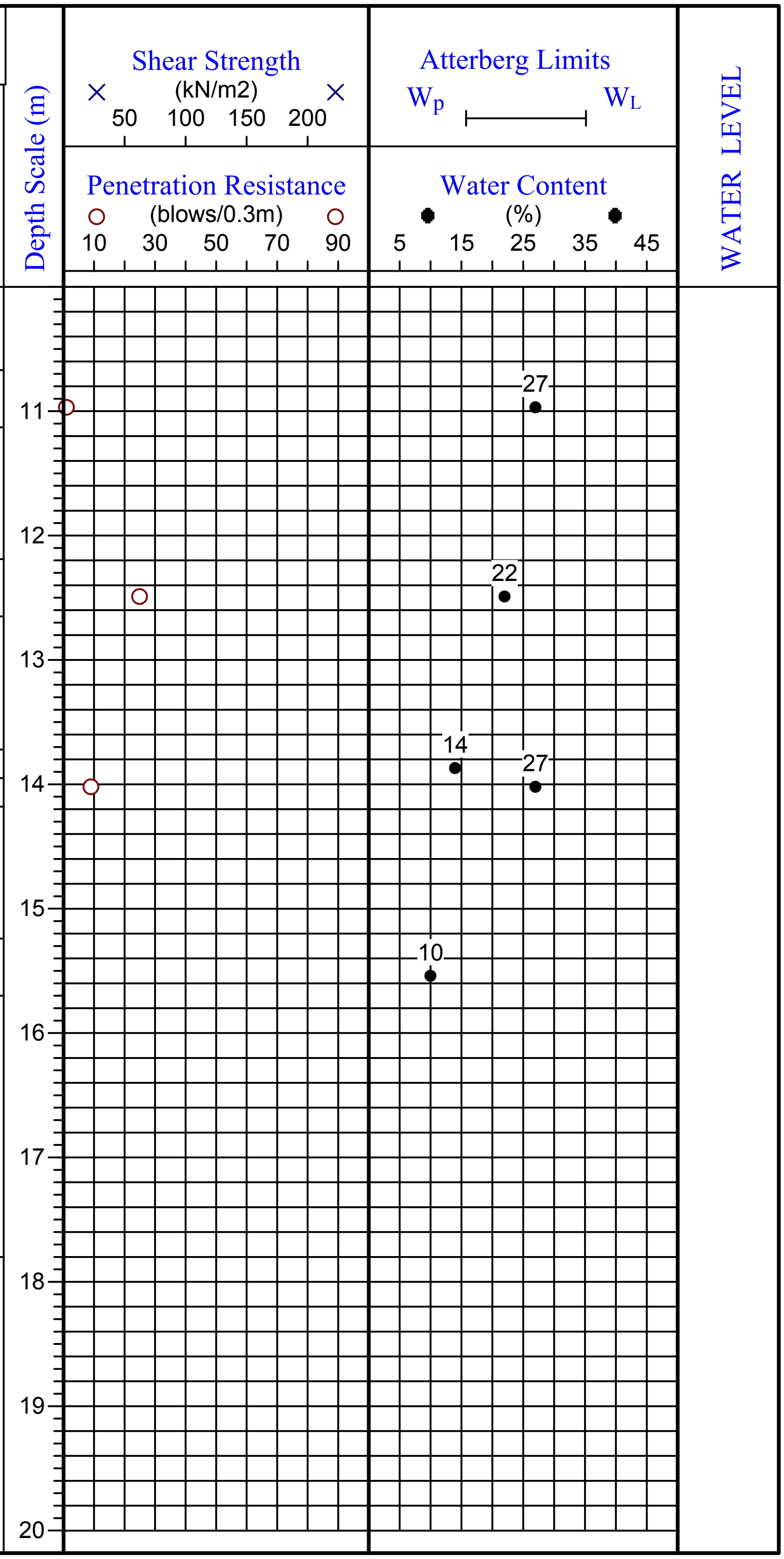
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: Sunnyside Dr./Harbourview Dr., Town of Midland

METHOD OF BORING: Flight-Auger

DATE: October 31, 2007

Elev. Depth (m)	SOIL DESCRIPTION Cont'd	SAMPLES Number	Type	N-Value
10.0	Grey, very soft **SILTY CLAY** a tr. of sand occ. wet sand and silt seams and layers	10	DO	1
11.7	Brown, loose to compact **SILT** a tr. of clay sand layer	11	DO	25
		12A	DO	-
		12B	DO	9
14.7	Brown, compact **SILTY SAND, Till** traces of clay and gravel occ. wet sand and silt seams and layers, cobbles and boulders	13	DO	19
17.8	Refusal to augering, inferred bedrock or boulder. **END OF BOREHOLE**			



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JOB NO.: 0705-S060

LOG OF BOREHOLE NO.: 3

FIGURE NO.: 3

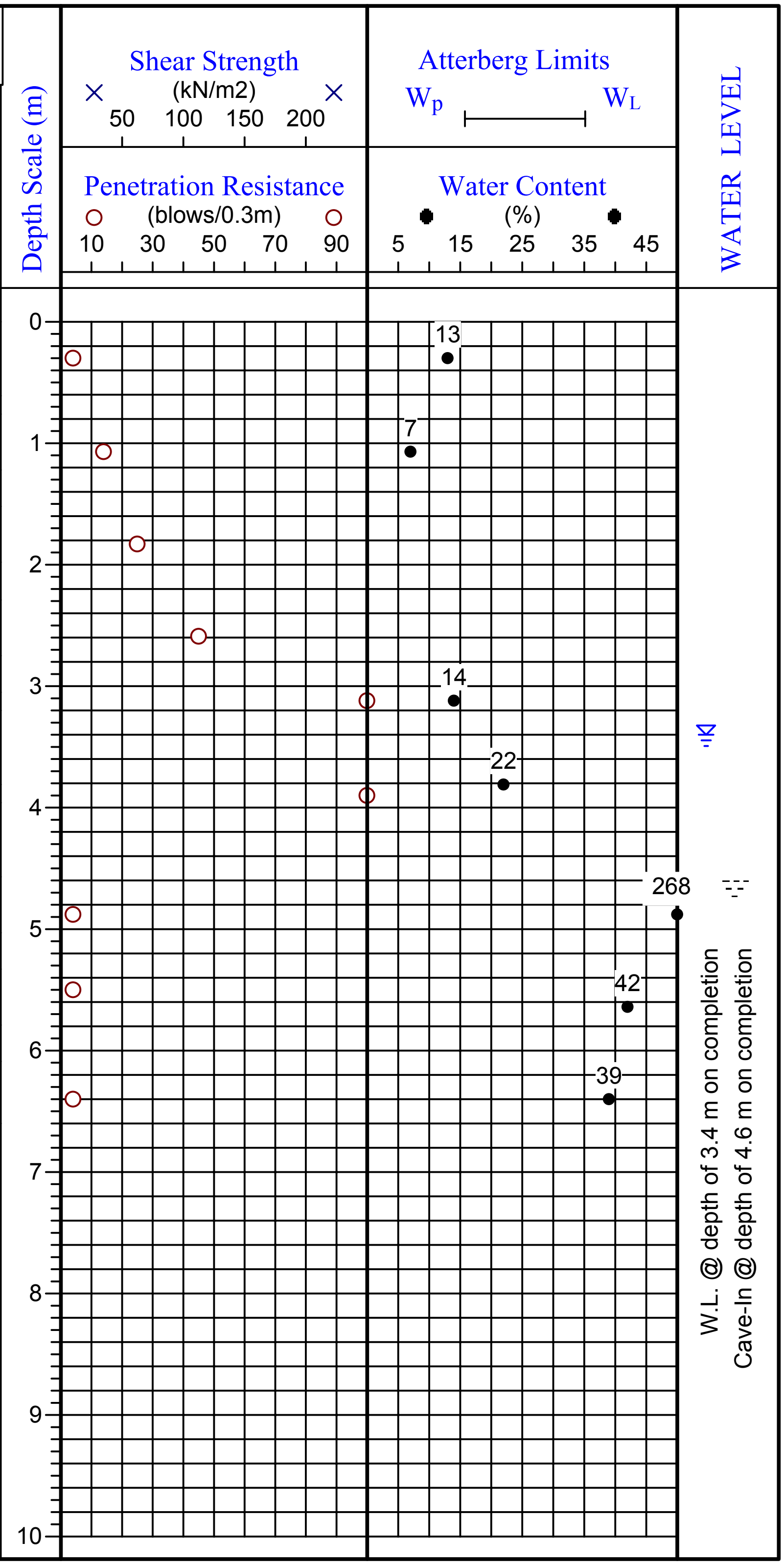
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: Sunnyside Dr./Harbourview Dr., Town of Midland

METHOD OF BORING: Flight-Auger

DATE: October 30, 2007

Elev. Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
	Ground Surface			
0.0	**60cm TOPSOIL, Fill**	1	DO	4
	Dark brown **SAND, Fill**	2	DO	14
1.4	Grey **SLAG, Fill**	3	DO	25
		4	DO	45
		5	DO	100+
		6	DO	100+
4.4	Black, granular-amorphous **PEAT**	7	DO	4
5.2	Grey, firm **SILTY CLAY**	8	DO	4
		9	DO	4
6.6	**END OF BOREHOLE**			



W.L. @ depth of 3.4 m on completion

Cave-In @ depth of 4.6 m on completion

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JOB NO.: 0705-S060

LOG OF BOREHOLE NO.: 4

FIGURE NO.: 4

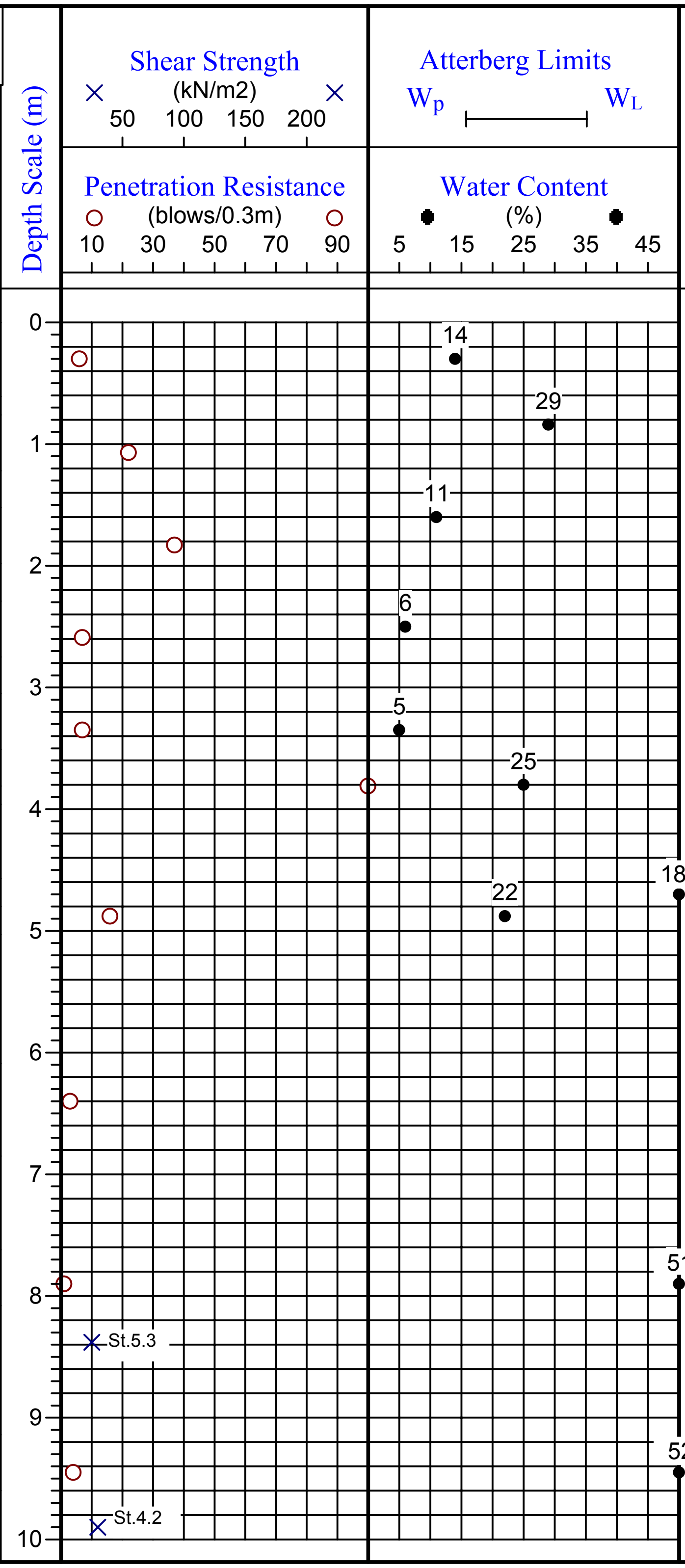
JOB DESCRIPTION: Proposed Residential Development

JOB LOCATION: Sunnyside Dr./Harbourview Dr., Town of Midland

METHOD OF BORING: Flight-Auger

DATE: October 31, 2007

Elev. Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
	Ground Surface			
0.0	Brown, dark brown **SILTY CLAY, Fill**	1	DO	6
		2	DO	22
		3	DO	37
2.1	Brown **SAND, Fill**	4	DO	7
		5	DO	7
3.7	Brown **SLAG, Fill**	6	DO	100+
4.6	**10cm PEAT**	7A	DO	-
	Brown, compact **SILTY FINE SAND**	7B	DO	16
5.6	Very soft to firm **SILTY CLAY** a tr. of sand occ. wet sand and silt seams and layers	8	DO	3
		9	DO	1
	grey brown	10	DO	4
10.0	Cont'd on Fig. 4A			



WATER LEVEL

W.L. @ depth of 3.4 m on completion

Cave-In @ depth of 4.9 m on completion

Soil Engineers Ltd.

JOB NO.: 0705-S060

LOG OF BOREHOLE NO.: 4

FIGURE NO.: 4 A

JOB DESCRIPTION: Proposed Residential Development

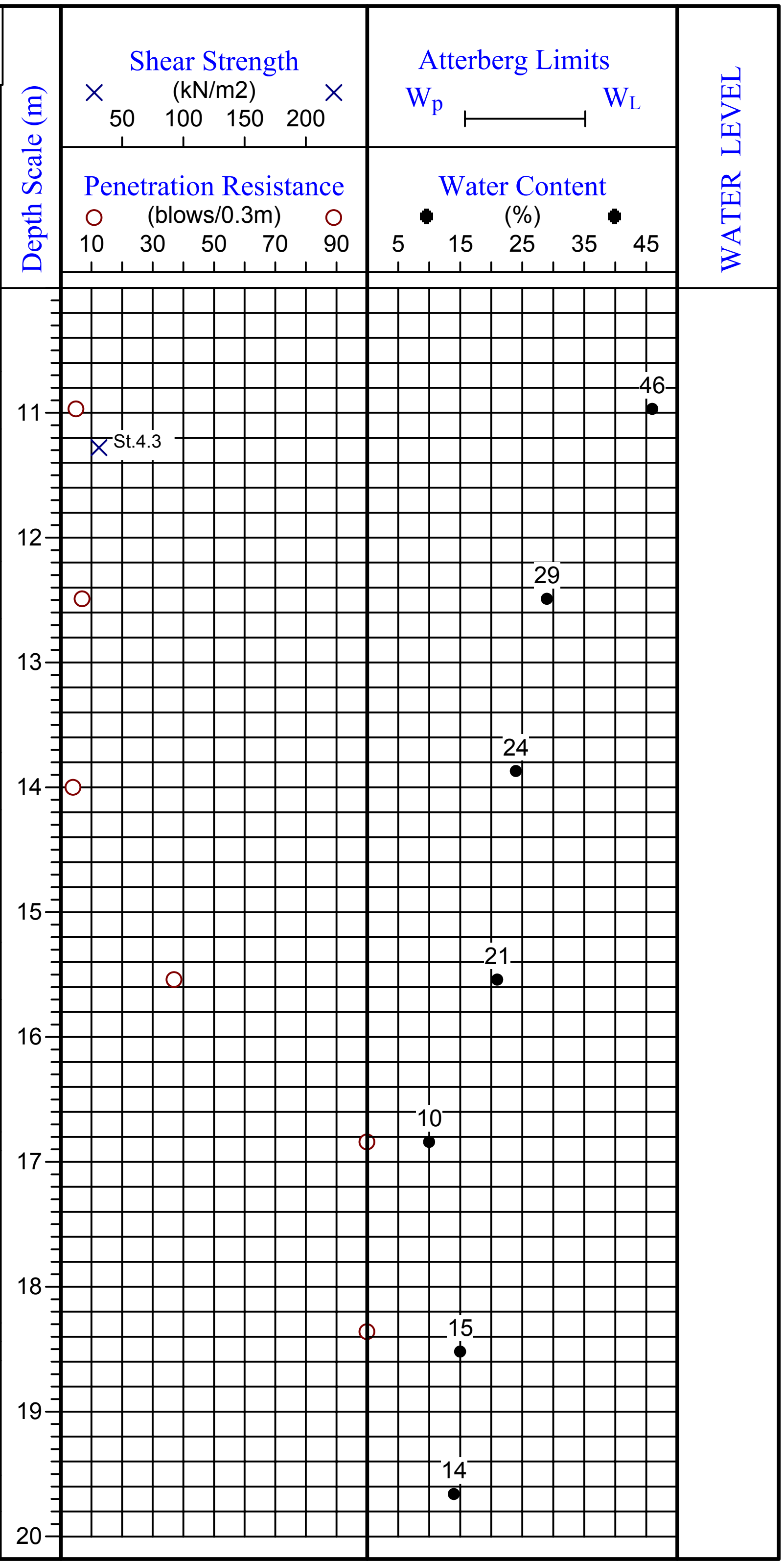
JOB LOCATION: Sunnyside Dr./Harbourview Dr., Town of Midland

METHOD OF BORING: Flight-Auger

DATE: October 31, 2007

Elev. Depth (m)	SOIL DESCRIPTION Cont'd
10.0	Brown, firm **SILTY CLAY** a tr. of sand occ. wet sand and silt seams and layers
13.2	Brown, loose to dense **SILTY FINE SAND**
16.2	Brown, very dense **SILTY SAND, Till** traces of clay and gravel occ. wet sand and silt seams and layers, cobbles and boulders
17.6	Grey, hard **SILTY CLAY, Till** sandy, a tr. of gravel occ. wet sand and silt seams and layers, cobbles and boulders
19.8	**END OF BOREHOLE**

SAMPLES		
Number	Type	N-Value
11	DO	4
12	DO	7
13	DO	4
14	DO	37
15	DO	100+
16	DO	100+
16A	AS	-
17	AS	-



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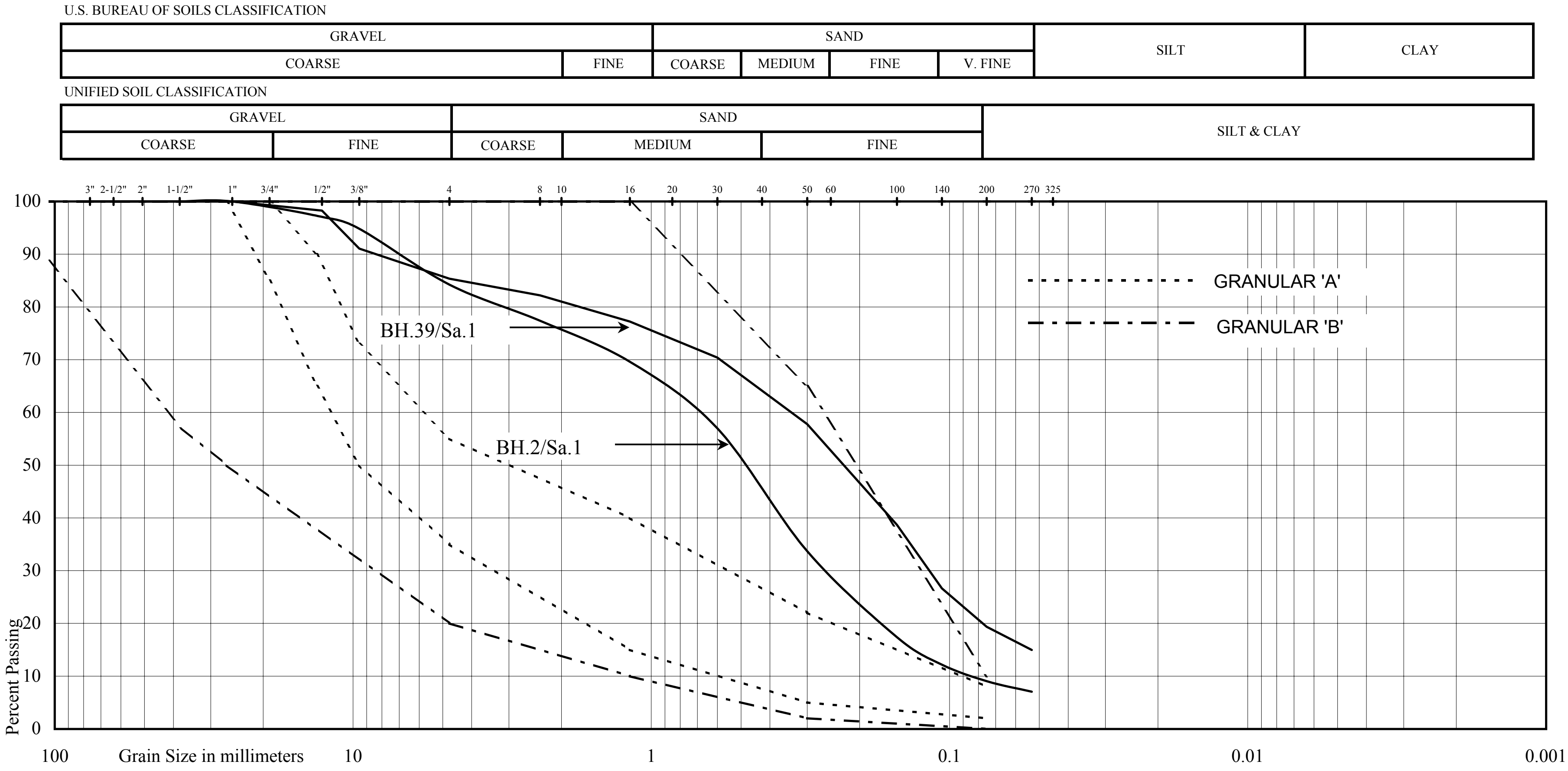
GRAIN SIZE DISTRIBUTION

Reference No: 0705-S060



Project:	Proposed Residential Development	
Location:	Sunnyside Dr./Harbourview Dr., Town of Midland	

Borehole No:	2	39
Sample No:	1	1
Depth (m):	0.3	0.3
Elevation (m):	-	178.8

BH./Sa.	2/1	39/1
Liquid Limit (%) =	-	-
Plastic Limit (%) =	-	-
Plasticity Index (%) =	-	-
Moisture Content (%) =	7	21
Estimated Permeability (cm./sec.) =	10^{-2}	10^{-3}

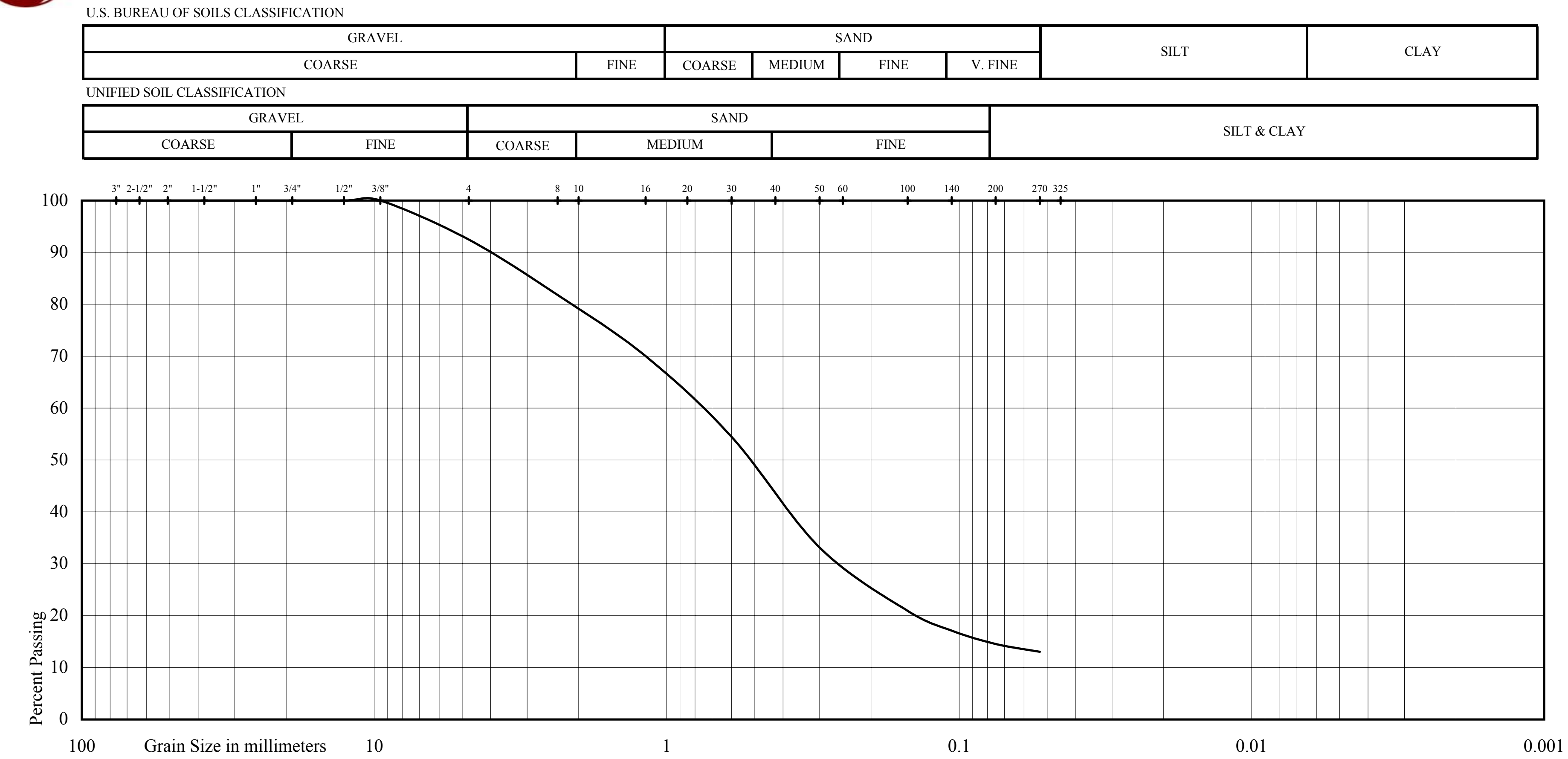
Classification of Sample [& Group Symbol]: GRANULAR, Fill

(fine to coarse sand, some gravel and silt)

Figure: 57

GRAIN SIZE DISTRIBUTION

Reference No: 0705-S060



Project: Proposed Residential Development

Location: Sunnyside Dr./Harbourview Dr., Town of Midland

Borehole No: 4

Sample No: 4

Depth (m): 2.6

Elevation (m): -

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

Moisture Content (%) = 6

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

Classification of Sample [& Group Symbol]: SAND, Fill
(fine to coarse sand, a trace of gravel)

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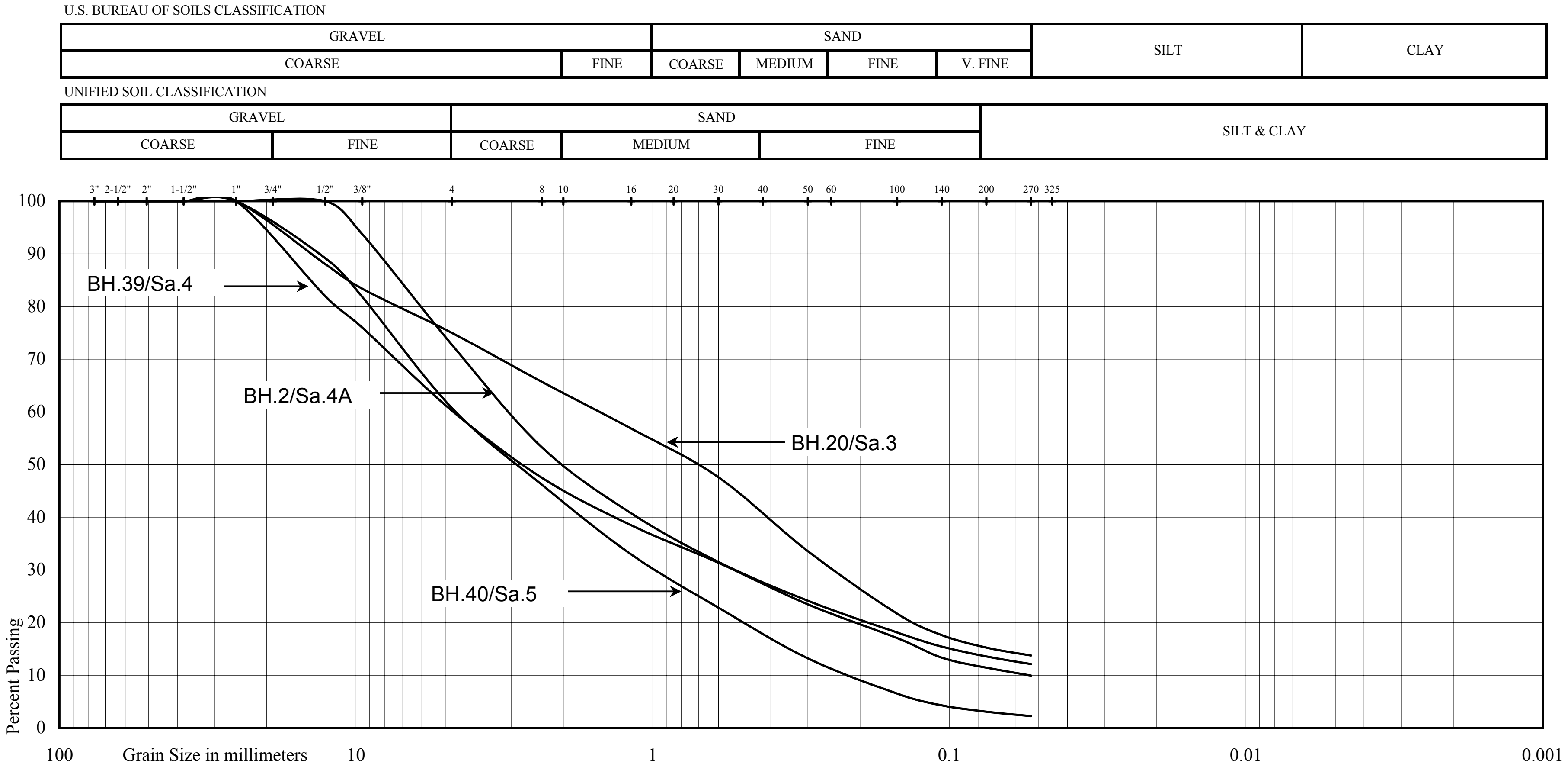
GRAIN SIZE DISTRIBUTION

Reference No: 0705-S060



Project: Proposed Residential Development

Location: Sunnyside Dr./Harbourview Dr., Town of Midland

Borehole No:	2	20	39	40
Sample No:	4A	3	4	5
Depth (m):	2.5	1.8	2.6	3.4
Elevation (m):	-	177.6	176.5	174.8

BH./Sa.	2/4A	20/3	39/4	40/5
Liquid Limit (%) =	-	-	-	-
Plastic Limit (%) =	-	-	-	-
Plasticity Index (%) =	-	-	-	-
Moisture Content (%) =	21	18	16	26
Estimated Permeability (cm./sec.) =	10^{-3}	10^{-3}	10^{-3}	10^{-2}

Classification of Sample [& Group Symbol]: SLAG, Fill

Figure: 61

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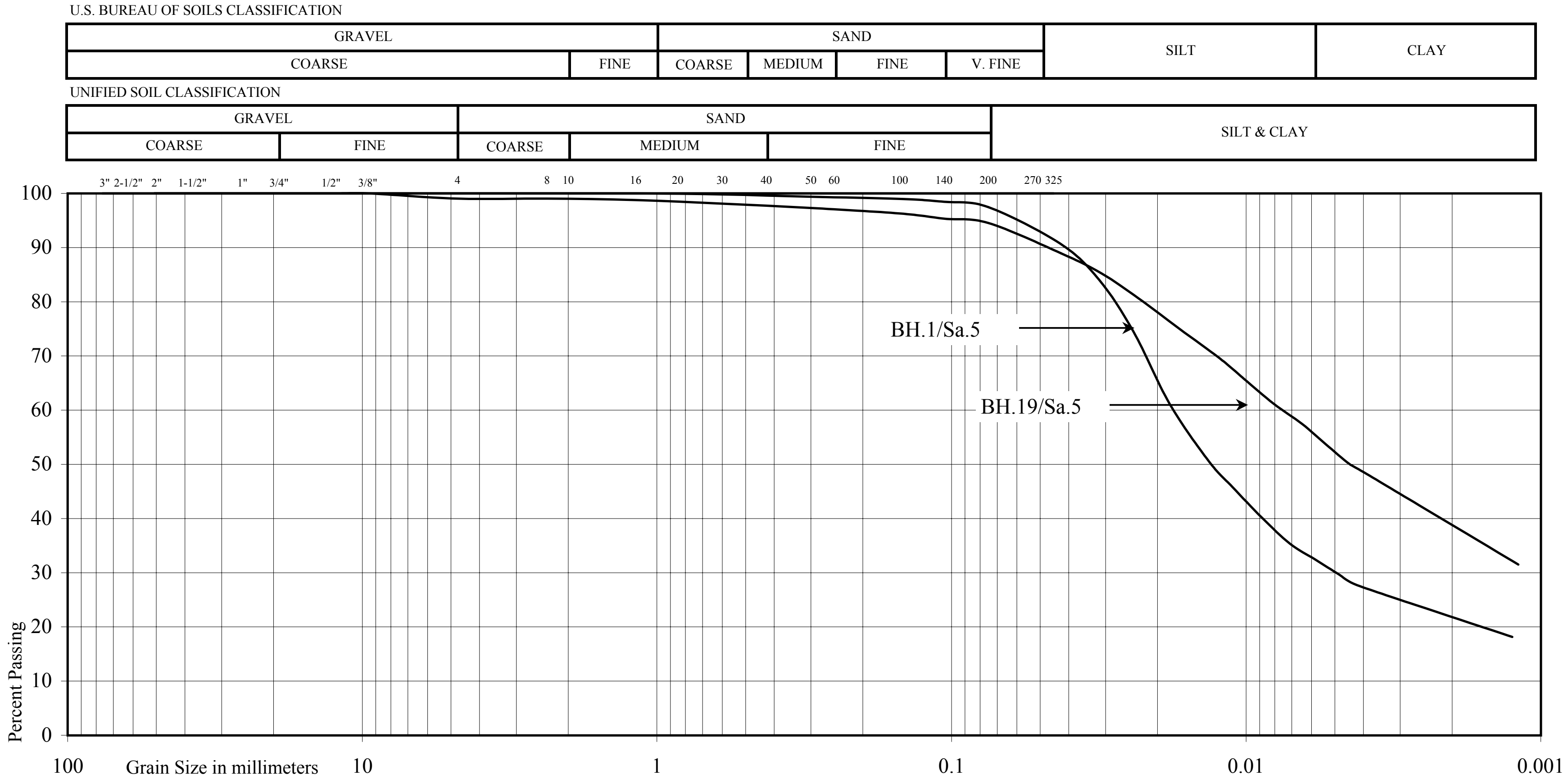
GRAIN SIZE DISTRIBUTION

Reference No: 0705-S060



Project: Proposed Residential Development

Location: Sunnyside Dr./Harbourview Dr., Town of Midland

Borehole No:	1	19
Sample No:	5	5
Depth (m):	3.4	3.4
Elevation (m):	-	176.3

BH./Sa.	1/5	19/5
Liquid Limit (%) =	30	36
Plastic Limit (%) =	17	19
Plasticity Index (%) =	13	17
Moisture Content (%) =	25	44
Estimated Permeability (cm./sec.) =	10^{-7}	10^{-7}

Classification of Sample [& Group Symbol]: SILTY CLAY
traces of sand and gravel

Figure: 62

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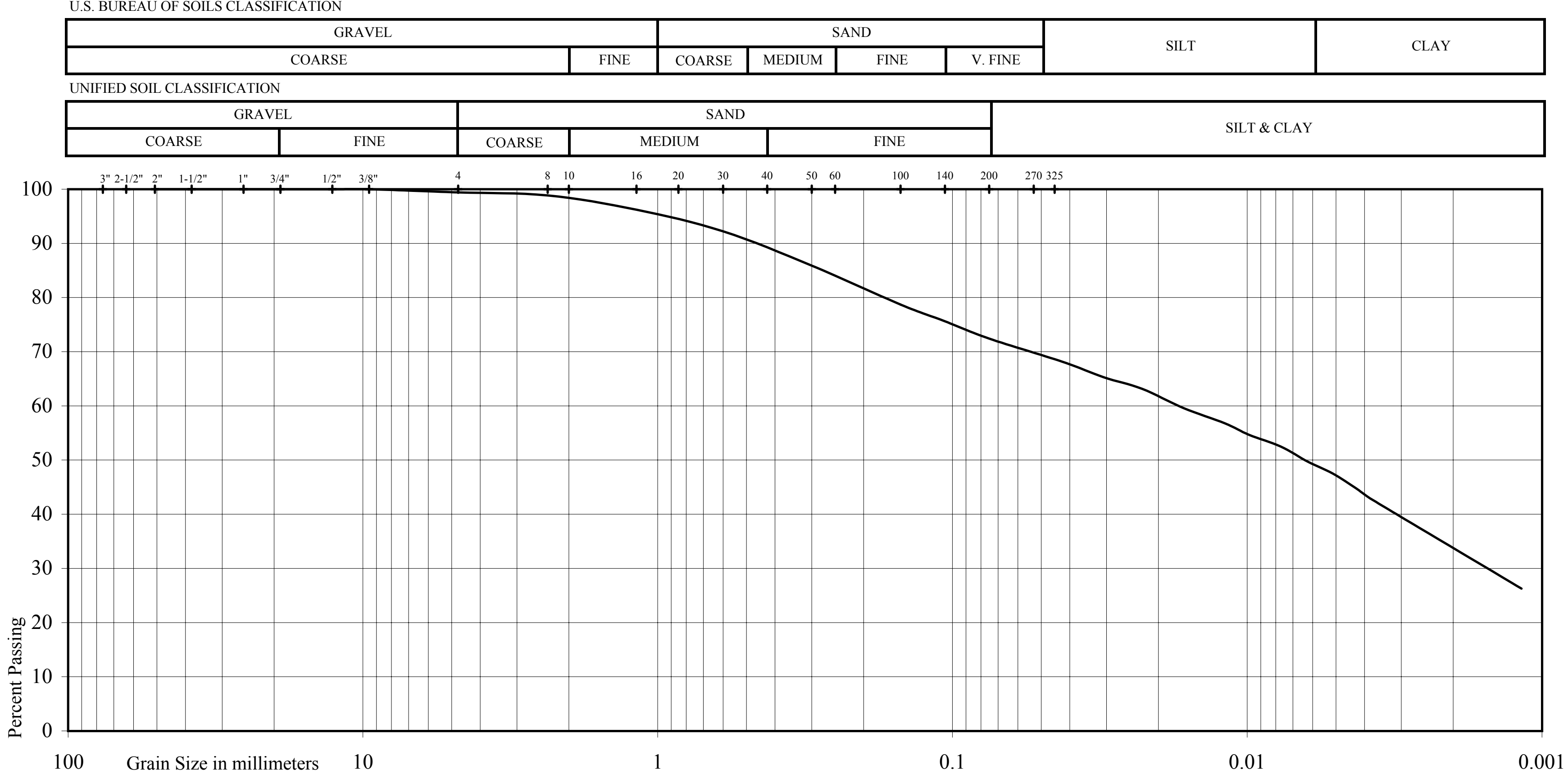
GRAIN SIZE DISTRIBUTION

Reference No: 0705-S060



Project: Proposed Residential Development

Location: Sunnyside Dr./Harbourview Dr., Town of Midland

Borehole No: 4

Sample No: 17

Depth (m): 19.7

Elevation (m): -

Liquid Limit (%) = 27

Plastic Limit (%) = 16

Plasticity Index (%) = 11

Moisture Content (%) = 14

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

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

Figure: 63

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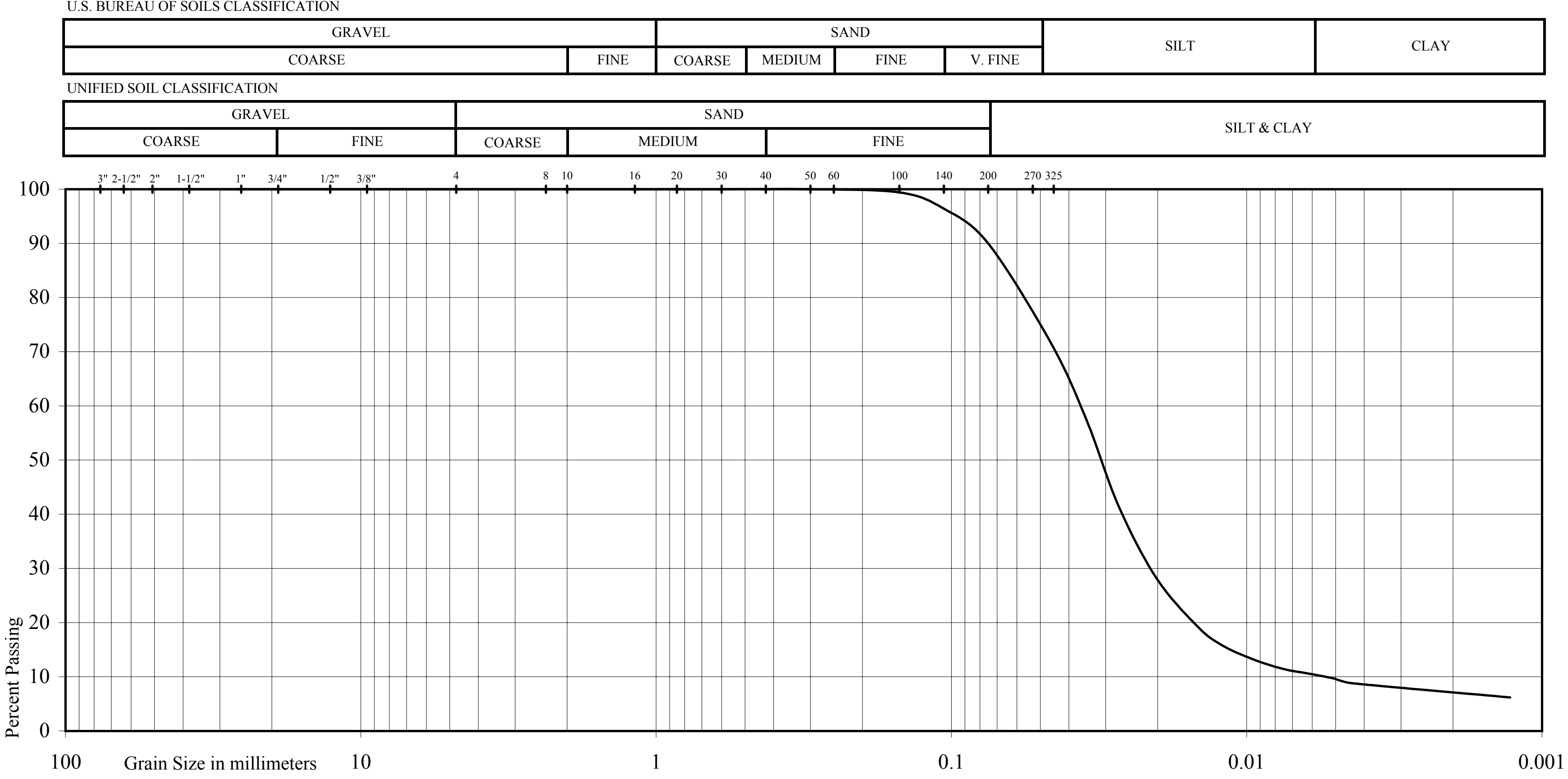
GRAIN SIZE DISTRIBUTION

Reference No: 0705-S060



Project: Proposed Residential Development

Location: Sunnyside Dr./Harbourview Dr., Town of Midland

Borehole No: 2

Sample No: 11

Depth (m): 12.5

Elevation (m): -

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

Moisture Content (%) = 22

Estimated Permeability (cm./sec.) = 10^{-5}

Classification of Sample [& Group Symbol]: SILT
a trace of clay

Figure: 66

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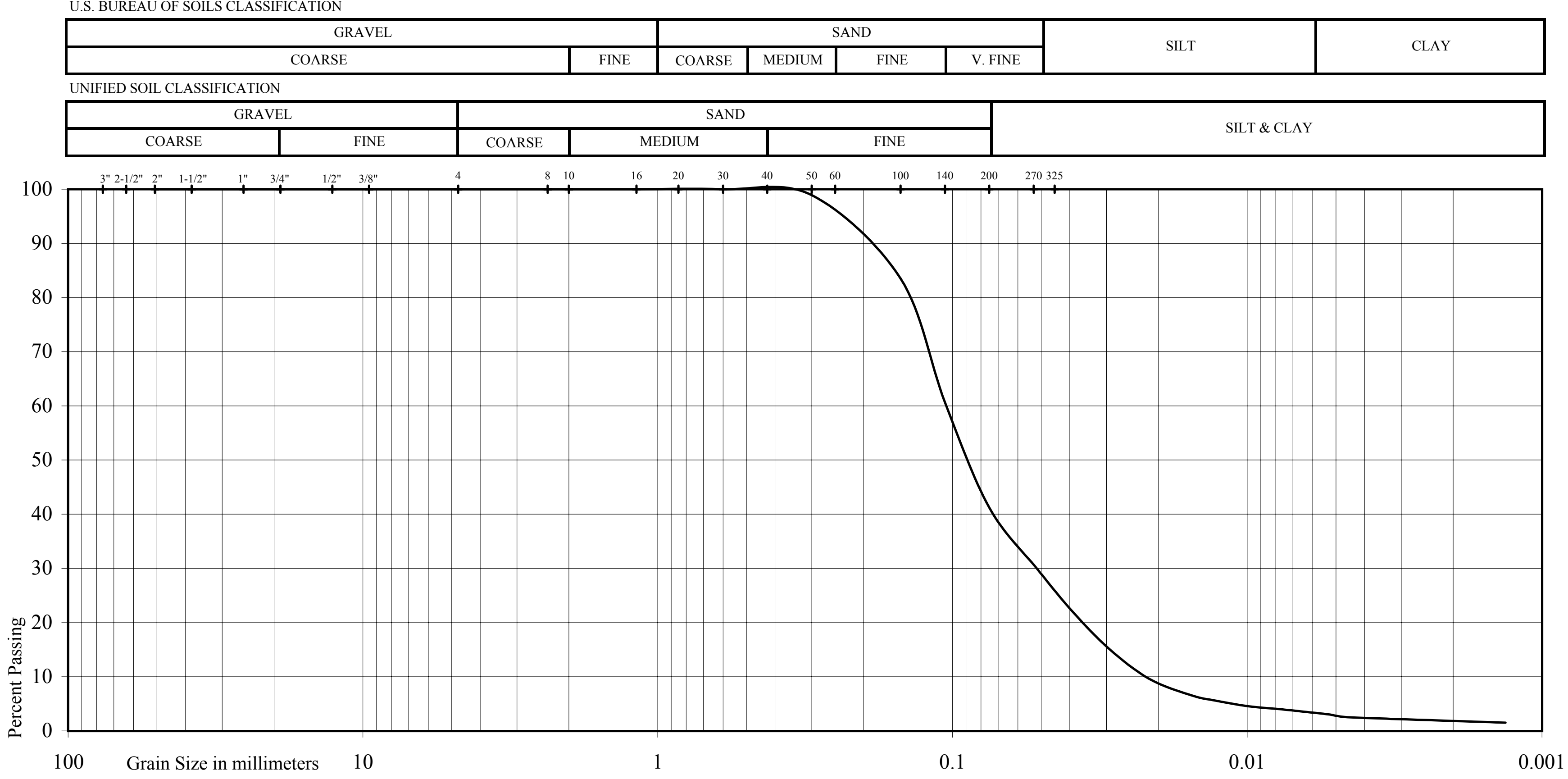
GRAIN SIZE DISTRIBUTION

Reference No: 0705-S060



Project: Proposed Residential Development

Location: Sunnyside Dr./Harbourview Dr., Town of Midland

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

Moisture Content (%) = 21

Estimated Permeability (cm./sec.) = 10^{-4}

Borehole No: 4

Sample No: 14

Depth (m): 15.6

Elevation (m): -

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

Figure: 67

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APPENDIX 'B'

RELEVANT BOREHOLE LOGS AND GRAIN SIZE DISTRIBUTION FROM REFERENCE NO. 1010-S027

REFERENCE NO. 1911-S109

JOB NO: 1010-S027

LOG OF BOREHOLE NO: 101

FIGURE NO: 1A

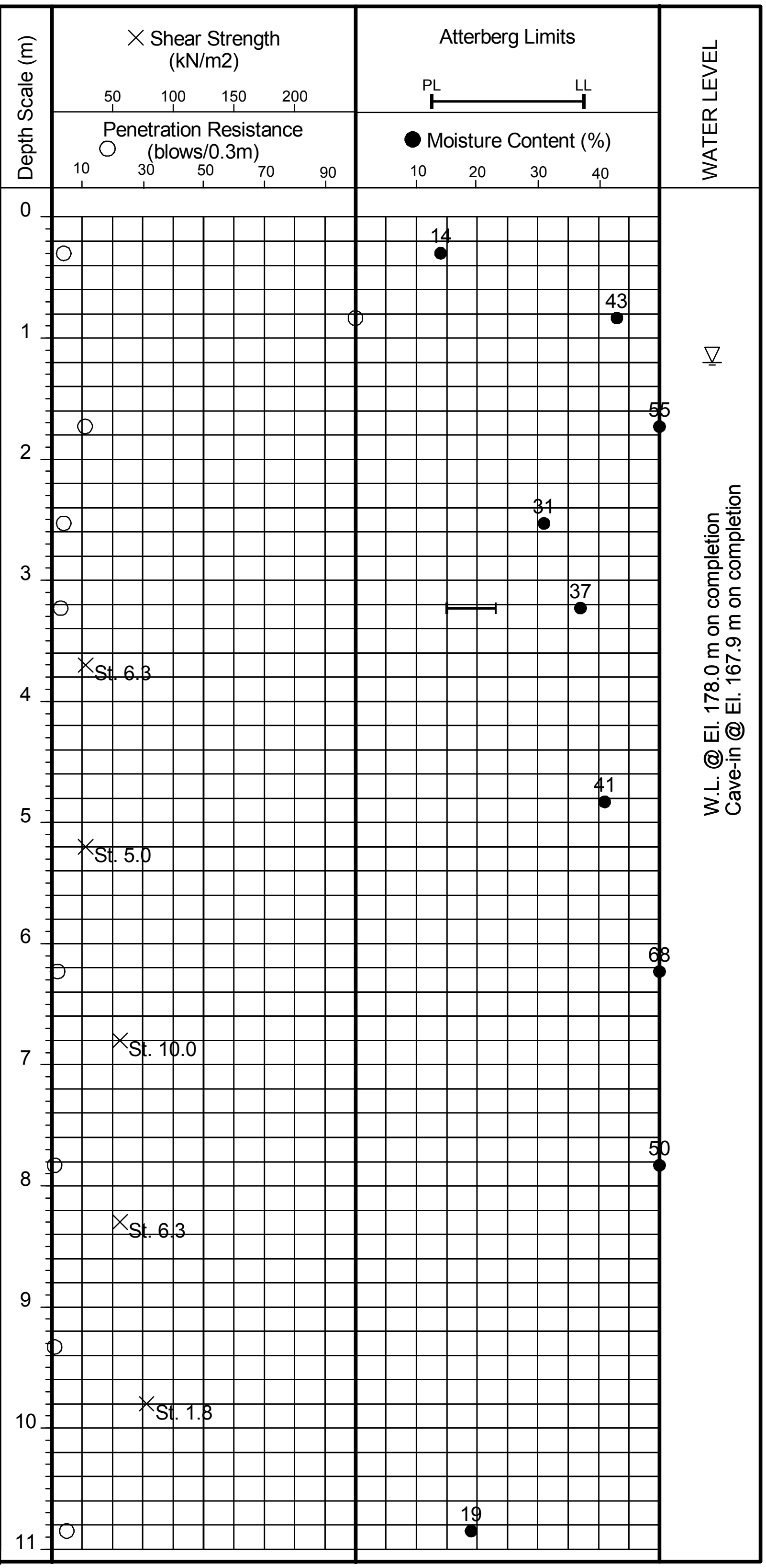
JOB DESCRIPTION: Proposed Townhouse Development

JOB LOCATION: Bayport Village - Phase 2, Town of Midland

METHOD OF BORING: Flight-Auger

DATE: November 3, 2010

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
0.0	Ground Surface			
179.2	Brown/grey	1	AS	4
		2	DO	100+
	SLAG, Fill			
	mixed with sand, rock and cobbles with topsoil and organic inclusions	3	DO	11
2.3 176.9	Very soft to soft	4	DO	4
		5	DO	3
	SILTY CLAY			
	brown grey	6	DO	WH
	a trace to some sand with wet silt and clay seams and layers	7	DO	2
		8	DO	1
		9	DO	1
10.0 169.2	Brown, loose **FINE TO MEDIUM SAND** a trace to some silt a trace of gravel			
11.0	*Cont'd on Fig. 1B*	10	DO	5



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JOB NO: 1010-S027

LOG OF BOREHOLE NO: 101

FIGURE NO: 1B

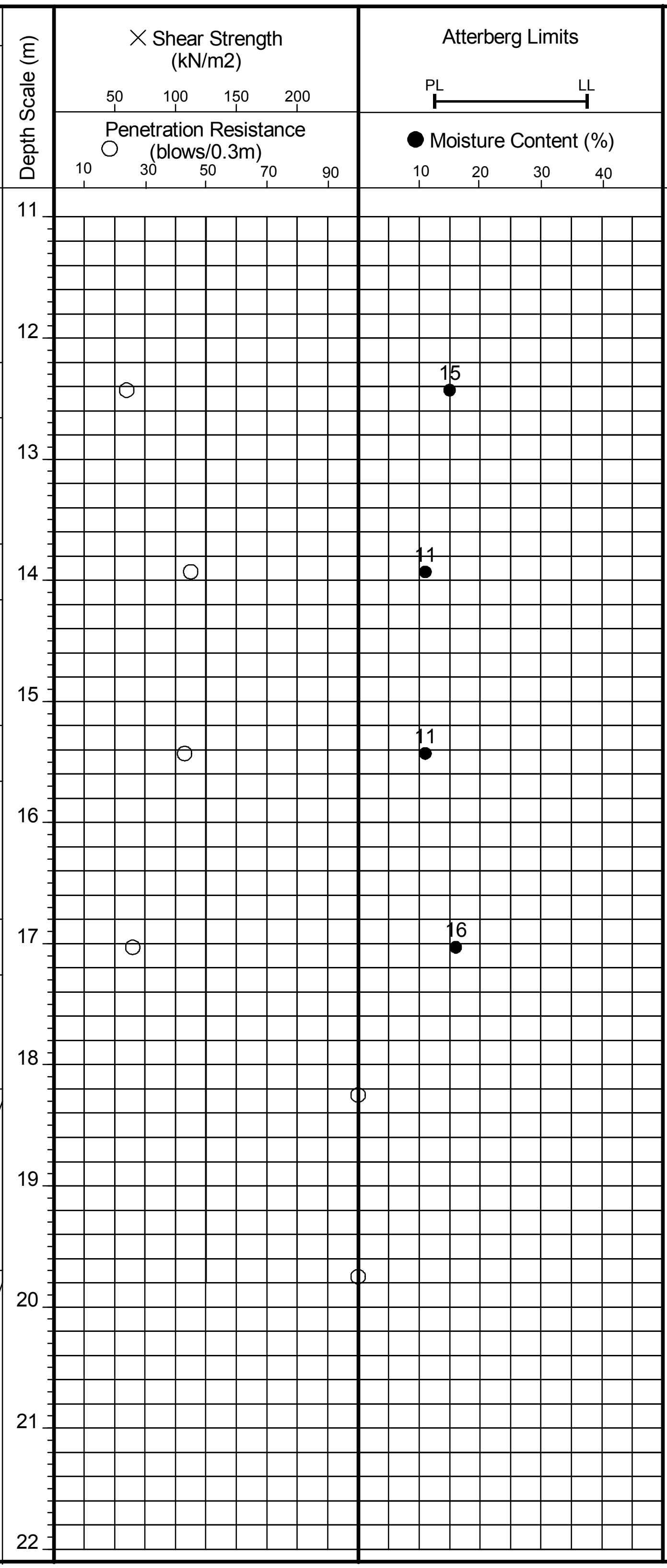
JOB DESCRIPTION: Proposed Townhouse Development

JOB LOCATION: Bayport Village - Phase 2, Town of Midland

METHOD OF BORING: Flight-Auger

DATE: November 3, 2010

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
11.0 168.2	Brown **FINE TO MEDIUM SAND** a trace to some silt a trace of gravel with silt seams and layers			
12.2 167.0	Brown, compact **FINE TO COARSE SAND** a trace to some silt a trace of gravel with silt seams and layers	11	DO	24
13.7 165.5	Brown, dense **SILTY SAND, Till** traces of gravel and clay with wet silt and clay seams and layers, cobbles and boulders	12	DO	45
		13	DO	43
16.8 162.4	Grey, compact **FINE TO MEDIUM SAND** a trace to some silt a trace of gravel with silt seams and layers	14	DO	26
18.3 160.9	Brown, very dense **SILTY SAND, Till** traces of gravel and clay frequent cobbles and boulders with wet silt and clay seams and layers	15	DO	100+
19.8 159.4	**END OF BOREHOLE**	16	DO	100+



WATER LEVEL

W.L. @ El. 178.0 m on completion
Cave-in @ El. 167.9 m on completion

Soil Engineers Ltd.

JOB NO: 1010-S027

LOG OF BOREHOLE NO: 102

FIGURE NO: 2A

JOB DESCRIPTION: Proposed Townhouse Development

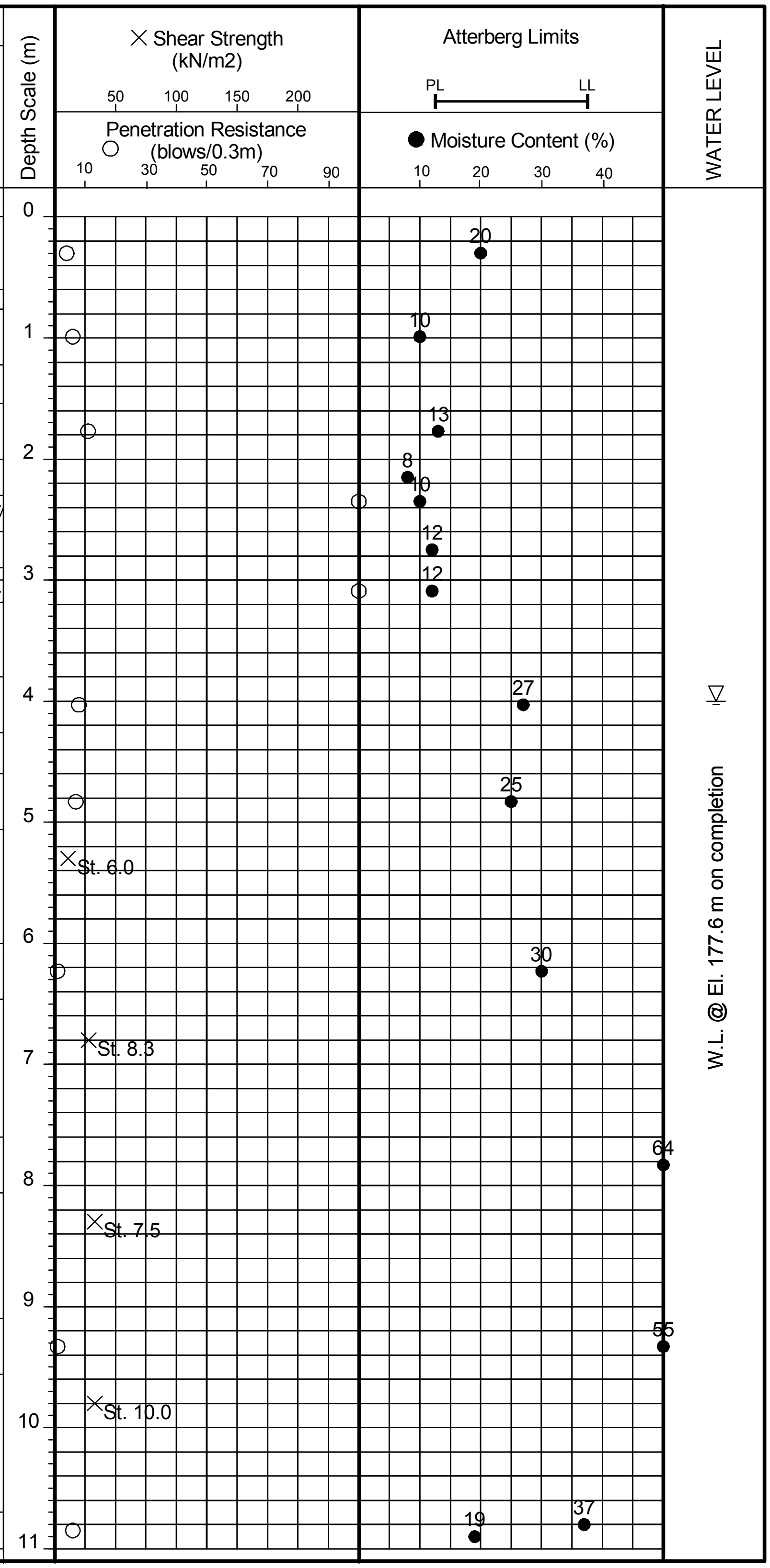
JOB LOCATION: Bayport Village - Phase 2, Town of Midland

METHOD OF BORING: Flight-Auger

DATE: November 3, 2010

Depth Elev. (m)	SOIL DESCRIPTION
0.0	Ground Surface
181.6	Dark brown/brown/grey **SLAG, Fill** mixed with sand, rock and cobbles with silty clay layers and topsoil inclusions
4.9 176.7	Very soft to firm **SILTY CLAY** a trace to some sand with wet silt and clay seams and layers brown / grey grey / brown *Cont'd on Fig. 2B*
11.0	

SAMPLES Number	Type	N-Value
1	DO	4
2	DO	6
3	DO	11
4	AS	-
5	DO	100+
6	AS	-
7	DO	100+
8	DO	8
9	DO	7
10	DO	1
11	DO	WH
12	DO	1
13	DO	6



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JOB NO: 1010-S027

LOG OF BOREHOLE NO: 102

FIGURE NO: 2B

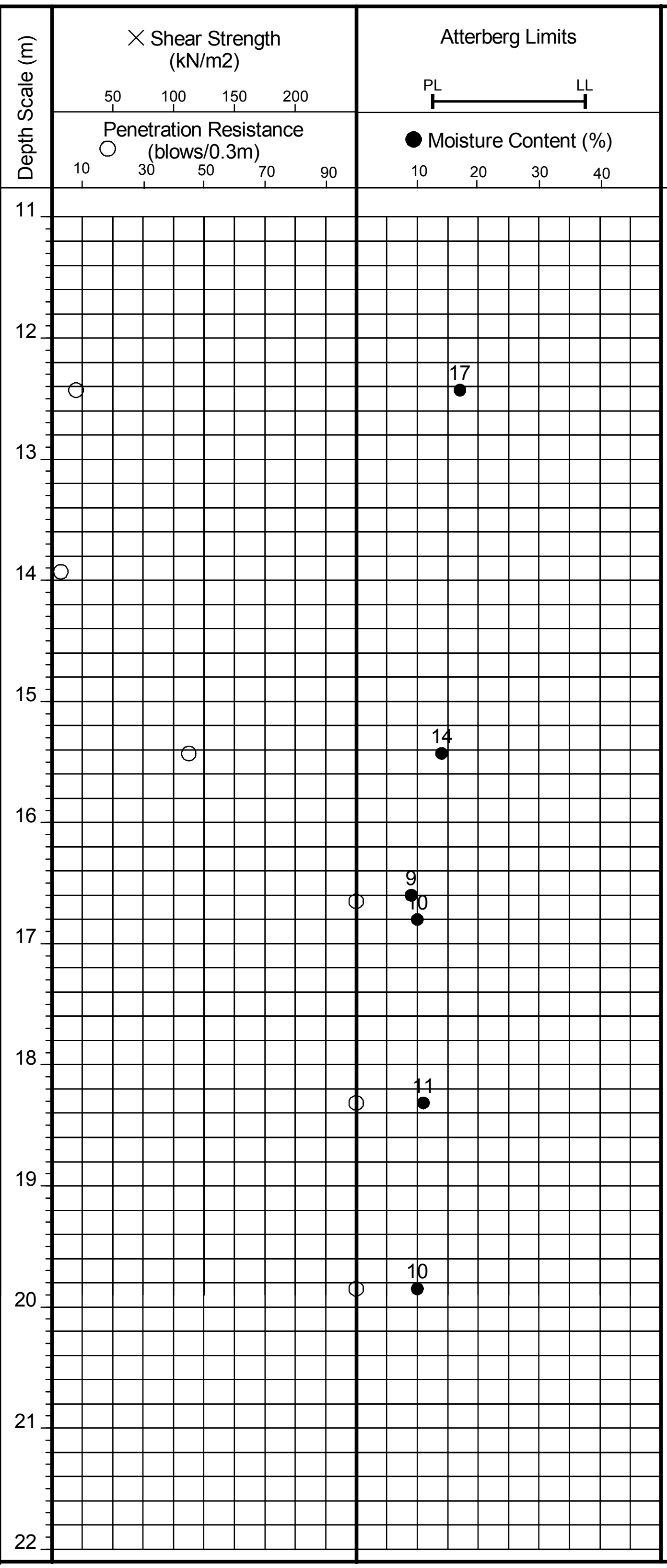
JOB DESCRIPTION: Proposed Townhouse Development

JOB LOCATION: Bayport Village - Phase 2, Town of Midland

METHOD OF BORING: Flight-Auger

DATE: November 3, 2010

Depth Elev. (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
11.0				
170.6	Brown, very loose to loose **SILTY FINE SAND** a trace to some sand with wet silt and clay seams and layers	14 15	DO DO	8 3
15.2 166.4	Brown, dense to very dense **SILTY SAND, Till** traces of gravel and clay frequent cobbles and boulders with wet silt and clay seams and layers	16 17	DO DO	45 100+
18.3 163.3	Grey, hard **SILTY CLAY, Till** sandy, a trace of gravel frequent cobbles and boulders with wet sand and silt seams and layers	18 19	DO DO	100+ 100+
19.9 161.7	**END OF BOREHOLE**			



WATER LEVEL

W.L. @ El. 177.6 m on completion

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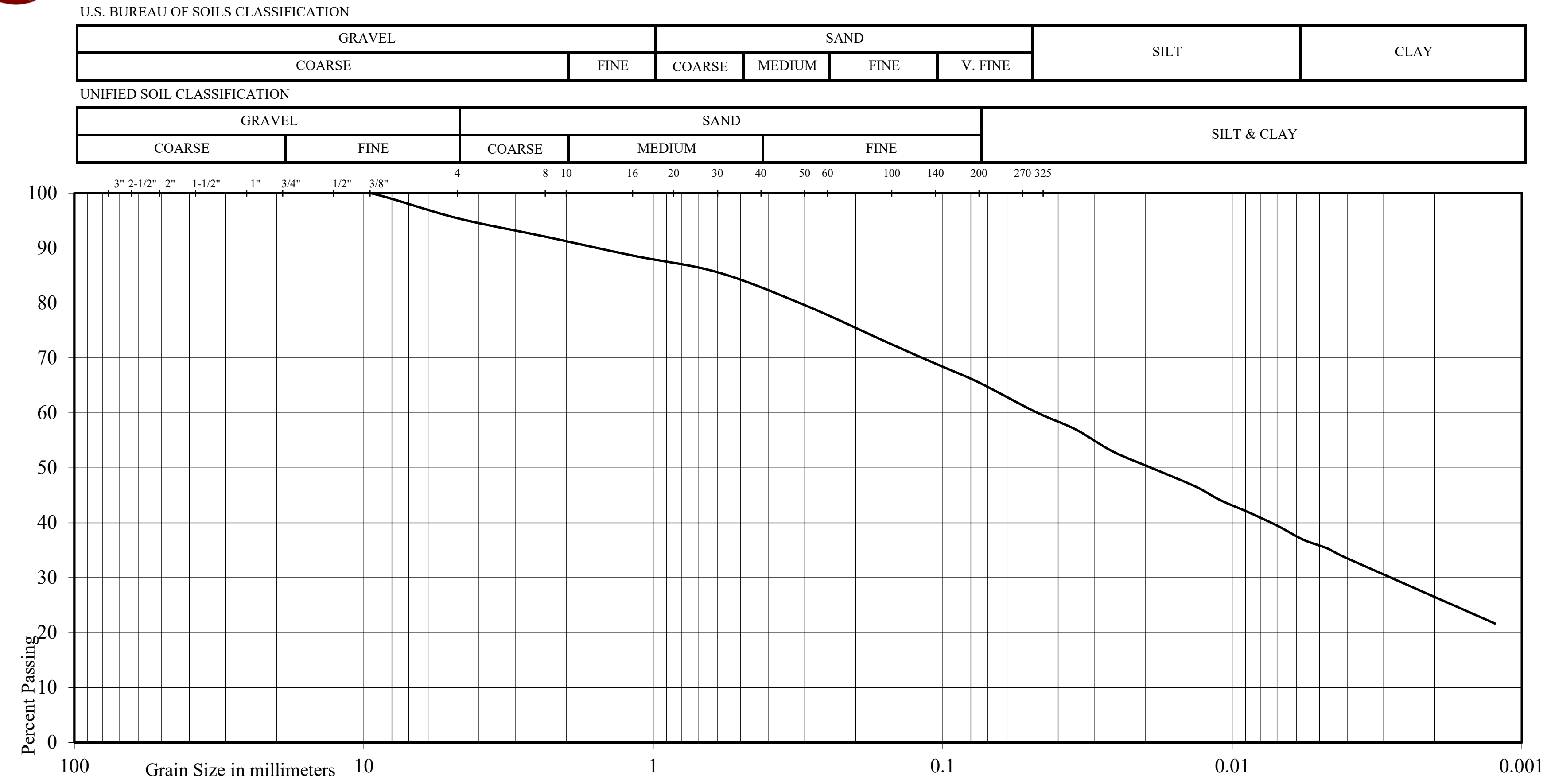
Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 1010-S027



Project: Proposed Townhouse Development

Location: Bayport Village - Phase 2, Town of Midland

Borehole No: 102

Sample No: 18

Depth (m): 18.4

Elevation (m): 163.2

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

Moisture Content (%) = 11

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

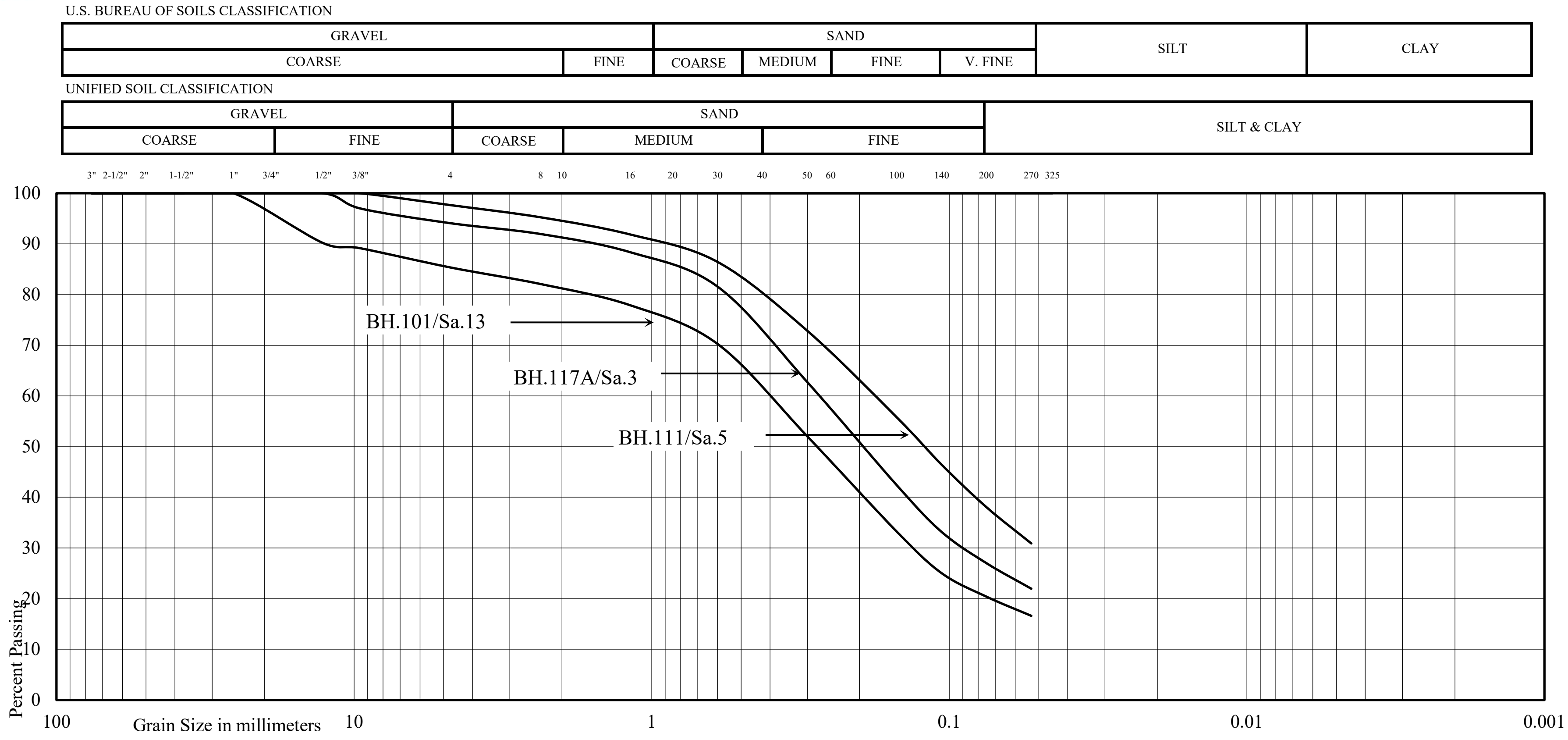
Classification of Sample [& Group Symbol]: SILTY CLAY, Till
sandy, a trace of gravel

Figure: 30

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 1010-S027



Project: Proposed Townhouse Development

Location: Bayport Village - Phase 2, Town of Midland

Borehole No:	101	111	117A
Sample No:	13	5	3
Depth (m):	15.5	3.3	1.8
Elevation (m):	163.7	178.1	182.5

BH./Sa.	101/13	111/5	117A/3
Liquid Limit (%) =	-	-	-
Plastic Limit (%) =	-	-	-
Plasticity Index (%) =	-	-	-
Moisture Content (%) =	11	18	9
Estimated Permeability (cm./sec.) =	10^{-3}	10^{-4}	10^{-3}

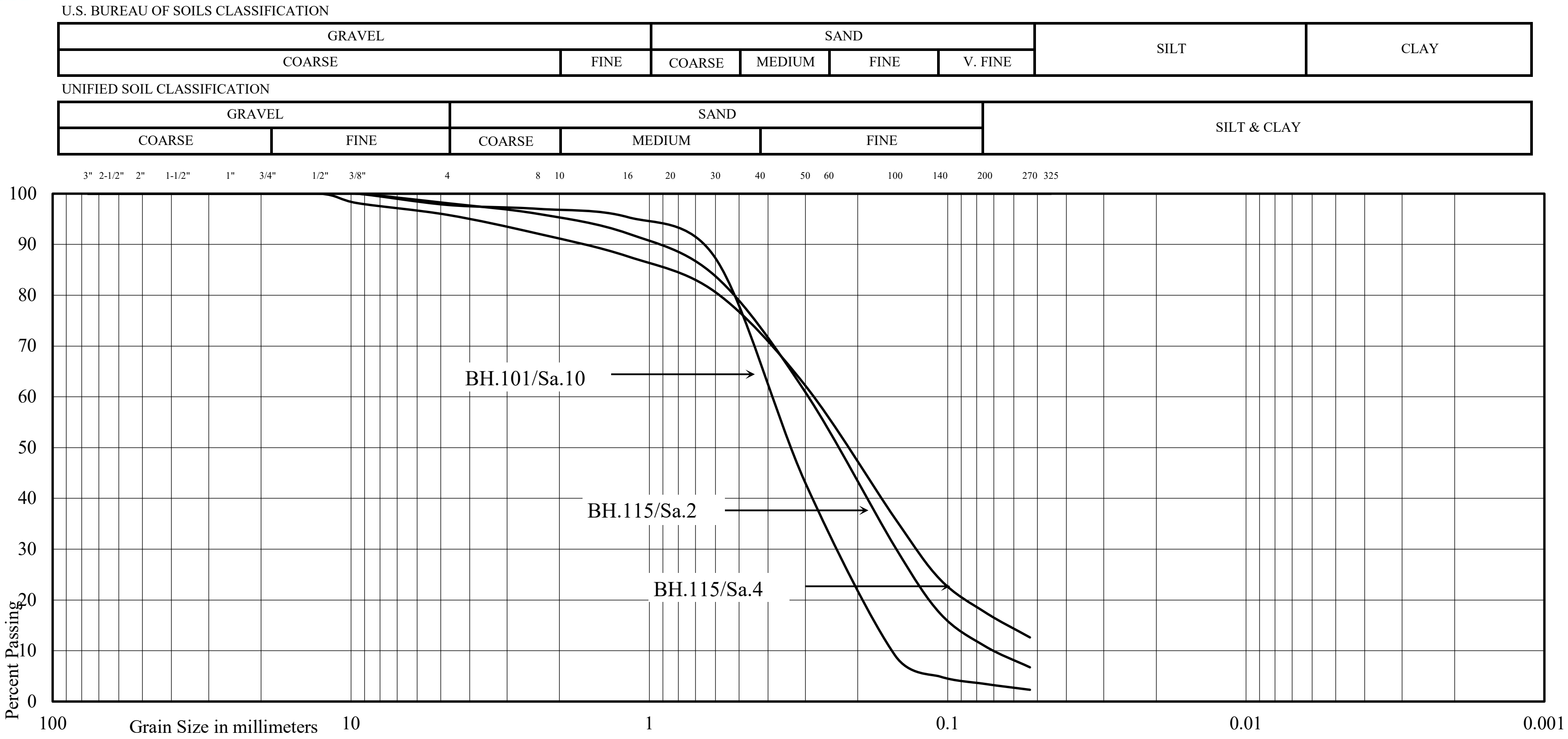
Classification of Sample [& Group Symbol]: SILTY SAND, Till
a trace to some gravel and clay

Figure: 31

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 1010-S027



Project: Proposed Townhouse Development

Location: Bayport Village - Phase 2, Town of Midland

Borehole No:	101	115	115.4
Sample No:	10	2	3
Depth (m):	10.9	1.0	2.6
Elevation (m):	168.3	181.7	180.1

BH./Sa.	101/10	115/2	115/4
Liquid Limit (%) =	-	-	-
Plastic Limit (%) =	-	-	-
Plasticity Index (%) =	-	-	-
Moisture Content (%) =	19	18	9
Estimated Permeability (cm./sec.) =	10^{-3}	10^{-4}	10^{-3}

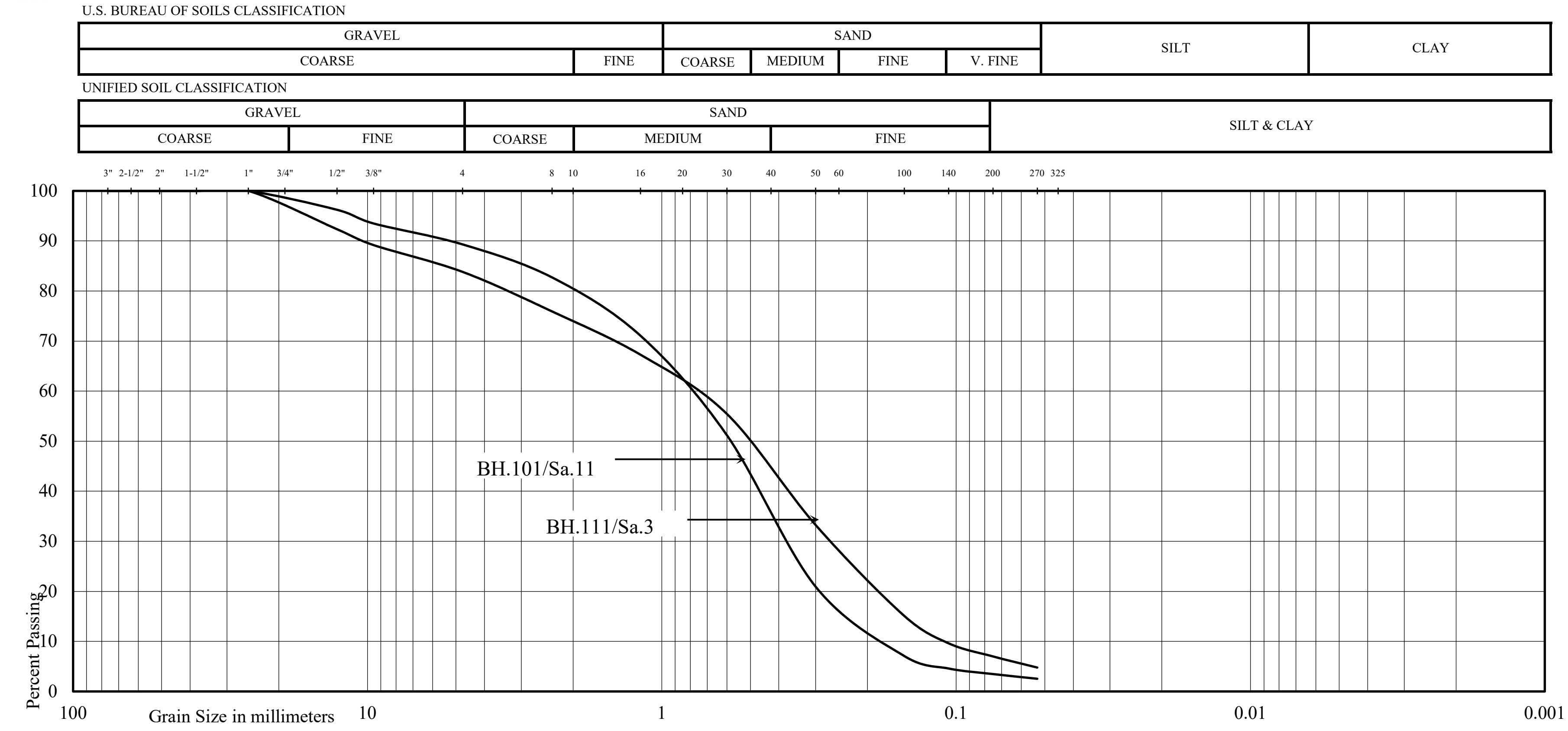
Classification of Sample [& Group Symbol]: FINE TO MEDIUM SAND
a trace to some silt; a trace of gravel

Figure: 35

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 1010-S027



Project: Proposed Townhouse Development

Location: Bayport Village - Phase 2, Town of Midland

Borehole No:	101	111
Sample No:	11	3
Depth (m):	12.5	1.8
Elevation (m):	166.7	179.6

BH./Sa.	101/11	111/3
Liquid Limit (%) =	-	-
Plastic Limit (%) =	-	-
Plasticity Index (%) =	-	-
Moisture Content (%) =	15	13
Estimated Permeability (cm./sec.) =	10^{-2}	10^{-2}

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

Figure: 37