September 29, 2016

PRELIMINARY GEOTECHNICAL INVESTIGATION

Proposed Residential Development, 4134 16th Ave Markham, Ontario

Submitted to:
Sixteenth Land Holdings Inc.
9980 Kennedy Road, Suite 200
Markham, Ontario
L6C 0M4

Attention: Mr. Glen Murphy and Mr. Frank Spaziani, P.Eng.

REPORT

Report Number: 1413472

Distribution:

8 Copies – Sixteenth Land Holdings Inc.

1 Copies - Golder Associates Ltd.

A world of capabilities delivered locally

Golder Associates

Table of Contents

ATTACHMENTS

APPENDICES

1.0 INTRODUCTION

Sixteenth Land Holdings Inc. has retained Golder Associates Ltd. (Golder) to prepare this Preliminary Geotechnical Investigation Report in support of an Official Plan Amendment ("OPA") application to permit the development of a residential community on the subject property. The report was originally prepared as part of acquisition due diligence for the development team and has been updated to reflect the current draft plan of subdivision.

This report presents the results of a preliminary geotechnical investigation carried out by Golder at the above referenced site, as shown on the Key Plan, Figure 1. The purpose of the investigation was to obtain information on the general subsurface soil and shallow groundwater conditions at the site by means of a limited number of boreholes. Based on our interpretation of the borehole data, this report provides preliminary geotechnical information in support of the proposed residential development at the site.

The factual data, interpretations and preliminary recommendations contained in this report pertain to a specific project as described in the report and are not applicable to any other project or site location. If the project is modified in concept, location or elevation, or if the project is not initiated within eighteen months of the date of the report, Golder should be given an opportunity to confirm that the preliminary recommendations are still valid. In addition, this report should be read in conjunction with the attached "Important Information and Limitations of This Report", included in Appendix A. The reader's attention is specifically drawn to this information, as it is essential for the proper use and interpretation of this report.

2.0 BACKGROUND

Golder previously carried out a preliminary geotechnical investigation for due diligence and acquisition purposes, a slope stability analysis, Phase I ESA and a Phase II ESA at the site. The results of which were presented in the following reports:

- *"Preliminary Geotechnical Investigation, Acquisition Due Diligence, York Downs Golf and Country Club, 4134 16th Avenue, Markham, Ontario"* Dated June 12, 2015;
- *"Phase I Environmental Site Assessments, 4134 16th Avenue, Markham, Ontario"* Dated November 2014;
- *"Phase II Environmental Site Assessment, 4134 16th Avenue, Markham, Ontario"* Dated January 2015; and
- *"Geotechnical Report, Slope Stability Analysis, York Downs Golf Club Redevelopment, Markham, Ontario"* Dated May 3, 2016

This preliminary geotechnical investigation is an updated report based on the current preliminary draft plan.

3.0 SITE DESCRIPTION

The property is municipally known as 4134 16th. Avenue, in the City of Markham, Region of York. The property is located in Part lots 16, 17 and 18, Concession 5. Except for an area adjacent to Kennedy Road, the balance of the property is currently used by its former owner York Downs Golf & Country Club for a golf course.

The property is a total of 168.64 hectares (416.72 acres), and is located on the north side of 16th. Avenue, on the west side of Kennedy Road, and has a small amount of frontage onto the east side of Warden Avenue as well. There is existing residential development surrounding the property on all sides.

A Berczy Creek traverses the western portion of the property, and Bruce Creek traverses the property in a roughly north / south direction, bisecting the property into west and east tableland areas.

The current golf course use has been in operation since York Downs Golf & Country Club opened on site in the early 1970's. The current Official Plan designation of 'Private Open Space' for the areas outside of the valleylands reflects this historic golf course use.

Sixteenth Land Holdings Inc. intends to develop the property for a residential community and is submitting an OPA to redesignate the developable portion of the property from 'Private Open Space' to appropriate urban residential designations to permit the development of residential uses.

This report has been prepared in conjunction with the OPA application in support of the redesignation as proposed in the draft OPA and in the Planning Report (Gatzios Planning, August 2016). Please refer to the draft OPA and to the Planning Report for a description of the proposed Official Plan land use designations proposed for the property.

The proposed residential development is detailed in the two draft plan of subdivision applications that accompany this OPA application. There is one draft plan of subdivision for the east portion of the property and one for the west portion of the property. The west draft plan of subdivision also contains the valleylands associated with both the Berczy creek and the Bruce creek.

4.0 GEOLOGY

According to Chapman & Putnam "*The Physiography of Southern Ontario*" published by the Ministry of Natural Resources (Chapman & Putman, 1984) this site is located within the physiographic region of Southern Ontario known as the Peel Plain. In the area of the site, the Peel Plain is a bevelled till plain bordering with drumlins (Chapman & Putman, 1984, Map P.2715).

5.0 INVESTIGATION PROCEDURE

The field work for this preliminary investigation was carried out in November 2014 on the 18^{th} to the 20^{th} and in December 2014 between the 5^{th} and the 17^{th}. During these periods thirty four boreholes (Nos. 14-1 through 14-34) were advanced at the approximate locations shown on the Borehole Location Plan, Figure 2. The boreholes were drilled using a track-mounted drillrig supplied and operated by a specialist drilling contractor, subcontracted to Golder. Standard penetration testing and sampling were carried out at regular intervals of depth in the boreholes using conventional 35 mm internal diameter split spoon sampling equipment advanced using an automatic hammer or drop hammer. Ten (10) 50 mm monitoring wells were installed in Boreholes 14-1, 14-2, 14-3, 14-8, 14-12, 14-15, 14-17, 14-29, 14-33 and 14-34. The remaining boreholes were loosely backfilled and sealed upon completion of drilling. All of the soil samples obtained during this investigation were brought to our Whitby laboratory for further examination, natural water content testing and selective soil classification testing.

The field work for this investigation was directed by a member of our engineering staff, who also logged the boreholes and cared for the recovered soil samples. The borehole locations were staked out in the field by Golder. The ground surface elevations at the location of the monitoring wells installed in Boreholes 14-1, 14-2, 14-3, 14-8, 14-12, 14-15, 14-17, 14-29 and 14-33 were surveyed by J.D. Barnes Ltd., which are understood to be referenced to geodetic datum. The ground surface elevations at the remaining borehole locations were interpreted from topographic mapping provided by York Downs Golf and Country Club. As such, these elevations should be considered to be approximate only. It is understood that the elevations provided on the topographic mapping are referenced to geodetic datum.

6.0 SUBSURFACE CONDITIONS

The subsurface soil and shallow groundwater conditions encountered in the boreholes, as well as the results of the field and laboratory testing are shown in detail on the Record of Borehole sheets following the text of this report. *Method of Soil Classification, List of Symbols* and *Abbreviations and Terms Used on Records of Boreholes and Test Pits* are provided to assist in the interpretation of the Record of Boreholes. It should be noted that the boundaries between the soil strata have been inferred from drilling observations and non-continuous samples. They generally represent a transition from one soil type to another and should not be inferred to represent an exact plane of geological change. Further, conditions will vary between and beyond the boreholes. The following is a summarized account of the subsurface conditions encountered in the boreholes drilled during this preliminary investigation, followed by more detailed descriptions of the major soil strata and shallow groundwater conditions.

Underlying asphalt and concrete (maintenance area), topsoil and fill elsewhere on site, the native subsoils encountered were variable across the site. The subsurface soils generally consisted of shallow glaciolacustrine deposits of silty clay, clayey silt, sand, silty sand and sandy silt mostly overlaying glacial till. The glacial till ranged in gradation from silty sand till to silty clay till. Deposits of non-cohesive soils ranging in gradation from silty sand to gravelly sand were interlayered within the glacial till and encountered below the glacial till. Interlayers of cohesive soils ranging in gradation from clayey silt to silty clay and localized till-like deposits were also encountered within and below the glacial till deposits. Groundwater was measured during the investigation in the monitoring wells at depths ranging from 1.2 m to 5.9 m below ground surface.

6.1 Topsoil/ Topsoil Fill

Surficial topsoil or topsoil fill were encountered in all boreholes with the exception of Boreholes 14-1 to 14-8, 14-17, 14-31 and 14-34. The thickness of the topsoil ranged from approximately 25 mm to 690 mm. Topsoil was also found below the fill in Boreholes 14-9 and 14-14.

6.2 Fills

Fill materials were encountered below the surficial topsoil fill in Boreholes 14-1, 14-2, 14-4, 14-7, 14-9, 14-17, 14-18, 14-19, 14-22, 14-25, 14-27, 14-28, 14-32 and 14-34. The fill consisted of variable materials ranging in gradation from silty sand to clayey silt as well as granular base materials related to asphalt or concrete pavements/slabs. The fills extended to depths ranging from approximately 0.1 m to 3.0 m below ground surface with a deep fill extending to about 4.6 m in the area of a service trench at Borehole 14-7. Borehole 14-7 was terminated within the fill at a depth of about 4.6 m. Standard penetration tests within the inorganic fill materials gave N values ranging from 3 blows to 23 blows per 0.3 m penetration. The in-situ water content of the fill samples ranged from about 4 percent to 29 percent.

6.3 Silty Clay to Clayey Silt

Deposits of silty clay to clayey silt were encountered in boreholes 14-4 to 14-6, 14-8 to 14-13, 14-15 to 14-17, 14-19 to 14-24, 14-26, 14-28, 14-31 and 14-33. Standard penetration tests carried out within the silty clay to clayey silt gave N values ranging widely from 3 blows to 36 blows per 0.3 m of penetration, indicating a soft to hard consistency. The natural water contents of the silty clay to clayey silt samples also ranged widely from about 10 percent to 42 percent. A single grain size distribution curve for a sample of silty clay is shown on Figure 3. The results of Atterberg limits tests completed on two (2) samples of the silty clay are shown on Figure 4 indicating that the silty clay can be classified as an inorganic clay of intermediate plasticity (CI soil type) under the Unified Soil Classification System.

6.4 Silty Sand, Sand, and Gravelly Sand

Non-cohesive strata, ranging in gradation from silty sand to gravelly sand were encountered in Boreholes 14-1 to 14-6, 14-8, 14-10 to 14-12, 14-14 to 14-16, 14-18 to 14-20 and 14-32 to 14-34. Standard penetration tests carried out within the silty sand to gravelly sand gave N values ranging widely from 4 blows to 45 blows per 0.3 m of penetration, indicating a loose to dense compactness. The natural water contents of the silty sand to gravelly sand samples also ranged widely from about 2 percent to 23 percent. Two grain size distribution curves for samples of silty sand are shown on Figure 5, and a single grain size distribution curve for a sample of gravelly silty sand is shown on Figure 6.

6.5 Silt and Sandy Silt

Deposits of silt and sandy silt were encountered in Boreholes 14-2 to 14-6, 14-13, 14-14, 14-18 and 14-20. Standard penetration tests carried out within the silt to sandy silt deposits gave N values ranging widely from 5 blows to 46 blows per 0.3 m of penetration, indicating a loose to dense compactness. The natural water contents of the silt samples also ranged widely from 9 percent to 27 percent. A single grain size distribution curve for a sample of silt is shown on Figure 7, and a single grain size distribution curve for a sample of sandy silt is shown on Figure 8.

6.6 Till-like Silty Clay to Till-Like Clayey Silt and Sand

Deposits of cohesive till-like silty clay to till-like clayey silt and sand were encountered in Boreholes 14-4, 14-12, 14-23, 14-25 and 14-30 to 14-32. Till-like deposits are characterized by having similar grain size distribution but lower N values (typically less than 10) than what would be typical of glacial tills.

Standard penetration tests carried out within the till-like silty clay to till-like clayey silt and sand gave N values ranging from 2 blows to 10 blows per 0.3 m of penetration, indicating a very soft to firm consistency. The natural water contents of the till-like samples ranged from about 11 percent to 34 percent. A single grain size distribution curve for a sample of till-like clayey silt and sand is shown on Figure 9.

6.7 Till-like Silty Sand

A deposit of a non-cohesive till-like silty sand was encountered overlying the silty sand till in Borehole 14-20. A single standard penetration test carried out within the till-like silty sand gave an N value of 9 blows per 0.3 m of penetration, indicating a loose compactness. The natural water content of the till-like silty sand sample was about 12 percent.

6.8 Silty Clay Till, Clayey Silt Till and Clayey Silt and Sand Till

Cohesive deposits of glacial till ranging in gradation from silty clay till to clayey silt and sand till were encountered in Boreholes 14-4 to 14-6, 14-9, 14-16 to 14-19, 14-21 to 14-31 and BH14-33. Cobbles and Boulders should be anticipated in this stratum as it is typical for Southern Ontario tills. Standard penetration tests carried out within the cohesive till gave N values ranging from 11 blows to greater than 100 blows per 0.3 m of penetration, indicating a stiff to hard consistency. The natural water contents of these till samples ranged from about 8 percent to 18 percent. A single grain size distribution curve for a sample of silty clay till is shown on Figure 10, and a single grain size distribution curve for a sample of clayey silt and sand till is shown on Figure 11.

6.9 Silty Sand Till

Non-cohesive deposits of non-cohesive silty sand till were encountered in Boreholes 14-10, 14-14, 14-15, 14-18, 14-19, 14-20, 14-22, 14-23 and 14-25. Cobbles and Boulders should be anticipated in this stratum as it is typical for Southern Ontario tills. Standard penetration tests carried out within the silty sand till gave N values ranging from 13 blows to 76 blows per 0.3 m of penetration, indicating a compact to very dense compactness. The natural water contents of the silty sand till samples ranged from 7 percent to 13 percent. Two grain size distribution curves for samples of silty sand till are shown on Figure 12.

6.10 Sandy Silt Till to Silt Till

Sandy silt till to silt till was encountered in Boreholes 14-2, 14-8, 14-17, 14-21, 14-22, 14-24, 14-25, 14-29 and 14-30. Cobbles and Boulders should be anticipated in this stratum as typical for Southern Ontario tills. Standard penetration tests carried out within the sandy silt till to silt till gave N values ranging from 11 blows to greater than 100 blows per 0.3 m of penetration, indicating a compact to very dense compactness. The natural water contents of the silty sand till to sandy silt till samples ranged from 7 percent to 12 percent.

7.0 GROUNDWATER

Groundwater was encountered during drilling at depths ranging widely from 1.2 m to 7.1 m below existing ground surface. Seven of the boreholes were noted as being dry upon the completion of drilling.

The groundwater levels measured in the standpipes installed as part of this investigation are summarized in the following table:

Standpipe	Approximate Ground Surface Elevation (m ASL)	Groundwater Level					
		November 18 to 20, 2014		December 17, 2014		January 5, 2015	
		Depth (m BGS)	Elevation (m ASL)	Depth (m BGS)	Elevation (m ASL)	Depth (m BGS)	Elevation (m ASL)
14-1	178.59	1.3	177.29	-		Frozen	
14-2	178.74	1.2	177.54	-		Frozen	
14-3	178.67	1.2	177.47	-		Frozen	
14-8	196.19	5.0	191.19	-		3.32	192.87
14-12	179.48			0.92	178.56	1.49	177.99
14-15	179.83			3.35	176.48	3.92	175.91
14-17	194.43			2.47	191.96	2.50	191.93
14-29	190.39			5.90	184.49	5.02	185.37
14-33	194.67			3.21	191.46	3.22	191.45
14-34	180.4*			1.29	179.11*	1.17	179.23*

* Elevation based on topographic mapping provided by York Downs Golf and Country Club. As such, these elevations should be considered to be approximate only.

It should be noted that these observations reflect the shallow groundwater conditions during the time of the field investigation and some seasonal fluctuations should be anticipated.

8.0 DISCUSSION

This section of the report provides preliminary geotechnical information based on our interpretation of the limited borehole information and on our understanding of the project requirements. The information in this portion of the report is provided for draft plan approval and is not sufficient for final design or construction purposes. Once the actual development plans and pertinent design details are available, the results of this preliminary investigation should be reviewed by Golder and an additional project specific investigation carried out, as appropriate, compatible with the final development plans for the site.

Where comments are made on construction, they are provided only in order to highlight aspects of construction which could affect the design of the project. Contractors bidding on or undertaking any work at the site should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction and make their own interpretation of the factual data as it affects their proposed construction techniques, schedule, equipment capabilities, costs, sequencing and the like.

Our professional services for this assignment address only the geotechnical (physical) aspects of the subsurface conditions at this site. The geo-environmental (chemical) aspects, including the consequences of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources, are outside of the terms of reference for this report and have not been addressed herein. However, as noted above, Golder has prepared a Phase I and II Environmental Site Assessments, the results of which were provided under a separate cover.

8.1 Project Description

Based on the preliminary draft plans provided, entitled "*4134 16th Avenue Composite Plan*" Drawing no. 1511-CP1 Prepared by The MBTW Group ("MBTW") dated August 22, 2016, the proposed subdivision will consist of a residential component with associated residential roads and underground servicing, open space blocks, school blocks, high to medium residential blocks, and four Stormwater Mangement (SWM) Pond blocks. The subdivision is divided into two areas by Bruce Creek which are referred to as the "East Draft Plan" and "West Draft Plan". It is understood the subdivision will be fully serviced with municipal sanitary and storm sewers and watermains. Based on the preliminary site servicing and grading plans, it is understood that installation of the underground services will require excavations of up to about 5.0 m below the existing ground surface at our borehole locations. Further, based on the preliminary site servicing plans, the proposed development will require grade raises of up to about 4.0 m above the existing ground surface and grade cuts of up to about 1 m below the existing ground surface at our borehole locations to establish the site grading.

8.2 Preliminary Geotechnical Information

8.2.1 Topsoil Stripping and Reuse

The following geotechnical comments are provided regarding topsoil stripping and reuse at the site:

- Where appropriate, consideration may be given to selective stripping operations, consisting of road allowances and building envelopes (incl. driveways).
- Outside of road allowances and building envelopes, the topsoil may be buried and/or reused as general lot fill to raise grades subject to approval from the governing agency. The primary factor controlling methane generation is the organic carbon content of the topsoil. The loss on ignition (LOI) test provides an indication of the organic carbon content of the sample. Generally, an LOI value of less than 10 percent is

considered to be acceptable in terms of methane generation potential. If topsoil is to be reused as general lot fill to raise grades, then LOI testing should be carried out.

- Stripping of the underlying organic stained layer would not be required in any site area from a geotechnical perspective. However, from a construction viewpoint, it may not be practical (or possible) for the contractor to distinguish between this zone and the overlying topsoil, especially if cuts of less than 150 mm are required.
- Where the topsoil is used as general lot fill, its thickness should be limited to about 1.5 m. The topsoil fill should be placed in maximum 300 mm loose lifts and uniformly compacted to 95 percent of standard Proctor maximum dry density. To have any success in placing topsoil as lot grading fill, it must be placed at or very close to its optimum water content to achieve workability and adequate compaction, in order to minimize post-construction settlements and/or lateral movements (e.g. of fences, etc.).

8.2.2 Engineered Fill

Based on the aforementioned plan drawings prepared by MBTW, it is understood that up to approximately 4.0 m of engineered fill will be required to establish the general site grading in some areas. Prior to placing engineered fill at the site, all topsoil, any existing septic systems, wells, old foundations and existing fill must first be removed from the development area. It should be noted that undocumented fill materials were encountered in Boreholes 14-1, 14-2, 14-4, 14-7, 14-9, 14-17, 14-18,14-19, 14-22, 14-25, 14-27, 14-28, 14-32 and 14-34. The existing fill consisted of variable materials ranging in gradation from silty sand to clayey silt as well as granular materials related to asphalt or concrete pavements/slabs. The fills extended to depths ranging from approximately 0.1 m to 3.0 m below ground surface with a deep fill extending to 4.6 m in the area of a service trench at Borehole 14-7. The fill material is not considered to be suitable to support house foundations or any other settlement sensitive structures and must be completely removed from the proposed building envelopes and replaced using engineered fill.

The exposed native subgrade area(s) should then be heavily proofrolled in conjunction with an inspection by the geotechnical engineer, to confirm that the exposed soils are native, undisturbed and competent, and have been adequately cleaned of ponded water and all disturbed, loosened, softened, organic and other deleterious material. Remedial work (i.e., further sub-excavation and replacement) should be carried out as directed by the geotechnical engineer.

Materials for reuse as engineered fill must be approved by Golder prior to placement. In this regard, excavated native soils from the site, free of significant amounts of organics and other deleterious materials, may be reused as engineered fill. The existing fill material would also be suitable for use as engineered fill provided the organics and any other deleterious materials can be removed from the fill and provided that the fill can be brought to within 2 percent of the optimum water content for compaction. Based on the measured natural water contents, the majority of the native glacial tills and non-cohesive silty/sandy soils above the local water table are generally near their estimated laboratory optimum water contents for compaction. However, the non-cohesive silt to silty sand and sand soils below the local water table and majority of the soft to stiff clayey soils are expected to be wet of their laboratory optimum water contents. These soils will likely require some drying prior to placement. Such fine grained soils may be difficult to adequately dry for use as engineered fill and may be considered for reuse as non-structural fill (i.e. in landscaping areas). It should also be noted that due to the fine-grained nature of the predominant clayey and silty subsoils, their workability is sensitive to moisture conditions and some difficulty would be expected in achieving adequate compaction during wet weather.

Imported materials to be used for engineered fill must be approved by Golder at the source(s), prior to hauling to the site. In this regard, imported sandy materials which generally meet the requirements for OPSS Select Subgrade Material (SSM) would be suitable for use as engineered fill. In any event, the approved materials for engineered fill should be placed in maximum 300 mm loose lifts and uniformly compacted to at least 98 percent of SPMDD throughout. The placement of engineered fill should be monitored by Golder on a full-time basis during placement.

The engineered fill footprint should extend to a minimum of 1 m outside the building envelope (in all directions) plus an equivalent of the depth of the engineered fill all around. Engineered fill slopes and any native cut slopes that will become permanent slopes at the development, if any, should be 2H:1V or flatter, and should be covered with topsoil and sodded or otherwise treated to reduce surface erosion. Maintenance will be required over the first several years until the vegetative mat has taken root.

The final surface of the engineered fill should be protected as necessary from construction traffic, and should be sloped to provide positive drainage for surface water during and following the construction period. During periods of freezing weather, additional soil cover should be placed above final subgrade to provide for frost protection. Prior to placing any additional engineered fill, the surface of the existing engineered fill must be re-inspected by the geotechnical engineer.

8.2.3 Consolidation Settlement

Deposits of compressible silty clay/clayey silt and till-like materials were encountered in Boreholes 14-4, 14-5, 14-6, 14-12, 14-13, 14-21, 14-23, 14-24, 14-25 and 14-31. These soils will be subject to consolidation settlement under loading. It should be noted, as part of this preliminary geotechnical investigation, consolidation settlement analysis was not carried out. As such, at the time of detailed design, additional boreholes and testing will be required to further define the limits of these areas as well as the soil strength, consolidation settlement potential and if applicable, preloading requirement. In this regard, installation of underground services, foundations, pavements and other settlement sensitive structures must be delayed until sufficient degree of consolidation settlement has occurred.

8.2.4 Excavation for Site Servicing

As noted above, it is anticipated that the proposed watermain, sanitary and storm sewer installations will require trench excavations up 5.0 m in depth below the existing road/ground surface. The finalized design pipe alignments and invert elevations are not available at this time. As such, the following generalized geotechnical information and recommendations are provided at this time to facilitate the detail design process. Once the finalized watermain and sewer alignments and invert depths are available, these recommendations should be reviewed and amended by the Golder, as required. Additional investigations should be carried out in identified areas of insufficient subsurface information.

Based on the results of this investigation, the founding soils for the services are likely to be variable and generally consist of engineered fill, silty clay/clayey silt, or clayey/silty tills or till-like deposits and non-cohesive sand and silt to silty sand. These subsoils are considered to be generally suitable for supporting the pipes, provided the integrity of the base can be maintained during construction. The till-like silty clay/clayey silt or soft clayey soil can also be used for the support of the pipes, however, additional bedding, in the order of 300 mm to 450 mm, may be required, as directed by Golder during construction. Some difficulty may be encountered in excavating the dense/hard tills at some locations. In addition, these tills are expected to contain cobbles and boulders, as previously noted.

Based on the groundwater conditions encountered in the boreholes, monitoring wells and standpipes, the pipes will generally be at or below the local water table at most locations. Groundwater control during excavation within the silty/clayey subsoils and tills at the site can be handled, as required, by pumping from properly constructed and filtered sumps located within the excavations. However, more significant groundwater seepage should be expected from the wet non-cohesive silty/sandy and granular deposits and fills (i.e. within vicinity of Boreholes 14-4, 14-7, 14-8, 14-13, 14-18, 14-19, 14-20 and 14-32) where encountered. Depending upon the actual thickness and extent of these wet non-cohesive silty/sandy and granular deposits and the finalized design pipe invert depths, some form of positive (active) groundwater control may be required to maintain the stability of the base and side slopes of the trench excavations in these areas, in addition to pumping from sumps. In any case, the groundwater level should be lowered to a minimum of 1 m below the invert of the pipes in advance of the excavation reaching the invert levels.

In any event, it would be prudent to carry out a "public digging" (i.e. test pitting) during the tender stage, to allow prospective bidders to assess the subsurface conditions and determine the type of groundwater control required, consistent with their equipment capabilities and the actual groundwater conditions at that time. The locations of the test pits should be determined in consultation with Golder.

An application under the Environmental Activity Section Registry (EASR) of the Ontario Ministry of the Environment and Climate Change should be submitted in the event that the pumping volumes exceed 50,000 L/day. Under the EASR, a Permit to Take Water is not required for water taking for construction site dewatering for volumes less than 400,000 L/day. Once the underground utility inverts are finalized, an assessment for the need for the PTTW should be carried out by the project hydrogeologist in conjunction with the geotechnical engineer.

It is anticipated that the trench excavations will consist of conventional temporary open cuts with side slopes not steeper than 1 horizontal to 1 vertical (i.e. for Type 3 soils). However, depending upon the construction procedures adopted by the contractor, groundwater seepage conditions and weather conditions at the time of construction, some local flattening and/or blanketing of the slopes may be required, especially where localized seepage is encountered. In particular, excavation into soft and very soft silty clay and till-like soils (vicinity of Boreholes 14-4, 14-6, 14-12, 14-13, 14-21, 14-25 and 14-31) will require utilization of some form of trench support or side slopes no steeper than 3 horizontal to 1 vertical (3:1) as these soft soils are classified as Type 4 under the Occupational Health and Safety Act and Regulations for construction project.

Depending on the proposed elevations of the services basal instability may be encountered in the soft clayey silt, silty clay or till-like clayey silt and till-like silty clay, depending on the final grade elevations and the geometry of the trench. It would be prudent at the time of construction to carry out periodic in situ vane shear tests at the base of the excavations to confirm the results of the boreholes and to provide basis for prediction basal instability so that appropriate steps can be taken during construction to mitigate or minimize its effects. As a preventive measure, in the event of potential basal instability, the excavated material should be placed well back from the edge of the excavation to minimize surcharge loading near the excavation crest. The trench in these areas should also be backfilled as soon as possible. Other methods may be recommended depending on the severity of the potential for instability.

Where side slopes of excavations are required to be steepened to limit the extent of the excavation, then some form of approved trench support system may be required. It must be emphasized that a trench liner box provides protection for construction personnel but does not provide any lateral support for the adjacent excavation walls, underground services or existing structures. It is imperative that any underground services or existing structures adjacent to the excavations be accurately located prior to construction and adequate support provided where required. In addition, steepened excavations should be left open for as short a duration as possible and completely backfilled at the end of each working day. Care should be taken to direct surface runoff away from the open excavations and all excavations should be carried out in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects.

8.2.5 Pipe Bedding and Cover

The bedding for watermains and sewers should be compatible with the type and class of pipe, the surrounding subsoil and anticipated loading conditions and should be designed in accordance with the Municipal and Regional standards. Where granular bedding is deemed to be acceptable, it should consist of at least 150 mm of OPSS Granular A or 19 mm crusher run limestone material. Depending upon the finalized design pipe invert depths and founding conditions, additional bedding (i.e. 300 to 450 mm in total) may be required in overly wet zones or soft clayey soils. From springline to 300 mm above obvert of the pipe, sand cover may be used. All bedding and cover materials should be placed in maximum 150 mm loose lifts and should be uniformly compacted to at least 98 percent of standard Proctor maximum dry density.

Clear stone bedding material should not be used in any case for pipe bedding or to stabilize the base unless specifically directed in the field by the Golder.

8.2.6 Trench Backfill

The excavated materials from the site will be variable, ranging from sandy/silty (non-cohesive) soils to clayey (cohesive) soils. The majority of the shallow subsoils from above the local water table as well as the underlying glacial till materials, are generally near their estimated optimum water contents for compaction and may be reused for trench backfill. The other excavated soils (silty clay, clayey silt, the till-like soils and non-cohesive silty/sandy soils) from at or below the local water table are generally wet of their estimated optimum water contents for compaction and may require some drying prior to placement. In this regard, depending upon schedule and weather conditions, it may not be practical to effectively dry the excavated wet till-like silty clay or wet upper till and silty materials in the field, for reuse as trench backfill. The excavated subsoils at suitable water contents may be reused as backfill provided they are free of significant amounts of topsoil, organics or other deleterious material and are placed and compacted as outlined below. All topsoil, existing fill and organic materials should be wasted or used for landscaping purposes.

Trench backfill, from the top of the cover material to 1 m below subgrade elevation, should be placed in maximum 450 mm loose lifts and uniformly compacted to at least 95 percent of standard Proctor maximum dry density. From 1 m below subgrade to subgrade elevation, the materials should be placed in maximum 300 mm loose lifts and uniformly compacted to at least 98 percent of standard Proctor maximum dry density.

Alternatively, if placement water contents at the time of construction are too high, or if there is a shortage of suitable in-situ material, then an approved imported granular material which meets the requirements for OPSS Select Subgrade Material (SSM) could be used. It should be placed in loose lift thicknesses and uniformly compacted as indicated above. Backfilling operations during cold weather should avoid inclusions of frozen lumps of material, snow and ice.

Normal post-construction settlement of the compacted trench backfill should be anticipated, with the majority of such settlement taking place within about 6 months following the completion of trench backfilling operations. This settlement will be reflected at the ground surface and may be compensated for, where necessary, by placing additional granular material prior to asphalt paving. Alternatively, if the asphalt binder course is placed shortly following the completion of trench backfilling operations in these areas, any settlement that may be reflected by subsidence of the surface of the binder asphalt should be compensated for by placing an additional thickness of binder asphalt or by padding. If scheduling permits, the surface course asphalt should not be placed over the binder course asphalt for at least 12 months.

It should be noted that in some cases, even though the compaction requirements have been met, the subgrade strength in the trench backfill areas may not be adequate to support heavy construction loading, especially during wet weather or where backfill materials wet of optimum have been placed. In any event, the subgrade should be proofrolled and inspected by Golder prior to placing the Granular B subbase and additional subbase material placed, as required and as determined in the field by Golder, consistent with the prevailing weather conditions and anticipated use by construction traffic.

8.2.7 Soil Bulking

Soil bulking is the increase in total volume of soil over the volume of the same material in the undisturbed state. Bulking of native soils occurs when they are excavated from undisturbed ground. It should be noted that due to the variability of the soils on the site, the actual soil bulking factor can be best determined when the final site grading plan is available and a series of additional laboratory and in-situ field tests are completed on the proposed "cut" soils. However, for initial design purposes and considering the soils at this site, bulking of about 10 percent (increase in total volume) would be expected after excavation and prior to re-compaction. After re-compaction, bulking of about 5 percent would be expected.

8.2.8 Trench Plugs

It is recommended that, where the utility trench encounters low permeability cohesive soils, trench plugs should be constructed to prevent preferential water flow through the granular bedding and trench backfill. These clay plugs could be constructed using excavated cohesive material or manufactured clay plugs. The need for and frequency of trench plugs must be evaluated during detailed design.

8.2.9 Residential Foundations

Based on the results of this investigation, the subsurface soil conditions are variable throughout the site. The grading plan has not been finalized at the time of the report preparation. However, conventional light residential houses/townhouses with basements may be founded on conventional shallow spread and/or continuous strip footings bearing in the native, undisturbed soils or on engineered fill at most locations. Actual allowable bearing capacities should be carefully considered at the detailed design stage in consultation with the geotechnical engineer. They will vary from 50 kPa to 150 kPa based on location, grading and actual founding elevations. Where soft and compressible clayey soils are present, the areas may require preloading as discussed in Section 8.2.3 prior to any footing construction.

In general, a preliminary allowable bearing capacity of 100 kPa to 150 kPa for 25 mm of settlement may be assumed for conventional shallow spread and/or strip footings bearing in the native, undisturbed competent subsoils (below any fill) at a depth of approximately 1.3 m below the existing ground surface (or deeper as required for basements) in most areas. It should be noted that zones of soft to stiff silty clay and clayey silt and till-like clayey silt or silty clay were encountered in Boreholes 14-4, 14-5, 14-6, 14-8, 14-12, 14-13, 14-15, 14-19, 14-20, 14-21, 14-23, 14-24, 14-25 and 14-31 at depths of up to 3.7 m. In the majority of these locations these soils were found immediately below the topsoil or shallow fill. Where these soils extend below a depth of 1.3 m below the existing ground surface (Boreholes 14-5, 14-6, 14-12, 14-23, 14-24 and 14-25) a reduced allowable bearing capacity in the order of 50 kPa to 75 kPa will likely be required. In addition, these soils may be subject to consolidation settlement under loading if grade raises are required. Again, once the final grading and the founding elevations are established, the design allowable bearing capacities should be reviewed and additional recommendations made at that time.

Footings bearing on or within approved engineered fill should have a minimum width of 450 mm and may also be designed using an allowable bearing pressure of 150 kPa, provided that the bases of these footings are a minimum of 1 m above the interface of the engineered fill and native soils. The allowable bearing pressure for footings founded within the engineered fill that are within 1 m of the underlying native soils, should be evaluated in the field by Golder on a case by case basis.

All foundation excavations at the site should be carried out in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects. The founding materials are susceptible to disturbance by construction activity especially during wet weather and care should be taken to preserve the integrity of the materials as bearing strata. Prior to pouring concrete for the footings, the foundation excavations should be inspected by the geotechnical engineer to confirm that the footings are founded within an undisturbed and competent bearing stratum that has been cleaned of ponded water and all disturbed, softened, loosened, organic and other deleterious material. Due to the variability of the subsurface conditions at the site, it is **essential** that all footings for all houses be inspected and bearing capacities confirmed in the field by Golder prior to pouring concrete. If the concrete for the footings on the native soil cannot be placed immediately after excavation and inspection, it is highly recommended that a working mat of lean concrete be placed in the excavation immediately to protect the integrity of the bearing stratum. As such, additional sub excavation should be carried out to allow for the placement of the working mat.

In general, for any houses placed wholly or in part on engineered fill, it is recommended that the foundation walls be provided with nominal reinforcement with reinforcing steel at the top and bottom of the foundation walls. This could typically consist of two 10 M bars in the top and two 10 M bars in the bottom of the walls. The bars should be placed as close as possible allowing for at least 50 mm of cover. Corner bars should have proper factory bends and all tied steel should have at least 600 mm of overlap. At window well locations, two 10 M bars should be placed in the foundation wall as close to the sill as possible (allowing for 50 mm of cover). The bars should extend laterally at least 600 mm beyond the edge of the window opening. The actual design should be approved by the home builder's structural engineer.

The perimeter house basement walls should be backfilled with a free draining, non-frost susceptible granular material carefully placed and compacted in lifts. The walls should be designed using a lateral earth pressure coefficient at rest, k_o, of 0.5 and a unit weight of backfill of 21 kN/m^3. Alternatively, where site excavated material is to be reused for exterior basement wall backfill, an approved geocomposite drainage system should be used directly against the wall. The upper 0.3 m of backfill should be clayey material to provide a relatively impermeable cap and should be sloped away from the house. Properly filtered perimeter drains at foundation level leading to a permanent outlet, such as a continuously pumped sump or a direct outlet to a sewer line, should be provided.

It is suggested that finalized basement floor elevations should be set above the local water table. Underfloor drains and upgraded level of water-proofing would be necessary in areas of the site if basements are proposed to be located below the local groundwater table and in potentially water bearing soils. Such conditions should be identified in the field Golder during construction.

Where spread footings are constructed at different elevations, the difference in elevation between the individual footings should not be greater than one half the clear distance between the footings. In addition, the lower footings should be constructed first so that if it is necessary to construct the lower footings at a greater depth than anticipated, the elevation of the upper footings can be adjusted accordingly. Stepped strip footings should be constructed in accordance with the 2012 Ontario Building Code, Section 9.15.3.9.

All exterior footings and footings in unheated areas should be provided with at least 1.3 m of soil cover after final grading, in order to minimize the potential for damage due to frost action. In addition, the bearing soil and fresh concrete should be protected from freezing during cold weather construction.

8.2.10 Pavement Consideration

Based on the subsoil conditions encountered in the boreholes, conventional asphaltic (flexible) pavement designs are considered to be appropriate for the proposed subdivision roadways. Details of the pavement design can be provided during detailed design once the roadway configuration, traffic data and site grading are available.

8.2.11 Stormwater Management Ponds

Based on the draft plan drawings provided to Golder, it is understood that the proposed development will include four (4) stormwater management pond blocks. Based on these plans, it should be noted that the boreholes drilled for the preliminary geotechnical investigation contain insufficient geotechnical and hydrogeological information for the pond design or review purposes. In all cases, the current groundwater levels are above the proposed pond base elevations and as such, pond liners are currently being considered by the design team. In this regard, further review and study of the on-going monitoring data as well as additional geotechnical and hydrogeological investigations will be required at the detailed design stage to address the pond design and construction details.

8.2.12 Slope Stability Analysis for Bruce Creek Valley Slopes

As noted above, Golder carried out a geotechnical setback analysis and slope investigation, the results of which were presented in our report entitled *"Geotechnical Report, Slope Stability Analysis, York Downs Golf Club Redevelopment, Markham, Ontario"* Dated May 3, 2016. This report should be read in conjunction with our aforementioned report.

9.0 CLOSURE

As previously indicated, the preliminary geotechnical recommendations provided in this report are prepared for draft plan approval process. Once the actual development plans are available, the information in this report should be reviewed by Golder and additional investigation(s) carried out, compatible with the detailed development plans for the site. In this regard, Golder would be pleased to provide further geotechnical services as the site development plans proceed.

We trust that this report provides sufficient preliminary geotechnical engineering information to aid in the planning and preliminary design of the proposed residential development at the site. If you have any questions regarding the contents of this report or require additional information, please do not hesitate to contact this office.

Yours truly,

GOLDER ASSOCIATES LTD.

LICENSED PROFESSIONAL ENGINEER
Sep. 29/16
A. MOHAMMAD
100127273
AM
PROVINCE OF ONTARIO

Alan Mohammad, P.Eng.
Geotechnical Engineer

Steven D. Keenan, C.E.T.
Principal

AM/SDK/AJH/mes/js;ms;nh

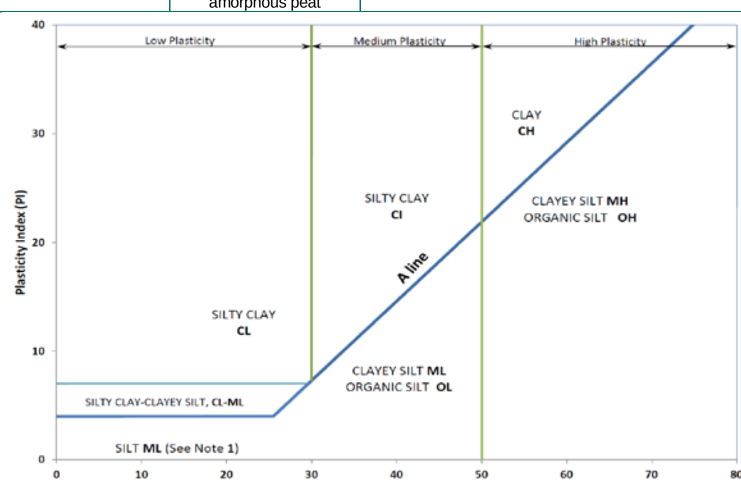
n:\active_2014\1182 - edd\1413472-metropia-phi & geotech-markham\reports\geotechnical\final report\1413472 rep 2016'09'29 preliminary geotechncial residential development final.docx

METHOD OF SOIL CLASSIFICATION

The Golder Associates Ltd. Soil Classification System is based on the Unified Soil Classification System (USCS)

Organic or Inorganic	Soil Group	Type of Soil		Gradation or Plasticity	$Cu = \frac{D_{60}}{D_{10}}$	$Cc = \frac{(D_{30})^2}{D_{10} x D_{60}}$	Organic Content	USCS Group Symbol	Group Name
INORGANIC (Organic Content ≤30% by mass)	COARSE-GRAINED SOILS (>50% by mass is larger than 0.075 mm)	GRAVELS (>50% by mass of coarse fraction is larger than 4.75 mm)	Gravels with ≤12% fines (by mass)	Poorly Graded	<4	≤1 or ≥3	≤30%	GP	GRAVEL
				Well Graded	≥4	1 to 3		GW	GRAVEL
			Gravels with >12% fines (by mass)	Below A Line	n/a			GM	SILTY GRAVEL
				Above A Line	n/a			GC	CLAYEY GRAVEL
		SANDS (≥50% by mass of coarse fraction is smaller than 4.75 mm)	Sands with ≤12% fines (by mass)	Poorly Graded	<6	≤1 or ≥3		SP	SAND
				Well Graded	≥6	1 to 3		SW	SAND
			Sands with >12% fines (by mass)	Below A Line	n/a			SM	SILTY SAND
				Above A Line	n/a			SC	CLAYEY SAND

Organic or Inorganic	Soil Group	Type of Soil	Laboratory Tests	Field Indicators: Dilatancy	Dry Strength	Shine Test	Thread Diameter	Toughness (of 3 mm thread)	Organic Content	USCS Group Symbol	Primary Name
INORGANIC (Organic Content ≤30% by mass)	FINE-GRAINED SOILS (≥50% by mass is smaller than 0.075 mm)	SILTS (Non-Plastic or PI and LL plot below A-Line on Plasticity Chart below)	Liquid Limit <50	Rapid	None	None	>6 mm	N/A (can't roll 3 mm thread)	<5%	ML	SILT
				Slow	None to Low	Dull	3mm to 6 mm	None to low	<5%	ML	CLAYEY SILT
				Slow to very slow	Low to medium	Dull to slight	3mm to 6 mm	Low	5% to 30%	OL	ORGANIC SILT
			Liquid Limit ≥50	Slow to very slow	Low to medium	Slight	3mm to 6 mm	Low to medium	<5%	MH	CLAYEY SILT
				None	Medium to high	Dull to slight	1 mm to 3 mm	Medium to high	5% to 30%	OH	ORGANIC SILT
		CLAYS (PI and LL plot above A-Line on Plasticity Chart below)	Liquid Limit <30	None	Low to medium	Slight to shiny	~ 3 mm	Low to medium	0% to 30% (see Note 2)	CL	SILTY CLAY
			Liquid Limit 30 to 50	None	Medium to high	Slight to shiny	1 mm to 3 mm	Medium		CI	SILTY CLAY
			Liquid Limit ≥50	None	High	Shiny	<1 mm	High		CH	CLAY
HIGHLY ORGANIC SOILS (Organic Content >30% by mass)		Peat and mineral soil mixtures							30% to 75%	PT	SILTY PEAT, SANDY PEAT
		Predominantly peat, may contain some mineral soil, fibrous or amorphous peat							75% to 100%		PEAT



Note 1 – Fine grained materials with PI and LL that plot in this area are named (ML) SILT with slight plasticity. Fine-grained materials which are non-plastic (i.e. a PL cannot be measured) are named SILT.

Note 2 – For soils with <5% organic content, include the descriptor "trace organics" for soils with between 5% and 30% organic content include the prefix "organic" before the Primary name.

Dual Symbol — A dual symbol is two symbols separated by a hyphen, for example, GP-GM, SW-SC and CL-ML.

For non-cohesive soils, the dual symbols must be used when the soil has between 5% and 12% fines (i.e. to identify transitional material between "clean" and "dirty" sand or gravel.

For cohesive soils, the dual symbol must be used when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart (see Plasticity Chart at left).

Borderline Symbol — A borderline symbol is two symbols separated by a slash, for example, CL/CI, GM/SM, CL/ML.

A borderline symbol should be used to indicate that the soil has been identified as having properties that are on the transition between similar materials. In addition, a borderline symbol may be used to ~~or~~ indicates a range of similar soil types within a stratum.

ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>300	>12
COBBLES	Not Applicable	75 to 300	3 to 12
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
SILT/CLAY	Classified by plasticity	<0.075	< (200)

MODIFIERS FOR SECONDARY AND MINOR CONSTITUENTS

Percentage by Mass	Modifier
>35	Use 'and' to combine major constituents (*i.e.,* SAND and GRAVEL, SAND and CLAY)
> 12 to 35	Primary soil name prefixed with "gravelly, sandy, SILTY, CLAYEY" as applicable
> 5 to 12	some
≤ 5	trace

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) split-spoon sampler for a distance of 300 mm (12 in.).

Cone Penetration Test (CPT)
An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (q_t), porewater pressure (u) and sleeve frictions are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance (DCPT); N_d:
The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure
PM: Sampler advanced by manual pressure
WH: Sampler advanced by static weight of hammer
WR: Sampler advanced by weight of sampler and rod

SAMPLES

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO or DP	Seamless open ended, driven or pushed tube sampler – note size
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
SS	Split spoon sampler – note size
ST	Slotted tube
TO	Thin-walled, open – note size
TP	Thin-walled, piston – note size
WS	Wash sample

SOIL TESTS

w	water content
PL , w_p	plastic limit
LL , w_L	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, Gs)
DS	direct shear test
GS	specific gravity
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
γ	unit weight

1. Tests which are anisotropically consolidated prior to shear are shown as CAD, CAU.

NON-COHESIVE (COHESIONLESS) SOILS

Compactness[2]

Term	SPT 'N' (blows/0.3m)[1]
Very Loose	0 - 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	>50

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects.
2. Definition of compactness descriptions based on SPT 'N' ranges from Terzaghi and Peck (1967) and correspond to typical average N_{60} values.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

COHESIVE SOILS

Consistency

Term	Undrained Shear Strength (kPa)	SPT 'N'[1] (blows/0.3m)
Very Soft	<12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	>200	>30

1. SPT 'N' in accordance with ASTM D1586, uncorrected for overburden pressure effects; approximate only.

Water Content

Term	Description
w < PL	Material is estimated to be drier than the Plastic Limit.
w ~ PL	Material is estimated to be close to the Plastic Limit.
w > PL	Material is estimated to be wetter than the Plastic Limit.

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	3.1416
ln x	natural logarithm of x
$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\,\sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
υ	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma$ - u)
σ'_{vo}	initial effective overburden stress
σ_1, σ_2, σ_3	principal stress (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight)*
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation

* Density symbol is ρ. Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

(a) Index Properties (continued)

w	water content
w_l or LL	liquid limit
w_p or PL	plastic limit
I_p or PI	plasticity index = $(w_l - w_p)$
w_s	shrinkage limit
I_L	liquidity index = $(w - w_p) / I_p$
I_C	consistency index = $(w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = $(e_{max} - e) / (e_{max} - e_{min})$ (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_α	secondary compression index
m_v	coefficient of volume change
c_v	coefficient of consolidation (vertical direction)
c_h	coefficient of consolidation (horizontal direction)
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

τ_p, τ_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = tan δ
c′	effective cohesion
c_u, s_u	undrained shear strength (ϕ = 0 analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p′	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 - \sigma_3)/2$ or $(\sigma'_1 - \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 - \sigma_3)$
S_t	sensitivity

Notes: 1 $\tau = c' + \sigma' \tan \phi'$
2 shear strength = (compressive strength)/2

PROJECT: 1413472

LOCATION: SEE FIGURE 2

RECORD OF BOREHOLE: 14-1

BORING DATE: November 19, 2014

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		178.59							
0	CME 85 Truck Mount; 203 mm O.D. Hollow Stem Augers	ASPHALT (100 mm)		0.00							Sand
		FILL - (SM) SILTY SAND, some clay, trace gravel; grey, trace organics, moist, loose		0.10	1	SS	9				
		(SP) SAND with clay, trace gravel, trace silt; brown with red iron mottling; non-cohesive, moist, compact		177.90 / 0.69	2	SS	11				Bentonite
1											
		(SW) SAND, some silt; brown; wet, loose to compact		177.14 / 1.45	3	SS	7				Sand Nov. 19, 2014
2					4	SS	14				Screen
3		(SW) SAND, some silt, some gravel; brown; wet, compact		175.62 / 2.97	5	SS	12				
		END OF BOREHOLE		174.93 / 3.66							1. Water level in piezometer measured at a depth of 1.30 m below ground surface (Elev. 177.29 m) on November 19, 2014.
4											
5											
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DG

CHECKED: SDK

RECORD OF BOREHOLE: 14-2

PROJECT: 1413472
LOCATION: SEE FIGURE 2

BORING DATE: November 18, 2014

SHEET 1 OF 1
DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

BORING METHOD: CME 85 Truck Mount, 203 mm O.D. Hollow Stem Augers

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80
HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}
WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl 10 20 30 40

ADDITIONAL LAB. TESTING

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
	GROUND SURFACE	178.74				
0	CONCRETE (100 mm)	0.00				Sand
	FILL - (SW) Gravelly SAND, angular, well graded; brown; non-cohesive	0.10	1	SS	5	
1			2	SS	14	Nov. 18, 2014
	(ML) SILT, some clay; brown; cohesive, wet, firm	177.29 / 1.45	3	SS	7	Bentonite
2	(SM) SILTY SAND, trace gravel; brown; non-cohesive, wet, loose to compact	176.45 / 2.29	4	SS	11	
3			5	SS	8	Sand
4			6	SS	4	
5			7	SS	20	Screen
			8A	SS	32	
	(ML) Sandy SILT, some gravel; grey (TILL); non-cohesive, dense, wet	173.04 / 5.70	8B			
6	END OF BOREHOLE	172.80 / 5.94				1. Water level in piezometer measured at a depth of 1.20 m below ground surface (Elev. 177.54 m) on November 18, 2014.
7						
8						
9						
10						

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: DG
CHECKED: SDK

GTA-BHS 001 S:\CLIENTS\KYLEMORE_COMMUNITIES\4134_16THAVE_MARKHAM\02_DATA\GINT\1413472.GPJ GAL-MIS.GDT 9/28/16 MK Dec. 2014

RECORD OF BOREHOLE: 14-3

PROJECT: 1413472
LOCATION: SEE FIGURE 2
BORING DATE: November 18, 2014
SHEET 1 OF 1
DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm
HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE	178.67				
0	CME 85 Truck Mount; 203 mm O.D. Hollow Stem Augers	CONCRETE (100 mm)	0.00				Sand
		Hydro-vacuumed and unsampled	0.10				Bentonite; Nov. 18, 2014
2		(ML) Sandy SILT, trace gravel; brown; non-cohesive, loose, wet	176.38 / 2.29	1	SS	7	Sand
3				2	SS	5	Screen
		(SW) SAND, some gravel, brown; non-cohesive, wet, compact	175.01 / 3.66	3	SS	16	
		END OF BOREHOLE	174.25 / 4.42				

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○; 20 40 60 80
HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}
WATER CONTENT PERCENT: Wp — W — Wl; 10 20 30 40
ADDITIONAL LAB. TESTING

1. Water level in piezometer measured at a depth of 1.20 m below ground surface (Elev. 177.47 m) on November 18, 2014.

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: DG
CHECKED: SDK

PROJECT: 1413472

LOCATION: SEE FIGURE 2

RECORD OF BOREHOLE: 14-4

BORING DATE: November 19, 2014

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

Boring method: CME 85 Truck Mount, 203 mm O.D. Hollow Stem Augers

DEPTH SCALE METRES	SOIL PROFILE – DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m
	GROUND SURFACE	181.30			
0	FILL - SAND and GRAVEL; grey; non-cohesive, dry	0.00	1A	SS	
	(ML) CLAYEY SILT; brown; cohesive, w<PL, stiff	0.10	1B	SS	11
	(ML) CLAYEY SILT, some sand, some gravel; brown, (TILL-LIKE); cohesive, w~PL, firm	180.69 / 0.61	2	SS	6
	(ML) CLAYEY SILT, some sand, some gravel; brown (TILL); cohesive, w~PL, stiff to very stiff	179.90 / 1.40	3	SS	11
			4	SS	24
			5	SS	25
	(ML) SILT, some sand; brown; non-cohesive, wet, dense	177.57 / 3.73	6A	SS	45
	(SW) SAND, well graded, some silt; brown with orange mottling, stratified; non-cohesive, wet, dense	177.03 / 4.27	6B	SS	
	(ML) SILT, some sand; brown, zones of silty fine sand; non-cohesive, wet, dense	4.42	7	SS	30
			8	SS	22
6	END OF BOREHOLE	175.36 / 5.94			

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ ; 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl ; 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Depth scale: 0 1 2 3 4 5 6 7 8 9 10

GTA-BHS 001 S:\CLIENTS\KYLEMORE_COMMUNITIES\4134_16THAVE_MARKHAM\02_DATA\GINT\1413472.GPJ GAL-MIS.GDT 9/28/16 MK Dec. 2014

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DG

CHECKED: SDK

RECORD OF BOREHOLE: 14-5

PROJECT: 1413472
LOCATION: SEE FIGURE 2
BORING DATE: November 19, 2014
SHEET 1 OF 1
DATUM: Geodetic
SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm
HAMMER TYPE: AUTOMATIC

BORING METHOD: CME 85 Truck Mount; 102 mm Solid Stem Augers

DESCRIPTION	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	183.50			
(SM) SILTY SAND, trace clay, trace organics; dark brown; non-cohesive, dry, loose	0.00	1	SS	6
(ML) Sandy SILT, trace clay; brown; non-cohesive, wet, compact	182.81 / 0.69	2	SS	11
(CI) SILTY CLAY; brown to grey; cohesive, w~PL, stiff to firm	181.98 / 1.52	3A	SS	11
		3B		
		4	SS	6
		5	SS	8
(ML) CLAYEY SILT, some gravel trace sand; grey (TILL); cohesive, w<PL, stiff to very stiff	179.77 / 3.73	6	SS	11
		7	SS	26
(CI) SILTY CLAY, trace to some gravel, trace sand; grey (TILL); w<PL, very stiff	178.17 / 5.33	8	SS	26
END OF BOREHOLE	177.56 / 5.94			

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○: 20 40 60 80
HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}
WATER CONTENT PERCENT: Wp ⊢ ○W ⊣ Wl: 10 20 30 40
ADDITIONAL LAB. TESTING
PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

GTA-BHS 001 S:\CLIENTS\KYLEMORE_COMMUNITIES\4134_16THAVE_MARKHAM\02_DATA\GINT\1413472.GPJ GAL-MIS.GDT 9/28/16 MK Dec. 2014

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: DG
CHECKED: SDK

PROJECT: 1413472

LOCATION: SEE FIGURE 2

RECORD OF BOREHOLE: 14-6

BORING DATE: November 19, 2014

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

BORING METHOD: CME 85 Truck Mount; 102 mm Solid Stem Augers

DEPTH SCALE METRES	SOIL PROFILE – DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m
	GROUND SURFACE	192.10			
0	(SM) SILTY SAND, trace to some gravel; mottled brown and orange; non-cohesive, loose	0.00	1	SS	4
	(CL) SILTY CLAY; light brown to grey; cohesive, w>PL, soft to stiff	191.34 / 0.76	2	SS	4
			3	SS	8
	(ML) CLAYEY SILT, some gravel; grey, with layers of silty clay (TILL-LIKE); cohesive, w<PL, stiff	189.89 / 2.21	4	SS	8
	(ML) SILT, trace sand, trace gravel; grey; non-cohesive, wet, compact	189.05 / 3.05	5A / 5B	SS	14
	(SP) SAND, angular to sub-angular, poorly graded, trace gravel; grey; non-cohesive, dense, moist	188.29 / 3.81	6	SS	25
	(SW) Gravelly SAND, trace silt; grey; non-cohesive, compact	187.60 / 4.50	7	SS	17
	(ML) CLAYEY SILT; grey, stratified; cohesive, w<PL, hard	186.77 / 5.33	8	SS	36
6	END OF BOREHOLE	186.16 / 5.94			

Chart column headings: DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40); ADDITIONAL LAB. TESTING; PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DG

CHECKED: SDK

PROJECT: 1413472

LOCATION: SEE FIGURE 2

RECORD OF BOREHOLE: 14-7

BORING DATE: November 20, 2014

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

BORING METHOD: Boomer Track Mount, 102 mm Solid Stem Augers

DESCRIPTION	ELEV. (m)	DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	189.60				
FILL - (ML) CLAYEY SILT, some organics, trace gravel; brown; cohesive, w<PL, firm		0.00	1	SS	8
FILL - (CL) SILTY CLAY; grey-brown; cohesive, w~PL, stiff	188.84	0.76	2	SS	9
FILL - (ML) CLAYEY SILT, some sand, trace gravel; brown; cohesive, w<PL, stiff	188.08	1.52	3	SS	12
FILL - (SM) SILTY SAND, trace gravel; mottled brown; non-cohesive, moist, loose	187.39	2.21	4	SS	9
FILL - (ML) CLAYEY SILT, trace gravel; brown; cohesive, w<PL, firm	186.55	3.05	5	SS	7
FILL - (CL) SILTY CLAY; grey-brown; cohesive, w~PL, stiff	185.79	3.81	6	SS	11
END OF BOREHOLE ON CONCRETE PIPE	185.03	4.57			

Column headings: DEPTH SCALE METRES (0–10); BORING METHOD; SOIL PROFILE; STRATA PLOT; SAMPLES; DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa — nat V. + Q - ● rem V. ⊕ U - ○ (20, 40, 60, 80); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT Wp — W — Wl (10, 20, 30, 40); ADDITIONAL LAB. TESTING; PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE

1 : 50

LOGGED: DG

CHECKED: SDK

PROJECT: 1413472

LOCATION: SEE FIGURE 2

RECORD OF BOREHOLE: 14-8

BORING DATE: November 20, 2014

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

BORING METHOD: Boomer Track Mount, 102 mm Solid Stem Augers

DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
GROUND SURFACE	196.19				
(CL) SILTY CLAY, trace sand, trace gravel; mottled grey-brown, organic inclusions in upper 0.3 m, layers of sandy silt below a depth of 1.0 m; cohesive, w~PL, firm to stiff	0.00	1	SS	7	Sand
		2	SS	13	
(SM) SILTY SAND, trace clay, trace gravel; brown to grey (TILL); non-cohesive, moist, compact	194.74 / 1.45	3	SS	13	Bentonite
		4A / 4B	SS	16	Sand
(SW) SAND; grey; non-cohesive, moist, dense	193.22 / 2.97	5A	SS		
(ML) SILT, some clay, trace sand, trace gravel; grey (TILL); cohesive, moist, very stiff	3.12	5B		27	Jan. 5, 2015
(SW) SAND; brown; non-cohesive, wet, compact	192.53 / 3.66	6	SS	19	Screen
		7	SS	23	
(SM) SILTY SAND; brown; non-cohesive, compact, wet	190.93 / 5.26	8	SS	13	
END OF BOREHOLE	190.25 / 5.94				

1. Water level in piezometer measured at a depth of 3.32 m below ground surface (Elev. 192.87 m) on January 5, 2015.

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp — W — Wl : 10 20 30 40

ADDITIONAL LAB. TESTING

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: DG

CHECKED: SDK

GTA-BHS 001 S:\CLIENTS\KYLEMORE_COMMUNITIES\4134_16THAVE_MARKHAM\02_DATA\GINT\1413472.GPJ GAL-MIS.GDT 9/28/16 MK Dec. 2014

PROJECT: 1413472

LOCATION: SEE FIGURE 2

RECORD OF BOREHOLE: 14-9

BORING DATE: December 10, 2014

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE – DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE	181.70					
0	Mini Mole; 102 mm Solid Stem Augers	FILL-Topsoil (130 mm)	0.00	1A	SS			
		FILL - (SM) SILT SAND, trace clay, trace to some gravel; trace organics; brown to grey, moist, compact	0.13	1B		23		
				2A	SS	9		
1		TOPSOIL	180.73 / 0.97	2B				
		(ML) CLAYEY SILT, some sand, some gravel; brown, zones of fine sand and gravel (TILL); w<PL, very stiff	180.33 / 1.37	3	SS	26		
2		(ML) CLAYEY SILT and SAND, some gravel, some silt, brown to grey (TILL); cohesive, moist, very stiff to hard	179.34 / 2.36	4	SS	29	MH	
3				5	SS	34		Dec. 10, 2014
4		(CI) SILTY CLAY, trace sand, trace gravel; grey, zones of silt; cohesive, w<PL, very stiff	177.59 / 4.11					
5				6	SS	28	MH	
		END OF BOREHOLE	176.52 / 5.18					1. Water level in open borehole measured at a depth of 3.7 m below ground surface (Elev. 177.70 m) on December 10, 2014.

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● ; rem V. ⊕ U - ○ ; 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢ ○W ⊣ Wl ; 10 20 30 40

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: DG

CHECKED: SDK

PROJECT: 1413472

LOCATION: SEE FIGURE 2

RECORD OF BOREHOLE: 14-10

BORING DATE: December 10, 2014

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

BORING METHOD: Mini Mole, 102 mm Solid Stem Augers

DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	WATER CONTENT (%)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
GROUND SURFACE	188.60						
TOPSOIL (130 mm)	0.00	1A					
(CI) SILTY CLAY; brown, stratified; cohesive, moist, stiff	0.13	1B	SS	11			
		2	SS	11			
(SM) SILTY SAND, some gravel, trace clay; brown, containing fissures with oxidation, containing cobbles and boulders (TILL); non-cohesive, moist to dry, compact to very dense	187.15 / 1.45	3	SS	12		MH	
		4	SS	73			
		5	SS	76			
(SM) SILTY SAND, trace clay, trace gravel; brown; non-cohesive, moist, compact	184.49 / 4.11						Dec. 10, 2014
		6	SS	29			
END OF BOREHOLE	183.42 / 5.18						1. Water level in open borehole measured at a depth of 4.6 m below ground surface (Elev. 184.61 m) on December 10, 2014.

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp W Wl : 10 20 30 40

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AVR

CHECKED: SDK

PROJECT: 1413472

LOCATION: SEE FIGURE 2

RECORD OF BOREHOLE: 14-11

SHEET 1 OF 1

DATUM: Geodetic

BORING DATE: December 10, 2014

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

BORING METHOD: Mini Mole, 102 mm Solid Stem Augers

DEPTH (m)	DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	WATER CONTENT PERCENT	ADDITIONAL LAB. TESTING
	GROUND SURFACE	182.20					
0	TOPSOIL	182.00 / 0.00	1A				
	(SM) SILTY SAND, trace gravel; brown, organic staining; non-cohesive, dry, compact	0.20	1B	SS	13		
	(CI) SILTY CLAY, trace sand, trace to some gravel; brown to grey, some layering; cohesive, w<PL, stiff to very stiff	181.44 / 0.76	2	SS	17		
	0.08 m sand seam at a depth of 1.83 m		3	SS	21		
			4	SS	22		
			5	SS	22		
	(SM) gravelly SILTY SAND, some clay; grey; non-cohesive, wet, compact	178.09 / 4.11	6	SS	16		MH
	END OF BOREHOLE	177.02 / 5.18					

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢ ○W ⊣ Wl 10 20 30 40

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AVR

CHECKED: SDK

PROJECT: 1413472

LOCATION: SEE FIGURE 2

RECORD OF BOREHOLE: 14-12

BORING DATE: December 16, 2014

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE	179.48					
0	Mini Mole; 102 mm Solid Stem Augers	TOPSOIL	0.00	1A			OP OC Nitrate Phospate	Cement
		(CI) SILTY CLAY; brown to grey, stratified; cohesive, w>PL, firm to soft	0.10	1B	SS	7		Sand
								Bentonite
1				2	SS	8	M&I	
								Sand; Jan. 5, 2015
2				3	SS	4		
				4	SS	3		
3		(CI) SILTY CLAY, trace sand, trace gravel; (TILL-LIKE); cohesive, w>PL, soft	176.51 2.97	5	SS	4		Screen
4		(SW) SAND, some silt; grey; non-cohesive, wet, loose	175.37 4.11					
5				6	SS	N/R		
		END OF BOREHOLE	174.30 5.18					

*N/R - Not Recorded

1. Water level in piezometer measured at a depth of 1.49 m below ground surface (Elev. 177.99 m) on January 5, 2015.

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢ W ⊣ Wl 10 20 30 40

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: AVR

CHECKED: SDK

PROJECT: 1413472

LOCATION: SEE FIGURE 2

RECORD OF BOREHOLE: 14-13

BORING DATE: December 16, 2014

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DESCRIPTION	ELEV. / DEPTH (m)
GROUND SURFACE	180.90
TOPSOIL	0.00
(CI) SILTY CLAY; mottled grey-brown; cohesive, w~PL, soft to firm	0.05
(ML) CLAYEY SILT, some sand, some gravel; grey; cohesive, w<PL, stiff	179.45 / 1.45
(ML) Sandy SILT, some clay; grey; non-cohesive, moist, dense	177.93 / 2.97
END OF BOREHOLE	175.72 / 5.18

SAMPLES NUMBER	TYPE	BLOWS/0.3m
1A	SS	
1B		3
2	SS	8
3	SS	18
4	SS	11
5	SS	46
6	SS	38

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● ; rem V. ⊕ U - ○ : 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp —○W— Wl : 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: EWB

CHECKED: SDK

PROJECT: 1413472

LOCATION: SEE FIGURE 2

RECORD OF BOREHOLE: 14-14

SHEET 1 OF 1

BORING DATE: December 9, 2014

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		176.30							
0	Mini Mole; 102 mm Solid Stem Augers	FILL - TOPSOIL (150 mm)		0.00	1A						
		FILL - (SM) SILTY SAND, some gravel, trace clay; mottled brown and grey; non-cohesive, moist, compact		0.15	1B	SS	22				
		TOPSOIL		175.44 0.86	2A						
1		(SW) SAND, some gravel; brown; non-cohesive, wet, compact		1.02	2B 2C	SS	12				
					3A	SS	28				
2		(SM) SILTY SAND, some gravel, trace to some clay; brown to grey (TILL); moist, compact to dense		174.42 1.88	3B						
					4	SS	20				
3					5	SS	40				
4		(ML) SILT, some sand, trace clay; grey; non-cohesive, w>PL, very stiff		172.19 4.11							
5					6	SS	21			MH	
		END OF BOREHOLE		171.12 5.18							
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AVR

CHECKED: SDK

PROJECT: 1413472

LOCATION: SEE FIGURE 2

RECORD OF BOREHOLE: 14-15

BORING DATE: December 9, 2014

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

BORING METHOD: Mini Mole, 102 mm Solid Stem Augers

DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
GROUND SURFACE	179.83				
TOPSOIL	0.00	1A	SS	7	
(SP) SAND, some gravel; brown; non-cohesive, dry, loose	0.15	1B			
(CI) SILTY CLAY, some sand, some gravel; mottled brown-grey, stratified; cohesive, w>PL, firm to very stiff	0.27	1C			
		2	SS	13	
		3A	SS	34	
(SM) SILTY SAND, some gravel; brown to grey (TILL); non-cohesive, moist, compact to dense	177.85 / 1.98	3B			
		4	SS	17	
		5	SS	31	
		6	SS	32	
(SM) SILTY SAND; grey; non-cohesive, compact	174.19 / 5.64				
		7	SS	20	MH
END OF BOREHOLE	173.12 / 6.71				

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp W Wl 10 20 30 40

PIEZOMETER OR STANDPIPE INSTALLATION: Bentonite; Sand; Screen; Jan. 5, 2015

1. Water level in piezometer measured at a depth of 3.92 m below ground surface (Elev. 175.91 m) on January 5, 2015.

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: AVR

CHECKED: SDK

GTA-BHS 001 S:\CLIENTS\KYLEMORE_COMMUNITIES\4134_16THAVE_MARKHAM\02_DATA\GINT\1413472.GPJ GAL-MIS.GDT 9/28/16 MK Dec. 2014

PROJECT: 1413472

LOCATION: SEE FIGURE 2

RECORD OF BOREHOLE: 14-16

BORING DATE: December 9, 2014

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

BORING METHOD: Mini Mole, 102 mm Solid Stem Augers

DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	181.30			
TOPSOIL	0.00	1A		
(SP) SAND, trace gravel; brown; non-cohesive, dry, compact	0.15	1B	SS	11
(CI) SILTY CLAY; brown, varved, containing sand seams at a depth of 1.07 m; cohesive, w>PL, stiff	180.61 / 0.69	2	SS	12
(CL) SILTY CLAY, trace sand, trace gravel; brown, stratified; cohesive, w~PL, very stiff	179.85 / 1.45	3	SS	24
		4	SS	23
(SM) SILTY SAND, some gravel; grey (TILL); non-cohesive, moist, compact	178.33 / 2.97	5	SS	17
(ML) CLAYEY SILT, some sand, some gravel; grey (TILL); cohesive, w<PL, hard	177.19 / 4.11	6	SS	50/ 0.10
END OF BOREHOLE	176.63 / 4.67			

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● ; rem V. ⊕ U - ○ ; 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢ ○W ⊣ Wl ; 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: AVR

CHECKED: SDK

PROJECT: 1413472

LOCATION: SEE FIGURE 2

RECORD OF BOREHOLE: 14-17

BORING DATE: December 15, 2014

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		194.43							
0		FILL - (ML) CLAYEY SILT, trace sand, trace gravel, some organics; dark brown; cohesive, firm to very stiff		0.00	1	SS	6				Sand
1					2	SS	12				Bentonite
2					3	SS	22				
					4	SS	22				Jan. 5, 2015
3		(CI) SILTY CLAY; mottled brown-grey; cohesive, w>PL, very stiff		191.46 2.97	5	SS	24				Sand
4		(ML) Sandy SILT, some clay, some gravel; mottled grey-brown (TILL); non-cohesive, moist, very dense		190.32 4.11							Screen
5					6	SS	50				
6		(ML) CLAYEY SILT, some sand, some gravel; grey (TILL); cohesive, w<PL, very stiff		188.79 5.64	7	SS	26				
7		END OF BOREHOLE		187.72 6.71							1. Water level in piezometer measured at a depth of 2.50 m below ground surface (Elev. 191.93 m) on January 5, 2015.
8											
9											
10											

GTA-BHS 001 S:\CLIENTS\KYLEMORE_COMMUNITIES\4134_16THAVE_MARKHAM\02_DATA\GINT\1413472.GPJ GAL-MIS.GDT 9/28/16 MK Dec. 2014

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: EWB

CHECKED: SDK

RECORD OF BOREHOLE: 14-18

PROJECT: 1413472
LOCATION: SEE FIGURE 2

BORING DATE: December 15, 2014

SHEET 1 OF 1
DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	DESCRIPTION	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m
	GROUND SURFACE	192.30			
0	TOPSOIL	0.00	1A		
	FILL - (ML) CLAYEY SILT, some sand, trace gravel, trace organics; brown; cohesive, w~PL, stiff	0.08	1B	SS	9
	(SM) SILTY SAND, fine grained; brown, stratified; non-cohesive, moist, compact	191.61 0.69	2	SS	14
	(SM) SILTY SAND, some gravel, trace clay; brown, with oxidation staining (TILL); non-cohesive, moist, dense to very dense	190.85 1.45	3	SS	48
			4	SS	65
	(ML) CLAYEY SILT, some gravel, trace sand; grey (TILL); cohesive, hard	189.33 2.97	5	SS	83/ 0.25
	(ML) Sandy SILT; brown; non-cohesive, wet, dense	188.19 4.11	6	SS	45
	END OF BOREHOLE	187.12 5.18			

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢ ○W ⊣ Wl : 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GTA-BHS 001 S:\CLIENTS\KYLEMORE_COMMUNITIES\4134_16THAVE_MARKHAM\02_DATA\GINT\1413472.GPJ GAL-MIS.GDT 9/28/16 MK Dec. 2014

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: EWB
CHECKED: SDK

PROJECT: 1413472

LOCATION: SEE FIGURE 2

RECORD OF BOREHOLE: 14-19

BORING DATE: December 15, 2014

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING
	GROUND SURFACE	188.80				
0	TOPSOIL	0.00	1A			OP OC Nitrate Phospate
	FILL - (ML) CLAYEY SILT, some sand, trace gravel, trace organics; brown to dark brown; cohesive, w>PL, firm	0.10	1B	SS	5	
	(CI) SILTY CLAY; brown, stratified; cohesive, w>PL, stiff	188.11 / 0.69	2	SS	9	M&I
1						
	(ML) CLAYEY SILT, some sand, some gravel; brown (TILL); cohesive, w<PL, stiff to very stiff	187.35 / 1.45	3A / 3B	SS	16	
2			4	SS	14	
3	(SW) SAND, some silt, trace clay; brown; wet, compact	185.83 / 2.97	5	SS	83/0.25	
4	(SM) SILTY SAND, some gravel, trace clay; brown (TILL); non-cohesive, very dense, wet	184.69 / 4.11	6	SS	45	
5	END OF BOREHOLE	183.62 / 5.18				

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ — 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ├─○W─┤ Wl — 10 20 30 40

PIEZOMETER OR STANDPIPE INSTALLATION

GTA-BHS 001 S:\CLIENTS\KYLEMORE_COMMUNITIES\4134_16THAVE_MARKHAM\02_DATA\GINT\1413472.GPJ GAL-MIS.GDT 9/28/16 MK Dec. 2014

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: EWB

CHECKED: SDK

RECORD OF BOREHOLE: 14-20

PROJECT: 1413472
LOCATION: SEE FIGURE 2
BORING DATE: December 15, 2014
SHEET 1 OF 1
DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm
HAMMER TYPE: AUTOMATIC

BORING METHOD: Geoprobe 7822 DT Track Mount, 83 mm Direct Push SVT

ELEV. (m)	DEPTH (m)	DESCRIPTION	SAMPLE NUMBER	TYPE	BLOWS/0.3m
184.60		GROUND SURFACE			
	0.00	TOPSOIL (150 mm)	1A	SS	6
	0.15	(CI) SILTY CLAY; mottled grey-brown, some layering; cohesive, w>PL, firm	1B		
183.91	0.69	(SM) SILTY SAND, trace clay, trace gravel; brown (TILL-LIKE); non-cohesive, loose	2	SS	9
183.15	1.45	(SM) SILTY SAND, some gravel, trace clay; brown to grey (TILL); non-cohesive, dry to moist, very dense to dense	3	SS	67
			4	SS	46
181.63	2.97	(ML) SILT, trace to some clay; grey, containing seams of silty clay; non-cohesive, wet, dense	5	SS	32
180.49	4.11	(SW) SAND, fine grained, trace silt, trace gravel; grey, stratified; non-cohesive, wet, compact	6	SS	16
179.42	5.18	END OF BOREHOLE			

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 20 40 60 80
HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}
WATER CONTENT PERCENT: Wp —○W— Wl : 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Dec. 15, 2014

1. Water level in open borehole measured at a depth of 3.7 m below ground surface (Elev. 180.90 m) on December 15, 2014.

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: AVR
CHECKED: SDK

PROJECT: 1413472

LOCATION: SEE FIGURE 2

RECORD OF BOREHOLE: 14-21

SHEET 1 OF 1

DATUM: Geodetic

BORING DATE: December 15, 2014

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

Boring method: Geoprobe 7822 DT Track Mount, 83 mm Direct Push SVT

DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	PIEZOMETER OR STANDPIPE INSTALLATION
GROUND SURFACE	182.80				
TOPSOIL (130 mm)	0.00	1A	SS	4	
(ML) CLAYEY SILT, trace gravel; mottled grey-brown, containing rootlets; cohesive, w>PL, firm to stiff	0.13	1B			
		2	SS	9	
(CI) SILTY CLAY; mottled brown to grey, some varves; cohesive, w<PL, very stiff	181.35 / 1.45	3	SS	17	
(ML) CLAYEY SILT, some gravel, trace sand; brown (TILL); cohesive, w>PL, stiff	180.59 / 2.21	4	SS	14	
(ML) Sandy SILT, some gravel, trace clay; grey, with zones of clayey silt (TILL); non-cohesive, moist, compact	180.06 / 2.74	5	SS	16	
		6	SS	11	
END OF BOREHOLE	177.62 / 5.18				1. Open borehole dry upon completion of drilling on Dec. 15, 2014.

Column headings: DEPTH SCALE METRES; BORING METHOD; SOIL PROFILE (DESCRIPTION, STRATA PLOT, ELEV. DEPTH (m)); SAMPLES (NUMBER, TYPE, BLOWS/0.3m); DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (20, 40, 60, 80); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT (Wp, W, Wl) (10, 20, 30, 40); ADDITIONAL LAB. TESTING; PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AVR

CHECKED: SDK

GTA-BHS 001 S:\CLIENTS\KYLEMORE_COMMUNITIES\4134_16THAVE_MARKHAM\02_DATA\GINT\1413472.GPJ GAL-MIS.GDT 9/28/16 MK Dec. 2014

PROJECT: 1413472

LOCATION: SEE FIGURE 2

RECORD OF BOREHOLE: 14-22

BORING DATE: December 15, 2014

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

BORING METHOD: Geoprobe 7822 DT Track Mount; 83 mm Direct Push SVT

DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	184.20			
TOPSOIL (200 mm)	184.00 / 0.00	1A		
FILL - (CI) SILTY CLAY, some gravel, trace organics; brown to grey, containing rootlets; cohesive, w>PL, firm to soft	0.20	1B	SS	6
		2	SS	3
(ML) CLAYEY SILT, trace sand, trace gravel; brown, with oxidation staining, fissured (TILL); cohesive, w>PL, stiff	182.75 / 1.45	3	SS	11
(ML) CLAYEY SILT; brown, layered; cohesive, w>PL, stiff	181.99 / 2.21	4A		
(SM) SILTY SAND, some gravel, trace clay; (TILL); wet, dense	181.69 / 2.51	4B	SS	34
(ML) Sandy SILT, some gravel, trace to some clay; brown to grey (TILL); non-cohesive, moist, dense to compact	2.68	4C		
		5	SS	20
		6	SS	27
END OF BOREHOLE	179.02 / 5.18			

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ ; 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢ W ⊣ Wl ; 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

1. Open borehole dry upon completion of drilling on Dec. 15, 2014.

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: AVR

CHECKED: SDK

RECORD OF BOREHOLE: 14-23

PROJECT: 1413472
LOCATION: SEE FIGURE 2

BORING DATE: December 8, 2014

SHEET 1 OF 1
DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

BORING METHOD: B-45HD Track Mount; 203 mm O.D. Hollow Stem Augers

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● ; rem V. ⊕ U - ○ ; 20 40 60 80
HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}
WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl ; 10 20 30 40

DEPTH SCALE METRES	SOIL PROFILE – DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	GROUND SURFACE	189.10					
0	TOPSOIL (200 mm)	0.00	1A				
	(CI) SILTY CLAY, trace sand, trace gravel; brown, varved; cohesive, w>PL, firm to stiff	188.90 / 0.20	1B	SS	6		
1			2	SS	11		
	(ML) CLAYEY SILT, some sand, some gravel; grey, with zones of fine sand (TILL); cohesive, w<PL, stiff	187.80 / 1.30	3	SS	14		
2	(ML) CLAYEY SILT and SAND, some sand, some gravel (TILL-LIKE); grey, with zones of fine sand; cohesive, w<PL, firm	186.89 / 2.21	4	SS	6	MH	
3			5	SS	8		
4	(SM) SILTY SAND, some gravel, trace clay; grey (TILL); non-cohesive, moist, compact	184.99 / 4.11	6	SS	27	MH	
5	END OF BOREHOLE	183.92 / 5.18					1. Open borehole dry upon completion of drilling on Dec. 8, 2014.
6							
7							
8							
9							
10							

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: AVR
CHECKED: SDK

PROJECT: 1413472

LOCATION: SEE FIGURE 2

RECORD OF BOREHOLE: 14-24

BORING DATE: December 8, 2014

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp W Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		186.70							
0	B-45HD Track Mount; 203 mm O.D. Hollow Stem Augers	FILL - TOPSOIL		0.00	1	SS	3				
		(CI) SILTY CLAY, trace sand, trace gravel; mottled brown-grey, block structure; cohesive, w~PL, firm to stiff		186.01 / 0.69	2	SS	7				
1–2					3	SS	15				
		(ML) CLAYEY SILT, some sand, some gravel; grey; cohesive, w<PL, stiff		184.49 / 2.21	4	SS	10				
3		(ML) SILT, some sand, some gravel; grey, with zones of medium sand (TILL); non-cohesive, moist, compact		183.73 / 2.97	5	SS	15				▽ Dec 8, 2014
4		(ML) CLAYEY SILT, some sand, some gravel; grey (TILL); cohesive, w<PL, stiff		182.59 / 4.11	6	SS	16				
5		END OF BOREHOLE		181.52 / 5.18							1. Water level in open borehole measured at a depth of 3.7 m below ground surface (Elev. 182.00 m) on December 8, 2014.
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AVR

CHECKED: SDK

PROJECT: 1413472

LOCATION: SEE FIGURE 2

RECORD OF BOREHOLE: 14-25

BORING DATE: December 15, 2014

SHEET 1 OF 1

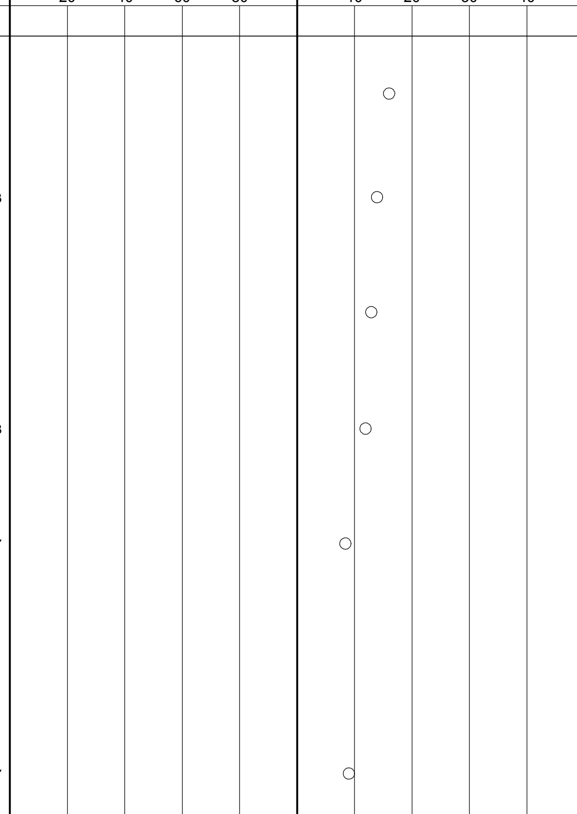
DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

Boring method: Geoprobe 7822 DT Track Mount, 83 mm Direct Push SVT

DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m
GROUND SURFACE	184.70			
TOPSOIL (150 mm)	0.00	1A	SS	
FILL - (SM) SILTY SAND, trace gravel, trace rootlets; dark brown; non-cohesive, moist, loose	0.15	1B		5
(ML) CLAYEY SILT; mottled grey-brown; cohesive, w<PL, firm	184.01 / 0.69			
(SM) SILTY SAND, some gravel, trace clay; brown (TILL); moist, compact	0.84	2	SS	13
(ML) CLAYEY SILT, some sand, some gravel; brown to grey (TILL-LIKE); cohesive, w>PL, soft	183.25 / 1.45	3	SS	2
(ML) Sandy SILT, some gravel, some clay; grey (TILL); non-cohesive, wet, compact	182.34 / 2.36	4	SS	18
(ML) CLAYEY SILT, some sand, some gravel; grey, with zones of silt, layered (TILL); cohesive, dry to moist, very stiff	181.73 / 2.97	5	SS	27
		6	SS	27
END OF BOREHOLE	179.52 / 5.18			



ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Dec. 15, 2014

1. Water level in open borehole measured at a depth of 4.7 m below ground surface (Elev. 180.80 m) on December 15, 2014.

DEPTH SCALE 1 : 50

LOGGED: AVR

CHECKED: SDK

PROJECT: 1413472

LOCATION: SEE FIGURE 2

RECORD OF BOREHOLE: 14-26

BORING DATE: December 16, 2014

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		193.10							
0		TOPSOIL (50 mm)		0.00							
		(CI) SILTY CLAY, some gravel, trace sand; brown (TILL); cohesive, w<PL, stiff to very stiff		0.05	1	SS	8		○		
1					2	SS	21				
					3	SS	21		○		
2		(ML) CLAYEY SILT, trace sand, some gravel; brown to grey (TILL); cohesive, w<PL, hard to very stiff		190.89 2.21							
					4	SS	34		○		
3					5	SS	32		○		
4											
5					6	SS	29		○		
		END OF BOREHOLE		187.92 5.18							
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: EWB

CHECKED: SDK

PROJECT: 1413472

LOCATION: SEE FIGURE 2

RECORD OF BOREHOLE: 14-27

BORING DATE: December 17, 2014

SHEET 1 OF 1

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m
		GROUND SURFACE		192.50			
0		TOPSOIL (25 mm)		0.00 / 0.03			
		FILL - (CI) SILTY CLAY, trace sand, trace gravel; cohesive, w<PL, firm			1	SS	5
		(ML) CLAYEY SILT, some gravel, trace sand; grey (TILL); w<PL, stiff to hard		191.81 / 0.69			
1					2	SS	13
2					3	SS	27
					4	SS	72
3					5	SS	65
4							
5					6	SS	84
		END OF BOREHOLE		187.32 / 5.18			
6							
7							
8							
9							
10							

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp —○W— Wl : 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: EWB

CHECKED: SDK

GTA-BHS 001 S:\CLIENTS\KYLEMORE_COMMUNITIES\4134_16THAVE_MARKHAM\02_DATA\GINT\1413472.GPJ GAL-MIS.GDT 9/28/16 MK Dec. 2014

RECORD OF BOREHOLE: 14-28

PROJECT: 1413472
LOCATION: SEE FIGURE 2
BORING DATE: December 16, 2014
SHEET 1 OF 1
DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm
HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m
	GROUND SURFACE	185.70			
0	TOPSOIL (200 mm)	0.00	1A		
	FILL - (ML) CLAYEY SILT, some gravel, trace sand, trace organics; brown; cohesive, moist, stiff to very stiff	185.50 / 0.20	1B	SS	9
1			2	SS	26
	(CI) SILTY CLAY, trace sand; brown to grey, varved; cohesive, w>PL, stiff to very stiff	184.25 / 1.45	3	SS	13
2–3			4	SS	21
3			5	SS	19
4	(ML) CLAYEY SILT, some gravel, trace sand; grey (TILL); cohesive, w<PL, very stiff	181.59 / 4.11	6	SS	20
5	END OF BOREHOLE	180.52 / 5.18			

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢ ○W ⊣ Wl : 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: EWB
CHECKED: SDK

PROJECT: 1413472

LOCATION: SEE FIGURE 2

RECORD OF BOREHOLE: 14-29

SHEET 1 OF 1

DATUM: Geodetic

BORING DATE: December 16, 2014

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

BORING METHOD	DESCRIPTION	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m
	GROUND SURFACE	190.39			
Geoprobe 7822 DT Track Mount, 83 mm Direct Push SVT	TOPSOIL (150 mm)	0.00	1A		
	(CI) SILTY CLAY, trace sand, trace gravel; mottled grey-brown (TILL-Like); cohesive, w~PL, firm	0.15	1B	SS	8
	(ML) CLAYEY SILT, some gravel, trace sand; mottled grey-brown (TILL); cohesive, w<PL, very stiff to hard	189.70 / 0.69	2	SS	18
			3	SS	32
Geoprobe 7822 DT Track Mount, 150 mm Hollow Stem Augers	(ML) Sandy SILT, some gravel, trace clay; brown to grey (TILL); dry to moist, very dense	188.18 / 2.21	4	SS	50/ 0.10
			5	SS	50/ 0.15
			6	SS	50/ .125
	(CI) SILTY CLAY, trace sand, trace gravel; grey (TILL); cohesive, w<PL, hard	184.75 / 5.64	7	SS	73
	END OF BOREHOLE	183.68 / 6.71			

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp —○W— Wl 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION: Bentonite; Sand; Screen; Jan. 5, 2015

1. Water level in open borehole measured at a depth of 5.0 m below ground surface (Elev. 185.39 m) on January 5, 2015.

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: AVR

CHECKED: SDK

GTA-BHS 001 S:\CLIENTS\KYLEMORE_COMMUNITIES\4134_16THAVE_MARKHAM\02_DATA\GINT\1413472.GPJ GAL-MIS.GDT 9/28/16 MK Dec. 2014

PROJECT: 1413472

LOCATION: SEE FIGURE 2

RECORD OF BOREHOLE: 14-30

SHEET 1 OF 1

DATUM: Geodetic

BORING DATE: December 16, 2014

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE – DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		194.40							
0	Geoprobe 7822 DT Track Mount; 83 mm Direct Push SVT	TOPSOIL (250 mm)		0.00	1A						
		(ML) CLAYEY SILT, some gravel, trace sand; brown (TILL-LIKE); cohesive, w>PL, soft		194.15 0.25	1B	SS	3				
		(ML) CLAYEY SILT, some gravel, trace to some sand; (TILL); cohesive, w<PL, stiff		193.71 0.69	2	SS	12				
1		(ML) Sandy SILT, some clay, some gravel; brown to grey (TILL); non-cohesive, moist to dry, dense to very dense		192.95 1.45	3	SS	17				
2					4	SS	28				
3					5	SS	26				
4				189.55	6	SS	50/ .125				
5		END OF BOREHOLE		4.85							
6											
7											
8											
9											
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: AVR

CHECKED: SDK

PROJECT: 1413472

RECORD OF BOREHOLE: 14-31

SHEET 1 OF 1

LOCATION: SEE FIGURE 2

BORING DATE: December 16, 2014

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	SOIL PROFILE – DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	WATER CONTENT PERCENT (W)
	GROUND SURFACE	182.70				
0	(CL) SILTY CLAY; brown to grey, varved; cohesive, w<PL, firm to stiff	0.00	1	SS	6	
1			2	SS	11	~24
2			3	SS	11	~29
	(CI) SILTY CLAY, trace sand, trace gravel; grey (TILL-LIKE); cohesive, w>PL, firm	180.49 / 2.21	4	SS	8	~17
3	(CI) SILTY CLAY; grey, massive; cohesive, w>PL to a depth of 4.27 m, w<PL below a depth of 4.27 m, very stiff to hard	179.73 / 2.97	5	SS	26	~18
5			6	SS	N/R	~17
	END OF BOREHOLE	177.52 / 5.18				
	*N/R - Not Recorded					

Other column headings: BORING METHOD; STRATA PLOT; DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○) (20, 40, 60, 80); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}); WATER CONTENT PERCENT Wp —○W— Wl (10, 20, 30, 40); ADDITIONAL LAB. TESTING; PIEZOMETER OR STANDPIPE INSTALLATION

GTA-BHS 001 S:\CLIENTS\KYLEMORE_COMMUNITIES\4134_16THAVE_MARKHAM\02_DATA\GINT\1413472.GPJ GAL-MIS.GDT 9/28/16 MK Dec. 2014

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: EWB

CHECKED: SDK

RECORD OF BOREHOLE: 14-32

PROJECT: 1413472
LOCATION: SEE FIGURE 2
BORING DATE: December 5, 2014
SHEET 1 OF 1
DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm
HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE	194.90					
0	B-45HD Track Mount; 102 mm Solid Stem Augers	TOPSOIL (100 mm)	0.00	1A	SS	12		
		FILL - (CI) SILTY CLAY, trace sand, trace gravel; brown, containing organics; cohesive, w>PL, stiff	0.10	1B				
		FILL - (SM) SILTY SAND, trace gravel, trace silt; brown/grey; non-cohesive, moist, loose	194.21 / 0.69	2	SS	7		
1		FILL - (CL) SILTY CLAY, some sand, trace gravel; mixed brown and grey, containing organics; cohesive, w<PL, firm	193.76 / 1.14	3	SS	6		
2		(ML) CLAYEY SILT, some sand, some gravel; grey (TILL-LIKE); cohesive, firm	192.46 / 2.44	4	SS	6		
3		(SM) SILTY SAND, trace gravel; grey; non-cohesive, moist, compact	191.80 / 3.10	5	SS	16		
5				6	SS	19	MH	
		END OF BOREHOLE	189.72 / 5.18					1. Open borehole dry upon completion of drilling on Dec. 5, 2014.

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 20 40 60 80
HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}
WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl : 10 20 30 40

DEPTH SCALE 1 : 50

Golder Associates

LOGGED: AVR
CHECKED: SDK

GTA-BHS 001 S:\CLIENTS\KYLEMORE_COMMUNITIES\4134_16THAVE_MARKHAM\02_DATA\GINT\1413472.GPJ GAL-MIS.GDT 9/28/16 MK Dec. 2014

PROJECT: 1413472

LOCATION: SEE FIGURE 2

RECORD OF BOREHOLE: 14-33

BORING DATE: December 5, 2014

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

HAMMER TYPE: AUTOMATIC

Boring method: B-45HD Track Mount, 203 mm O.D. Hollow Stem Augers

DESCRIPTION	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
GROUND SURFACE	194.67					
TOPSOIL (150 mm)	0.00	1A	SS	10		
(CL) SILTY CLAY, trace gravel; mottled grey-brown;, containing rootlets in upper zones; cohesive, w>PL, stiff	0.15	1B				
		2	SS	12		
(SM) SILTY SAND, some clay, some gravel; mottled grey-brown to grey; non-cohesive, moist to wet, compact	193.22 / 1.45	3	SS	12		
		4	SS	21		Bentonite
(CL) sandy SILTY CLAY, trace to some gravel; grey (TILL); cohesive, moist, stiff to hard	191.70 / 2.97	5	SS	12		Jan. 5, 2015
						Sand
		6	SS	16	MH	
		7	SS	66		Screen
(SP) SAND, fine grained, trace silt; grey, with layers of clayey silt; moist, compact	187.51 / 7.16	8	SS	21		
END OF BOREHOLE	186.44 / 8.23					

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ — 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}

WATER CONTENT PERCENT: Wp ⊢ ○W ⊣ Wl — 10 20 30 40

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

1. Water level in piezometer measured at a depth of 3.22 m below ground surface (Elev. 191.45 m) on January 5, 2015.

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: AVR
CHECKED: SDK

RECORD OF BOREHOLE: 14-34

PROJECT: 1413472
LOCATION: SEE FIGURE 2
BORING DATE: December 8, 2014
SHEET 1 OF 1
DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm
HAMMER TYPE: AUTOMATIC

BORING METHOD: B-45HD Track Mount; 203 mm O.D. Hollow Stem Augers

DESCRIPTION	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
GROUND SURFACE	180.40					
ASPHALT	0.00	1A				Bentonite
GRANULAR FILL	0.15	1B	SS	10		
(SW) Gravelly SAND, trace silt; brown; non-cohesive, moist to wet, compact	179.56 / 0.84	2	SS	11		Jan. 5, 2015
		3	SS	25		Sand
(SM) SILTY SAND, fine grained, some gravel, trace clay; grey; non-cohesive, wet, compact to very loose	178.04 / 2.36	4	SS	12		
		5	SS	WR		Screen
(SM) SILTY SAND, fine grained, trace clay; grey; non-cohesive, wet, compact	176.67 / 3.73	6	SS	17	MH	
		7	SS	14		
END OF BOREHOLE	175.22 / 5.18					1. Water level in piezometer measured at a depth of 1.17 m below ground surface (Elev. 179.23 m) on January 5, 2015.

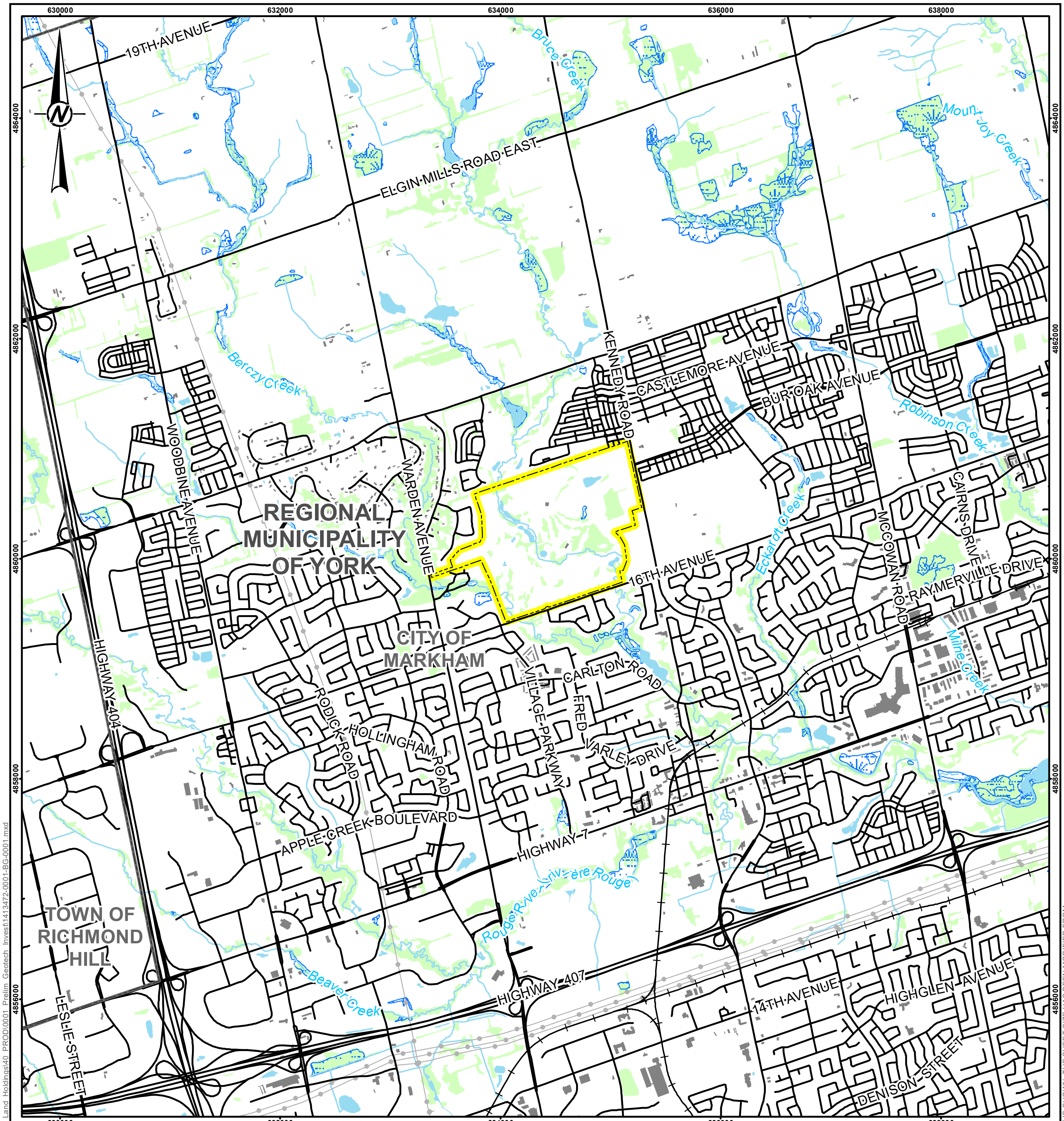
DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 20 40 60 80
HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-6} 10^{-5} 10^{-4} 10^{-3}
WATER CONTENT PERCENT: Wp —○W— Wl : 10 20 30 40

DEPTH SCALE METRES: 0 1 2 3 4 5 6 7 8 9 10

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: AVR
CHECKED: SDK



LEGEND

- RAILWAY
- UTILITY LINE
- APPROXIMATE SITE BOUNDARY
- BUILDING
- MUNICIPAL BOUNDARY
- WATERBODY
- WETLAND
- WOODED AREA

0 1,000 2,000

1:50,000 METERS

CLIENT
SIXTEENTH LAND HOLDINGS INC.

PROJECT
PRELIMINARY GEOTECHNICAL INVESTIGATION
4134 16TH AVENUE, MARKHAM, ONTARIO

TITLE
KEY PLAN

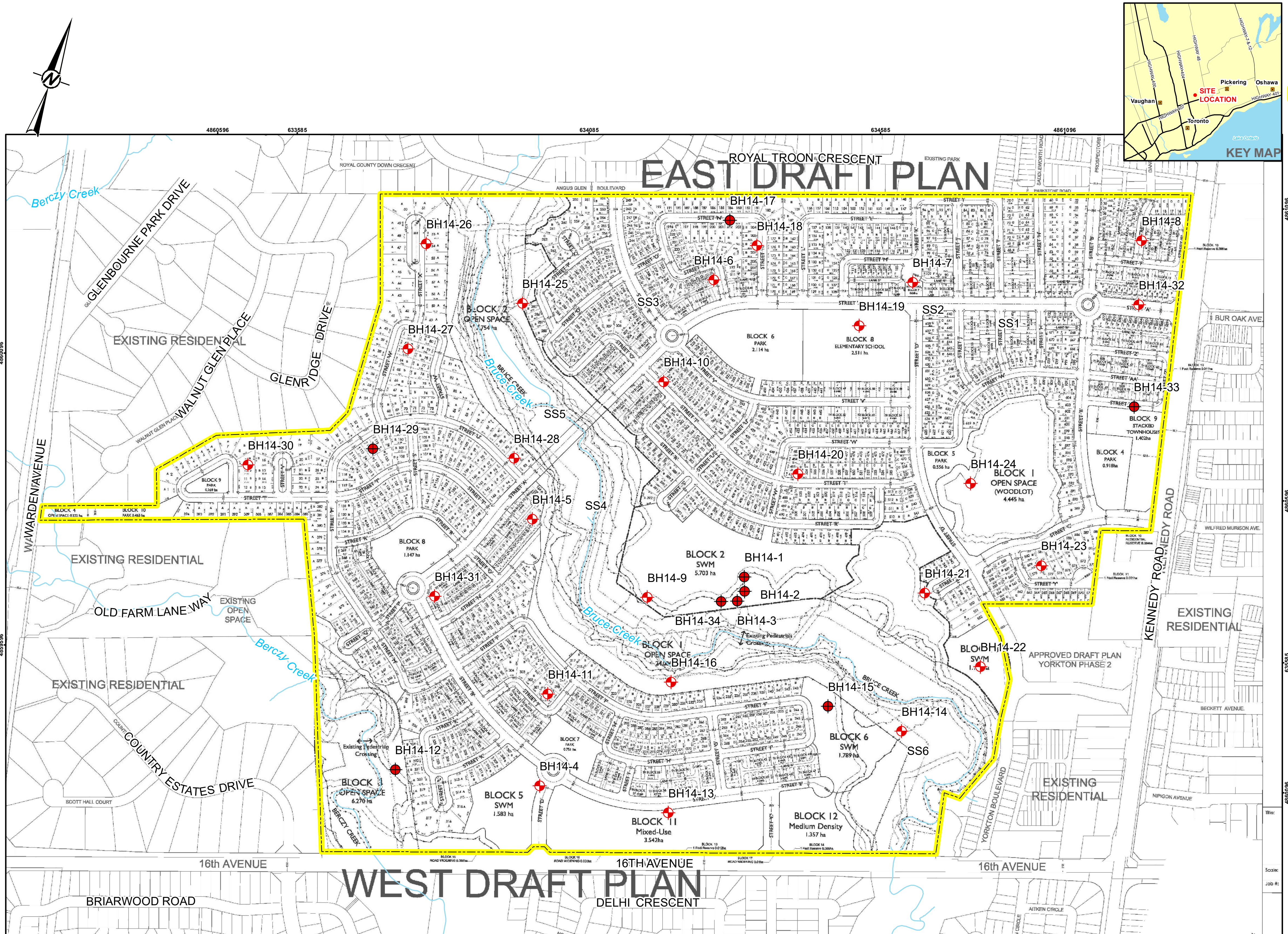
CONSULTANT

Golder Associates

YYYY-MM-DD	2015-01-06
DESIGNED	JT
PREPARED	JT/MK
REVIEWED	AM
APPROVED	AJH

PROJECT NO.	CONTROL	REV.	FIGURE
1413472			1

REFERENCES
BASE DATA - MNR LIO, OBTAINED 2013
PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2014
PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N



0 250 500
1:7,500 METERS

LEGEND

- APPROXIMATE BOREHOLE LOCATION
- APPROXIMATE MONITORING WELL LOCATION
- WATERCOURSE
- APPROXIMATE SITE BOUNDARY

REFERENCES

BASE DATA - ATLAS OF CANADA, NATURAL RESOURCES CANADA, 2011. MNR LIO, OBTAINED 2013 PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2014
BASE IMAGERY - MICROSOFT BING ©2014 MICROSOFT CORPORATION AND ITS DATA SUPPLIERS.
PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N
BASE PLAN PROVIDED BY THE MBTW GROUP, ENTITLED "YORK DOWNS RESIDENTIAL DEVELOPMENT COMPOSITE PLAN", JOB NO. 65MA-1511, DRAWING NO. 1511-CP1, DATED AUGUST 10, 2016.

CLIENT
SIXTEENTH LAND HOLDINGS INC.

PROJECT
PRELIMINARY GEOTECHNICAL INVESTIGATION
4134 16TH AVENUE, MARKHAM, ONTARIO

TITLE
BOREHOLE LOCATION PLAN

CONSULTANT

Golder Associates

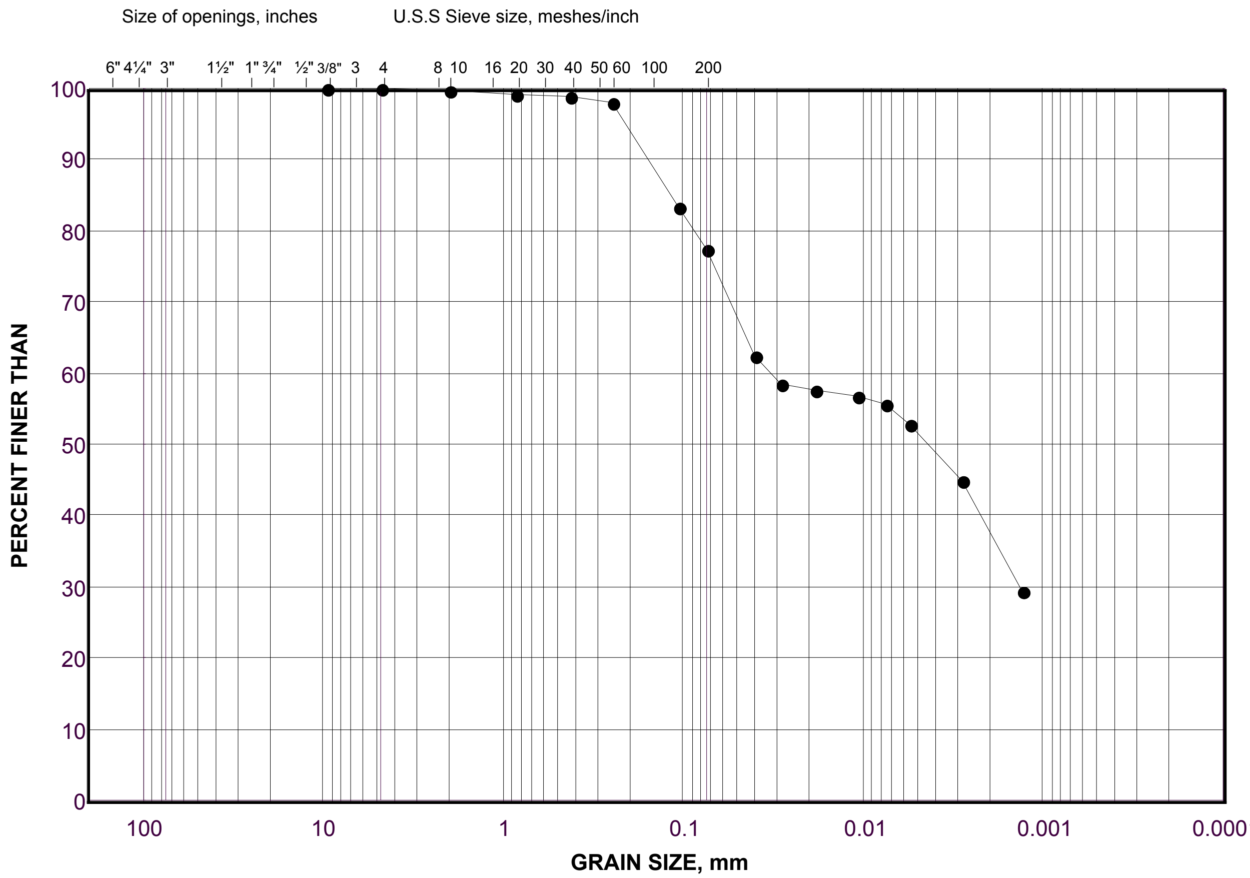
YYYY-MM-DD	2015-01-07
DESIGNED	JT
PREPARED	JT /MK
REVIEWED	AM
APPROVED	AJH

PROJECT NO.	CONTROL	REV.	FIGURE
1413472			2

25mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:

S:\Clients\Kylemore_Communities\4134_16thAve_Markham\99_PROJ\1413472_Montgomery_Homes40_PROD\0003_Prelim_Geotech_Invest\1413472-0003-BG-0002.mxd

GRAIN SIZE DISTRIBUTION (CI) SILTY CLAY	FIGURE 3



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

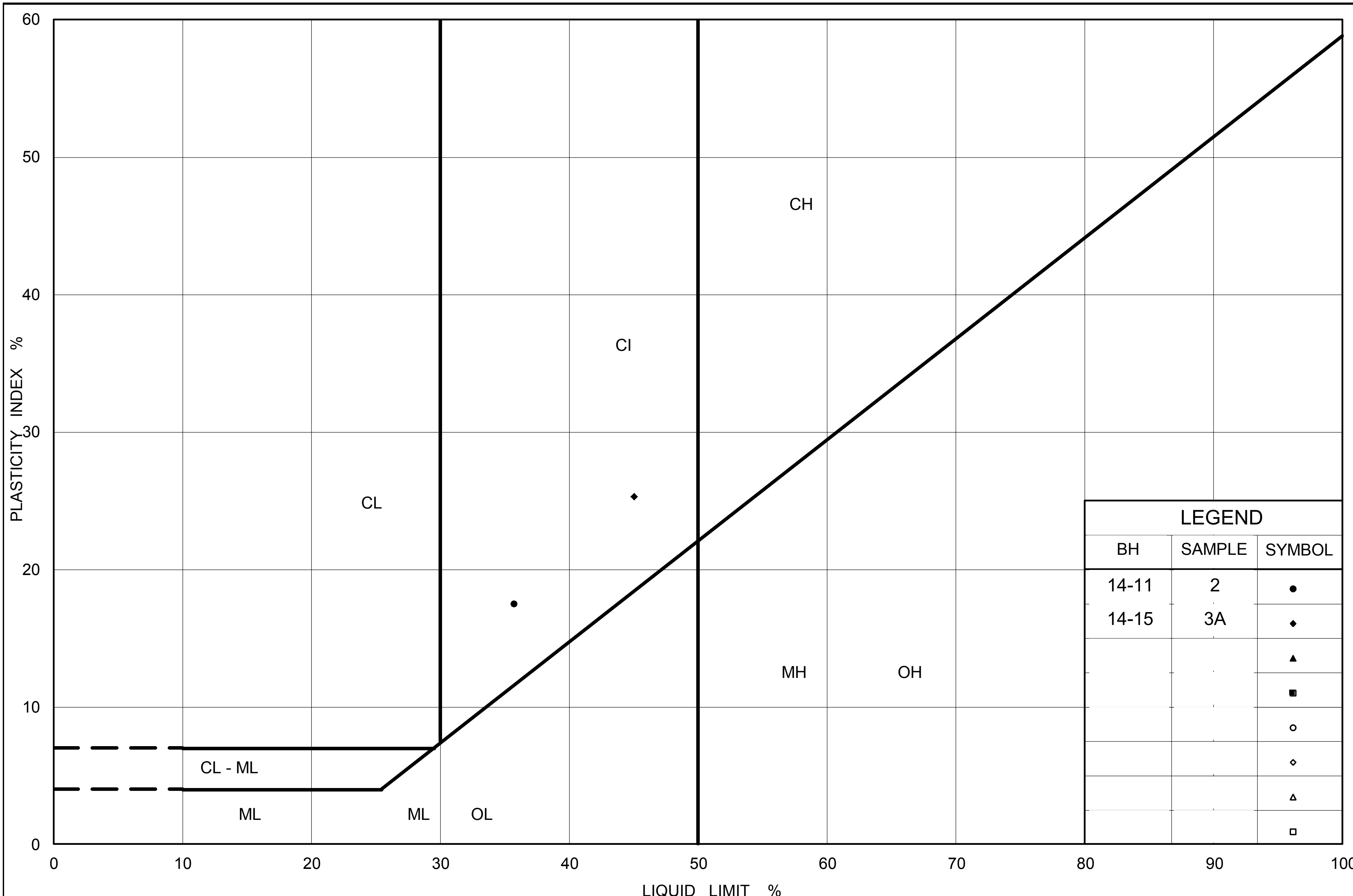
SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	14-9	6	4.6 - 5.2

Project Number: 14-13472

Checked By: AM

Golder Associates

Date: 21-Sep-16



Golder Associates

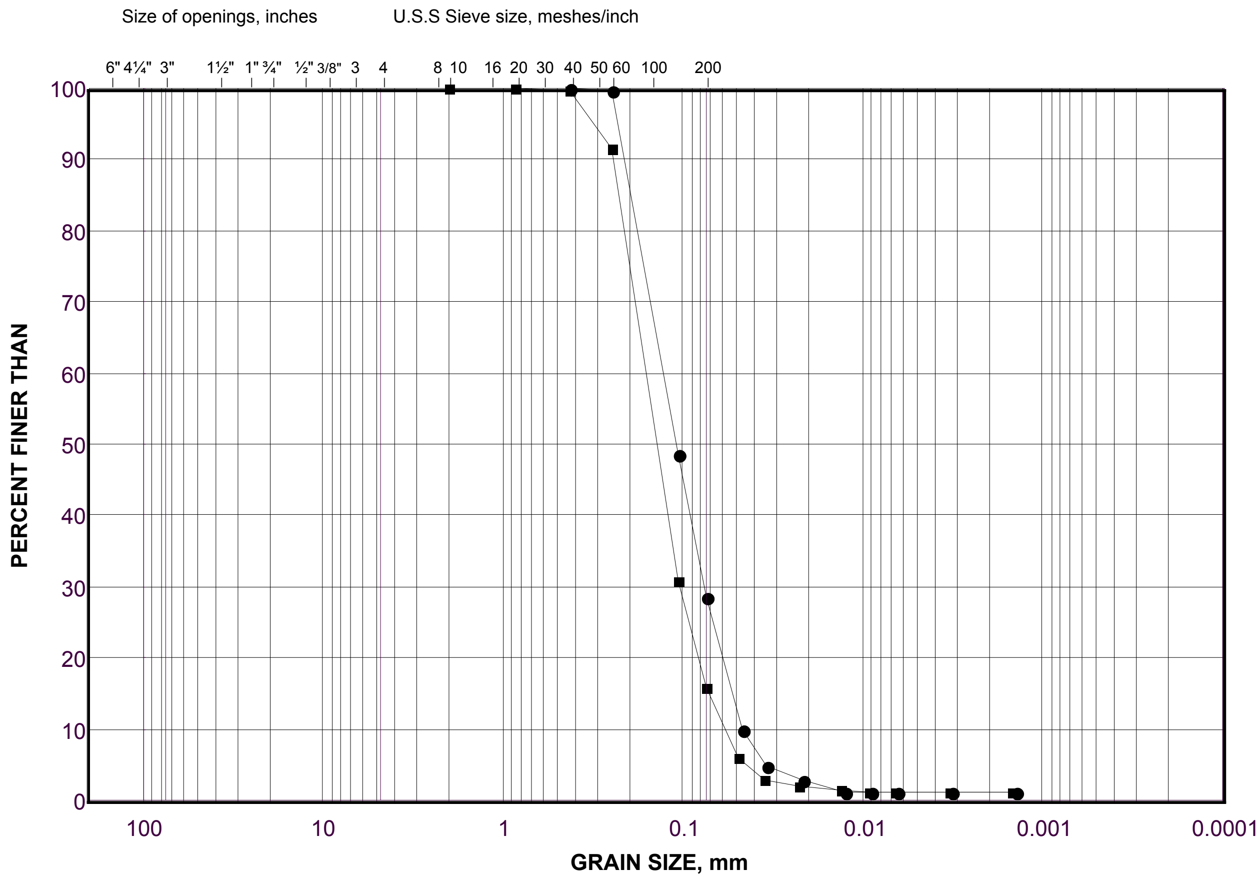
PLASTICITY CHART
(CI) SILTY CLAY

Figure No	4
Project No.	14-13472
Checked By:	AM

GRAIN SIZE DISTRIBUTION

(SM) SILTY SAND

FIGURE 5



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	14-32	6	4.6 - 5.2
■	14-15	7	6.1 - 6.7

Project Number: 14-13472

Checked By: AM

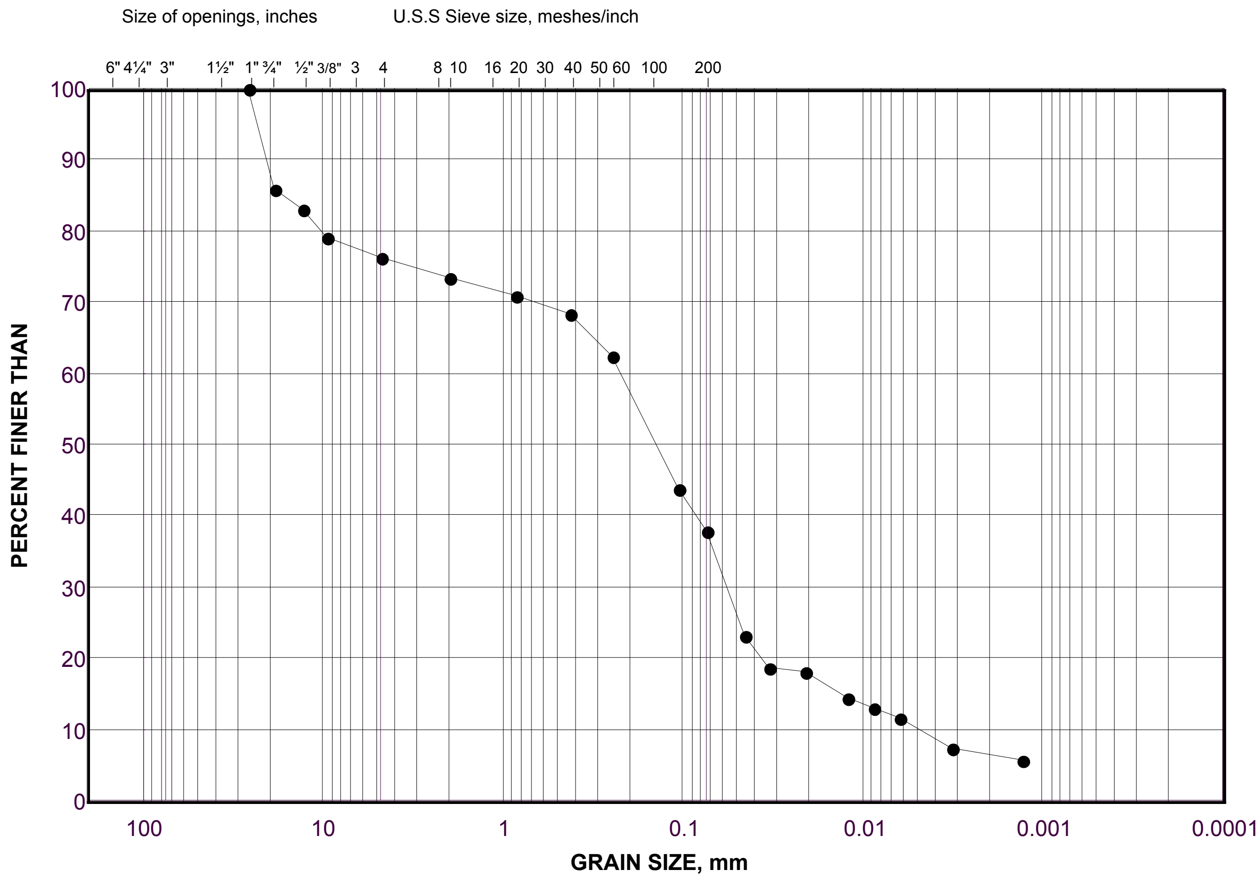
Golder Associates

Date: 21-Sep-16

GRAIN SIZE DISTRIBUTION

(SM) gravelly SILTY SAND

FIGURE 6



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	14-11	6	4.6 - 5.2

Project Number: 14-13472

Checked By: AM

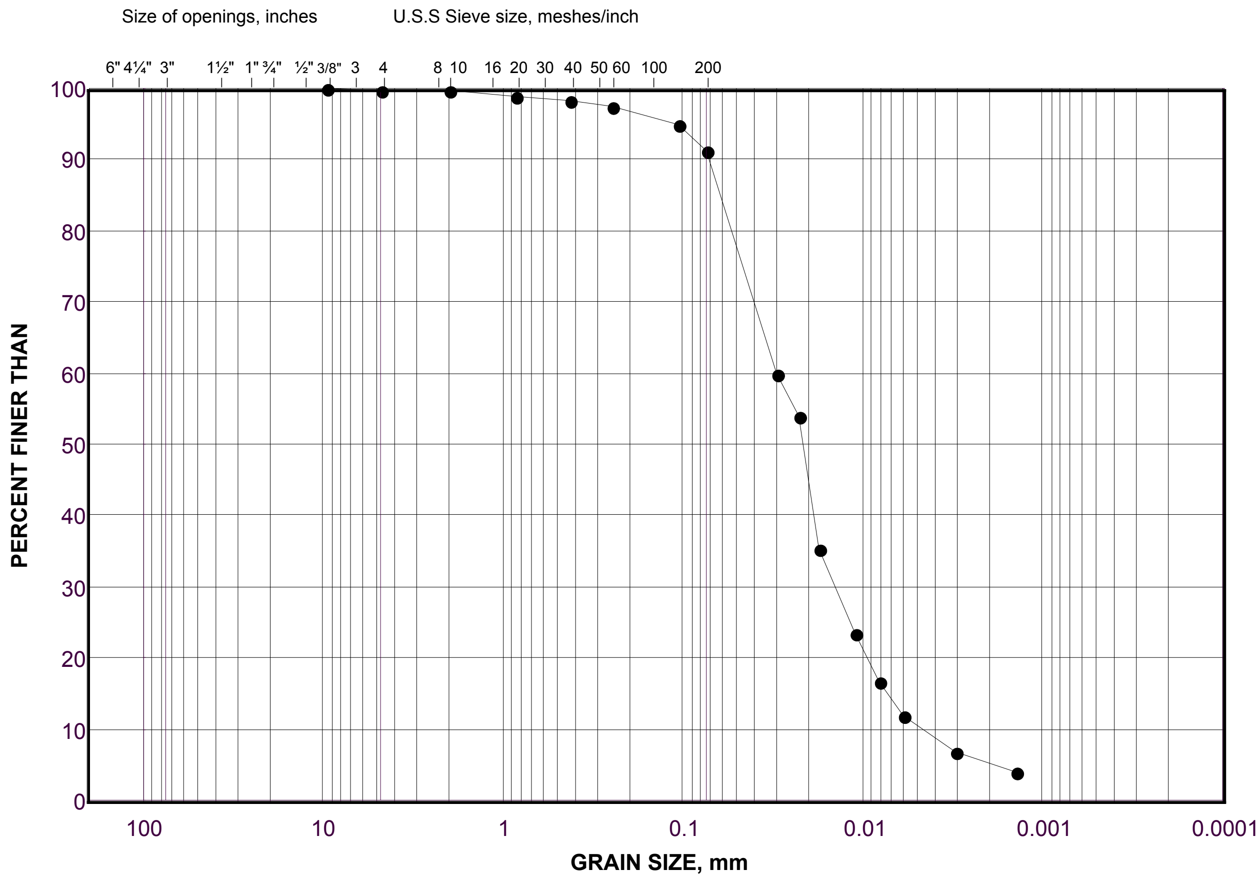
Golder Associates

Date: 21-Sep-16

GRAIN SIZE DISTRIBUTION

(ML) SILT

FIGURE 7



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	14-14	6	4.6 - 5.2

Project Number: 14-13472

Checked By: AM

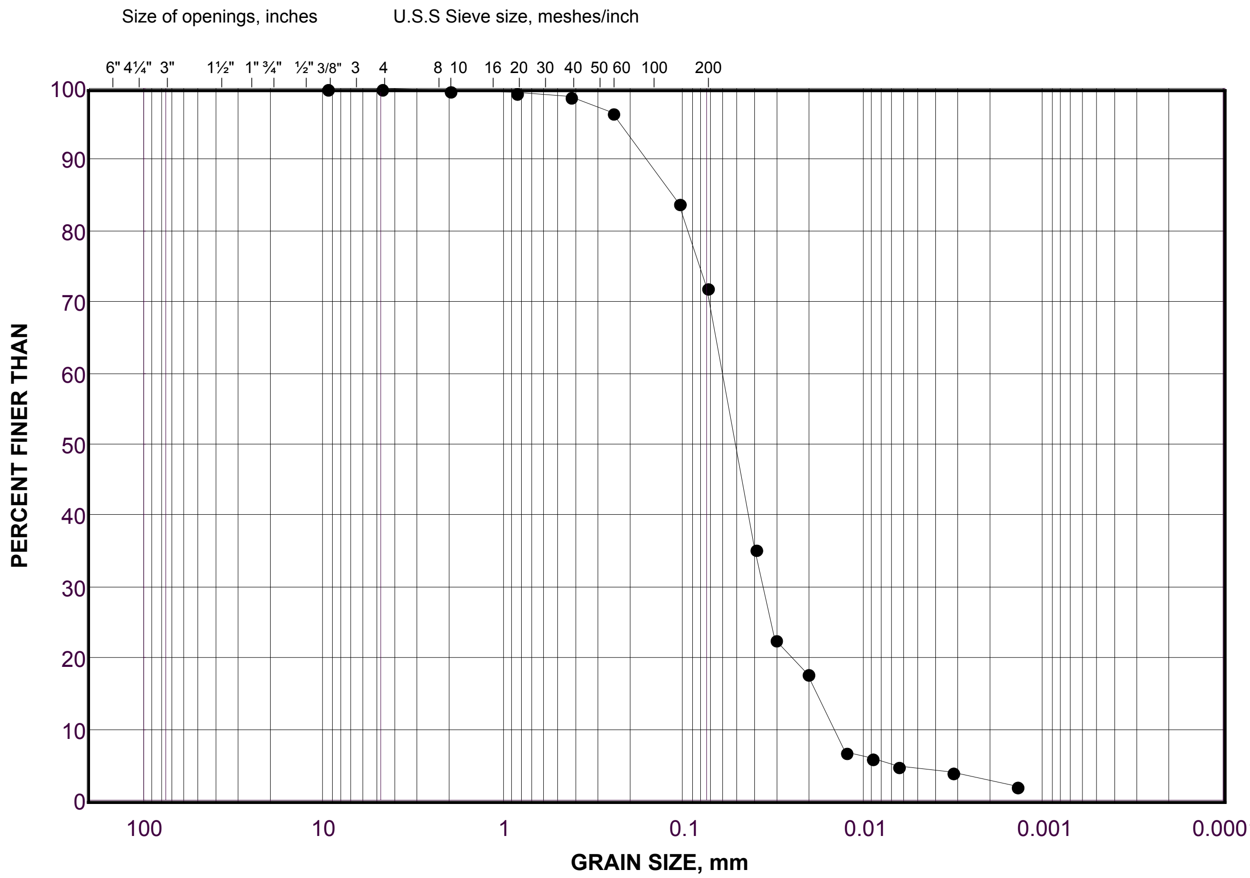
Golder Associates

Date: 21-Sep-16

GRAIN SIZE DISTRIBUTION

(ML) sandy SILT

FIGURE 8



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	14-34	6	3.8 - 4.4

Project Number: 14-13472

Checked By: AM

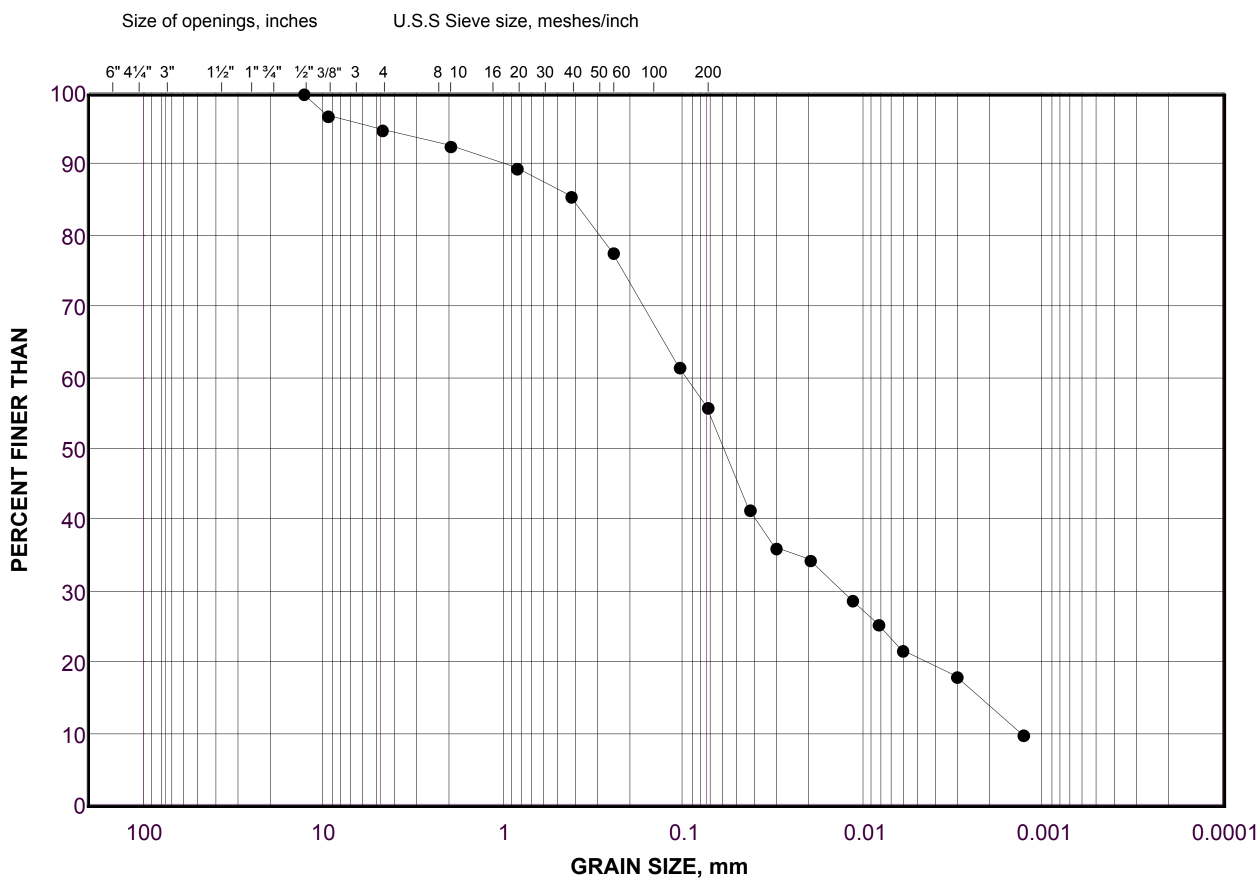
Golder Associates

Date: 21-Sep-16

GRAIN SIZE DISTRIBUTION

(ML) CLAYEY SILT and SAND (TILL-LIKE)

FIGURE 9



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	14-23	4	2.3 - 2.9

Project Number: 14-13472

Checked By: AM

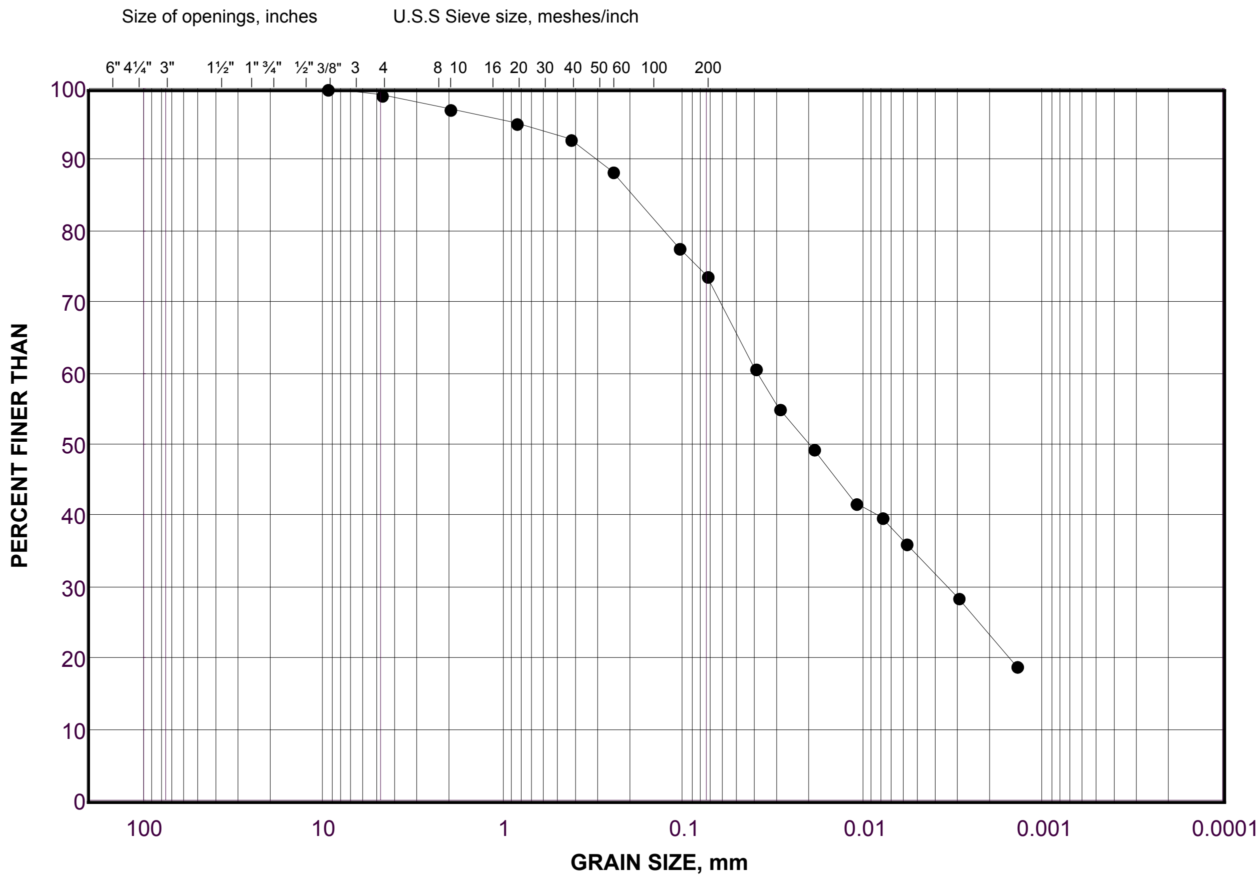
Golder Associates

Date: 21-Sep-16

GRAIN SIZE DISTRIBUTION

(CL) SILTY CLAY (TILL)

FIGURE 10



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	14-33	6	4.6 - 5.2

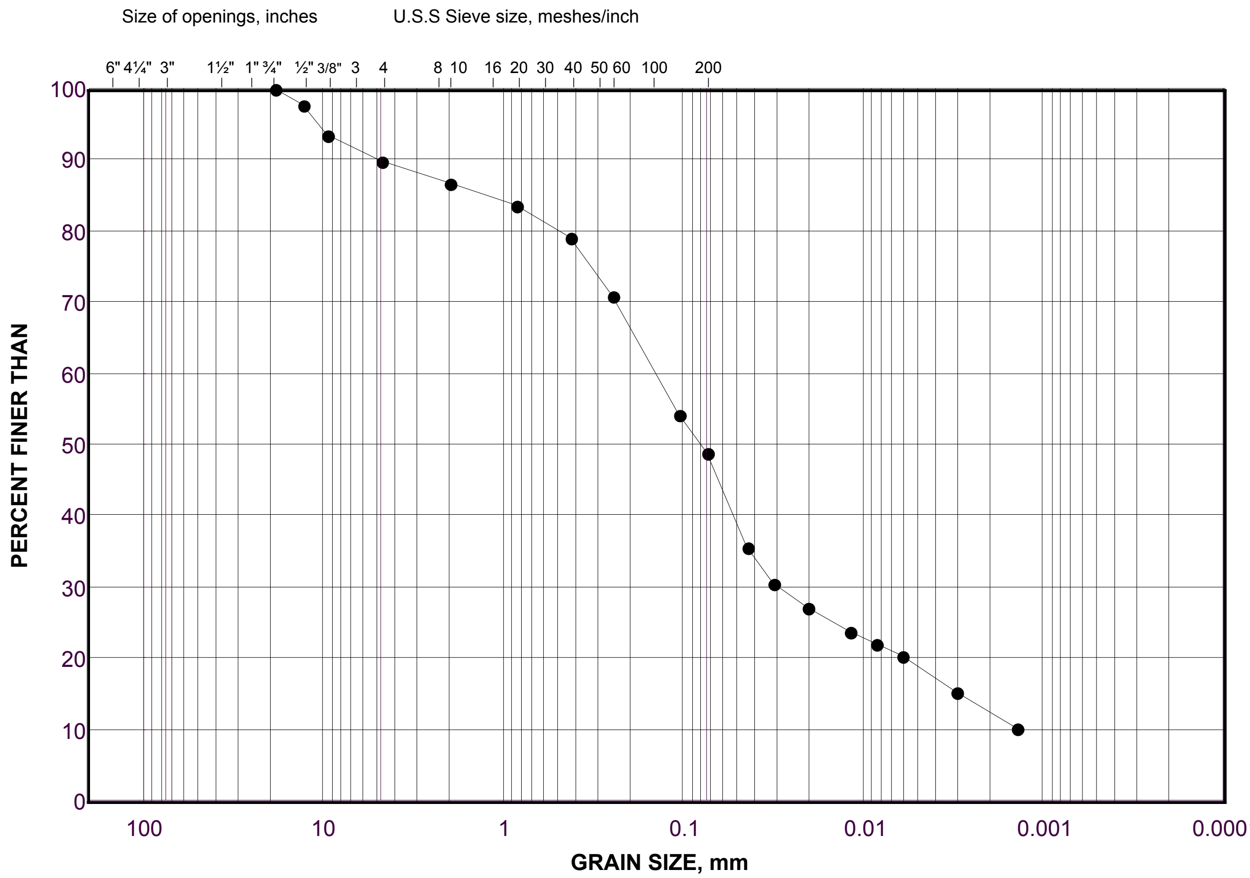
Project Number: 14-13472

Checked By: AM

Golder Associates

Date: 21-Sep-16

GRAIN SIZE DISTRIBUTION (ML) CLAYEY SILT and SAND (TILL)	FIGURE 11



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	14-9	4	2.3 - 2.7

Project Number: 14-13472

Checked By: AM

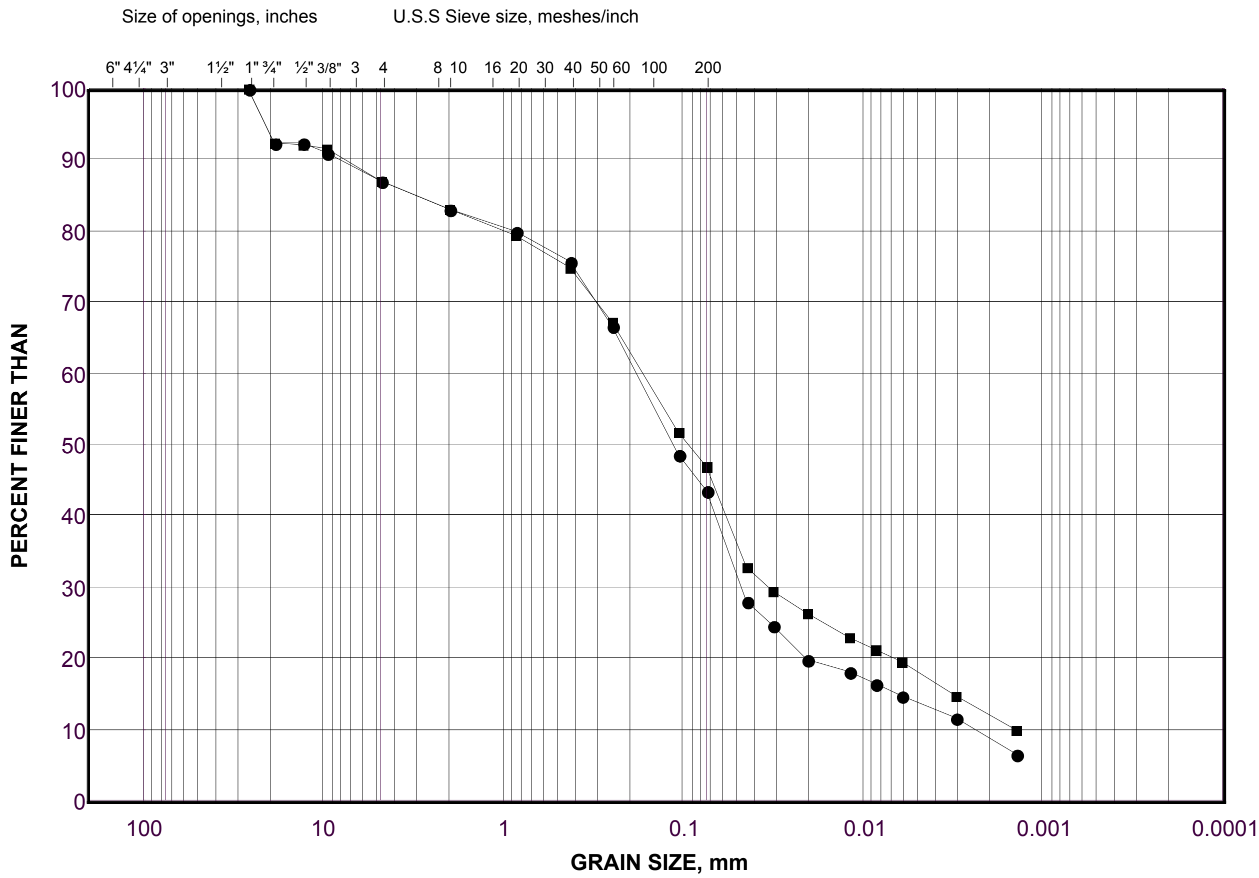
Golder Associates

Date: 21-Sep-16

GRAIN SIZE DISTRIBUTION

(SM) SILTY SAND (TILL)

FIGURE 12



COBBLE	COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY SIZES
SIZE	GRAVEL SIZE		SAND SIZE			FINE GRAINED

LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	14-10	3	1.5 - 2.1
■	14-23	6	4.6 - 5.2

Project Number: 14-13472

Checked By: AM

Golder Associates

Date: 21-Sep-16

APPENDIX A

Important Information and Limitations of This Report

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder can not be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Groundwater Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

At Golder Associates we strive to be the most respected global group of companies specializing in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organizational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

Africa	+ 27 11 254 4800
Asia	+ 852 2562 3658
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

solutions@golder.com
www.golder.com

Golder Associates Ltd.
100, Scotia Court
Whitby, Ontario, L1N 8Y6
Canada
T: +1 (905) 723 2727

Golder Associates