Appendix H
Geotechnical and Pavement Investigations

REPORT

September 2016

PRELIMINARY GEOTECHNICAL INVESTIGATION

Hewitt's Secondary Plan Environmental Assessment City of Barrie, Ontario

Submitted to:
Hatch Corporation
15 Allstate Parkway, Suite 300
Markham ON, L3R 5B4

Report Number: 1525357

Distribution:

1 e-Copy - Hatch Corporation
1 e-Copy - Golder Associates Ltd.

Golder Associates

Table of Contents

ATTACHMENTS:

Important Information and Limitations of This Report
Method of Soil Classification
Abbreviations and Terms Used on Records of Boreholes
List of Symbols

LIST OF FIGURES

APPENDICES

1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Hatch Corporation (Hatch) to provide geotechnical engineering services for the proposed infrastructure improvements as part of the Hewitt's Secondary Plan Environmental Assessment, in the City of Barrie, Ontario. The scope of work completed for this project is in accordance with our proposal submitted to Hatch (Proposal P1525357) dated April 2015.

The purpose of this report is to summarize the geotechnical information (soil and groundwater) acquired within the study areas and to provide preliminary recommendations and comments on the geotechnical aspects of the design and construction of the proposed structures.

This report should be read in conjunction with the "Important Information and Limitations of this Report", attached. 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 PROJECT BACKGROUND

As described in the RFP (REF # FIN 2015-011P), the Hewitt's Study requires the following:

- Conceptual design of drainage works associated with the road widenings; and,
- Compliance with Phases 3-4 of the Municipal Class EA for arterial road widenings and two grade-separated railway crossings within the Hewitt's Secondary Plan Area.

Within the project boundaries, six watercourse crossings were identified that required investigation for arterial road widenings. The watercourses cross beneath either Mapleview Drive East or Lockhart Road. Both roadways are currently two lane paved roads that will be widened as part of future works.

In addition, two grade separation areas were identified where Metrolinx railway crossings currently exist:

- Mapleview Drive East, east of Yonge Street, and;
- Lockhart Road, east of Yonge Street.

The site location, showing the grade separation areas as well as the locations of the watercourse crossings is shown on Figure 1.

The existing watercourse crossings include Corrugated Steel Pipe (CSP) culverts and concrete box culvert structures. It is anticipated that some of the CSP culverts will be replaced entirely, whereas the existing box culverts may be extended / widened to support the widening of the roadways.

3.0 INVESTIGATION PROCEDURES

3.1 Field Investigation

The field work for this investigation was carried out between June 8 and June 15, 2015, during which time a total of ten boreholes were advanced using a track-mounted drill rig operated by a specialist drilling subcontractor. The boreholes, which are designated as BH16-01 to BH16-10 were advanced at approximately the locations shown on Figure 1.

The boreholes were advanced to depths ranging from 8.7 m to 11.3 m below existing ground surface using hollow stem auger drilling methods. The boreholes were advanced either through the paved roadway or through the gravel shoulder. Soil samples were obtained in the boreholes at 0.75 m and 1.5 m intervals of depth using 50 mm outer diameter split-spoon samplers driven by an automatic hammer, in accordance with the Standard Penetration Test (SPT) procedure. The results of the in-situ tests (SPT 'N'-values) given on the Record of Borehole sheets are uncorrected.

The groundwater conditions were observed in the open boreholes during and immediately following the drilling operations. Monitoring wells were installed in eight of the boreholes to permit monitoring of the groundwater levels at these locations. The monitoring wells consist of 50 mm diameter PVC pipe, with a slotted screen sealed within a sand filter pack at a selected depth interval within the borehole. The monitoring well details and the water level recorded in the open boreholes / monitoring wells are indicated on the borehole records contained in Appendix A. The two open boreholes were backfilled with bentonite upon completion, in accordance with Ontario Regulation 903 (as amended).

The field work was supervised on a full-time basis by a member of Golder's staff who observed the drilling, sampling and in situ testing operations, and logged the subsurface conditions encountered in the boreholes. The soil samples were identified in the field, placed in labelled containers and transported to Golder's laboratory in Barrie for further examination and laboratory testing. Index and classification tests consisting of water contents and grain size distributions were carried out on selected soil samples.

The borehole locations were noted relative to identifiable site features and the coordinates and ground surface elevations were obtained from the topographic plans provided to our office by Hatch.

4.0 SUBSURFACE CONDITIONS

The detailed subsurface soil and groundwater conditions encountered in the boreholes advanced at this site together with the results of geotechnical laboratory testing are shown on the Record of Borehole sheets in Appendix A. The Methods of Soil Classification, Symbols and Terms used on the Records of Boreholes are provided to assist in the interpretation of the Record of Borehole sheets. The results of the geotechnical laboratory testing on selected soil samples are presented in Appendix B.

The Record of Borehole sheets indicate the subsurface conditions at the borehole locations only. The stratigraphic boundaries shown on the borehole records are inferred from non-continuous sampling, observations of drilling progress as well as results of Standard Penetration Tests and, therefore, represent transitions between soil types rather than exact planes of geological change. Subsurface soil conditions will vary between and beyond the borehole locations.

The following sections of this report provide an overview of the subsurface conditions encountered at the site followed by more detailed descriptions of the major soil strata and shallow groundwater conditions encountered at the borehole locations.

4.1 General Overview

In summary, the subsoils encountered in the boreholes consist of non-cohesive fill underlain by interlayered native strata comprised of silty sand to sand, and silty sand glacial till. Minor thin cohesive deposits were encountered in two of the boreholes. In addition a layer of topsoil was also encountered between the fill and native stratum in

one of the boreholes. A more detailed description of the subsurface conditions encountered in the boreholes is provided in the following sections.

4.1.1 Pavement Structure / Topsoil / Fill

All of the boreholes penetrated through a layer of non-cohesive fill, in places through the existing asphalt overlying the fill. The asphalt thicknesses encountered generally ranged in thickness from 80 mm to 130 mm, except at one of the boreholes east of the railway crossing where the borehole encountered an asphalt thickness of 650 mm.

The thickness of asphalt and fill as encountered in each of the boreholes is summarized below.

Borehole No.	Asphalt Thickness (mm)	Fill Thickness (m)
BH16-01	-	2.3
BH16-02	130	3.2
BH16-03	110	3.4
BH16-04	-	2.3
BH16-05	-	4.6
BH16-06	80	3.4
BH16-07	-	2.4
BH16-08	100	2.2
BH16-09	130	2.5
BH16-10	650	3.2

The fill is variable in composition ranging from sand and gravel to sand to sandy silt. The fill is brown to grey to black. Topsoil and/or trace organic inclusions were noted in several of the fill samples.

A 2.3 m thick layer of silty sand topsoil was encountered underlying the fill at a depth of about 2.3 m below ground surface in Borehole BH16-04; and a 0.5 m thick layer of silty clay fill was encountered within the overall fill deposit in BH16-04.

The measured SPT “N”-values in the fill deposit ranged from weight of hammer to 56 blows per 0.3 m of penetration indicating that these soils are very loose to very dense compactness; however in general the fill deposit is compact. The SPT “N”-values in the silty sand topsoil deposit are 4 blows per 0.3 m of penetration to 8 blows per 0.3 m of penetration, indicating a loose compactness.

The natural water content of the non-cohesive fill deposit ranges from 2 percent to 29 percent and is generally less than 15 percent. The natural water content of the silty sand topsoil layer (pocket) ranges between 20 percent and 35 percent.

4.1.2 Silty Clay

A cohesive deposit comprised of silty clay was encountered in Boreholes BH16-03 and BH16-06 underlying the fill deposit. The silty clay deposit is 0.6 m and 1.1 m thick in the respective boreholes, grey to black in colour, and contains a trace sand or trace organics.

The measured SPT "N"-values within the silty clay deposit were 1 blow per 0.3 m of penetration and 8 blows per 0.3 m of penetration, suggestive of a soft to firm consistency.

The water content of the silty clay is noted to be wetter than the estimated plastic limit, and ranges between 11 percent and 20 percent as measured in three samples of the deposit.

4.1.3 Glacial Till

A glacial till was encountered in Boreholes BH16-01, BH16-03, BH16-04, BH16-06, BH16-07, BH16-08, and BH16-10 directly underlying the cohesive fill, the topsoil deposit, or the silty sand deposit (described in Section 6.1.4).

The till deposit ranges in composition from a silty sand to a silt and sand, is brown to grey and contains trace to some gravel content, and is moist to wet. Boreholes BH16-01, BH16-03, BH16-04, and BH16-08 were terminated in the till deposit at a maximum depth of 11.3 m below ground surface. Borehole BH16-03 encountered refusal at a depth of 9.8 m due to auger refusal inferred to be on a boulder.

Although not indicated on the borehole records except for the refusal condition, glacial till deposits in Ontario are known to contain cobbles and boulders; as such, these materials are anticipated to be present throughout the till deposits at this site.

The water content measured on samples of the till deposit range from 7 per cent to 18 per cent.

The measured SPT "N"-values within the till deposit range from 5 blows per 0.3 m of penetration to greater than 50 blows per 0.3 m of penetration, indicating this deposit is loose to very dense, but generally dense in compactness.

The results of grain size distribution tests completed on eight selected samples of the till deposit are shown on Figures B1 to B3.

4.1.4 Silty Sand to Sand

A silty sand to silt and sand to sand deposit was encountered in Boreholes BH16-01, BH16-02, BH16-05, BH16-07, BH16-09, and BH16-10 underlying the silty sand till deposit. The silty sand to sand is generally moist to wet, brown to grey, and contains trace to some gravel. Although the majority of the deposit ranges between silty sand to sand, a silty sand and gravel layer was encountered in Borehole BH16-01 underlying the fill. Boreholes BH16-02, BH16-05, BH16-07, BH16-09, BH16-10 were terminated in the silty sand to sand deposit. Borehole BH16-03 encountered refusal at a depth of 9.8 m due to auger refusal on a boulder. Borehole BH16-02 encountered refusal at a depth of 8.7 m due to auger refusal inferred to be on a boulder. Where fully penetrated, the deposit is about 1 m to 5.3 m thick and is greater than 4.7 m to greater than 8.7 m where not fully penetrated.

The water content measured on samples of the silty sand to sand deposit range from 8 per cent to 24 per cent.

The measured SPT "N"-values measured within the silty sand to sand deposit range from 5 blows per 0.3 m of penetration to greater than 50 blows per 0.3 m indicating these soils are typically loose to very dense, but generally dense in compactness.

The results of four gradation analyses of the silty sand to sand deposit are displayed on Figures B4 and B5.

4.2 Groundwater Conditions

The shallow groundwater conditions encountered in the open boreholes during this investigation and monitoring well installation details are presented on the Record of Borehole sheets in Appendix A. The detailed groundwater levels measured in the open boreholes upon completion of drilling and in the monitoring wells installed at the site are summarized below.

Borehole No.	Ground Elevation (m)	Groundwater Levels			
		Upon Completion		July 14, 2016	
		Depth (m)	Elevation (m)	Depth (m)	Elevation (m)
BH16-01	241.8	1.8	240.0	2.0	239.8
BH16-02	247.8	5.7	242.1	2.4	245.4
BH16-03	248.6	4.1	244.5	1.6	247.0
BH16-04	246.5	Dry	--	2.7	243.8
BH16-05	260.2	2.4	257.8	2.5*	257.7*
BH16-06	255.5	5.1	250.4	2.6	252.9
BH16-07	267.4	3.6	263.8	4.7	262.7
BH16-08	267.3	4.9**	262.4**	--	--
BH16-09	260.6	2.8	257.8	3.1	257.5
BH16-10	260.0	4.8**	255.2**	--	--

* Groundwater was measured on August 15, 2016 in Borehole BH16-05

** Measured within the open borehole

It should be noted that the groundwater levels at the site are anticipated to fluctuate with seasonal variations in precipitation and runoff.

5.0 GEOTECHNICAL COMMENTS AND RECOMMENDATIONS

This section of the report provides preliminary design recommendations on geotechnical aspects of the proposed watercourse crossings and grade-separated railway crossings, based on interpretation of the factual data obtained from the boreholes advanced at the site and our understanding of the project requirements. The preliminary geotechnical information in this portion of the report is provided for the guidance of the design engineers and professionals. Where comments are made on construction, they are provided in order to highlight those aspects 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 information provided as it may affect equipment selection, proposed construction methods, scheduling and the like.

5.1 Subsurface Conditions Summary

As noted above in Section 4.1, the subsoils encountered in the boreholes consist of non-cohesive fill underlain by interlayered native strata comprised of loose to very dense silty sand to sand, and silty sand glacial till. Minor pockets / layers of soft to firm cohesive deposits and a topsoil layer were encountered in three of the boreholes.

Stabilized groundwater levels measured in the monitoring wells ranged from about 1.6 m to 4.7 m below existing ground surface.

5.2 Watercourse Crossing Structures

5.2.1 General

Details regarding the proposed founding elevations for the watercourse crossing structures were not available at the time of preparation of this report; however it is anticipated that these structures would be founded at relatively shallow depths taking into account the depth of frost penetration and scour protection requirements. It is anticipated that the structures will consist of a concrete culvert (either an open bottom or closed bottom box), either as an extension of the existing box culverts, or a replacement structure where CSP culverts currently exist.

Provided that the integrity of the native compact to dense silty sand to sand deposits and till deposits are protected during the construction process, these materials are considered suitable for the support of shallow foundations for the proposed crossing structures. As such, deep foundations are not anticipated to be required for this project.

5.2.2 Temporary Excavations for Foundation Construction

Strip footings for the culverts should be founded at a minimum depth of 1.5 m below the lowest surrounding grade, to provide adequate protection against frost penetration. In this regard, excavations for the construction of the foundations for each of the culverts will extend below the water level within predominantly granular soils (sand and/or till). As such, a dewatering system will be required to be implemented to provide a dry working area.

Consideration could be given to the use of sheet pile enclosures around all foundation excavation areas to separate and provide a groundwater cut-off between the work areas and the creek channel. Although sheet pile enclosures will limit lateral groundwater flow through the near-surface granular soils into the excavation areas, seepage from the base of the excavation would still occur from groundwater travelling below the tips of the sheet piles. In addition, basal instability (e.g. ‘piping’, ‘quick conditions’ or ‘boiling’) can occur where an unbalanced hydrostatic head results in large upward seepage gradients at the bottom of the excavation within a sheet pile enclosure. As such, additional analysis should be completed during the detail design stage to provide additional input into both dewatering requirements and sheet pile enclosure methods.

Due to the potential need for pumping from within the sheet pile enclosure and/or the installation of a dewatering well/system, an Environmental Activity and Sector Registry (EASR) or a Permit to Take Water (PTTW) will likely be required for these works.

Excavation works must be carried out in accordance with the guidelines outlined in the Occupational Health and Safety Act. Side slopes of temporary excavations into the existing embankment fill materials should not be steeper than 1H:1V and the stability of such temporary cut slopes should be confirmed at the detail design stage. An adequate temporary support system should be provided at all locations where space limitations prevent construction of sufficiently shallow slopes or where required to provide protection to buried services, roadways or other existing facilities.

5.2.3 Subexcavation Requirements and Foundation Design Parameters

As noted in Section 5.2.2, strip footings for the culverts should be founded at a minimum depth of 1.5 m below the lowest surrounding grade, to provide adequate protection against frost penetration. The footings should also be

founded at sufficient depth to provide protection against scour and scour protection (such as adequate rip-rap) should be provided at all footings locations.

The proposed culverts should be founded on the compact to very dense, native granular deposits or till deposits below any topsoil and/or fill materials. It is not recommended to found the culverts on the soft to firm clayey soils encountered in Boreholes BH16-03 and BH16-06. As noted in Section 5.2.1, design grades were not available at the time of this report; however subexcavation through the fill materials, organic soils (buried topsoil as in BH16-04) or soft, loose, or otherwise unsuitable materials which extend below the proposed founding levels will be necessary to be able to found the foundations for each culvert on suitable material.

Strip footings for the culverts that are founded on the compact to very dense granular soils or till materials may be designed based on a preliminary factored ultimate geotechnical resistance at Ultimate Limit States (ULS) of 200 kPa assuming a minimum footing width of 0.9 m. A preliminary factored serviceability geotechnical resistance at Serviceability Limit States (SLS) of 80 kPa may be used in the design of the culvert foundations for foundations 0.9 m to 2.5 m wide.

The factored ULS and SLS resistances provided above should be considered preliminary and are dependent on the footing size, configuration and applied loads; the geotechnical resistances should, therefore, be reviewed if the selected footing widths are outside of the range outlined above or the founding levels differ significantly from those discussed above. The factored geotechnical resistances provided are given under the assumption that the loads will be applied perpendicular to the surface of the footings. Where the load is not applied perpendicular to the surface of the footing, inclination of the load should be taken into account in accordance with the *Canadian Highway Bridge Design Code (CHBDC, 2014).*

The foundation subgrade soils should be inspected by qualified geotechnical personnel following excavation to ensure that all existing fill, organic soils or other unsuitable material have been removed; any subexcavated area should be backfilled with granular materials meeting Ontario Provincial Standard Specifications (OPSS.MUNI) for Granular A or Granular B Type II materials that are placed in maximum 200 mm thick lifts and compacted to a minimum of 100 percent of their Standard Proctor maximum dry density.

The foundation subgrade soils are considered to be highly susceptible to disturbance as a result of groundwater seepage, ponding of water and/or construction activity. In order to limit this degradation, it is recommended that a concrete working slab of concrete be placed on the subgrade immediately after preparation, inspection and approval of the footing or base slab subgrade.

5.3 Grade Separation Structures

5.3.1 General

Similar to the culverts, details regarding the proposed founding elevations for the grade separation structures were not available at the time of preparation of this report; however similar to the culverts it is anticipated that these structures would be founded at relatively shallow depths taking into account protection from frost penetration requirements. Approach embankment construction will be required as part of these structures; it is anticipated that the embankment heights would range between 7 m and 10 m above existing site grades.

Based on the results of the field investigation, compact to very dense till soils were encountered underlying the fill at the Lockhart Road crossing. At the Mapleview Drive East crossing, the surficial roadway fill is underlain by compact silty sand and silty sand till deposits at a depth of about 4.0 m below existing site grades.

Provided that the integrity of the native compact to dense silty sand and till deposits is protected during the construction process, these materials are suitable for the support of shallow foundations for the proposed crossing structures. As such, deep foundations are not anticipated to be required for this project, although deep foundations such as steel H-piles or augered piles (caissons) would also be suitable to support such structures.

5.3.2 Preliminary Foundation Input

Spread footings for support of the grade separation structures should be founded below any existing fill materials, on the generally compact to very dense silty sand deposit or the silty sand till deposit.

At the Lockhart Road proposed structure location (Boreholes BH16-07 and BH16-08), compact silty sand till was encountered at a depth of about 2.5 m below existing site grades. At the Mapleview Drive East proposed structure location (Boreholes BH16-09 and BH16-10), loose silty sand and marginally compact silty sand till was encountered to depths of up to 4 m to 5.5 m below existing site grades. As such, at the Mapleview Drive East structure location subexcavation of the upper native materials (i.e. 2.6 m to 3.8 m of fill and 1.4 m to 1.7 m of silty sand fill) should be expected to be able to found the footings on suitable native compact materials.

For 3 m wide concrete footings founded at the depths indicated above, the following preliminary factored resistances are provided:

Location	Approximate Depth below Existing Road Grades (m)	Preliminary Factored Ultimate Geotechnical Resistance at ULS	Preliminary Factored Serviceability Geotechnical Resistance at SLS (for 25 mm of settlement)
Lockhart Road	2.5 m	500 kPa	200 kPa
Mapleview Drive East	4.0 m – 5.5 m	500 kPa	160 kPa

The preliminary factored geotechnical resistances provided above are dependent on the footing size, configuration and applied loads; therefore, additional analyses should be completed during the detailed design stages once design elevations, footing dimensions, and loading requirements are known.

The preliminary factored geotechnical resistances provided above are given for loadings that will be applied perpendicular to the surface of the footings. Where the load is not applied perpendicular to the surface of the footing, inclination of the load should be taken into account in accordance with the *Canadian Highway Bridge Design Code (CHBDC).*

The base of each footing excavation should be cleaned of loose / softened material. It is recommended that the founding level for the footings be inspected by geotechnical personnel immediately prior to pouring concrete to confirm the adequacy of the foundation conditions for the above-noted geotechnical resistances. If the concrete for the footings cannot be poured immediately after excavation and inspection, it is recommended that a concrete working slab be placed on the subgrade to protect the integrity of the bearing stratum.

5.3.3 Approach Embankments

As noted above, new approach embankments will be required to be constructed at each of the grade separation structures. Although embankment heights and geometry have not been provided at this time, it is estimated that the embankments could be as high as 10 m above existing grades.

A preliminary settlement analysis was completed for Lockhart Road and Mapleview Drive East to determine the approximate amount of settlement that may occur as a result of loading the existing roadways with the embankment fill. The maximum fill thickness of 10 m was used for each analysis. Further, it is assumed that all existing fill is removed from the embankment footprint and that the embankment is constructed on a suitable compact native material subgrade. The values of input parameters used in the analyses of settlement are based on field and laboratory test data and correlations suggested by Bowles (1984) from the soil conditions encountered in Boreholes BH16-07, BH16-08, BH16-09, and BH16-10.

The estimated preliminary magnitude of (factored) settlement for the approach embankment areas is provided below.

Location	Boreholes	Estimated Elastic Settlement (mm)
Lockhart Road	BH16-07, BH16-08	35 mm
Mapleview Drive East	BH16-09, BH16-10	95 mm

The majority of the settlement is expected to occur during or shortly after construction in response to filling, based on the non-cohesive nature of the silty sand and silty sand till deposits. However, given the loose to low compact soil conditions at Mapleview Drive East, consideration should be given preloading within the areas of the embankments at this site to mitigate the potential for future settlement associated with the embankment construction.

Additional settlement analyses should be completed during the detail design stage and when the embankment geometry is known.

5.4 Lateral Earth Pressures

The lateral earth pressures acting on the grade separation structures, culverts and any associated wing walls / retaining walls will depend on the type and method of placement of the backfill materials, the nature of the soils behind the backfill, the magnitude of surcharge including construction loadings, the freedom of lateral movement of the structure, and the drainage conditions behind the walls. Seismic (earthquake) loading must also be taken into account in the design.

The following recommendations are made concerning the design of the grade separation structures, culverts and walls. It should be noted that these design recommendations and parameters assume level backfill and ground surface behind the walls. Where there is sloping ground behind the walls, the coefficient of lateral earth pressure must be adjusted to account for the slope.

- Select, free-draining granular fill in accordance with OPSS.MUNI 1010 Granular ‘A’ or Granular ‘B’ Type II should be used as backfill behind the walls. Longitudinal drains and weep holes should be installed to provide positive drainage of the granular backfill. Other aspects of the granular backfill requirements with respect to

sub drains and frost taper should be in accordance with OPSD 3101.150 (*Wall, Abutments, Backfill)* and OPSD 3121.150 (*Walls, Retaining, Backfill).*

- A minimum compaction surcharge of 12 kPa should be included in the lateral earth pressures for the structural design of the wall stem, in accordance with *CHBDC* Section 6.12.3 and Figure 6.6. Compaction equipment should be used in accordance with OPSS.PROV 501. Other surcharge loadings should be accounted for in the design as required.

- For restrained structures, the granular fill may be placed in a zone with the width equal to at least 1.5 m behind the back of the walls (Figure C6.20 (a) of the *Commentary* to the *CHBDC*). For unrestrained structures, the granular fill should be placed within the wedge-shaped zone defined by a line drawn at 1.5 horizontal to 1 vertical (1.5H:1V) extending up and back from the rear face of the footing (Figure C6.20 (b) of the *Commentary* to the *CHBDC*).

- For restrained structures, the pressures are based on the existing embankment fill materials and the following parameters (unfactored) may be used assuming the use of granular earth fill such as OPSS.MUNI 1010 (Aggregates) Select Subgrade Material (SSM) for embankment construction:

Unfactored Parameters		**Earth Fill**
Soil unit weight:		21 kN/m^3
Coefficients of static lateral earth pressure:	At rest, K_o	0.47
	Active, K_a	0.31

- For unrestrained structures, where the pressures are based on OPSS.MUNI 1010 granular fill behind the wall, the following parameters (unfactored) may be assumed:

Unfactored Parameters		**Granular A / Granular B Type II**
Soil unit weight:		22 kN/m^3
Coefficients of static lateral earth pressure:	At rest, K_o	0.43
	Active, K_a	0.27

- If the wall support and superstructure allow lateral yielding of the stem, active earth pressures may be used in the geotechnical design of the structure. If the abutment support does not allow lateral yielding (such as for a rigid frame structure, including the anticipated box culverts), at-rest earth pressures should be assumed for geotechnical design. The movement required to allow active pressures to develop within the backfill, and thereby assume an unrestrained structure for design, should be calculated in accordance with Section C6.12.1 and Table C6.6 of the *Commentary* to the *CHBDC*.

5.5 Preliminary Pavement Design

Based on the borehole results, the subgrade for the pavement structure will generally comprise non-cohesive fill underlain by interlayered native strata comprised of loose to very dense silty sand to sand, and silty sand glacial till. A buried topsoil layer was encountered in Borehole BH16-04, which was advanced in proximity to Lover's Creek on Lockhart Road.

Prior to placing any granular material, the exposed subgrade should be prepared and heavily proof-rolled under the supervision of the geotechnical engineer. Remedial work should be carried out on any disturbed, softened or poorly performing zones, as directed by the geotechnical engineer. Future pavement structures should not be constructed on the topsoil layer as encountered in Borehole BH16-04; in this regard, removal of the topsoil layer and subsequent replacement with engineered fill is recommended.

The recommended preliminary pavement design for Lockhart Road and Mapleview Drive East is outlined below and is consistent with City of Barrie Standards.

Material		**Thickness of Pavement Elements (mm)**	
		14 m Asphalt Road	**18 m Asphalt Road**
Asphaltic Material (OPSS 1150)	HL1 Surface	40 mm	40 mm
	HL4 or HL8 Binder	100 mm	100 mm
Granular Material (OPSS 1010	Granular A Base	150 mm	150 mm
	Granular B Subbase	500 mm	500 mm – 600 mm
Total Pavement Thickness (mm)		**790 mm**	**790 mm to 890 mm**
		Over Prepared And Approved Subgrade	

Granular materials should be uniformly compacted to 100 percent of the Standard Proctor Maximum Dry Density (SPMDD). The asphalt materials should be compacted to between 92.0 and 96.5 percent of their respective Marshall Maximum Relative Density (MRD), as measured in the field using a nuclear density gauge.

Golder should provide additional design recommendations regarding the pavement design once final grades have been determined and traffic data is provided.

5.6 Soil Submission

In order to provide preliminary information regarding the chemical quality of the subsurface soil, eight soil samples were submitted to AGAT Laboratories Ltd. of Mississauga, Ontario ("AGAT") for metals and inorganic parameter analyses. The boreholes and depth of the samples is detailed in the table below.

Borehole No.	**Sample No.**	**Sample Depth (m)**
BH16-01	SA3	1.5
BH16-02	SA2	0.8
BH16-03	SA2	0.8
BH16-04	SA3	1.5
BH16-05	SA3	1.5

Borehole No.	Sample No.	Sample Depth (m)
BH16-06	SA2	0.8
BH16-08	SA3	1.5
BH16-10	SA2	0.8

5.6.1 Soil Analytical Results

The soil sample analytical results were compared to the Ontario Ministry of the Environment ("MOE") *"Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act"*, April 15, 2011, Table 1 Full Depth Background Site Condition Standards for All Other Types of Property Use ("MOE Table 1 Standards").

A summary of the soil analytical results and the MOE Table 1 Standards is provided on the Laboratory Certificates of Analysis, included in Appendix C. Based on the results of the analyses and the Standards comparison, the following parameters were identified to be above the MOE Table 1 Standards:

- Sodium Absorption Ratio ("SAR") was detected above the MOE Table 1 Standard of 2.4 in each of the soil samples tested
- Electrical Conductivity ("EC") was detected above the MOE Table 1 Standard of 0.57 mS/cm in five of the eight soil samples tested

5.6.2 Discussion of Analytical Results

Elevated EC and SAR values in soils beneath roadways are often attributable to the application of de-icing salts. Although the levels identified are generally above the MOE generic full-depth remediation standards, some receivers (depending on their intended land use) may consider accepting materials for which only EC and/or SAR have been identified as potential contaminants of concern. For example, such materials may be considered environmentally suitable for re-use as road base materials. Available analytical data pertaining to this material should be forwarded to the potential receiver for review. Written authorization should be provided to the site representative by the potential receiver, indicating that this data was received and reviewed, and that the receiver accepts the excavated material. It is noted that receiving sites may be subject to filling or other land use restrictions which could affect the importation and placement of fill on their sites.

6.0 ADDITIONAL WORK, INSPECTIONS AND TESTING

Prior to tendering, the geotechnical aspects of the design drawings and specifications and the proposed construction methodology should be reviewed by Golder to confirm that the intent of the recommendations contained in this report have been met. During construction, sufficient subgrade inspections, in-situ density tests, and materials tests should be carried out to confirm that the conditions encountered are consistent with those encountered in the boreholes, and to monitor conformance with the pertinent project specifications. Full-time inspection should be performed by geotechnical personnel during structural fill placement.

Report Signature Page

If you have any questions or concerns regarding the contents of this report, please do not hesitate to contact our office.

Yours truly,

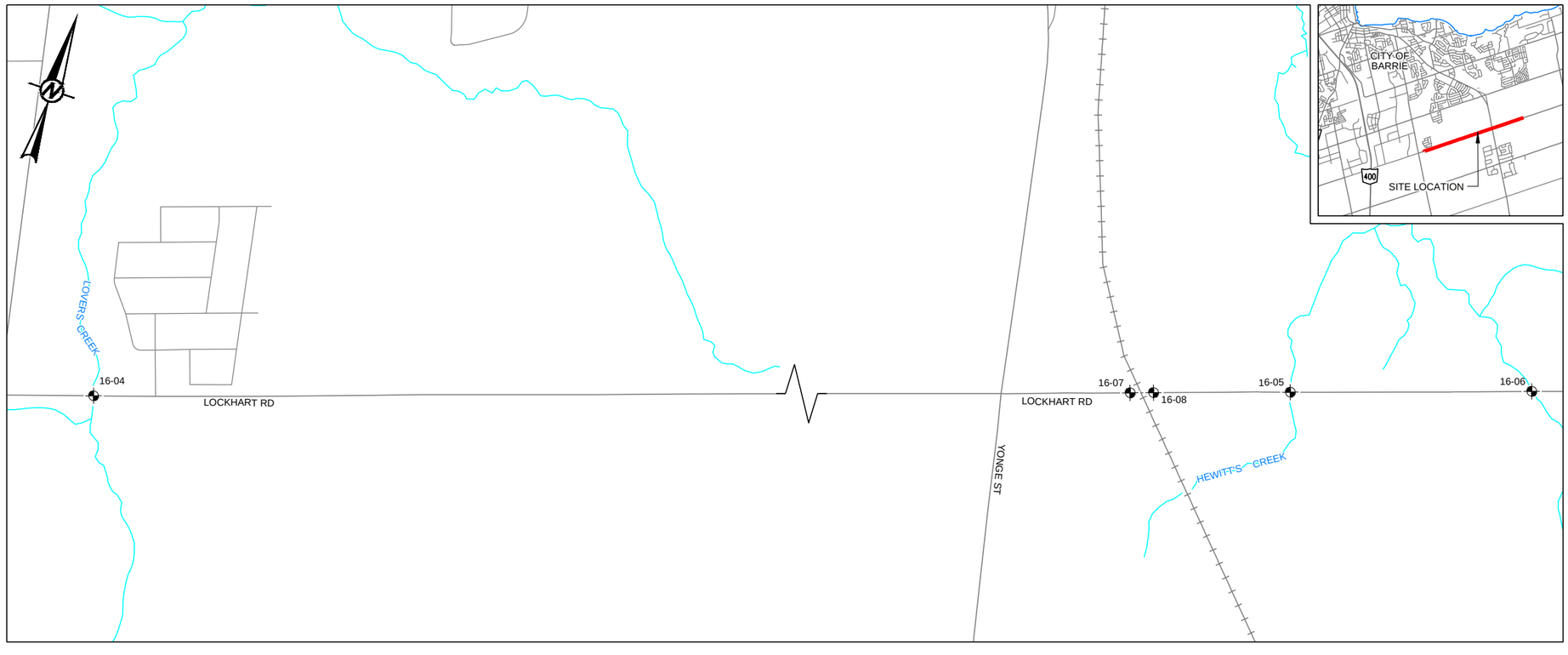
GOLDER ASSOCIATES LTD.

Nick La Posta, P.Eng.
Geotechnical Engineer

Jorge M.A. Costa, P.Eng.
Senior Consultant

NLP/JMAC/sm/plc

FIGURES



LEGEND

APPROXIMATE BOREHOLE LOCATION

0 250 500

1:12,500 METRES

(INSET MAP SCALE 1:200,000 KM)

REFERENCE(S)

BASE DATA - MNR LIO, OBTAINED 2016

PRODUCED BY GOLDER ASSOCIATES LTD UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2016

PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83 COORDINATE SYSTEM: UTM ZONE 17N

CLIENT
HATCH CORPORATION

PROJECT
GEOTECHNICAL INVESTIGATION
HEWITT'S CLASS ENVIRONMENTAL ASSESSMENT

TITLE
SITE AND BOREHOLE LOCATION PLAN

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-09-07
DESIGNED	
PREPARED	STB
REVIEWED	NL
APPROVED	JMAC

PROJECT NO. 1525357 | Control | REV. | Figure 1

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

25 mm

Path: \\golder.gds\gal\Mississauga\SIM\Clients\Hatch_Mott_MacDonald\Barrie\99_PRO\1\1525357_Hatch_Geotech\v\0_PROD\0001_Geotech_EA\ | File Name: 1525357-0001-BG-0001.dwg

APPENDIX A

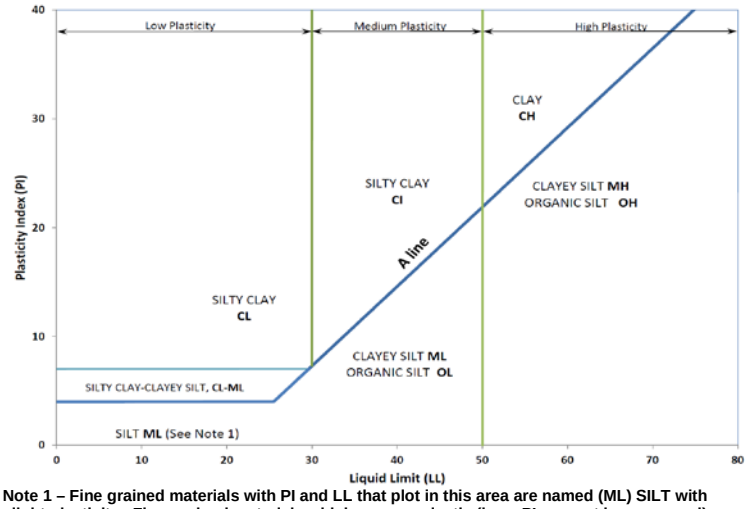
Record of Borehole Sheets

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					Organic Content	USCS Group Symbol	Primary Name
					Dilatancy	Dry Strength	Shine Test	Thread Diameter	Toughness (of 3 mm thread)			
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~~ indicate~~s~~ 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 ($\phi = 0$ 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

LITHOLOGICAL AND GEOTECHNICAL ROCK DESCRIPTION TERMINOLOGY

WEATHERINGS STATE

Fresh: no visible sign of weathering

Faintly weathered: weathering limited to the surface of major discontinuities.

Slightly weathered: penetrative weathering developed on open discontinuity surfaces but only slight weathering of rock material.

Moderately weathered: weathering extends throughout the rock mass but the rock material is not friable.

Highly weathered: weathering extends throughout rock mass and the rock material is partly friable.

Completely weathered: rock is wholly decomposed and in a friable condition but the rock and structure are preserved.

BEDDING THICKNESS

Description	Bedding Plane Spacing
Very thickly bedded	Greater than 2 m
Thickly bedded	0.6 m to 2 m
Medium bedded	0.2 m to 0.6 m
Thinly bedded	60 mm to 0.2 m
Very thinly bedded	20 mm to 60 mm
Laminated	6 mm to 20 mm
Thinly laminated	Less than 6 mm

JOINT OR FOLIATION SPACING

Description	Spacing
Very wide	Greater than 3 m
Wide	1 m to 3 m
Moderately close	0.3 m to 1 m
Close	50 mm to 300 mm
Very close	Less than 50 mm

GRAIN SIZE

Term	Size*
Very Coarse Grained	Greater than 60 mm
Coarse Grained	2 mm to 60 mm
Medium Grained	60 microns to 2 mm
Fine Grained	2 microns to 60 microns
Very Fine Grained	Less than 2 microns

Note: * Grains greater than 60 microns diameter are visible to the naked eye.

CORE CONDITION

Total Core Recovery (TCR)
The percentage of solid drill core recovered regardless of quality or length, measured relative to the length of the total core run.

Solid Core Recovery (SCR)
The percentage of solid drill core, regardless of length, recovered at full diameter, measured relative to the length of the total core run.

Rock Quality Designation (RQD)
The percentage of solid drill core, greater than 100 mm length, recovered at full diameter, measured relative to the length of the total core run. RQD varied from 0% for completely broken core to 100% for core in solid sticks.

DISCONTINUITY DATA

Fracture Index
A count of the number of discontinuities (physical separations) in the rock core, including both naturally occurring fractures and mechanically induced breaks caused by drilling.

Dip with Respect to Core Axis
The angle of the discontinuity relative to the axis (length) of the core. In a vertical borehole a discontinuity with a 90^{o} angle is horizontal.

Description and Notes
An abbreviation description of the discontinuities, whether naturally occurring separations such as fractures, bedding planes and foliation planes or mechanically induced features caused by drilling such as ground or shattered core and mechanically separated bedding or foliation surfaces. Additional information concerning the nature of fracture surfaces and infillings are also noted.

Abbreviations

JN	Joint	PL	Planar
FLT	Fault	CU	Curved
SH	Shear	UN	Undulating
VN	Vein	IR	Irregular
FR	Fracture	K	Slickensided
SY	Stylolite	PO	Polished
BD	Bedding	SM	Smooth
FO	Foliation	SR	Slightly Rough
CO	Contact	RO	Rough
AXJ	Axial Joint	VR	Very Rough
KV	Karstic Void		
MB	Mechanical Break		

PROJECT: 1525357-BG-0001

LOCATION: See Figure 1

RECORD OF BOREHOLE: BH16-01

SHEET 1 OF 2

BORING DATE: June 15, 2016

DATUM: Geodetic

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

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		241.80							
0	Track Mount Power Auger 8" Hollow Stem Auger	FILL-(SP/GW) SAND and GRAVEL; brown; non-cohesive, moist, compact		0.00 / 241.39	1A	DO	11				Concrete Casing
		FILL-(SM) SILTY SAND to sandy SILT and TOPSOIL, trace gravel; brown to black; non-cohesive, moist, very loose to loose		0.41	1B						
1					2	DO	5			Metals	Bentonite
											#1 Silica Sand
2					3	DO	2				
				239.46							July 14, 2016
		(SM) SILTY SAND and GRAVEL; brown to grey; non-cohesive, wet, dense		2.34	4	DO	33				
3					5A						10 Slot PVC Screen
				238.50							
		(SM) SILTY SAND, trace to some gravel; grey, (TILL); non-cohesive, wet, loose to very dense		3.30	5B	DO	6				
4					6	DO	14			MH	
5					7	DO	11				
6					8	DO	18				
7					9	DO	108/ 279 mm				
8											
9					10	DO	44				
10		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SP

CHECKED: NL

GTA-BHS 001 S:\CLIENTS\HATCH_MOTT_MACDONALD\BARRIE\02_DATA\GINT\1525357-BG-0001.GPJ GAL-MIS.GDT 9-7-16 STB

PROJECT: 1525357-BG-0001

LOCATION: See Figure 1

RECORD OF BOREHOLE: BH16-01

BORING DATE: June 15, 2016

SHEET 2 OF 2

DATUM: Geodetic

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

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: 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
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	Track Mount Power Auger / 8" Hollow Stem Auger	(SM) SILTY SAND, trace to some gravel; grey, (TILL); non-cohesive, wet, loose to very dense		230.52							
11					11	DO	71		○		
		End of Borehole		11.28							
12		NOTE: 1. Groundwater level measured at a depth of 1.8 m in open borehole upon completion of drilling June 15, 2016. 2. Groundwater level measured at a depth of 2.0 m on July 14, 2016.									
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SP

CHECKED: NL

GTA-BHS 001 S:\CLIENTS\HATCH_MOTT_MACDONALD\BARRIE\02_DATA\GINT\1525357-BG-0001.GPJ GAL-MIS.GDT 9-7-16 STB

PROJECT: 1525357-BG-0001

LOCATION: See Figure 1

RECORD OF BOREHOLE: BH16-02

BORING DATE: June 13, 2016

SHEET 1 OF 1

DATUM: Geodetic

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

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 WI) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		247.80							
0	Track Mount Power Auger 8" Hollow Stem Auger	ASPHALT		0.00							
		FILL-(SW/GW) SAND and GRAVEL to gravelly SILTY SAND; brown to grey to black, trace organics; non-cohesive, moist to wet, loose to dense		0.13	1	DO	46				Concrete Casing
1					2	DO	22			Metals	Bentonite
					3	DO	12				#1 Silica Sand
2		organic seam at 2.5 to 2.7 mbgs increasing fines content with depth			4A	DO	8				July 14, 2016
					4B						
3					5A						10 Slot PVC Screen
				244.45		DO	18				
		(SM) SILTY SAND, trace to some gravel, some clay; grey, occasional cobble; non-cohesive, wet, compact to very dense		3.35	5B						
4					6	DO	34			MH	
					7	DO	97/ 254 mm				
5											
6					8	DO	50/ 102 mm				
7											
					9	DO	50/ 25 mm				
8											
				239.14	10	DO	66/ 127 mm				
		End of Borehole Split Spoon and Auger Refusal on Boulder		8.66							
9											
		NOTE: 1. Groundwater level measured at a depth of 5.7 m in open borehole upon completion of driling on June 13, 2016. 2. Groundwater level measured at a depth of 2.4 m on July 14, 2016.									
10											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SP

CHECKED: NL

GTA-BHS 001 S:\CLIENTS\HATCH_MOTT_MACDONALD\BARRIE\02_DATA\GINT\1525357-BG-0001.GPJ GAL-MIS.GDT 9-7-16 STB

PROJECT: 1525357-BG-0001

LOCATION: See Figure 1

RECORD OF BOREHOLE: BH16-03

SHEET 1 OF 2

BORING DATE: June 13, 2016

DATUM: Geodetic

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

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. +, rem V. ⊕, Q - ●, 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		248.60							
0	Track Mount Power Auger; 8" Hollow Stem Auger	ASPHALT		0.00							
		FILL-(SM-SW/GW) SAND and GRAVEL to SILTY SAND, trace clay; brown to grey to black; non-cohesive, moist to wet, very loose to compact		0.11	1	DO	20				Concrete Casing
											Bentonite
1					2	DO	18			Metals	
											#1 Silica Sand
											July 14, 2016
2					3	DO	9				
					4	DO	4				
3											10 Slot PVC Screen
					5A	DO	2				
				245.09							
		(CL) SILTY CLAY, trace sand; grey; cohesive, w>PL, soft to firm		3.51	5B						
					6A						
4				244.49							
		(ML-SW/SM) SILTY SAND, some gravel to gravelly; grey, (TILL); non-cohesive, wet, loose to very dense		4.11	6B	DO	8				
					7	DO	49				
5											
6					8	DO	42			MH	
		decreasing gravel content, with depth									
7											
					9A	DO	73				
8					9B						
9											
					10	DO	53				
				238.85							
		End of Borehole Auger Refusal on Inferred Boulder		9.75							
10		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SP

CHECKED: NL

GTA-BHS 001 S:\CLIENTS\HATCH_MOTT_MACDONALD\BARRIE\02_DATA\GINT\1525357-BG-0001.GPJ GAL-MIS.GDT 9-7-16 STB

PROJECT: 1525357-BG-0001

RECORD OF BOREHOLE: BH16-03

SHEET 2 OF 2

LOCATION: See Figure 1

BORING DATE: June 13, 2016

DATUM: Geodetic

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

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: 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
10		*--- CONTINUED FROM PREVIOUS PAGE ---*									
		NOTE: 1. Groundwater level measured at a depth of 4.1 m in open borehole upon completion of drilling June 13, 2016. 2. Groundwater level measured at a depth of 1.6 m on July 14, 2016.									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SP

CHECKED: NL

GTA-BHS 001 S:\CLIENTS\HATCH_MOTT_MACDONALD\BARRIE\02_DATA\GINT\1525357-BG-0001.GPJ GAL-MIS.GDT 9-7-16 STB

PROJECT: 1525357-BG-0001

RECORD OF BOREHOLE: BH16-04

SHEET 1 OF 2

LOCATION: See Figure 1

BORING DATE: June 10, 2016

DATUM: Geodetic

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

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		246.50							
0	Track Mount Power Auger 8" Hollow Stem Auger	FILL-(SW/GW) SAND and GRAVEL; brown, asphalt pieces; non-cohesive, moist, very loose to compact		0.00	1	DO	25		○		Concrete Casing
1					2	DO	9		○		
					3	DO	2		○	Metals	Bentonite
2				244.21							
		TOPSOIL-(SM) SILTY SAND; grey to black; moist, loose		2.29	4	DO	4		○		
3											July 14, 2016 ▽
					5	DO	4		○		#1 Silica Sand
4					6	DO	8		○		
				241.93							
		(SM) SILTY SAND, trace to some clay, trace to some gravel; grey, (TILL); non-cohesive, wet, loose to compact		4.57	7	DO	5		○		10 Slot PVC Screen
5											
6					8	DO	6		○	MH	
7											
8					9	DO	7		○		
9											
					10	DO	20		○		
10		*CONTINUED NEXT PAGE*									

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: SP
CHECKED: NL

GTA-BHS 001 S:\CLIENTS\HATCH_MOTT_MACDONALD\BARRIE\02_DATA\GINT\1525357-BG-0001.GPJ GAL-MIS.GDT 9-7-16 STB

PROJECT: 1525357-BG-0001

LOCATION: See Figure 1

RECORD OF BOREHOLE: BH16-04

BORING DATE: June 10, 2016

SHEET 2 OF 2

DATUM: Geodetic

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

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: 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
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	Track Mount Power Auger 8" Hollow Stem Auger	(SM) SILTY SAND, trace to some clay, trace to some gravel; grey, (TILL); non-cohesive, wet, loose to compact		235.22							
11					11	DO	9		○		
		End of Borehole		11.28							
		NOTE:									
12		1. Groundwater level not encountered in open borehole upon completion of drilling June 10, 2016. 2. Groundwater level measured at a depth of 2.7 m on July 14, 2016.									
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SP

CHECKED: NL

GTA-BHS 001 S:\CLIENTS\HATCH_MOTT_MACDONALD\BARRIE\02_DATA\GINT\1525357-BG-0001.GPJ GAL-MIS.GDT 9-7-16 STB

PROJECT: 1525357-BG-0001

RECORD OF BOREHOLE: BH16-05

SHEET 1 OF 2

LOCATION: See Figure 1

BORING DATE: June 9, 2016

DATUM: Geodetic

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

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		260.20							
0	Track Mount Power Auger 8" Hollow Stem Auger	FILL-(SW/GW) SAND and GRAVEL; brown to black, trace organics, asphalt; non-cohesive, moist to wet, very loose to compact		0.00	1	DO	19				Concrete Casing
1					2	DO	17				Cuttings
2					3	DO	19			Metals	Bentonite
					4	DO	1				August 15, 2016
3				257.15							#1 Silica Sand
		FILL-(SM) SILTY SAND; grey to black, trace organics; non-cohesive, wet, very loose to compact		3.05	5	DO	WH				
4		gravelly in Sample 6			6	DO	22				
				255.63							10 Slot PVC Screen
5		(SW) SAND, trace silt, trace gravel; brown to grey; non-cohesive, wet, compact to dense		4.57	7	DO	18			M	
6					8A	DO	36				
					8B						
7											
				252.40	9A						
8		(SM) SILTY SAND, fine; grey; non-cohesive, wet, dense to very dense		7.80	9B	DO	31				
9											
					10	DO	88/ 279 mm			M	
10		*CONTINUED NEXT PAGE*									

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: SP
CHECKED: NL

GTA-BHS 001 S:\CLIENTS\HATCH_MOTT_MACDONALD\BARRIE\02_DATA\GINT\1525357-BG-0001.GPJ GAL-MIS.GDT 9-7-16 STB

PROJECT: 1525357-BG-0001

RECORD OF BOREHOLE: BH16-05

SHEET 2 OF 2

LOCATION: See Figure 1

BORING DATE: June 9, 2016

DATUM: Geodetic

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

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: 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
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	Track Mount Power Auger 8" Hollow Stem Auger	(SM) SILTY SAND, fine; grey; non-cohesive, wet, dense to very dense									
11					11	DO	5		○		
				248.92							
		End of Borehole		11.28							
12		NOTE: 1. Groundwater level measured at a depth of 2.4 m in open borehole upon completion of drilling June 9, 2016. 2. Groundwater level measured at a depth of 2.5 m on August 15, 2016.									
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: SP
CHECKED: NL

GTA-BHS 001 S:\CLIENTS\HATCH_MOTT_MACDONALD\BARRIE\02_DATA\GINT\1525357-BG-0001.GPJ GAL-MIS.GDT 9-7-16 STB

PROJECT: 1525357-BG-0001

RECORD OF BOREHOLE: BH16-06

SHEET 1 OF 2

LOCATION: See Figure 1

BORING DATE: June 9, 2016

DATUM: Geodetic

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

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		255.50							
0	Track Mount Power Auger 8" Hollow Stem Auger	ASPHALT		0.00							
		FILL-(GW/SW) SAND and GRAVEL; brown; non-cohesive, moist to wet, very loose to compact		0.08	1	DO	18				Concrete Casing
1					2	DO	6			Metals	Cuttings
					3	DO	5				
2											Bentonite
					4	DO	12				July 14, 2016
3											#1 Silica Sand
					5A	DO	1			Metals	
		organics and wood pieces at 3.4 mbgs		251.99							
		(CL) SILTY CLAY; grey to black, trace organics; cohesive, w>PL		3.51	5B						
4											
				250.93							10 Slot PVC Screen
		(SM) SILTY SAND to SILT and SAND, trace gravel, some clay; grey, (TILL); non-cohesive, wet, dense to very dense		4.57	6	DO	36			MH	
5											
6					7	DO	30				
7											
8					8	DO	40				
9					9	DO	50/127 mm				
				246.23							
		End of Borehole Auger Refusal on Inferred Boulder		9.27							
		NOTE:									
10		1. Groundwater level measured at a									

CONTINUED NEXT PAGE

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SP

CHECKED: NL

PROJECT: 1525357-BG-0001

RECORD OF BOREHOLE: BH16-06

SHEET 2 OF 2

LOCATION: See Figure 1

BORING DATE: June 9, 2016

DATUM: Geodetic

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

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: 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
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		depth of 5.1 m in open borehole upon completion of drilling June 9, 2016. 2. Groundwater level measured at a depth of 2.6 m on July 14, 2016.									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SP

CHECKED: NL

GTA-BHS 001 S:\CLIENTS\HATCH_MOTT_MACDONALD\BARRIE\02_DATA\GINT\1525357-BG-0001.GPJ GAL-MIS.GDT 9-7-16 STB

PROJECT: 1525357-BG-0001

RECORD OF BOREHOLE: BH16-07

SHEET 1 OF 2

LOCATION: See Figure 1

BORING DATE: June 10, 2016

DATUM: Geodetic

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

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		267.40							
0	Track Mount Power Auger / 8" Hollow Stem Auger	FILL-(SW/GW) SAND and GRAVEL; brown; non-cohesive, moist, loose to compact		0.00	1	DO	29		○		Concrete Casing
1					2	DO	9			Metals	Cuttings
		some silt from 1.5 to 2.3 mbgs			3	DO	9		○		
2											Bentonite
				264.96							
		(SM) SILTY SAND, some clay; brown, (TILL); non-cohesive, moist to wet, compact to very dense		2.44	4	DO	27		○	MH	
3					5	DO	69/ 279 mm		○		#1 Silica Sand
4					6	DO	31		○		10 Slot PVC Screen
					7	DO	35		○		July 14, 2016
5											
6					8	DO	54		○		
7				260.08							
		(SM) SILTY SAND; brown; non-cohesive, wet, dense to very dense		7.32							
8					9	DO	44		○		
9											
					10	DO	51		○		
				257.65							
		End of Borehole		9.75							
10		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SP

CHECKED: NL

GTA-BHS 001 S:\CLIENTS\HATCH_MOTT_MACDONALD\BARRIE\02_DATA\GINT\1525357-BG-0001.GPJ GAL-MIS.GDT 9-7-16 STB

PROJECT: 1525357-BG-0001

RECORD OF BOREHOLE: BH16-07

SHEET 2 OF 2

LOCATION: See Figure 1

BORING DATE: June 10, 2016

DATUM: Geodetic

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

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: 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
10		*--- CONTINUED FROM PREVIOUS PAGE ---*									
		NOTE: 1. Groundwater level measured at a depth of 3.6 m in open borehole upon completion of drilling June 10, 2016. 2. Groundwater level measured at a depth of 4.7 m on July 14, 2016.									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SP

CHECKED: NL

GTA-BHS 001 S:\CLIENTS\HATCH_MOTT_MACDONALD\BARRIE\02_DATA\GINT\1525357-BG-0001.GPJ GAL-MIS.GDT 9-7-16 STB

PROJECT: 1525357-BG-0001

RECORD OF BOREHOLE: BH16-08

SHEET 1 OF 2

LOCATION: See Figure 1

BORING DATE: June 8, 2016

DATUM: Geodetic

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

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		267.30							
0	Track Mount Power Auger 8" Hollow Stem Auger	ASPHALT		0.00							
		FILL-(SW/GW) SAND and GRAVEL; brown, asphalt pieces; non-cohesive, moist, compact to dense		0.10	1	DO	38				
1					2	DO	12				
					3	DO	13			Metals	
2				265.01							
		(SM) SILTY SAND, trace gravel; brown, (TILL); non-cohesive, moist to wet, compact to very dense		2.29	4	DO	18				
3					5	DO	22				
4					6	DO	35				
					7	DO	73			MH	
5											
6					8	DO	47				
7											
8					9	DO	53				
9											
					10	DO	38				
10		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SP

CHECKED: NL

GTA-BHS 001 S:\CLIENTS\HATCH_MOTT_MACDONALD\BARRIE\02_DATA\GINT\1525357-BG-0001.GPJ GAL-MIS.GDT 9-7-16 STB

PROJECT: 1525357-BG-0001

LOCATION: See Figure 1

RECORD OF BOREHOLE: BH16-08

BORING DATE: June 8, 2016

DATUM: Geodetic

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

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: 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
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	Track Mount Power Auger 8" Hollow Stem Auger	(SM) SILTY SAND, trace gravel; brown, (TILL); non-cohesive, moist to wet, compact to very dense									
11					11	DO	56		○		
				256.02							
		End of Borehole		11.28							
		NOTE:									
		1. Groundwater level measured at a depth of 4.9 m in open borehole upon completion of drilling June 9, 2016.									
12											
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SP

CHECKED: NL

PROJECT: 1525357-BG-0001

LOCATION: See Figure 1

RECORD OF BOREHOLE: BH16-09

SHEET 1 OF 2

BORING DATE: June 14, 2016

DATUM: Geodetic

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

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		260.60							
0	Track Mount Power Auger 8" Hollow Stem Auger	ASPHALT		0.00							
		FILL-(GW/SW) SAND and GRAVEL; brown; non-cohesive, moist, loose to dense		0.13	1	DO	35			Metals	Concrete Casing
					2A	DO	5				Bentonite
1				259.53							
		FILL-(CL) SILTY CLAY, trace sand; brown to black; cohesive, w~PL, firm		1.07	2B						#1 Silica Sand
				259.08							
		FILL-(SW/ML) SILT and SAND, trace gravel; brown; non-cohesive, moist, loose		1.52	3	DO	6				
2		trace organics at 2.2 to 2.3 mbgs									10 Slot PVC Screen
					4A	DO	7				
				257.96							
		(SM) SILTY SAND; brown; non-cohesive, wet, loose to dense		2.64	4B						
3					5	DO	9				July 14, 2016
4					6	DO	15				
5					7	DO	19			MH	
6					8	DO	30				
7											
		increasing fines content with depth									
8					9	DO	39				
9				251.46							
		(SM) SILT and SAND; grey; non-cohesive, wet, compact to dense		9.14	10	DO	38			M	
10		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

LOGGED: SP

CHECKED: NL

Golder Associates

GTA-BHS 001 S:\CLIENTS\HATCH_MOTT_MACDONALD\BARRIE\02_DATA\GINT\1525357-BG-0001.GPJ GAL-MIS.GDT 9-7-16 STB

PROJECT: 1525357-BG-0001

LOCATION: See Figure 1

RECORD OF BOREHOLE: BH16-09

BORING DATE: June 14, 2016

SHEET 2 OF 2

DATUM: Geodetic

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

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: 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
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	Track Mount Power Auger 8" Hollow Stem Auger	(SM) SILT and SAND; grey; non-cohesive, wet, compact to dense									
11				249.32	11	DO	29		W		
		End of Borehole		11.28							
12		NOTE: 1. Groundwater level measured at a depth of 2.8 m in open borehole upon completion of drilling June 14, 2016. 2. Groundwater level measured at a depth of 3.1 m on July 14, 2016.									
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SP

CHECKED: NL

GTA-BHS 001 S:\CLIENTS\HATCH_MOTT_MACDONALD\BARRIE\02_DATA\GINT\1525357-BG-0001.GPJ GAL-MIS.GDT 9-7-16 STB

PROJECT: 1525357-BG-0001

LOCATION: See Figure 1

RECORD OF BOREHOLE: BH16-10

BORING DATE: June 14, 2016

SHEET 1 OF 2

DATUM: Geodetic

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

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 WI) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		260.00							
0	Track Mount Power Auger 8" Hollow Stem Auger	ASPHALT		0.00	1	DO					
				259.35							
		FILL-(SW/GW) SAND and GRAVEL; brown; non-cohesive, moist, very dense to loose		0.65							
1					2	DO	56		○	Metals	
		topsoil mixed from 1.5 to 2.2 mbgs									
					3	DO	12		○		
2											
					4	DO	6		○		
3				256.95							
		FILL-(ML) CLAYEY SILT and SAND, trace gravel; brown; cohesive, w>PL, firm		3.05	5	DO	5		○		
				256.19							
4		(SM) SILTY SAND, trace to some gravel, some clay; brown to grey, (TILL); non-cohesive, moist to wet, compact to very dense		3.81	6	DO	10		○		
					7	DO	11		○	MH	
5											
6					8	DO	27		○		
7											
					9	DO	84/ 292 mm		○		
8											
9				250.86							
		(SM) SILTY SAND; grey; non-cohesive, wet, very dense		9.14	10	DO	60		○		
10		*CONTINUED NEXT PAGE*									

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SP

CHECKED: NL

GTA-BHS 001 S:\CLIENTS\HATCH_MOTT_MACDONALD\BARRIE\02_DATA\GINT\1525357-BG-0001.GPJ GAL-MIS.GDT 9-7-16 STB

PROJECT: 1525357-BG-0001

LOCATION: See Figure 1

RECORD OF BOREHOLE: BH16-10

BORING DATE: June 14, 2016

SHEET 2 OF 2

DATUM: Geodetic

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

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: 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
		--- CONTINUED FROM PREVIOUS PAGE ---									
10	Track Mount Power Auger 8" Hollow Stem Auger	(SM) SILTY SAND; grey; non-cohesive, wet, very dense									
11				248.72	11	DO	49				
		End of Borehole		11.28							
12		NOTE: 1. Groundwater level measured at a depth of 4.8 m in open borehole upon completion of drilling June 14, 2016.									
13											
14											
15											
16											
17											
18											
19											
20											

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: SP

CHECKED: NL

GTA-BHS 001 S:\CLIENTS\HATCH_MOTT_MACDONALD\BARRIE\02_DATA\GINT\1525357-BG-0001.GPJ GAL-MIS.GDT 9-7-16 STB

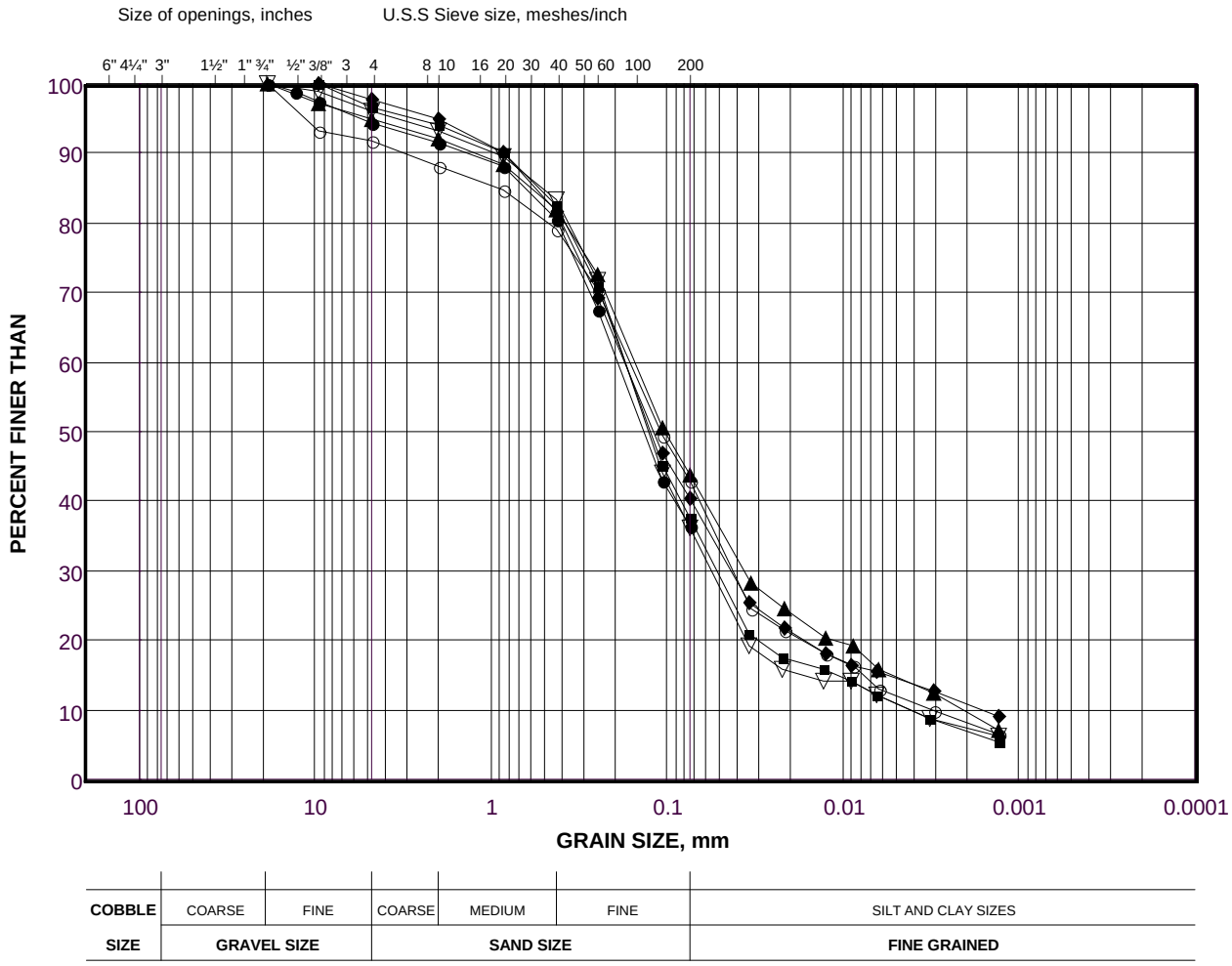
APPENDIX B

Laboratory Test Results

GRAIN SIZE DISTRIBUTION

SILTY SAND TILL

FIGURE B1



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	BH16-7	4	2.29 - 2.90
■	BH16-2	6	3.81 - 4.42
◆	BH16-1	6	3.81 - 4.42
▲	BH16-10	7	4.57 - 5.18
▽	BH16-8	7	4.57 - 5.18
❍	BH16-4	8	6.10 - 6.71

Project Number: 1525357

Checked By: _____

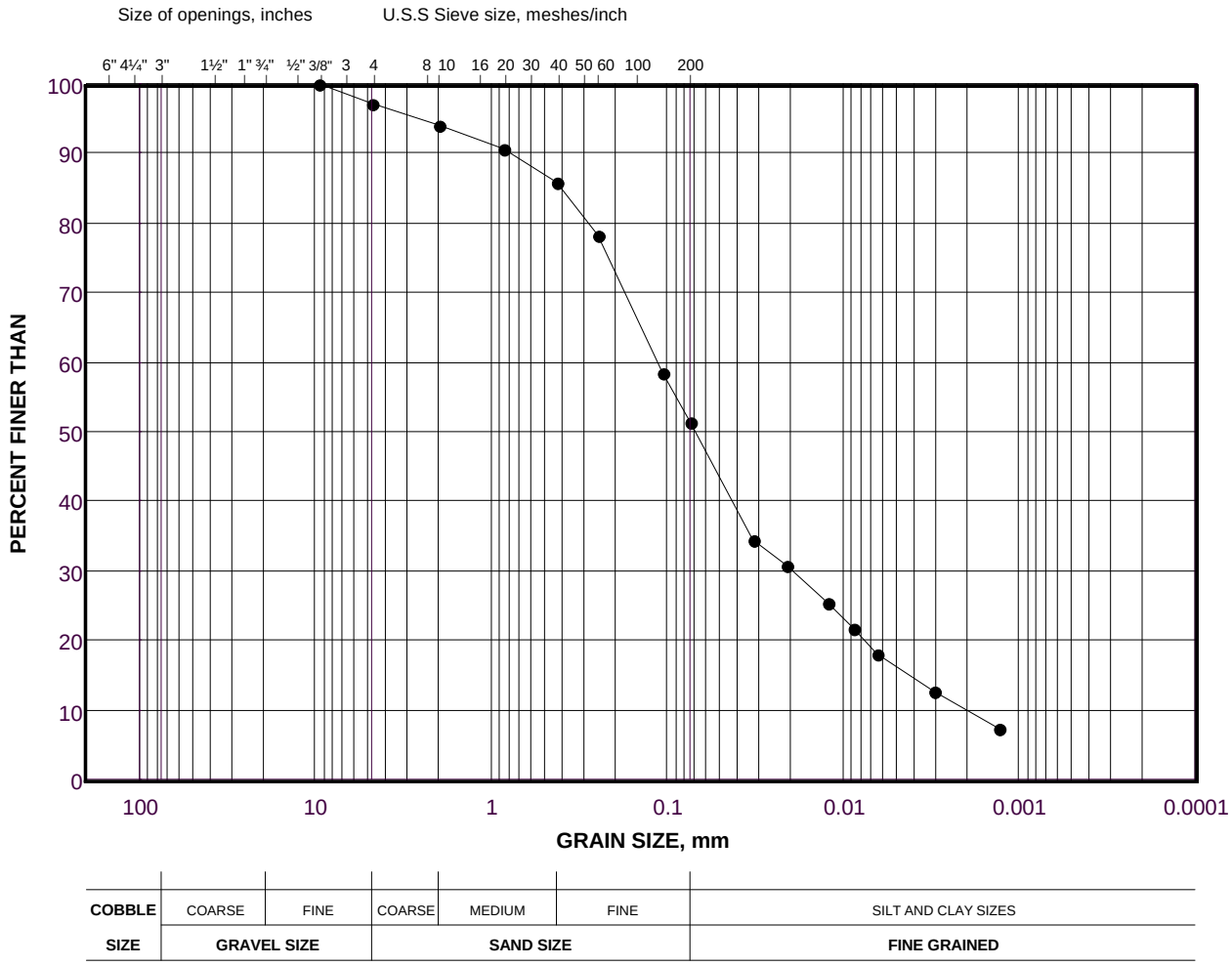
Golder Associates

Date: 11-Aug-16

GRAIN SIZE DISTRIBUTION

SAND and SILT TILL

FIGURE B2



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	BH16-6	6	4.57 - 5.18

Project Number: 1525357

Checked By: _____

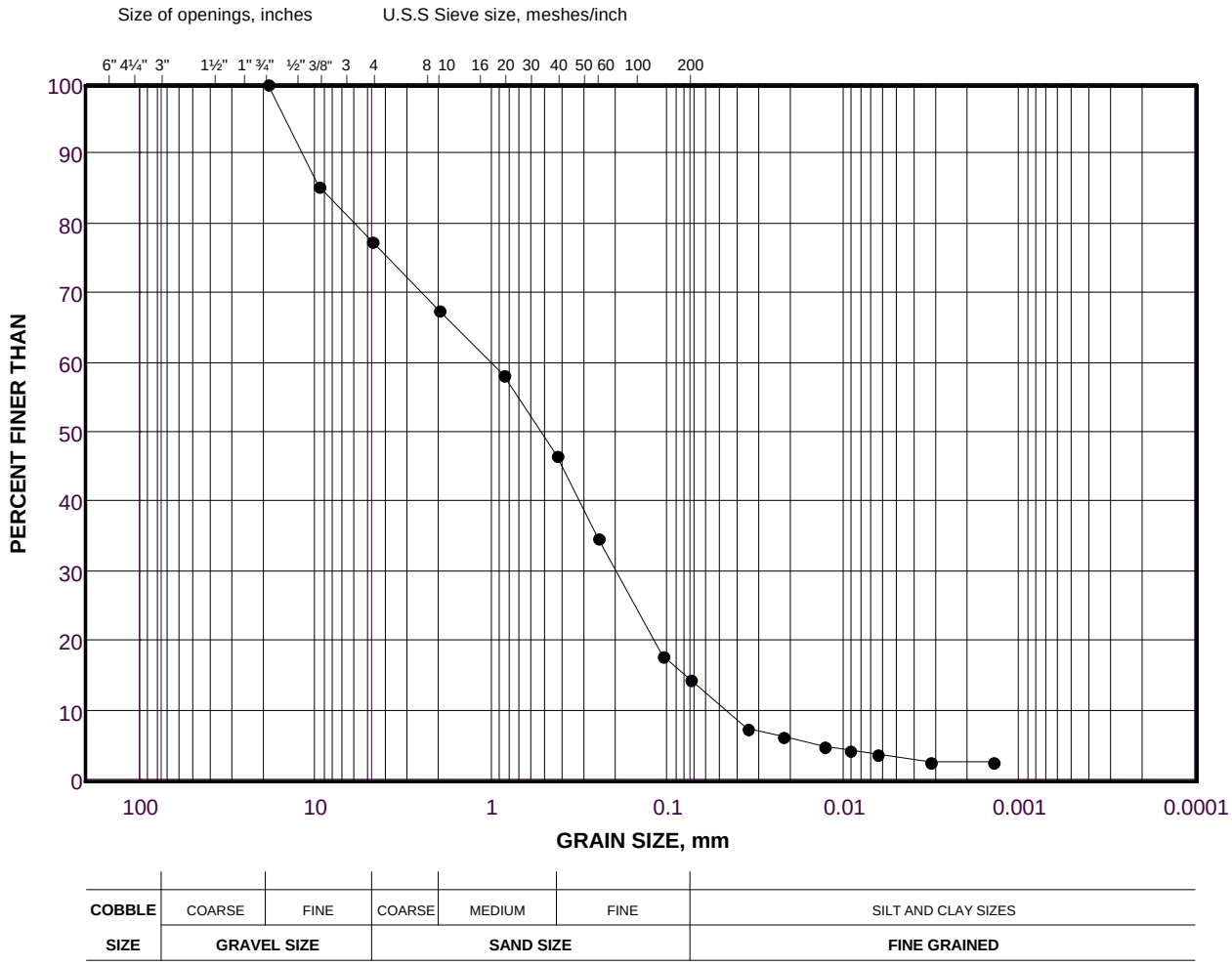
Golder Associates

Date: 11-Aug-16

GRAIN SIZE DISTRIBUTION

GRAVELLY SILTY SAND TILL

FIGURE B3



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	BH16-3	8	6.10 - 6.71

Project Number: 1525357

Checked By: _____

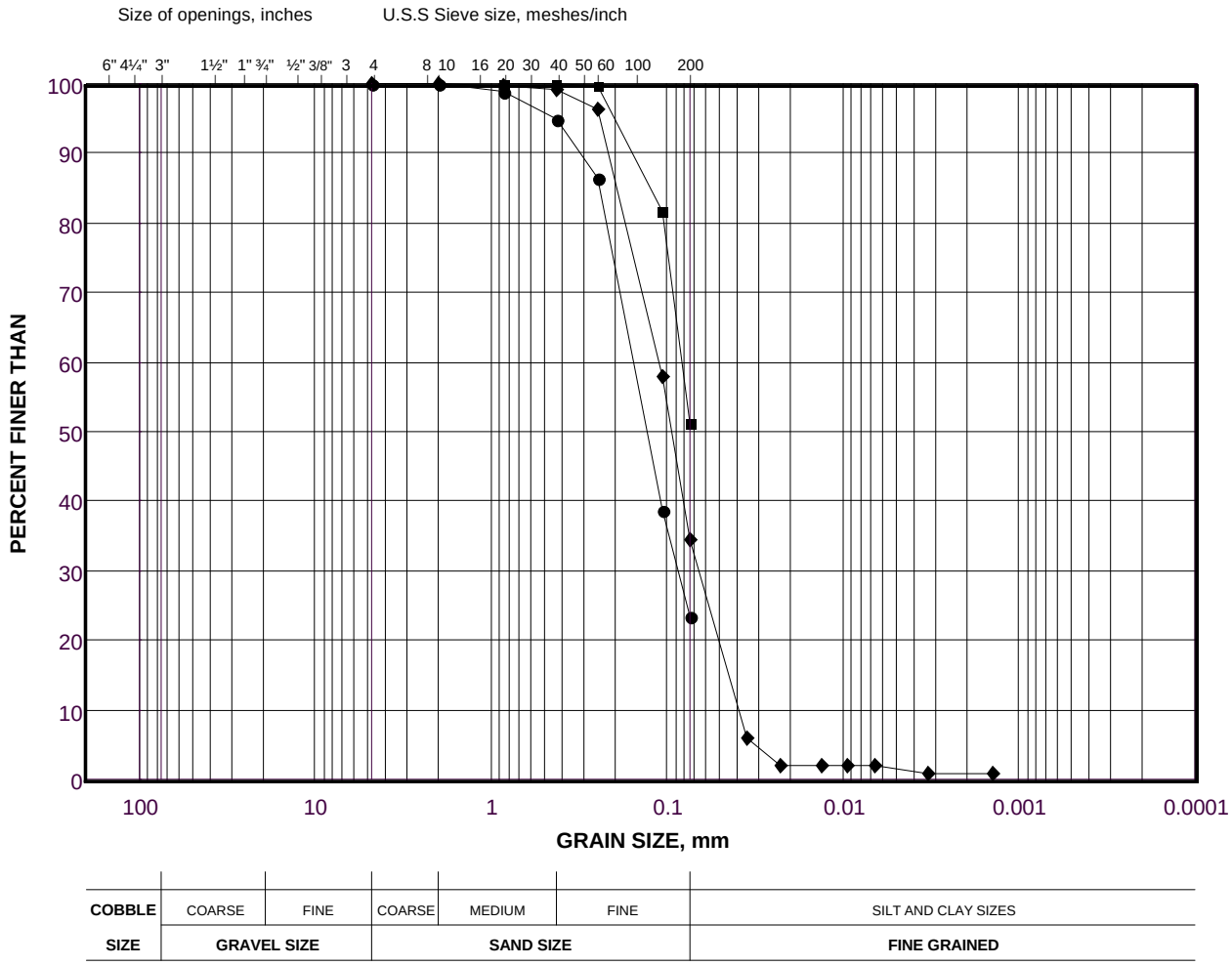
Golder Associates

Date: 29-Aug-16

GRAIN SIZE DISTRIBUTION

SILTY SAND to SILT and SAND

FIGURE B4



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	BH16-5	10	9.14 - 9.75
■	BH16-9	10	9.14 - 9.75
◆	BH16-9	7	4.57 - 5.18

Project Number: 1525357

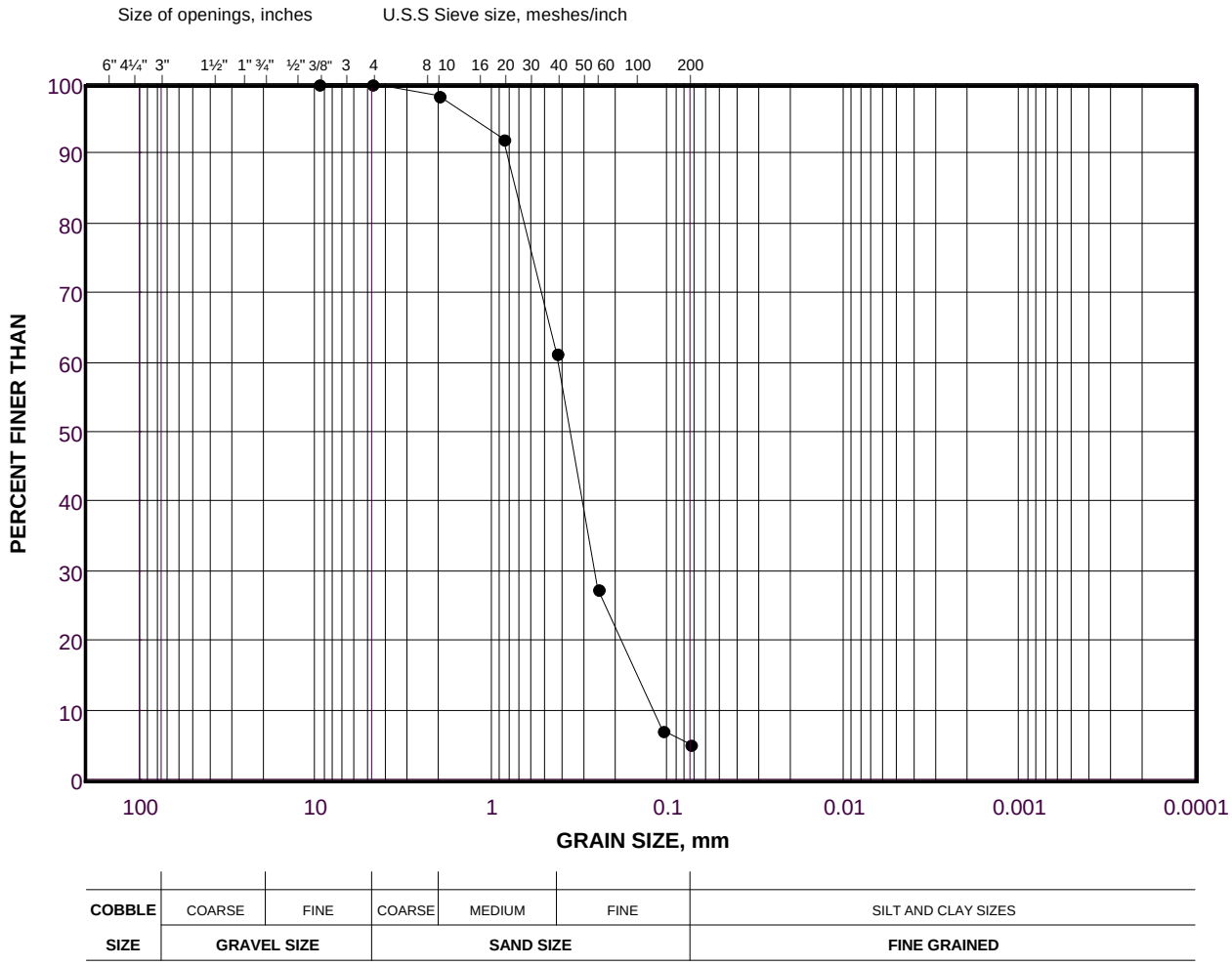
Checked By: _____

Golder Associates

Date: 11-Aug-16

GRAIN SIZE DISTRIBUTION
SAND

FIGURE B5



LEGEND

SYMBOL	BOREHOLE	SAMPLE	DEPTH(m)
●	BH16-5	7	4.57 - 5.18

Project Number: 1525357

Checked By: _____

Golder Associates

Date: 11-Aug-16

APPENDIX C

Analytical Laboratory Results

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: GOLDER ASSOCIATES LTD.
121 COMMERCE PARK DRIVE, UNIT L
BARRIE, ON L4N8X1
(705) 722-4492

ATTENTION TO: Nick LaPosta

PROJECT: Mapleview and Lockhart

AGAT WORK ORDER: 16T113658

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Coordinator

DATE REPORTED: Jul 19, 2016

PAGES (INCLUDING COVER): 6

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories
5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 16T113658

PROJECT: Mapleview and Lockhart

CLIENT NAME: GOLDER ASSOCIATES LTD.

ATTENTION TO: Nick LaPosta

SAMPLING SITE:

SAMPLED BY:

O. Reg. 153(511) - Metals & Inorganics (Soil)

DATE RECEIVED: 2016-07-08

DATE REPORTED: 2016-07-19

		SAMPLE DESCRIPTION:		BH16-1 SA3	BH16-2 SA2	BH16-3 SA2	BH16-4 SA3	BH16-5 SA3	BH16-6 SA2	BH16-8 SA3	BH16-10 SA2
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		6/9/2016	6/13/2016	6/13/2016	6/10/2016	6/9/2016	6/9/2016	6/9/2016	6/14/2016
Parameter	Unit	G / S	RDL	7690894	7690897	7690898	7690899	7690900	7690901	7690902	7690903
Antimony	µg/g	1.3	0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8
Arsenic	µg/g	18	1	1	<1	<1	1	<1	<1	1	<1
Barium	µg/g	220	2	37	26	38	40	26	27	43	21
Beryllium	µg/g	2.5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Boron	µg/g	36	5	<5	<5	<5	<5	<5	<5	<5	<5
Boron (Hot Water Soluble)	µg/g	NA	0.10	0.59	0.15	<0.10	0.16	<0.10	<0.10	<0.10	<0.10
Cadmium	µg/g	1.2	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	µg/g	70	2	10	9	10	12	10	8	11	8
Cobalt	µg/g	21	0.5	2.3	2.6	3.3	4.1	2.9	2.9	4.0	2.4
Copper	µg/g	92	1	4	5	7	7	6	5	7	7
Lead	µg/g	120	1	5	5	4	5	7	3	3	3
Molybdenum	µg/g	2	0.5	<0.5	<0.5	<0.5	0.8	<0.5	<0.5	<0.5	0.5
Nickel	µg/g	82	1	4	5	6	7	6	5	7	4
Selenium	µg/g	1.5	0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Silver	µg/g	0.5	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium	µg/g	1	0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Uranium	µg/g	2.5	0.5	<0.5	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5
Vanadium	µg/g	86	1	17	18	19	21	21	19	20	15
Zinc	µg/g	290	5	23	17	18	27	18	16	20	16
Chromium VI	µg/g	0.66	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cyanide	µg/g	0.051	0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040
Mercury	µg/g	0.27	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Electrical Conductivity	mS/cm	0.57	0.005	4.11	0.282	0.629	1.04	0.539	1.33	2.85	0.388
Sodium Adsorption Ratio	NA	2.4	NA	24.1	3.61	6.39	19.1	7.14	22.0	35.0	7.86
pH, 2:1 CaCl2 Extraction	pH Units		NA	6.92	7.63	7.73	7.78	7.79	7.99	7.90	7.98

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Table 1: Full Depth Background Site Condition Standards - Soil - Residential/Parkland/Institutional/Industrial/Commercial/Community Property Use

7690894-7690903 EC & SAR were determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio. Please note that samples were received and analyzed past hold time for Cyanide analysis.

Certified By: Amanjot Bhela

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Guideline Violation

AGAT WORK ORDER: 16T113658

PROJECT: Mapleview and Lockhart

CLIENT NAME: GOLDER ASSOCIATES LTD.

ATTENTION TO: Nick LaPosta

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	GUIDEVALUE	RESULT
7690894	BH16-1 SA3	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	0.57	4.11
7690894	BH16-1 SA3	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	24.1
7690897	BH16-2 SA2	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	3.61
7690898	BH16-3 SA2	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	0.57	0.629
7690898	BH16-3 SA2	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	6.39
7690899	BH16-4 SA3	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	0.57	1.04
7690899	BH16-4 SA3	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	19.1
7690900	BH16-5 SA3	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	7.14
7690901	BH16-6 SA2	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	0.57	1.33
7690901	BH16-6 SA2	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	22.0
7690902	BH16-8 SA3	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	0.57	2.85
7690902	BH16-8 SA3	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	35.0
7690903	BH16-10 SA2	ON T1 S RPI/ICC	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	7.86

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: GOLDER ASSOCIATES LTD.

AGAT WORK ORDER: 16T113658

PROJECT: Mapleview and Lockhart

ATTENTION TO: Nick LaPosta

SAMPLING SITE:

SAMPLED BY:

Soil Analysis

RPT Date: Jul 19, 2016			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
O. Reg. 153(511) - Metals & Inorganics (Soil)															
Antimony	7690894	7690894	<0.8	<0.8	NA	< 0.8	118%	70%	130%	101%	80%	120%	104%	70%	130%
Arsenic	7690894	7690894	1	1	NA	< 1	101%	70%	130%	96%	80%	120%	91%	70%	130%
Barium	7690894	7690894	37	35	5.6%	< 2	97%	70%	130%	94%	80%	120%	97%	70%	130%
Beryllium	7690894	7690894	<0.5	<0.5	NA	< 0.5	114%	70%	130%	114%	80%	120%	101%	70%	130%
Boron	7690894	7690894	<5	<5	NA	< 5	75%	70%	130%	105%	80%	120%	86%	70%	130%
Boron (Hot Water Soluble)	7690894	7690894	0.59	0.63	6.6%	< 0.10	98%	60%	140%	100%	70%	130%	103%	60%	140%
Cadmium	7690894	7690894	<0.5	<0.5	NA	< 0.5	98%	70%	130%	102%	80%	120%	113%	70%	130%
Chromium	7690894	7690894	10	11	9.5%	< 2	94%	70%	130%	114%	80%	120%	101%	70%	130%
Cobalt	7690894	7690894	2.3	2.5	NA	< 0.5	100%	70%	130%	109%	80%	120%	96%	70%	130%
Copper	7690894	7690894	4	4	NA	< 1	98%	70%	130%	110%	80%	120%	91%	70%	130%
Lead	7690894	7690894	5	5	0.0%	< 1	98%	70%	130%	105%	80%	120%	108%	70%	130%
Molybdenum	7690894	7690894	<0.5	<0.5	NA	< 0.5	105%	70%	130%	100%	80%	120%	106%	70%	130%
Nickel	7690894	7690894	4	4	NA	< 1	95%	70%	130%	101%	80%	120%	92%	70%	130%
Selenium	7690894	7690894	<0.4	<0.4	NA	< 0.4	99%	70%	130%	98%	80%	120%	99%	70%	130%
Silver	7690894	7690894	<0.2	<0.2	NA	< 0.2	98%	70%	130%	110%	80%	120%	103%	70%	130%
Thallium	7690894	7690894	<0.4	<0.4	NA	< 0.4	112%	70%	130%	94%	80%	120%	90%	70%	130%
Uranium	7690894	7690894	<0.5	<0.5	NA	< 0.5	107%	70%	130%	106%	80%	120%	111%	70%	130%
Vanadium	7690894	7690894	17	17	0.0%	< 1	91%	70%	130%	106%	80%	120%	89%	70%	130%
Zinc	7690894	7690894	23	23	NA	< 5	103%	70%	130%	108%	80%	120%	102%	70%	130%
Chromium VI	7691550		<0.2	<0.2	NA	< 0.2	92%	70%	130%	90%	80%	120%	90%	70%	130%
Cyanide	7688523		<0.040	<0.040	NA	< 0.040	107%	70%	130%	103%	80%	120%	92%	70%	130%
Mercury	7690894	7690894	<0.10	<0.10	NA	< 0.10	106%	70%	130%	93%	80%	120%	93%	70%	130%
Electrical Conductivity	7690894	7690894	4.11	4.11	0.0%	< 0.005	99%	90%	110%	NA			NA		
Sodium Adsorption Ratio	7690894	7690894	24.1	24.8	2.9%	NA	NA			NA			NA		
pH, 2:1 CaCl2 Extraction	7690898	7690898	7.73	7.72	0.1%	NA	100%	80%	120%	NA			NA		

Comments: NA signifies Not Applicable.
Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By: Amanjot Bhela

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: GOLDER ASSOCIATES LTD.

AGAT WORK ORDER: 16T113658

PROJECT: Mapleview and Lockhart

ATTENTION TO: Nick LaPosta

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Antimony	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Arsenic	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Barium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Beryllium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Boron (Hot Water Soluble)	MET-93-6104	EPA SW 846 6010C; MSA, Part 3, Ch.21	ICP/OES
Cadmium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Cobalt	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Copper	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Lead	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Molybdenum	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Nickel	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Selenium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Silver	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Thallium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Uranium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Vanadium	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Zinc	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Chromium VI	INOR-93-6029	SM 3500 B; MSA Part 3, Ch. 25	SPECTROPHOTOMETER
Cyanide	INOR-93-6052	MOE CN-3015 & E 3009 A;SM 4500 CN	TECHNICON AUTO ANALYZER
Mercury	MET-93-6103	EPA SW-846 3050B & 6020A	ICP-MS
Electrical Conductivity	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Sodium Adsorption Ratio	INOR-93-6007	McKeague 4.12 & 3.26 & EPA SW-846 6010B	ICP/OES
pH, 2:1 CaCl2 Extraction	INOR-93-6031	MSA part 3 & SM 4500-H+ B	PH METER

AGAT Laboratories
5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
www.agatlabs.com webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water intended for human consumption)

Laboratory Use Only

Work Order #: 16T 113658

Cooler Quantity: 2 Bags

Arrival Temperatures: 3.8 | 3.5 | 3.7
3.2 | 3 | 2.9

Custody Seal Intact: ☐ Yes ☐ No ☐ N/A

Notes:

Report Information:

Company: Golder Associates Ltd
Contact: Nick LaPosta
Address: 121 Commerce Park Drive Unit L
Barrie ON L4N 8X1
Phone: (705) 722 4492 Fax: 705 722 3786
Reports to be sent to:
1. Email: nlaposta@golder.com
2. Email:

Regulatory Requirements:

☐ No Regulatory Requirement
(Please check all applicable boxes)

☒ Regulation 153/04 Table 1 *Indicate One*
☐ Ind/Com
☐ Res/Park
☐ Agriculture

Soil Texture *(Check One)*
☒ Coarse
☐ Fine

☐ Sewer Use
☐ Sanitary
☐ Storm

Region _____ *Indicate One*

☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☐ Other _____ *Indicate One*

Is this submission for a **Record of Site Condition?** ☐ Yes ☒ No

Report Guideline on *Certificate of Analysis* ☐ Yes ☐ No

Turnaround Time (TAT) Required:

Regular TAT ☒ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ 1 Business Day

OR Date Required (Rush Surcharges May Apply): _____

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

Project Information:

Project: Maplaview and Lockhart
Site Location:
Sampled By: Scott Patrick
AGAT Quote #: _____ PO: _____
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:

Bill To Same: Yes ☒ No ☐

Company:
Contact:
Address:
Email:

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Metals and Inorganics	Metal Scan	Hydride Forming Metals	Client Custom Metals	ORPs: ☐ B-HWS ☐ Cl⁻ ☐ CN⁻ ☐ Cr^{6+} ☐ EC ☐ FOC ☐ NO_3/NO_2 ☐ Total N ☐ Hg ☐ pH ☐ SAR	Nutrients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3/NO_2	Volatiles: ☐ VOC ☐ BTEX ☐ THM	CCME Fractions 1 to 4	ABNs	PAHs	Chlorophenols	PCBs	Organochlorine Pesticides	TCLP Metals/Inorganics	Sewer Use
BH 16-1 SA 3	June 9		1	Soil		X													
BH 16-2 SA 2	June 13		1																
BH 16-3 SA 2	June 13		1																
BH 16-4 SA 3	June 10		1																
BH 16-5 SA 3	June 9		1																
BH 16-6 SA 2	June 9		1																
BH 16-8 SA 3	June 9		1																
BH 16-10 SA 2	June 14		1																

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
				2016/7/8	9:05
	2016/7/8	10:57			

Page _____ of _____

N°: T 007606

Pink Copy - Client | Yellow Copy - AGAT | White Copy- AGAT

Document ID: DIV 78-1001.006 Date Issued: Jan 8, 2015

As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

For more information, visit golder.com

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 44 1628 851851
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates Ltd.
121 Commerce Park Drive, Unit L
Barrie, Ontario, L4N 8X1
Canada
T: +1 (705) 722 4492

Golder Associates