Terraprobe

Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

GEOTECHNICAL INVESTIGATION
MCLAUGHLIN ROAD CLASS ENVIRONMENTAL ASSESSMENT (EA) STUDY
BRITANNIA ROAD WEST TO BRISTOL ROAD WEST
CITY OF MISSISSAUGA, ONTARIO

Prepared for:	IBI Group 30 International Road Toronto, Ontario M9W 5P3
Attention:	Mr. Allan Ortlieb Associate

File No. 11-12-2098
September 8, 2015

Distribution:

1 Copy	-	IBI Group
2 Copies	-	City of Mississauga
1 Copy	-	Terraprobe Inc., Brampton

Terraprobe Inc.

Greater Toronto
11 Indell Lane
Brampton, Ontario L6T 3Y3
(905) 796-2650 Fax: 796-2250
brampton@terraprobe.ca

Hamilton – Niagara
903 Barton Street, Unit 22
Stoney Creek, Ontario L8E 5P5
(905) 643-7560 Fax: 643-7559
stoneycreek@terraprobe.ca

Central Ontario
220 Bayview Drive, Unit 25
Barrie, Ontario L4N 4Y8
(705) 739-8355 Fax: 739-8369
barrie@terraprobe.ca

Northern Ontario
1012 Kelly Lake Rd., Unit 1
Sudbury, Ontario P3E 5P4
(705) 670-0460 Fax: 670-0558
sudbury@terraprobe.ca

www.terraprobe.ca

TABLE OF CONTENTS

REFERENCES

LIST OF FIGURES

Figure 1	Site Location Plan
Figures 2, 3 and 4	Site Photographs
Figures 5, 6, 7 and 8	Borehole Location Plan

APPENDIX A Borehole Logs

Abbreviations and Terminology
Borehole Logs BH 1 to BH 30
Core Logs BH 3, BH 5, BH 8, BH 12, BH 15, BH 17, BH 25 and BH 27

APPENDIX B Laboratory Test Results

Figure B1	Grain Size Distribution – Granular Base/Subbase
Figure B2	Grain Size Distribution – Clayey Silt to Silty Clay Till
Figure B3	Plasticity Chart – Clayey Silty to Silty Clay Till
Figure B4	Grain Size Distribution – Silty Sand to Sandy Silt Till
Figure B5	Plasticity Chart – Silty Sand to Sandy Silt Till

APPENDIX C Certificates of Chemical Analysis (Soil Chemistry)

APPENDIX D Pavement Condition Survey

APPENDIX E Pavement Design Data

Table E1	Equivalent Single Axle Load Calculations – Britannia Road West to Bristol Road West
Table E2	Equivalent Single Axle Load Calculations – Britannia Road West to Matheson Blvd.

1.0 INTRODUCTION

Terraprobe Inc. (Terraprobe) has been retained by IBI Group (IBI) to provide geotechnical engineering services in support of preliminary designs for the Class EA Study for McLaughlin Road extending from Britannia Road West to Bristol Road West, in the City of Mississauga, Ontario.

The scope of work for the geotechnical engineering services of this project are outlined in Terraprobe's proposal titled *"Class EA Study, McLaughlin Road, City of Mississauga"* dated April 23, 2012.

This report addresses the preliminary geotechnical investigation carried out for this project. The purpose of this investigation was to explore the subsurface conditions within the project limits by borehole drilling and pavement coring, in-situ testing and laboratory testing on soil samples. The data obtained from this investigation was used to provide Borehole Location drawings, Borehole Logs, laboratory test results, a description of the subsurface conditions and preliminary geotechnical design recommendations.

2.0 SITE AND PROJECT DESCRIPTION

The McLaughlin Road site extends northerly from Britannia Road West to Bristol Road West, in the City of Mississauga, Ontario. Refer to Figure 1 for the Site Location Plan and Figures 2, 3 and 4 for site photographs. The roadway is a north-south oriented urban roadway, consisting of two through lanes in each direction with a centre turning lane provided between Britannia Road West and Ceremonial Drive. There are mainly residential and commercial properties within the project limits and a wood lot is located on the east side of McLaughlin Road between Bristol Road and Matheson Boulevard.

3.0 INVESTIGATION PROCEDURES

The field work for this study was carried out during the period November 28 to December 04, 2012, and consisted of drilling and sampling thirty boreholes to depths ranging from 2.0 m to 8.1 m below ground surface. In addition, eight asphaltic concrete cores were extracted from McLaughlin Road with a 150 mm diameter diamond core barrel. The boreholes and core-holes were numbered as BH1 to BH30 and their approximate locations are shown on Figures 5, 6, 7 and 8.

The borehole locations were staked in the field by a member of Terraprobe's technical staff by referring to existing features shown on the base plan provided by IBI. The ground surface elevations of the boreholes were interpolated from the contour drawings provided on the base plan.

The boreholes were drilled using conventional truck mounted drill rigs supplied and operated by DBW Drilling Ltd. of Ajax, Ontario. The borings were extended through the overburden soils using solid stem augering techniques and soil samples were obtained at regular intervals of depth using a 50 mm outer diameter (O.D.) split-spoon sampler in conjunction with the Standard Penetration Test (SPT) procedures as specified in ASTM Method D1586[1].

Ground water conditions were observed in the open boreholes during and immediately following the drilling operations. To permit longer term ground water level monitoring, two selected boreholes were instrumented with a standpipe piezometer consisting of 50 mm diameter Schedule 40 Polyvinyl Chloride (PVC) pipe with a slotted screen enclosed in sand. The piezometer installation details and water level readings are described on the Borehole Logs in Appendix A.

---

[1] ASTM D1586 – Standard Test Method for Standard Penetration Tests and Split Barrel Sampling of Soils.

Members of Terraprobe's technical staff observed and recorded the drilling and sampling operations on a full-time basis. The soil samples were visually inspected in the field, placed in labelled plastic containers and transported to Terraprobe's Brampton laboratory for further visual examination and laboratory testing.

Select soil samples were subjected to a laboratory testing program consisting of natural water content, grain size distribution and Atterberg limits in accordance with MTO and/or ASTM Standards as appropriate. The results of the soil testing program are presented on the Borehole Logs in Appendix A and on the figures included in Appendix B.

Soil samples were also submitted to AGAT Laboratories for soil chemical testing to assess soil disposal options for excess soils generated during construction. The results of the soil chemical tests are provided in Appendix C.

A visual pavement condition assessment was also carried out on March 14, 2013 in accordance with MTO's manual *Flexible Pavement Condition Rating Guidelines for Municipalities, SP-022*. The pavement condition evaluation form is included in Appendix D.

4.0 SUBSURFACE CONDITIONS

4.1 General

Reference is made to the Borehole Logs and Core Logs in Appendix A. Details of the encountered pavement structure and soil stratigraphy are presented in this appendix. An overall description of the pavement structure and soil stratigraphy is given in the following paragraphs however; the factual data presented in the Borehole Logs and Core Logs governs any interpretation of the site conditions.

The stratigraphic boundaries shown on the Borehole Logs are inferred from non-continuous sampling as well as observations during drilling and, therefore, represent transitions between soil types rather than exact planes of geological change. The subsurface conditions will vary between and beyond the borehole locations.

4.2 Pavement Structure

The pavement structure of McLaughlin Road, Matheson Boulevard West and Bristol Road West are summarized below.

Pavement Component	**Average Pavement Thickness (mm)**		
	McLaughlin Road	**Matheson Blvd. West**	**Bristol Road West**
Asphaltic Concrete	160	170	165
Base/ Subbase Course	620	570	545
Total Average Pavement Thickness	780	740	710

Standard Penetration Tests carried out in the granular base/subbase courses of the pavement measured SPT "N"-values that range from 20 to 98 blows per 0.3 m of penetration. Based on these results the relative density of the granular base/subbase is described as compact to very dense. The moisture content of samples of the granular base/subbase ranges from 1% to 6% by weight.

Grain size distribution tests were carried out on two granular base/subbase samples and the grain size distribution curves are referenced to the grain size distribution curves of the Ontario Provincial Standards (OPSS) Granular A and Granular B Type I specifications. The results are illustrated in Figure B1 in Appendix B.

4.3 Topsoil

Surficial topsoil layers were encountered at three borehole locations (BH7, BH14 and BH24). The topsoil thickness varied between 125 mm and 180 mm. Topsoil thickness may vary between and beyond the boreholes.

4.4 Fills

Fill soils were encountered within the project limits. The fill material is variable in composition and generally consists of cohesive clayey silt to silty clay soils and non-cohesive gravelly sand and sandy silt to silty sand.

The clayey silt to silty clay fill soils extend to depths ranging from 1.1 m to at least 2.0 m below ground surface. The Standard Penetration Test “N”-values measured in the clayey silt to silty clay fill ranges from 5 to 16 blows per 0.3 m of penetration, suggesting that this fill has a firm to very stiff consistency. The moisture content of the clayey silt to silty clay fill ranges from 10% to 25% by weight.

The non-cohesive gravelly sand, sandy silt and silty sand fill extend to depths ranging from 1.1 m to 4.6 m below ground surface. SPT “N”-values measured within the non-cohesive gravelly sand and sandy silt to silty sand fill ranges from 2 to 30 blows per 0.3 m of penetration. Based on these values the non-cohesive fill is described as very loose to dense. The moisture content of the non-cohesive fill ranges from 6% to 14% by weight.

4.5 Till Deposit

A major glacial till deposit was encountered throughout the site. This glacial deposit consists of broadly graded till soils with a soil matrix that ranges from cohesive clayey silt and silty clay; to non-cohesive silty sand, sandy silt and sand.

4.5.1 Clayey Silt to Silty Clay Till

The cohesive clayey silt to silty clay till deposit extends to depths ranging from 2.0 m to 4.0 m below ground surface and some of the borings were also terminated in this till deposit at depths of 2.0 m below ground surface.

The SPT “N”-values measured within this cohesive unit ranges from 4 blows per 0.3 m of penetration to 50 blows for less than 0.3 m of penetration, suggesting a firm to hard consistency.

Samples of the clayey silt to silty clay till were subjected to grain size distribution tests and the grain size distribution curves are illustrated on Figure B2 in Appendix B. The test results show a grain size distribution consisting of 4% to 15% gravel, 19% to 34% sand, 35% to 49% silt and 15% to 25% clay sized particles. While not specifically encountered in the boreholes, random cobble and boulder inclusions can also be expected to occur within the matrix of till soils at this site.

Atterberg limits tests were also carried out on samples of the clayey silt to silty clay till and the results are plotted on the plasticity chart on Figure B3 in Appendix B. The results indicate that the till matrix is a cohesive soil of low plasticity (CL). The Atterberg limits test results are summarized below.

Liquid Limit:	24% to 29 %
Plastic Limit:	16% to 17 %
Plasticity Index:	8% to 12 %
Natural Water Content:	10% to 14 %

The natural water content of samples of the clayey silt to silty clay till ranges from 9% to 25% by weight.

4.5.2 Silty Sand to Sandy Silt Till

Within the project limits non-cohesive till deposits with a soil matrix consisting of silt sand, sand and sandy silt were encountered. These till deposits were fully explored in Boreholes 4, 6 and 8 where they extend to depths ranging from 1.4 m to 1.5 m below ground surface. The remaining boreholes were terminated in these deposits at depths ranging from 2.0 m to 8.1 m below ground surface.

The SPT “N”-values measured within these non-cohesive units range from 4 blows per 0.3 m of penetration to 50 blows for less than 0.3 m of penetration, suggesting a very loose to very dense relative density.

Samples of the silty sand to sandy silt till were subjected to grain size distribution tests and the grain size distribution curves are illustrated on Figure B4 in Appendix B. The test results show a grain size distribution consisting of 0% to 6% gravel, 23% to 77% sand, 14% to 65% silt and 4% to 12% clay sized particles. While not specifically encountered in the boreholes, random cobble and boulder inclusions can also be expected to occur within the matrix of till soils at this site.

Atterberg limits tests were also carried out on a sample of the sandy silt till and the results are plotted on the plasticity chart on Figure B4 in Appendix B. The results indicate that the till matrix is a non-cohesive silt (ML). The Atterberg limits test results are summarized below.

Liquid Limit:	20 %
Plastic Limit:	17 %
Plasticity Index:	3 %
Natural Water Content:	15 %

The natural water content of samples of the silty sand to sandy silt till ranges from 1% to 27% by weight.

4.5.3 Sands and Silts

A layer of sand was encountered in Borehole 22 extending at least to a borehole termination depth of 2.0 m. The SPT “N”-value measured within this non-cohesive unit is 10 blows per 0.3 m of penetration, suggesting a loose to compact relative density. The moisture content of a sample of the sand deposit is 20% by weight.

In Borehole 24 a 0.7 m thick layer of sandy silt was encountered extending to a depth of 1.8 m below ground surface. The moisture content of a sample of the sandy silt deposit is 10% by weight.

4.6 Ground Water Observations

Ground water measurements were carried out in the open boreholes during and upon completion of the drilling operations and this information is reported on the Borehole Logs in Appendix A. No free water was encountered in the boreholes.

Boreholes 15 and 24 were also instrumented with a 50 mm diameter ground water monitoring well. Ground water level measurements in the monitoring wells taken on January 18, 2013, approximately fifty days after the monitoring well installation indicated that both wells were dry and it is inferred that the ground water levels at these two borehole locations are below the borehole termination depths.

The ground water levels can however be expected to fluctuate seasonally as well as in response to major weather events. Perched water can also be expected to occur where permeable sands and silts are underlain by relatively impermeable clayey silt and silty clay soils.

5.0 DISCUSSIONS AND RECOMMENDATIONS

5.1 General

This section of the report presents an interpretation of the factual geotechnical data and provides preliminary geotechnical design recommendations. These discussions and recommendations are based on our understanding of the project and our interpretation of the factual data obtained from the subsurface investigations. Further investigations will be required for detail design.

6.0 PAVEMENT DESIGNS

The pavement structures were designed based on the traffic data provided by IBI and the data obtained from the field investigations.

The following references and guidelines were used for the pavement designs.

- MTO's "Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions, MI-183", March 19, 2008; and
- American Association of State Highway and Transportation Officials, "AASHTO Guide for Design of Pavement Structures", 1993.

6.1 Design Parameters

The pavement designs were carried out using the AASHTO pavement design parameters tabulated below.

DESIGN PARAMETER	VALUE
Initial/Terminal Serviceability Index (New Construction) Initial/Terminal Serviceability Index (Rehabilitation)	$P_i = 4.4$ $P_t = 2.2$ $P_i = 4.2$ $P_t = 2.2$
Loss in Serviceability index	2.2 to 2.0
Desired Reliability (R %) and Standard Deviation (SD)	R = 85 SD = 0.44
Estimated Elastic Modulus of Subgrade Soil (MPa)	30 - 35
Estimated Cumulative ESALS (20 yr. Design Period)	834,000 – 1,162,000
Layer Coefficients of Hot Mix Asphalt (HMA)	New HMA = 0.42 Existing HMA = 0.28
Layer Coefficient of Granular Materials	19 mm crusher run limestone = 0.14 50 mm crusher run limestone = 0.12 Existing Granular = 0.09
Drainage Coefficient	m = 1.0 (New granular base/subbase) m = 0.09 (Existing granular material)

6.2 Pavement Thickness (New Construction)

The Equivalent Single Axle Load (ESAL) calculations are provided in Tables E1 and E2 in Appendix E. For a maximum design traffic of 1,162,000 ESAL's the required design structural number is 100 mm. For new construction i.e. pavement widening, the flexible pavement structure required to achieve this structural number is:

Hot Mix Asphalt	140 mm
19 mm Crusher Run Limestone Base	200 mm
50 mm Crusher Run Limestone Subbase	420 mm
Total Depth	760 mm
Structural Number Provided	137 mm
Granular Base Equivalency	840 mm

The structural number provided (137 mm) is much higher than the design structural number of 100 mm but the thickness of the new pavement cannot be reduced because it is necessary to match the thicknesses of the existing and new pavements to ensure reliable lateral drainage across the pavement platform.

The AASHTO pavement designs were also compared to pavements designed in accordance with the City of Mississauga Standard No. 2220.020 and Standard No. 2220.010 for an arterial road. For a frost susceptibility factor of 15 the total depth of the new pavement structure is 740 mm which is inadequate because the new and existing pavement thickness should be similar to promote lateral drainage.

6.3 Existing Pavement Rehabilitation

The structural capacity of the McLaughlin Road pavement structure was analysed using AASHTO's pavement overlay design procedure. A structural number of 100 mm is required to support the 20 year design load of 1,162,000 ESAL's and; the structural number of the existing pavement is estimated to be about 94 mm. Therefore, the existing pavement is not structurally adequate to carry the design traffic over a service life extension of 20 years.

A conventional mill and overlay strategy will strengthen the existing pavement to support the 20 year design traffic but, there is a risk of reflective cracking propagating to the surface course a few years after construction. We understood that the City of Mississauga prefers a rehabilitation strategy that involves full-depth removal of the existing asphaltic concrete to avoid reflective cracking. For this pavement rehabilitation strategy the rehabilitated pavement will have a structural number of 115 mm and the recommended construction sequence is:

- Remove the existing asphaltic concrete full depth (assume an average thickness of 160 mm);
- Regrade and recompact the existing granular material; and
- Place and compact 100 mm of HDBC hot mix asphalt binder course followed by 40 mm of HL 1 hot mix asphalt surface course. The finished pavement surface should be provided with a 2 % slope towards the sides.

7.0 RECOMMENDATIONS AND CONSTRUCTION FEATURES

7.1 Pavement Structure and Material Types

The following mix types are considered suitable for this project.

HL 1	Surface Course
HDBC	Binder Course

Crusher run limestone (19 mm) material should be used for the base course and crusher run limestone (50 mm) is recommended for the subbase course. The 19 mm and 50 mm crusher run limestone material should meet the OPSS MUNI 1010 specifications.

7.2 Padding

If required, HL3 HS mix is recommended as padding. Padding should be placed in lifts not exceeding 50 mm.

7.3 Asphalt Cement Grade

Performance graded asphalt cement PG 64-28 conforming to OPSS MUNI 1101 requirements, is recommended for the HMA binder and surface courses.

7.4 Tack Coat

A tack coat (SS1) should be applied to all construction joints prior to placing hot mix asphalt to create an adhesive bond. Prior to placing hot mix asphalt SS1 tack coat must also be applied to all existing or milled surfaces and between all new lifts.

7.5 Pavement Tapers

At the limits of construction, appropriate tapering of the pavement thickness to match the existing pavement structure should be implemented in accordance with OPSS or applicable City of Mississauga’s practice or specifications.

At arterial road intersections an additional thickness of 150 mm of 50 mm crusher run limestone shall be added and this extra depth of granular material should extend for a minimum of 15 m from the property line of the intersecting road.

8.0 CUTS AND FILLS

No slope stability problems are anticipated for earth fills or earth cuts less than 4 m high provided that the constructed side slope geometry is 2 Horizontal:1 Vertical (2H:1V) or flatter. Where existing embankments are to be widened the new fill material should be benched into the existing slope as per current OPSD standards.

The placement of borrow material must be carefully monitored and properly compacted. Mixing materials from different sources is not recommended because of the risks associated with differential settlement, drainage problems and frost heave. Seeding/mulching should be completed as soon as possible to control erosion.

9.0 DRAINAGE

9.1 Culvert Bedding, Cover and Backfill

Bedding for minor pipe culverts should be in accordance with the OPSD 802 series. Granular A material is recommending for bedding and cover. Clean native material can also be used as cover provided it is placed below the design frost depth.

Granular frost tapers will be required when the frost line is below the top of culvert.

9.2 Ditches and Subdrains

Ditches are required to collect and remove excess surface water. In cut sections the ditch will be located adjacent to the roadway and the ditch invert must be at least 0.5 m below the top of the subgrade. For fill sections, the ditch invert should extend at least 0.25 m below the base of the fill and should be separated at least 1.5 m horizontally from the toe of the fill.

To promote drainage of the pavement structure, the base and sub-base granulars must extend across the full width of the roadway and must daylight in the ditches.

In all areas where a curb and gutter arrangement is present (urban sections), full-length subdrains placed beneath the curb in accordance with OPSD 216.020 is recommended for pavement drainage. Subdrains should consist of filter wrapped perforated plastic pipe placed in a trench excavated 300 mm by 300 mm into the subgrade. The trench should be backfilled with 19 mm clear stone. The subdrain pipe should be connected to a positive outlet.

10.0 OTHER DESIGN FEATURES

10.1 Compaction

All granular base and subbase materials should be placed in 150 mm lifts and compacted to 100% of the material's Standard Proctor Maximum Dry Density (SPMDD) at ±2% of its Optimum Moisture Content (OMC). Asphalt concrete should be placed and compacted in accordance with the appropriate OPSS or Region of Peel specifications.

10.2 Excavations

All excavations must be carried out in accordance with the Occupational Health and Safety Act (OHSA). For the purposes of the OHSA, the soils at this site may be classified as:

- Fill material – Type 3 soil.
- Clayey Silt to Silty Clay Till – Type 2 soil.
- Silty Sand to Sandy Silt Till – Type 2 soil.

10.3 Stripping

For estimating purposes assume an average topsoil thickness of 150 mm in the widening areas.

11.0 STORM SEWERS

It is understood that new storm sewers may be required and the installations will be carried out by open cut excavations.

Pipe installation should be carried out in accordance with OPSS 410 (Pipe Sewer Installation in Open Cut) and the City of Mississauga Standard Drawing 2112.080 (Standard Bedding for Concrete Pipe).

11.1 Excavation Method

The soils encountered at this site are considered to be suitable for open cut excavation using trenching and excavating equipment, such as backhoes normally used by contractors for sewer installations. Excavations should be carried out in accordance with OPSS 401 (Trenching, Backfilling and Compacting) and OPSS 402 (Excavating, Backfilling and Compacting for Maintenance Holes, Catch Basins, Ditch Inlets and Valve Chambers).

Till soils inherently contain cobbles and boulders. However, boulder frequency is unlikely to be high enough to prevent the use of suitable trenching and excavating equipment.

11.2 Pipe Bedding

The bedding for the sewer must conform to the requirements of OPSD 802.030 and 802.031 (Rigid Pipe Bedding, Earth Excavation) as appropriate. The subsurface conditions at this site are considered suitable to provide adequate pipe support and therefore Class “B” bedding will suffice. Additional bedding requirements that may be imposed by the pipe supplier or the City of Mississauga must also be followed.

Granular A material meeting OPSS MUNI 1010 (Aggregates) or, 19 mm clear stone (HL8) meeting the City’s Standard No. 2112.110 should be used as pipe bedding. Prior to placing the pipe bedding, any accumulation of water at the base of the excavation should be removed and any soft/loose soils should be sub-excavated and replaced with compacted granular fill or pipe bedding material. Placement of the pipe bedding must be carried out in the dry.

The bedding and cover material should be placed in 150 mm thick loose lifts and uniformly compacted to at least 95 % of the materials SPMDD using suitable vibratory compaction equipment.

11.3 Trench Backfill

The majority of the fill and native soils are generally considered suitable for reuse as trench backfill provided they are free of topsoil, organic material or other deleterious material and provided that these soils are approved for use by the Engineer. Trench backfill materials should be placed in maximum 300 mm loose lifts and be uniformly compacted in accordance with OPSS 501 (Construction Specification for Compacting).

Where the alignments are located below, or crosses existing roadways, it is recommended that the trench be backfilled with unshrinkable fill in accordance with the City of Mississauga standards. Elsewhere the backfill may consist of the excavated soil compacted to 98% SPMDD.

Normal post construction settlement of the compacted backfill materials equivalent to about 1% of the backfill height is expected to occur within about six months following the completion of backfill operations. Therefore, the surface course paving should be carried out after post construction settlement is complete.

11.4 Trench Clay Plugs and Cut-off Collars

Clay plugs or cutoff collars are usually installed in trenches to minimize the extent of ground water lowering due to the “French Drain” effect and to prevent lateral ground water movement in the granular bedding and backfill material.

Clay plugs should be placed in the trenches at 50 m intervals (or less) along the full length of the trench. The plug should be 1 m thick measured along the pipe, and should completely replace the granular bedding and sand backfill placed above the spring line and obvert of the sewer pipes. The clay plugs should be compacted to at least 95 % SPMDD.

Material used for the clay plugs should contain not less than 15% particles finer than 2 microns and the compacted mass should have a coefficient of permeability less than 10^{-6} cm/s.

Alternatively, cut off collars consisting of unshrinkable fill can be installed around the pipe barrel to achieve the same effect. Collars should not be placed closer than 1 m to a pipe joint and precautions should be taken to ensure that at least 95% SPMDD compaction is achieved on the soil backfill placed around the collars. Watertight connections should be made between the collar and the pipe wall.

12.0 RETAINING WALLS

An existing gabion retaining wall is located on the east side of McLaughlin Road adjacent to the wood lot area south of Ceremonial Drive (Station 10+600 to 10+700 approximately). It is envisaged that a new retaining structure will be required in this area if the roadway is widened on the east side. To provide preliminary foundation design recommendations for a new structure in this area Borehole 20 was drilled at this site.

Based on the subsurface stratigraphy encountered at this location, the recommended founding depths and geotechnical resistances for a structure foundation founded on undisturbed competent natural soils are tabulated below.

Borehole Number	**Existing Ground Surface Elevation (m)**	**Recommended Bottom of Footing Level Below Existing Ground Surface (m)**	**Founding Elevation (m)**	**Geotechnical Resistances* (kPa)**		**Subgrade Soil****
				Factored ULS	**SLS**	
BH20	178.3	Below 4.6	Below 173.5	250	175	Sand Till

* Assumes a minimum footing width of 1.0 m and a ground water table at the footing level.

** Soft weak soils if encountered at the founding subgrade must be removed and replaced with OPSS 1010 Granular “A” compacted to 95% Standard Proctor Maximum Dry Density.

The geotechnical resistance values tabulated above are for concentric, vertical loads only. Effects of load inclination and eccentricity should be taken into account as illustrated in the Canadian Highway Bridge Design Code (CHBDC) CAN/CSA-S6-06, Clauses 6.7.3 and 6.7.4. The SLS values provided correspond to a settlement of up to 25 mm assuming that the founding soils will remain undisturbed during construction.

12.1 Ultimate Coefficient of Friction

Resistance to lateral forces/sliding resistance between the concrete footing and the subgrade soils should be evaluated in accordance with the CHBDC 2006. The following ultimate coefficient of friction values are recommended between the concrete and the bedding material or subgrade soils:

- OPSS Granular “A” bedding – ultimate coefficient of friction of 0.7; and
- Sand Till – ultimate coefficient of friction of 0.6.

12.2 Design Frost Depth

Footings should be founded at a minimum depth of 1.2 m of earth cover below the lowest surrounding grade to provide adequate protection against frost penetration.

12.3 Lateral Earth pressure

Earth pressures are generally calculated using the following expression:

$P_h = K(\gamma h + q)$

where P_h = horizontal pressure on the wall (kPa)
K = earth pressure coefficient
γ = unit weight of retained soil
h = depth below top of fill where pressure is computed (m)
q = value of any surcharge (kPa)

Earth pressures acting on the structure should be computed in accordance with Clause 6.9 of the CHBDC 2006 and according to Clause 6.9.3 of the CHBDC 2006, a compaction surcharge should also be added. For soils with an angle of internal friction ranging from 30º to 35º the magnitude should be 12 kPa at the top of the fill decreasing linearly to 0 kPa at a depth of 1.7 m; or decreasing linearly to 0 kPa at a depth of 2.0 m for soils with an angle of internal friction that exceeds 35º. Compaction equipment including hand operated vibratory equipment should be in accordance with OPSS 501.

Earth pressure coefficients for backfill to the retaining walls are dependent on the material used as backfill and typical values are provided in the following table.

Wall Condition	**Earth Pressure Coefficient (K)**			
	OPSS Granular A or OPSS Granular B Type II $\phi = 35^\circ$; $\gamma = 22.8$ kN/m^3		OPSS Granular B Type I $\phi = 32^\circ$; $\gamma = 21.2$ kN/m^3	
	Horizontal Surface Behind Wall	Sloping Surface Behind Wall (2H:1V)	Horizontal Surface Behind Wall	Sloping Surface Behind Wall (2H:1V)
Active (Unrestrained Wall)	0.27	0.38	0.30	0.46
At rest (Restrained Wall)	0.43	-	0.47	-
Passive (Movement Towards Soil Mass)	3.70	-	3.30	-

The earth pressure coefficients in the table above are “ultimate” values and require certain movements for the respective conditions to be mobilized. The values to use in design can be estimated from Figure C6.16 in the Commentary to the CHBDC, 2006.

13.0 SOIL CHEMISTRY

Nine selected soil samples were submitted to AGAT Laboratories for chemical characterization with respect to general inorganic parameters including metals, pH, sodium adsorption ration (SAR) and electrical conductivity (EC) to assess options for reuse or disposal of excess soils that will be generated during construction. Based on visual and/or olfactory screening of soil samples, these nominal parameters are analysed when there are no indications of environmental impacts. However, additional sampling/testing will likely be required during construction to confirm disposal or re-use options. The Certificates of Analysis are included in Appendix C.

The analytical results were compared to Table 1 (Full Depth Background Site Condition Standards, Residential/Parkland/Institutional/Industrial/Commercial/Commmunity Property Use) of the *Ministry of Environment (MOE) Soil, Ground Water and Sediment Standards for Use under Part XV.1 of the Environmental Protection Act, April 15, 2011*. Comparison of the test results to the MOE Standard indicates that the SAR and electrical conductivity of some tested samples exceeded the guideline values. The metal concentrations are below the remediation concentrations stipulated in Table 1.

During the detail design phase, we recommend that additional sampling and chemical testing be carried out. Soil that does not meet the Ontario Regulation 153/04 Table 3 Standards will typically have to be managed as waste.

14.0 RECOMMENDED ADDITIONAL STUDIES

It is recommended that the following issues be considered during the future detailed design studies:

- Carry out detailed field investigations at the retaining wall sites for the design of these walls;
- Confirm the ground water level(s), perched or otherwise, at the retaining wall sites; and
- Confirm and further refine the preliminary geotechnical recommendations provided in this report.

15.0 LIMITATIONS AND RISK

15.1 Procedures

This preliminary investigation has been carried out using investigation techniques and engineering analysis methods consistent with those ordinarily exercised by Terraprobe and other engineering practitioners, working under similar conditions and subject to the time, financial and physical constraints applicable to this project. The discussions and recommendations that have been presented are based on the factual data obtained by Terraprobe.

It must be recognized that there are special risks whenever engineering or related disciplines are applied to identify subsurface conditions. Even a comprehensive sampling and testing programme implemented in accordance with the most stringent level of care may fail to detect certain conditions. Terraprobe has assumed for the purposes of providing design parameters and advice, that the conditions that exist between sampling points are similar to those found at the sample locations. The conditions that Terraprobe has interpreted to exist between sampling points can differ from those that actually exist.

It may not be possible to drill a sufficient number of boreholes or sample and report them in a way that would provide all the subsurface information that could affect construction costs, techniques, equipment and scheduling. Further investigations will be required to complete the detail designs.

15.2 Changes in Site and Scope

It must also be recognized that the passage of time, natural occurrences, and direct or indirect human intervention at or near the site have the potential to alter subsurface conditions. Ground water levels are particularly susceptible to seasonal fluctuations.

The discussion and recommendations are based on the factual data obtained from preliminary investigations made at the site by Terraprobe and are intended for use by the owner and its retained designers in the preliminary design phase of the project. If there are changes to the project scope and development features, the interpretations made of the subsurface information, the preliminary geotechnical design parameters and comments relating to constructability issues and quality control may not be relevant or complete for the revised project. Terraprobe should be retained to review the implications of such changes with respect to the contents of this report.

This report was prepared for the express use of IBI, the City of Mississauga and their retained design consultants and is not for use by others. This report is copyright of Terraprobe Inc. and no part of this report may be reproduced by any means, in any form, without the prior written permission of Terraprobe Inc. IBI, The City of Mississauga and their retained design consultants are authorized users.

16.0 CLOSURE

This report was prepared by Mr. Seth Zhang, M.Sc., P.Eng., a Geotechnical Engineer with Terraprobe, and reviewed by Mr. Rehman Abdul, M.S., P.Eng., a Senior Geotechnical Engineer and Associate with Terraprobe.

Terraprobe Inc.

LICENSED PROFESSIONAL ENGINEER
L. ZHANG
100108585
2015-09-08
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
R.A. ABDUL
Sept. 08, 2015.
PROVINCE OF ONTARIO

Rehman Abdul

Seth Zhang, M.Eng., M.Sc., P.Eng., PMP
Geotechnical Engineer

Rehman Abdul, M.S., P.Eng.
Associate, Senior Geotechnical Engineer

REFERENCES

REFERENCES

American Association of State Highway Officials, *AASHTO Guide for Design of Pavement Structures*, 1993.

ASTM D1586-08a, *Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils*, 2008.

Ministry of Environment Ontario. *Soil, Ground Water and Sediment Standards for Use under Part XV.1 of the Environmental Protection Act*, April 15, 2011.

Ministry of Transportation Ontario, *Flexible Pavement Condition Rating Guidelines for Municipalities*, August 1989.

Ministry of Transportation Ontario, *MI-183 Adaption and Verification of AASHTO Pavement Design Guide for Ontario Conditions*, 2008.

Ministry of Transportation Ontario. *Pavement Design and Rehabilitation Manual (SDO 90-01)*, 1990.

Ontario Regulation 213/91, *Occupational Health and Safety Act (OHSA) and Regulations for Construction Projects*, April 11, 2012.

Ontario Provincial Standard Specifications (OPSS)

OPSS 310	Construction Specification for Hot Mix Asphalt.
OPSS 341	Construction Specification for Routing and Sealing Cracks in Hot Mix Asphalt Pavement
OPSS 401	Construction Specification for Trenching, Backfilling and Compacting.
OPSS 402	Construction Specification for Excavating, Backfilling, and Compacting for Maintenance Holes, Catch Basins, Ditch Inlets and Valve Chambers.
OPSS 410	Construction Specification for Pipe Sewer Installation in Open Cut.
OPSS 501	Construction Specification for Compacting.
OPSS.MUNI 1010	Material Specification for Aggregates Base, Subbase, Select Subgrade and Backfill Material.
OPSS.MUNI 1101	Material Specification for Performance Graded Asphalt Cement.
OPSS.MUNI 1151	Material Specification for Superpave and Stone Mastic Asphalt Mixtures.

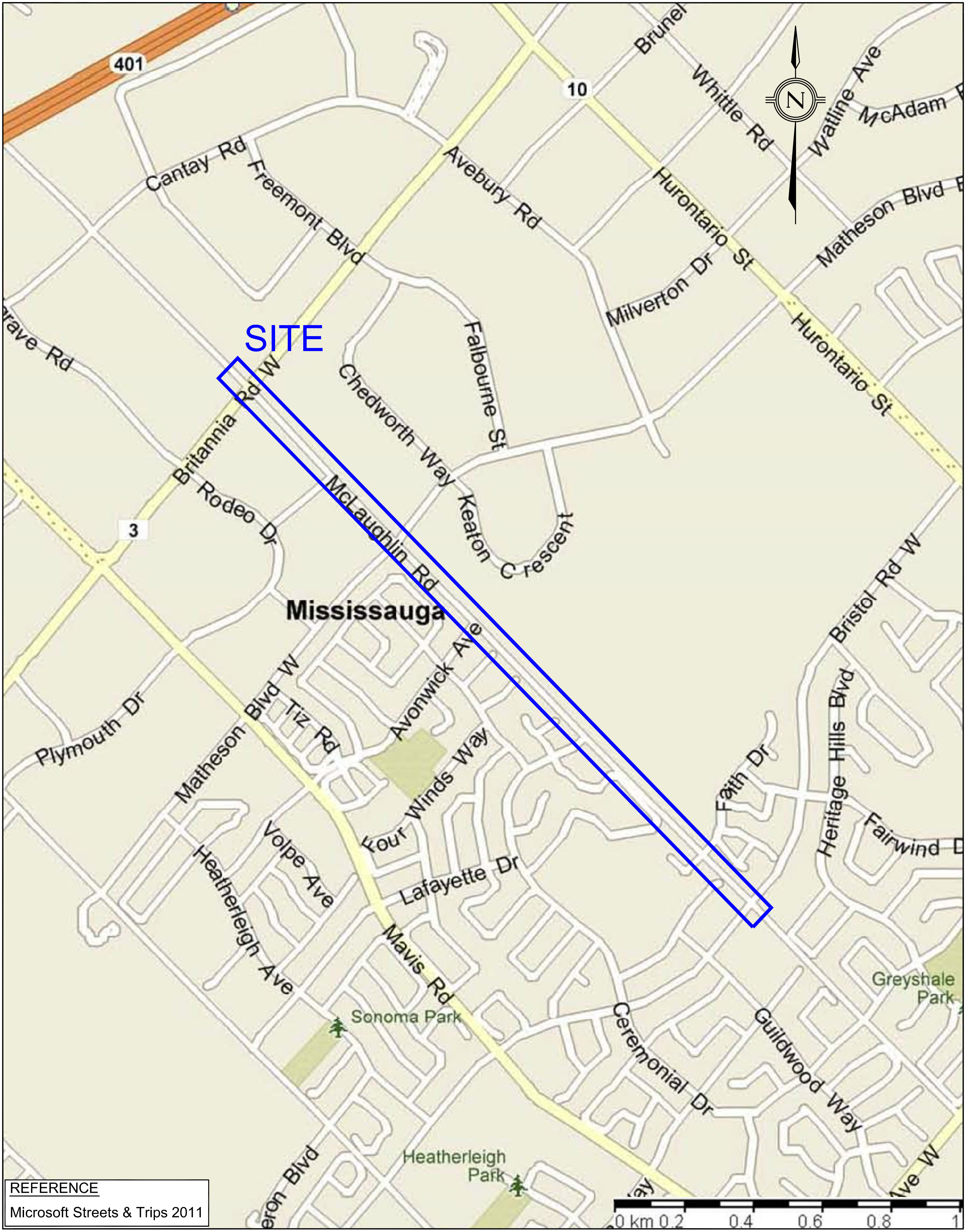
Ontario Provincial Standard Drawings (OPSD)

OPSD 216.020	Hot Mix, Concrete, and Composite Pavement on Granular Base, Urban Section.
OPSD 802.030	Rigid Pipe Bedding, Cover and Backfill, Type 1 or 2 Soil – Earth Excavation
OPSD 802.031	Rigid Pipe Bedding, Cover and Backfill, Type 3 Soil – Earth Excavation

City of Mississauga Standard Drawings

City of Mississauga	Standard Pavement and Road Base Design Requirements, Standard Drawing No. 2220.010.
City of Mississauga	Standard Frost Suitability of Soils, Standard Drawing No. 2220.020.
City of Mississauga	Standard Bedding for Concrete Pipe, Standard Drawing No. 2112.080.
City of Mississauga	Standard Sewer Bedding (19 mm Stone), Standard Drawing No. 2112.110.

FIGURES



REFERENCE

Microsoft Streets & Trips 2011

Terraprobe

11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:

McLaughlin Road, Mississauga, Ontario
(Site Location Plan)

File No.

11-12-2098

FIGURE :

1

\\PDC\Server\1-Project Files\11-Geo\2012\11-12-2001 - 2099\11-12-2098\A. Dwgs, Logs\AutoCAD\11-12-2098 Site Location Plan.dwg, Kamal

SITE PHOTOGRAPHS

PHOTOGRAPH 1. McLaughlin Road, approaching Britannia Road West, approximate Sta. 12+050, looking north.

PHOTOGRAPH 2. McLaughlin Road, approximate Sta. 11+ 800, looking north.

SITE PHOTOGRAPHS

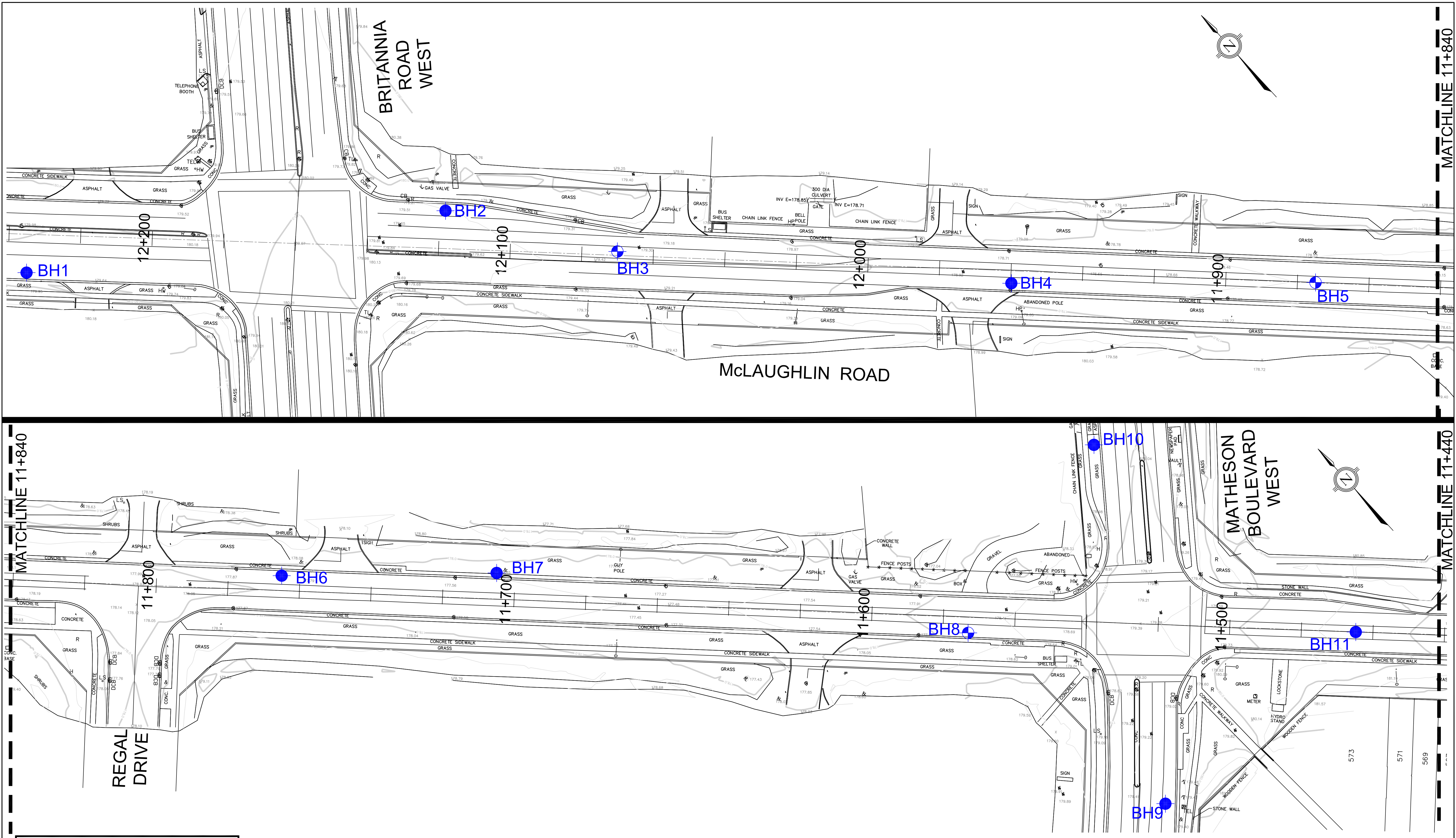
PHOTOGRAPH 3. McLaughlin Road, Approximate Sta. 11+650, looking north.

PHOTOGRAPH 4. McLaughlin Road, approximate Sta. 11+300, looking north.

SITE PHOTOGRAPHS

PHOTOGRAPH 5. McLaughlin Road, approximate Sta. 10+600, looking north.

PHOTOGRAPH 6. McLaughlin Road, approximate Sta. 10+200, looking north.



REFERENCE
Drawing provided in digital format by IBI Group, drawing files are Toposurvey-2D, McLaughlin-NC-Option-2-LDD (4 lanes)

LEGEND

●	Borehole
⊕	Core and Borehole

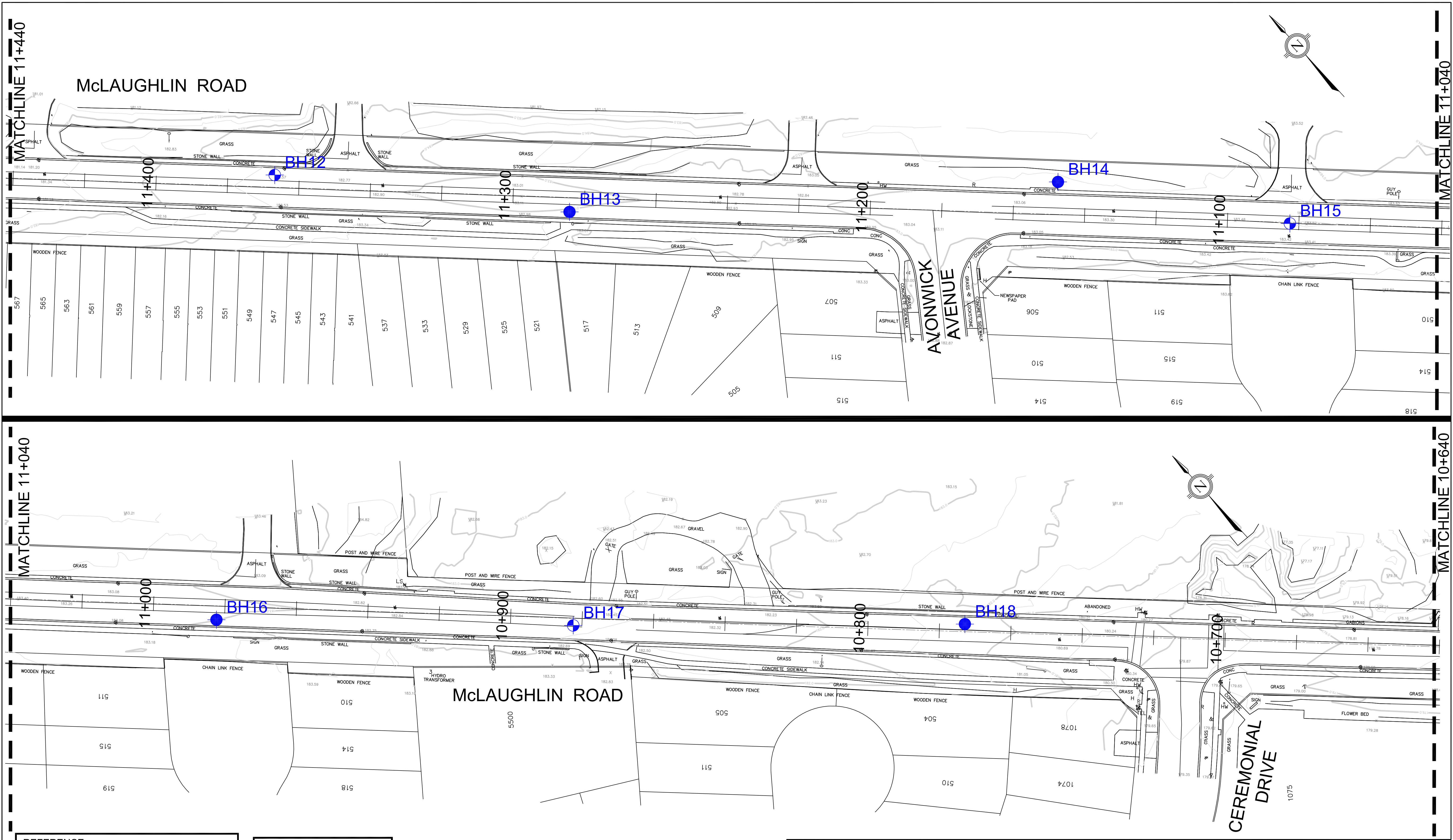
Terraprobe
11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:
McLaughlin Road, Mississauga, Ontario
(Borehole Location Plan)

File No.
11-12-2098

Figure :
5

\\PDC\Server\1-Project Files\11-Geo\2012\11-12-2001 - 2099\11-12-2098\A. Dwgs, Logs\AutoCAD\11-12-2098 BH Location Plan R1.dwg, Kamal



REFERENCE
Drawing provided in digital format by IBI Group,
drawing files are Toposurvey-2D,
McLaughlin-NC-Option-2-LDD (4 lanes)

LEGEND	
●	Borehole
⊕	Core and Borehole

SCALE 1:1000
10 5 0 5 10 15 20m

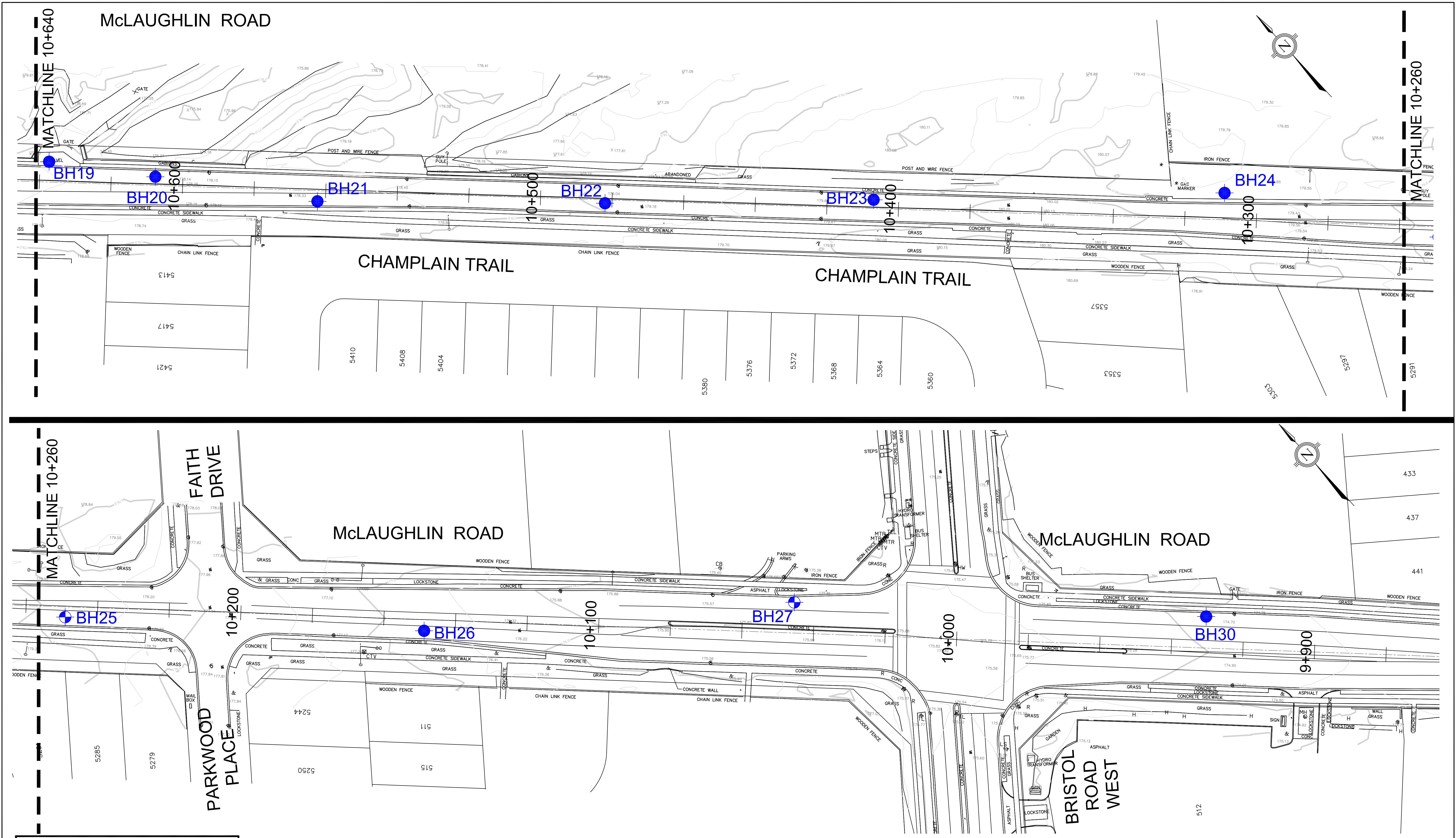
Terraprobe
11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:
McLaughlin Road, Mississauga, Ontario (Borehole Location Plan)

File No.
11-12-2098

Figure :
6

\\PDC\Server\1-Project Files\11-Geo\2012\11-12-2001 - 2099\11-12-2098\A. Dwgs, Logs\AutoCAD\11-12-2098 BH Location Plan_R1.dwg, Kamal



REFERENCE
Drawing provided in digital format by IBI Group, drawing files are Toposurvey-2D, McLaughlin-NC-Option-2-LDD (4 lanes)

LEGEND	
●	Borehole
⊕	Core and Borehole

SCALE 1:1000
10 5 0 5 10 15 20m

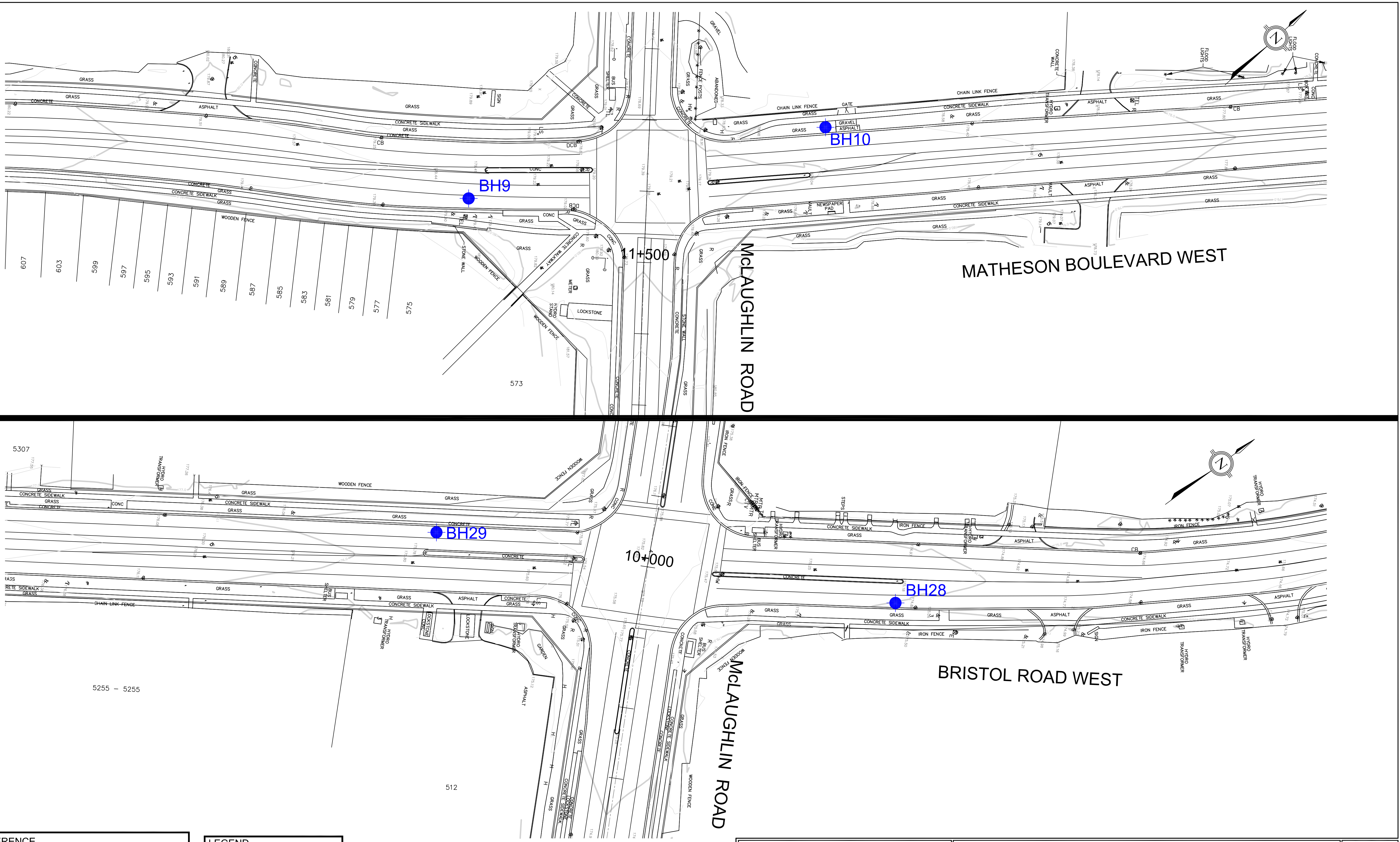
Terraprobe
11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:
McLaughlin Road, Mississauga, Ontario (Borehole Location Plan)

File No.
11-12-2098

Figure :
7

\\PDC\Server\1-Project Files\11-Geo\2012\11-12-2001 - 2099\11-12-2098\A_Dwgs, Logs\AutoCAD\11-12-2098 BH Location Plan R1.dwg, Kamal



REFERENCE
Drawing provided in digital format by IBI Group, drawing files are Toposurvey-2D, McLaughlin-NC-Option-2-LDD (4 lanes)

LEGEND

●	Borehole
⊕	Core and Borehole

SCALE 1:1000
10 5 0 5 10 15 20m

Terraprobe
11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title:
McLaughlin Road, Mississauga, Ontario
(Borehole Location Plan)

File No.
11-12-2098

Figure :
8

\\PDC\Server\1-Project Files\11-Geo\2012\11-12-2001 - 2099\11-12-2098\A. Dwgs, Logs\AutoCAD\11-12-2098 BH Location Plan R1.dwg, Kamal

APPENDIX A

Borehole Logs

ABBREVIATIONS AND TERMINOLOGY

SAMPLING METHODS

AS	Auger sample
GS	Grab sample
SS	Split spoon
ST	Shelby tube
WS	Wash sample
RC	Rock core
SC	Soil core

PENETRATION RESISTANCE

Standard Penetration Test (SPT) N-value (penetration resistance) is defined as the number of blows required to advance a standard 50 mm (2 in.) diameter split spoon sampler for a distance of 0.3 m (12 in.) with a hammer weighing 63.5 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.).

Dynamic Cone Penetration Test (DCPT) resistance is defined as the number of blows required to advance a conical steel point 50 mm (2 in.) base diameter tapered 60° to the apex and attached to 'A' size drill rods for a distance of 0.3 m (12 in.), with a hammer weighing 63.5 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.).

COHESIONLESS SOILS

Relative Density	N-value Blows/0.3m
Very loose	< 5
Loose	5 – 10
Compact	10 – 30
Dense	30 – 50
Very dense	> 50

COHESIVE SOILS

Consistency	N-value Blows/0.3m	Undrained Shear Strength (kPa)
Very soft	< 2	< 12
Soft	2 – 4	12 – 25
Firm	4 – 8	25 – 50
Stiff	8 – 15	50 – 100
Very stiff	15 – 30	100 – 200
Hard	> 30	> 200

MINOR SOIL CONSTITUENTS

Modifier (e.g)	% by weight
trace (trace silt)	< 10
some (some silt)	10 – 20
(ey) or (y) (sandy)	20 – 35
and (sand and silt)	> 35

TESTS AND SYMBOLS

MH	combined sieve and hydrometer analysis
w,	water content
w_L,	liquid limit
w_P,	plastic limit
I_P,	plasticity index
k	coefficient of permeability
γ	soil unit weight, bulk
G_s	specific gravity
Φ'	effective angle of internal friction
c'	effective cohesion
c_u	undrained shear strength (Φ = 0 analysis)

▽	Unstabilized water level
⧨	1st water level measurement
⧩	2nd water level measurement
▼	Most recent water level measurement
3.0 +	Undrained shear strength from field vane (with sensitivity)
C_c	compression index (normally consolidated range)
C_r	recompression index (overconsolidated range)
c_v	coefficient of consolidation
m_v	coefficient of compressibility (volume change)
e	void ratio

FIELD MOISTURE DESCRIPTIONS

Dry	refers to a soil sample with a moisture content well below optimum ($w < w_{opt}$), absence of moisture, dusty, dry to the touch.
Moist	refers to a soil sample with a moisture content at or near optimum ($w \approx w_{opt}$), no visible pore water.
Wet	refers to a soil sample with a moisture content well above optimum ($w > w_{opt}$), has visible pore water.

BOREHOLE LOG BH1

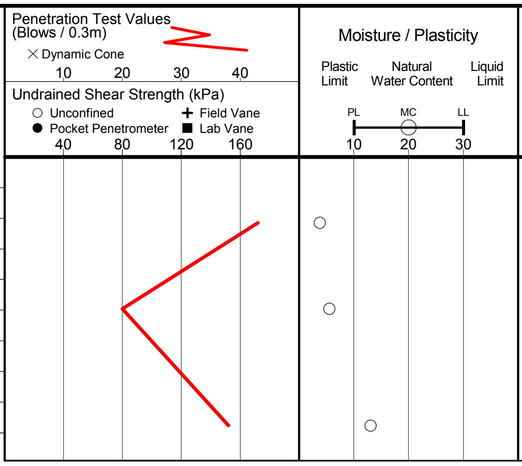
Client : IBI Group
Project : McLaughlin Road
Location : Mississauga, Ontario

Project No.: 11-12-2098
Date started : December 3, 2012
Sheet No. : 1 of 1

Position : E: 605616, N: 4830182 (UTM 17T)
Rig type : truck-mounted

Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	Graphic Log	SAMPLES Number	Type	SPT 'N' Value	Elevation Scale (m)
0	**179.8**	**GROUND SURFACE**					
		200mm **ASPHALTIC CONCRETE**					
	179.6 0.2	910mm **GRANULAR BASE / SUBBASE**, compact to dense, brown, dry		1	SS	43	
							179
1				2	SS	20	
	178.7 1.1	**CLAYEY SILT**, some sand to sandy, trace gravel, hard, brown, moist (GLACIAL TILL)					
				3	SS	38	178
	177.8 2.0	**END OF BOREHOLE**					



Headspace Vapour

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

Borehole was dry and open upon completion of drilling.

Terraprobe

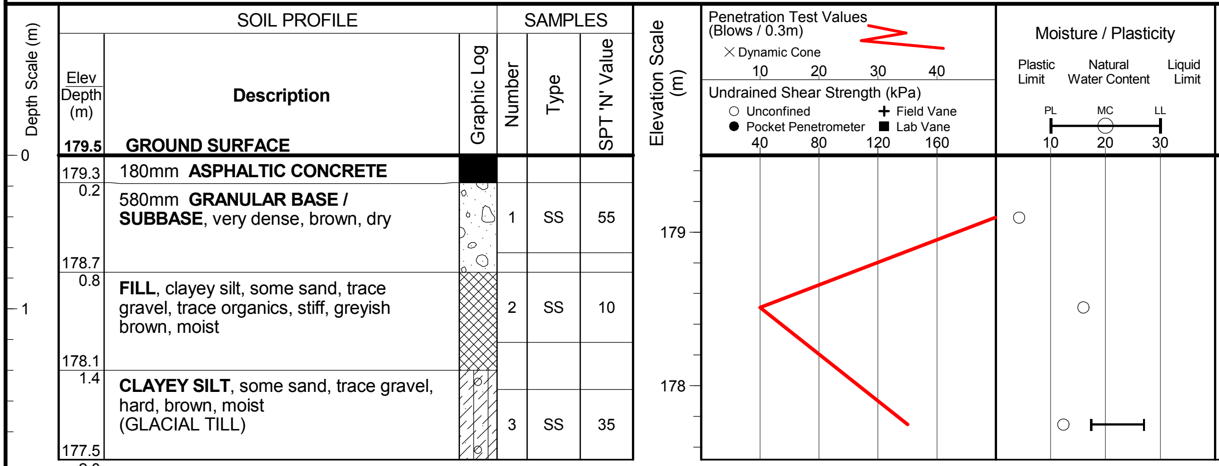
BOREHOLE LOG BH2

Client : IBI Group
Project : McLaughlin Road
Location : Mississauga, Ontario

Project No.: 11-12-2098
Date started : November 30, 2012
Sheet No. : 1 of 1

Position : E: 604043, N: 4831318 (UTM 17T)
Rig type : truck-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

SOIL PROFILE		SAMPLES			Lab Data and Comments
Elev Depth (m)	Description	Number	Type	SPT 'N' Value	GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
179.5	**GROUND SURFACE**				
179.3 0.2	180mm **ASPHALTIC CONCRETE**				
178.7 0.8	580mm **GRANULAR BASE / SUBBASE**, very dense, brown, dry	1	SS	55	
178.1 1.4	**FILL**, clayey silt, some sand, trace gravel, trace organics, stiff, greyish brown, moist	2	SS	10	
177.5 2.0	**CLAYEY SILT**, some sand, trace gravel, hard, brown, moist (GLACIAL TILL)	3	SS	35	8 19 49 24



END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

library: library - terraprobe gint.glb **report:** terraprobe soil log **file:** 11-12-2098 bh logs.gpj

Terraprobe

BOREHOLE LOG BH3

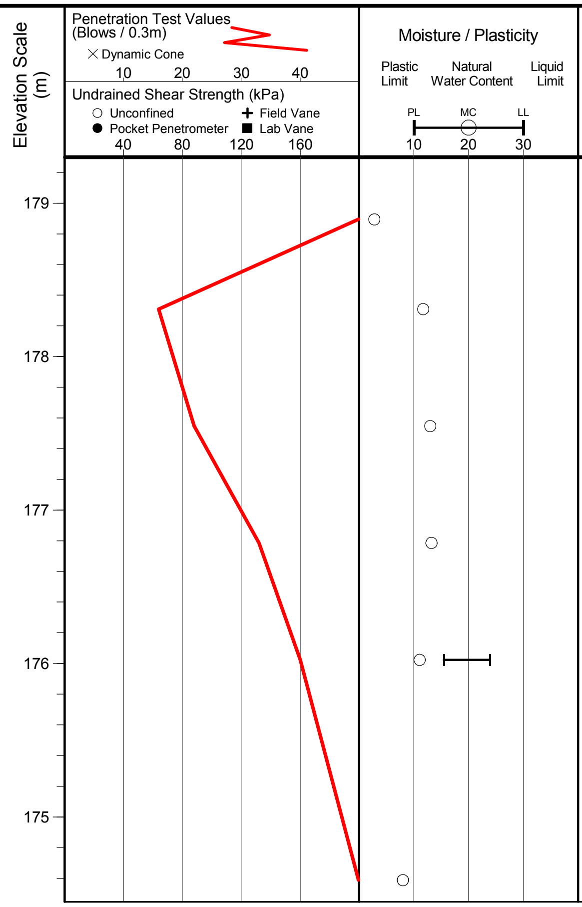
Client : IBI Group
Project : McLaughlin Road
Location : Mississauga, Ontario

Project No.: 11-12-2098
Date started : November 30, 2012
Sheet No. : 1 of 1

Position : E: 605756, N: 4830092 (UTM 17T)
Rig type : truck-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Elev Depth (m)	SOIL PROFILE Description	SAMPLES Number	Type	SPT 'N' Value	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
179.3	**GROUND SURFACE**				
	170mm **ASPHALTIC CONCRETE**				
179.1 0.2	580mm **GRANULAR BASE / SUBBASE**, very dense, brown, dry	1	SS	54	
178.5 0.8	**CLAYEY SILT**, some sand to sandy, trace to some gravel, very stiff to hard, brown, moist (GLACIAL TILL)	2	SS	16	
		3	SS	22	
		4	SS	33	
		5	SS	40	6 27 47 20
175.3 4.0	**SILTY SAND**, trace gravel, trace clay, very dense, brown, moist (GLACIAL TILL)	6	SS	50 / 125mm	
174.4 4.9	**END OF BOREHOLE**				

Borehole was dry and open upon completion of drilling.



Headspace Vapour | Instrument Details | Unstabilized Water Level

Terraprobe

BOREHOLE LOG BH4

Client : IBI Group
Project : McLaughlin Road
Location : Mississauga, Ontario

Project No.: 11-12-2098
Date started : December 3, 2012
Sheet No. : 1 of 1

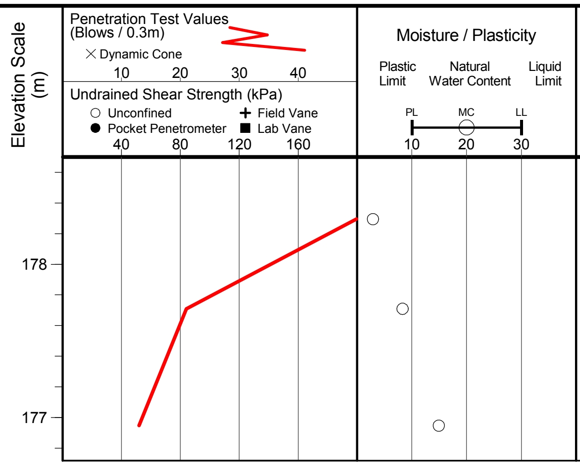
Position : E: 605831, N: 4830008 (UTM 17T)
Rig type : truck-mounted

Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	Graphic Log	SAMPLES Number	SAMPLES Type	SAMPLES SPT 'N' Value
	178.7	**GROUND SURFACE**				
0	178.5 0.2	180mm **ASPHALTIC CONCRETE**				
	177.9 0.8	635mm **GRANULAR BASE / SUBBASE**, very dense, brown, dry		1	SS	74
1	177.3 1.4	**SAND**, some silt, trace gravel, trace clay, compact, brown, moist (GLACIAL TILL)		2	SS	21
	176.7 2.0	**CLAYEY SILT**, some sand, trace gravel, stiff, brown, moist (GLACIAL TILL)		3	SS	13

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.



Headspace Vapour	Instrument Details	Unstabilized Water Level	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

library: library - terraprobe gint.glb **report:** terraprobe soil log **file:** 11-12-2098 bh logs.gpj

Terraprobe

BOREHOLE LOG BH5

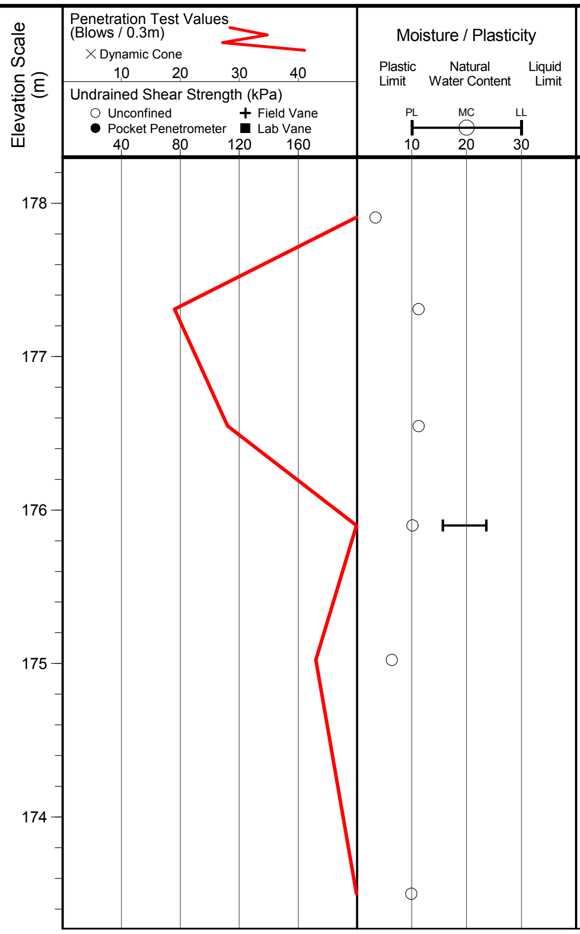
Client : IBI Group
Project : McLaughlin Road
Location : Mississauga, Ontario

Project No.: 11-12-2098
Date started : November 30, 2012
Sheet No. : 1 of 1

Position : E: 605890, N: 4829954 (UTM 17T)
Rig type : truck-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description
	178.3	**GROUND SURFACE**
0	178.1 0.2	160mm **ASPHALTIC CONCRETE**
	177.5 0.8	620mm **GRANULAR BASE / SUBBASE**, very dense, brown, dry
1 – 5	173.3 5.0	**CLAYEY SILT**, some sand to sandy, trace to some gravel, very stiff, brown, moist (GLACIAL TILL)

Number	Type	SPT 'N' Value
1	SS	62
2	SS	19
3	SS	28
4	SS	50 / 75mm
5	SS	43
6	SS	73



Headspace Vapour | Instrument Details | Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%)			
GR	SA	SI	CL
15	34	36	15

...at 2.5m, Auger grinding
...at 2.6m, Auguer grinding, very hard to 2.7m

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Terraprobe

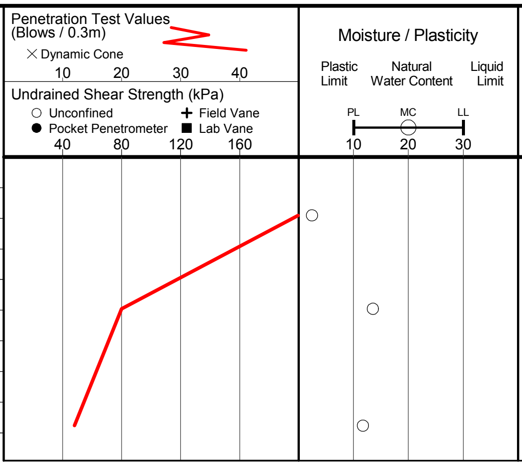
BOREHOLE LOG BH6

Client	: IBI Group	Project No.:	11-12-2098
Project	: McLaughlin Road	Date started :	November 30, 2012
Location	: Mississauga, Ontario	Sheet No. :	1 of 1

Position	: E: 605971, N: 4829880 (UTM 17T)	Elevation Datum	: Geodetic
Rig type	: truck-mounted	Drilling Method	: Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	Graphic Log	SAMPLES Number	SAMPLES Type	SAMPLES SPT 'N' Value	Elevation Scale (m)
0	**177.8**	**GROUND SURFACE**					
	177.6 0.2	150mm **ASPHALTIC CONCRETE**					
		560mm **GRANULAR BASE / SUBBASE**, very dense, brown, dry		1	SS	62	
	177.1 0.7	**SAND**, some silt, trace gravel, trace clay, compact, brown, wet (GLACIAL TILL)					177
1				2	SS	20	
	176.3 1.5	**SANDY SILT**, trace gravel, trace clay, compact, brown, moist (GLACIAL TILL)		3	SS	12	176
	175.8 2.0	**END OF BOREHOLE**					

Borehole was dry and open upon completion of drilling.



Headspace Vapour	Instrument Details	Unstabilized Water Level	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

library: library - terraprobe gint.glb report: terraprobe soil log file: 11-12-2098 bh logs.gpj

Terraprobe

BOREHOLE LOG BH7

Client : IBI Group
Project : McLaughlin Road
Location : Mississauga, Ontario

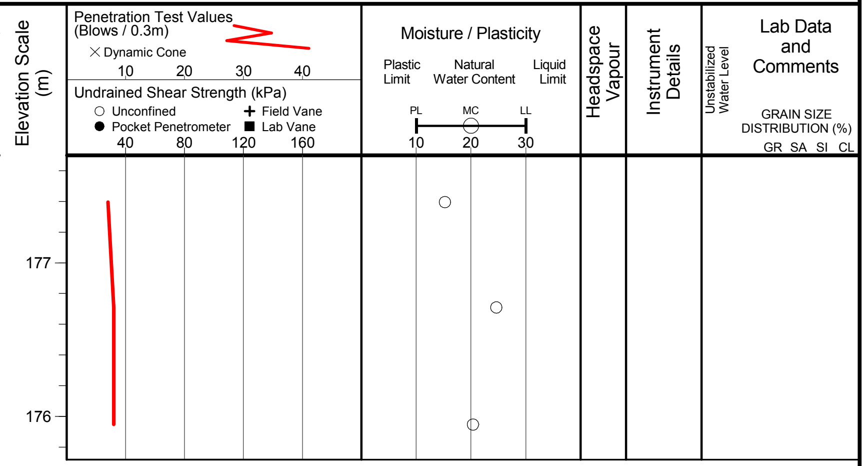
Project No.: 11-12-2098
Date started : November 30, 2012
Sheet No. : 1 of 1

Position : E: 606015, N: 4829846 (UTM 17T)
Rig type : truck-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	Graphic Log	SAMPLES Number	Type	SPT 'N' Value
0	**177.7**	**GROUND SURFACE**				
	177.5 0.2	180mm **TOPSOIL**				
		FILL, silty clay, some sand, trace gravel, trace organics, firm, greyish brown, wet		1	SS	7
1				2	SS	8
				3	SS	8
	175.7 2.0					

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.



Terraprobe

BOREHOLE LOG BH8

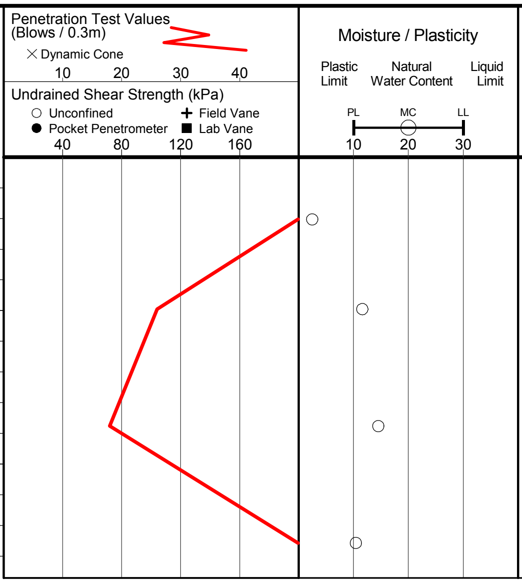
Client : IBI Group
Project : McLaughlin Road
Location : Mississauga, Ontario

Project No.: 11-12-2098
Date started : December 3, 2012
Sheet No. : 1 of 1

Position : E: 606100, N: 4829144 (UTM 17T)
Rig type : truck-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	SAMPLES Number	SAMPLES Type	SPT 'N' Value	Elevation Scale (m)	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0	178.0	**GROUND SURFACE**					
		130mm **ASPHALTIC CONCRETE**					
	177.8 0.2	610mm **GRANULAR BASE / SUBBASE**, very dense, brown, dry	1	SS	72		
1	177.2 0.8	**SILTY SAND**, some silt, trace gravel, trace clay, compact, brown, wet (GLACIAL TILL)	2	SS	26	177	5 70 21 4
2	176.5 1.5	**CLAYEY SILT**, some sand, trace gravel, very stiff, brown, moist (GLACIAL TILL)	3	SS	18	176	
	175.7 2.3	**SILTY SAND**, trace gravel, trace clay, very dense, brown, moist (GLACIAL TILL)	4	SS	53		...at 2.6m, Auger refusal, spoon bouncing
	175.3 2.7	**END OF BOREHOLE**					

Borehole was dry and open upon completion of drilling.



Headspace Vapour | Instrument Details | Unstabilized Water Level

Terraprobe

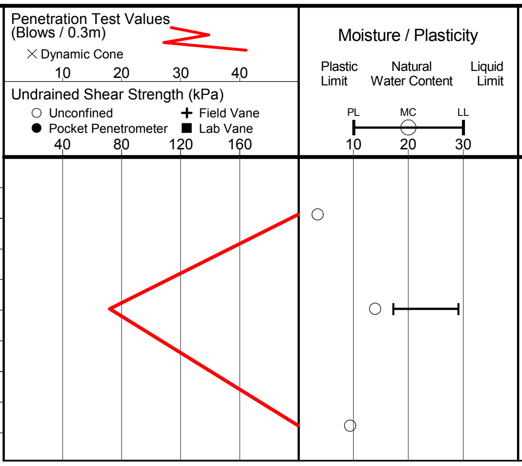
BOREHOLE LOG BH9

Client : IBI Group
Project : McLaughlin Road
Location : Mississauga, Ontario

Project No.: 11-12-2098
Date started : November 30, 2012
Sheet No. : 1 of 1

Position : E: 606109, N: 4829662 (UTM 17T)
Rig type : truck-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	Graphic Log	SAMPLES Number	Type	SPT 'N' Value	Elevation Scale (m)	Headspace Vapour	Instrument Details	Unstabilized Water Level	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0	179.4	**GROUND SURFACE**									
		140mm **ASPHALTIC CONCRETE**									
	178.7 0.7	570mm **GRANULAR BASE / SUBBASE**, very dense, brown, dry		1	SS	70	179				
1		**CLAYEY SILT**, some sand to sandy, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		2	SS	18	178				4 27 44 25
	177.4 2.0			3	SS	76					



END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Terraprobe

BOREHOLE LOG BH10

Client : IBI Group

Project : McLaughlin Road

Location : Mississauga, Ontario

Project No.: 11-12-2098

Date started : November 30, 2012

Sheet No. : 1 of 1

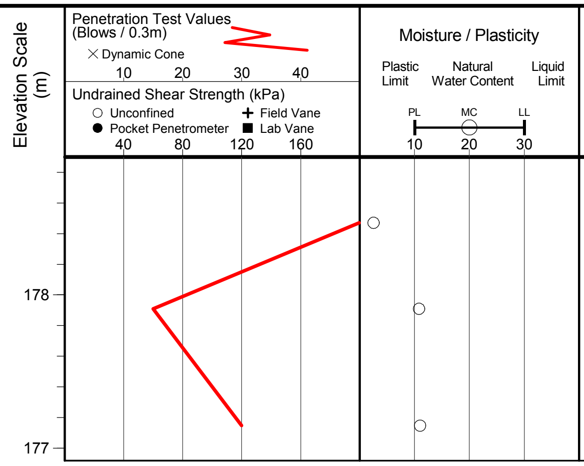
Position : E: 606165, N: 4829753 (UTM 17T)

Rig type : truck-mounted

Elevation Datum : Geodetic

Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	Graphic Log	SAMPLES Number	Type	SPT 'N' Value
0	178.9	**GROUND SURFACE**				
	178.7 0.2	200mm **ASPHALTIC CONCRETE**				
		710mm **GRANULAR BASE / SUBBASE**, compact to very dense, brown, dry		1	SS	57
1	178.0 0.9	**SANDY SILT**, trace gravel, trace clay, compact, brown, moist (GLACIAL TILL)		2	SS	15
				3	SS	30
	176.9 2.0					



Headspace Vapour

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%)

GR SA SI CL

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

library: library - terraprobe gint.glb **report:** terraprobe soil log **file:** 11-12-2098 bh logs.gpj

Terraprobe

BOREHOLE LOG BH11

Client : IBI Group
Project : McLaughlin Road
Location : Mississauga, Ontario

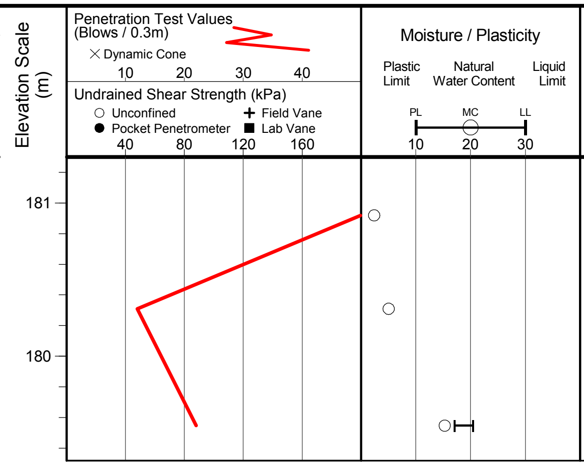
Project No.: 11-12-2098
Date started : November 29, 2012
Sheet No. : 1 of 1

Position : E: 606179, N: 4829669 (UTM 17T)
Rig type : truck-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	Graphic Log	SAMPLES Number	Type	SPT 'N' Value	Headspace Vapour	Instrument Details	Unstabilized Water Level	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	181.3	**GROUND SURFACE**								
0	181.1 0.2	150mm **ASPHALTIC CONCRETE**								
	180.5 0.8	685mm **GRANULAR BASE / SUBBASE**, compact to very dense, brown, dry to moist		1	SS	98				
1	179.3 2.0	**SANDY SILT**, some clay, trace gravel, compact, brown, moist to wet (GLACIAL TILL)		2	SS	12				
				3	SS	22				0 23 65 12

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.



Terraprobe

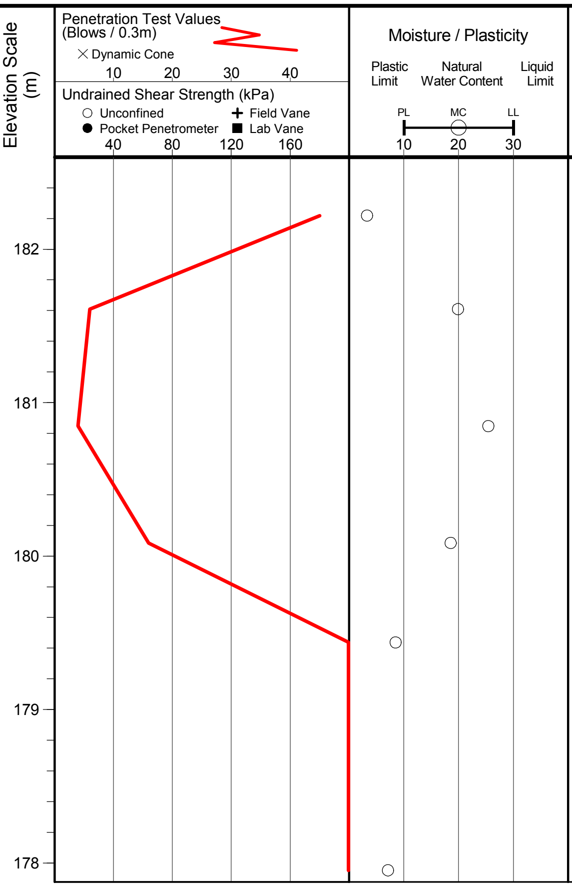
BOREHOLE LOG BH12

Client : IBI Group
Project : McLaughlin Road
Location : Mississauga, Ontario

Project No.: 11-12-2098
Date started : November 29, 2012
Sheet No. : 1 of 1

Position : E: 606260, N: 4829593 (UTM 17T)
Rig type : truck-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Elev Depth (m)	SOIL PROFILE Description	SAMPLES Number	Type	SPT 'N' Value	Lab Data and Comments
182.6	**GROUND SURFACE**				
182.4	140mm **ASPHALTIC CONCRETE**				
0.2	810mm **GRANULAR BASE / SUBBASE**, loose to dense, brown, dry	1	SS	45	
181.6					
1.0	**CLAYEY SILT**, some sand, trace gravel, soft to firm, brown, wet (GLACIAL TILL)	2	SS	6	
		3	SS	4	
180.3					
2.3	**SANDY SILT**, trace to some gravel, trace clay, compact to very dense, brown, moist to wet (GLACIAL TILL)	4	SS	16	
		5	SS	50 / 75mm	...at 3.0m, Auger grinding
					...at 4.0m, Auger grinding very hard
177.9		6	SS	50 / 150mm	
4.7					



Headspace Vapour | Instrument Details | Unstabilized Water Level | GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

BOREHOLE LOG BH13

Client : IBI Group
Project : McLaughlin Road
Location : Mississauga, Ontario

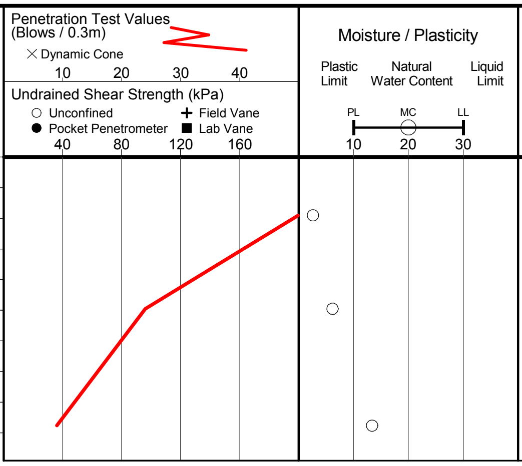
Project No.: 11-12-2098
Date started : December 3, 2012
Sheet No. : 1 of 1

Position : E: 606306, N: 4829536 (UTM 17T)
Rig type : truck-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	SOIL PROFILE: Elev Depth (m)	SOIL PROFILE: Description	SOIL PROFILE: Graphic Log	SAMPLES: Number	SAMPLES: Type	SAMPLES: SPT 'N' Value	Elevation Scale (m)	Headspace Vapour	Instrument Details	Unstabilized Water Level	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0	**183.0**	**GROUND SURFACE**					183				
	182.8 0.2	150mm **ASPHALTIC CONCRETE**									
		760mm **GRANULAR BASE / SUBBASE**, compact to very dense, brown, dry		1	SS	78					
1	182.1 0.9	**SILTY SAND**, trace gravel, trace clay, loose to compact, brown, moist (GLACIAL TILL)		2	SS	24	182				
				3	SS	9					
	181.0 2.0										

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.



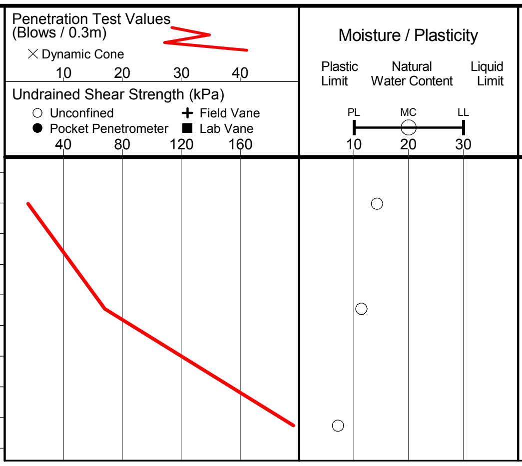
BOREHOLE LOG BH14

Client : IBI Group
Project : McLaughlin Road
Location : Mississauga, Ontario

Project No.: 11-12-2098
Date started : November 29, 2012
Sheet No. : 1 of 1

Position : E: 606413, N: 4829448 (UTM 17T)
Rig type : truck-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	Graphic Log	SAMPLES Number	Type	SPT 'N' Value	Elevation Scale (m)
0	183.5	**GROUND SURFACE**					
		125mm **TOPSOIL**					
		SANDY SILT, trace gravel, trace clay, very loose to dense, brown, moist (GLACIAL TILL)		1	SS	4	183
1				2	SS	17	
				3	SS	49	182
	181.5 2.0						



Headspace Vapour	Instrument Details	Unstabilized Water Level	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Terraprobe

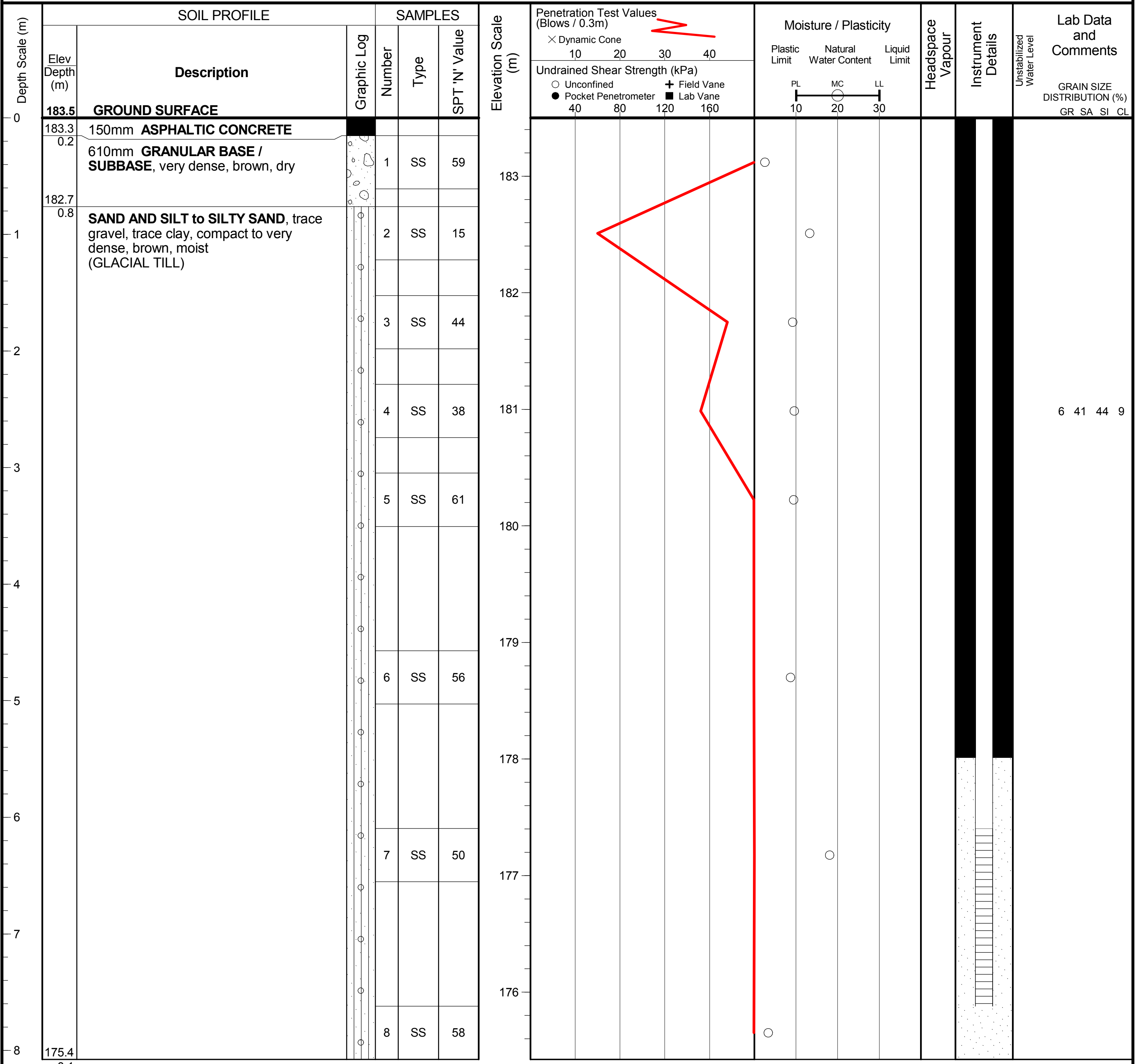
BOREHOLE LOG BH15

Client : IBI Group
Project : McLaughlin Road
Location : Mississauga, Ontario

Project No.: 11-12-2098
Date started : November 29, 2012
Sheet No. : 1 of 1

Position : E: 606448, N: 4829393 (UTM 17T)
Rig type : truck-mounted

Elevation Datum : Geodetic
Drilling Method : Solid stem augers



Elev Depth (m)	Description
183.5	**GROUND SURFACE**
183.3 0.2	150mm **ASPHALTIC CONCRETE**
182.7 0.8	610mm **GRANULAR BASE / SUBBASE**, very dense, brown, dry
175.4 8.1	**SAND AND SILT to SILTY SAND**, trace gravel, trace clay, compact to very dense, brown, moist (GLACIAL TILL)

Number	Type	SPT 'N' Value	GR SA SI CL
1	SS	59	
2	SS	15	
3	SS	44	
4	SS	38	6 41 44 9
5	SS	61	
6	SS	56	
7	SS	50	
8	SS	58	

END OF BOREHOLE

Piezometer installation consists of 50mm diameter PVC pipe with a 1.5 slotted screen

Borehole was dry and open upon completion of drilling.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jan 18, 2013	dry	n/a

library: library - terraprobe gint.glb **report:** terraprobe soil log **file:** 11-12-2098 bh logs.gpj

Terraprobe

BOREHOLE LOG BH16

Client : IBI Group

Project : McLaughlin Road

Location : Mississauga, Ontario

Project No.: 11-12-2098

Date started : December 3, 2012

Sheet No. : 1 of 1

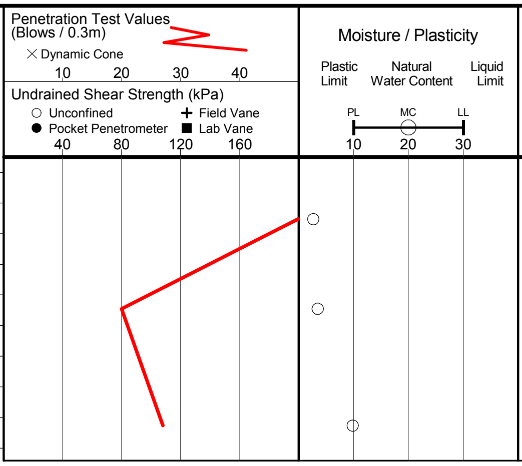
Position : E: 606513, N: 4829338 (UTM 17T)

Elevation Datum : Geodetic

Rig type : truck-mounted

Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	Graphic Log	SAMPLES Number	Type	SPT 'N' Value	Elevation Scale (m)
	183.1	**GROUND SURFACE**					
0	182.9 0.2	180mm **ASPHALTIC CONCRETE**					183
		740mm **GRANULAR BASE / SUBBASE**, compact to very dense, brown, dry		1	SS	55	
1	182.0 1.1			2	SS	20	182
		SANDY SILT, trace gravel, trace clay, compact, brown, moist (GLACIAL TILL)		3	SS	27	
	181.1 2.0						



Headspace Vapour	Instrument Details	Unstabilized Water Level	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Terraprobe

BOREHOLE LOG BH17

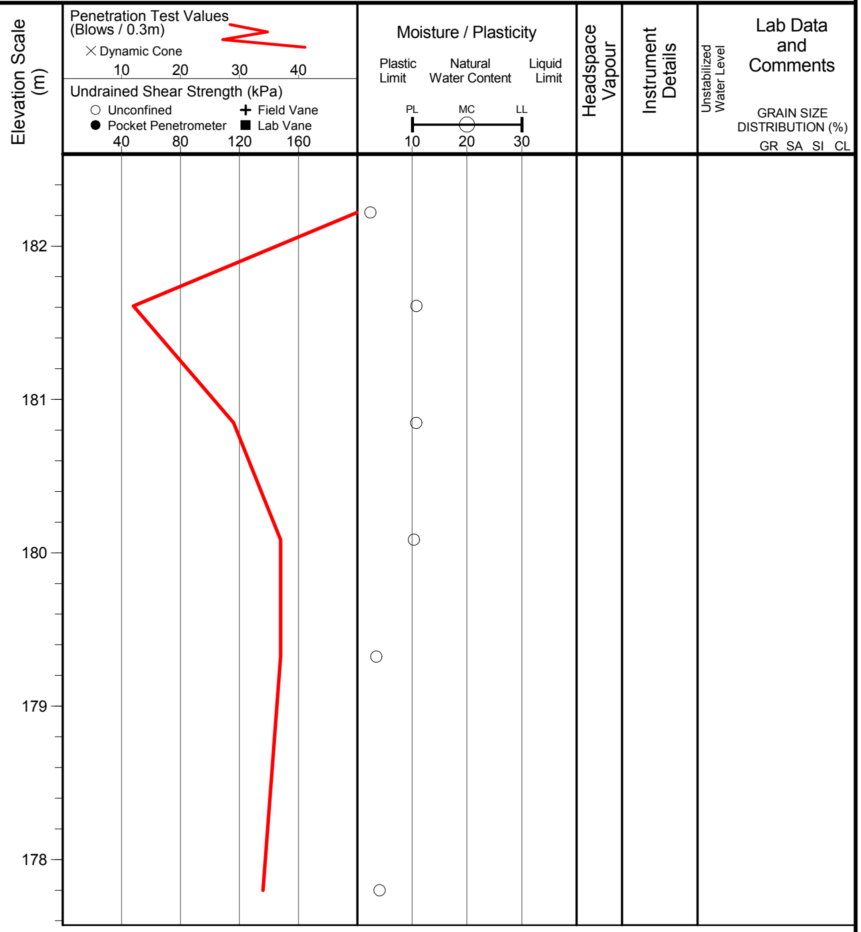
Client : IBI Group
Project : McLaughlin Road
Location : Mississauga, Ontario

Project No.: 11-12-2098
Date started : November 28, 2012
Sheet No. : 1 of 1

Position : E: 606596, N: 489259 (UTM 17T)
Rig type : truck-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Elev Depth (m)	Description	Number	Type	SPT 'N' Value
182.6	**GROUND SURFACE**			
182.4	120mm **ASPHALTIC CONCRETE**			
0.2	610mm **GRANULAR BASE / SUBBASE**, very dense, brown, dry	1	SS	63
181.8				
0.8	**SAND**, some silt to silty, trace gravel, trace clay, compact to dense, brown, moist (GLACIAL TILL)	2	SS	12
		3	SS	29
		4	SS	37
		5	SS	37
		6	SS	34
177.6 5.0				

Depth Scale (m): 0, 1, 2, 3, 4, 5



END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

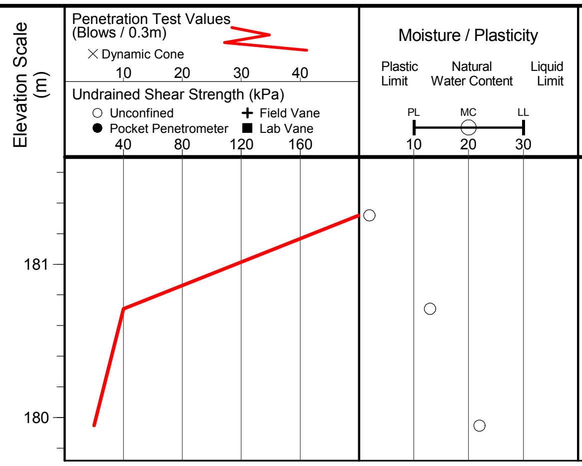
BOREHOLE LOG BH18

Client : IBI Group
Project : McLaughlin Road
Location : Mississauga, Ontario

Project No.: 11-12-2098
Date started : November 28, 2012
Sheet No. : 1 of 1

Position : E: 606673, N: 4829186 (UTM 17T)
Rig type : truck-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	181.7	**GROUND SURFACE**				
		150mm **ASPHALTIC CONCRETE**				
	181.5 0.2	560mm **GRANULAR BASE / SUBBASE**, very dense, brown, dry		1	SS	51
	181.0 0.7	**SANDY SILT**, trace gravel, trace clay, loose, brown, moist to wet (GLACIAL TILL)				
1				2	SS	10
				3	SS	5
	179.7 2.0	**END OF BOREHOLE**				



Headspace Vapour | Instrument Details | Unstabilized Water Level | Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

Borehole was dry and open upon completion of drilling.

Terraprobe

BOREHOLE LOG BH19

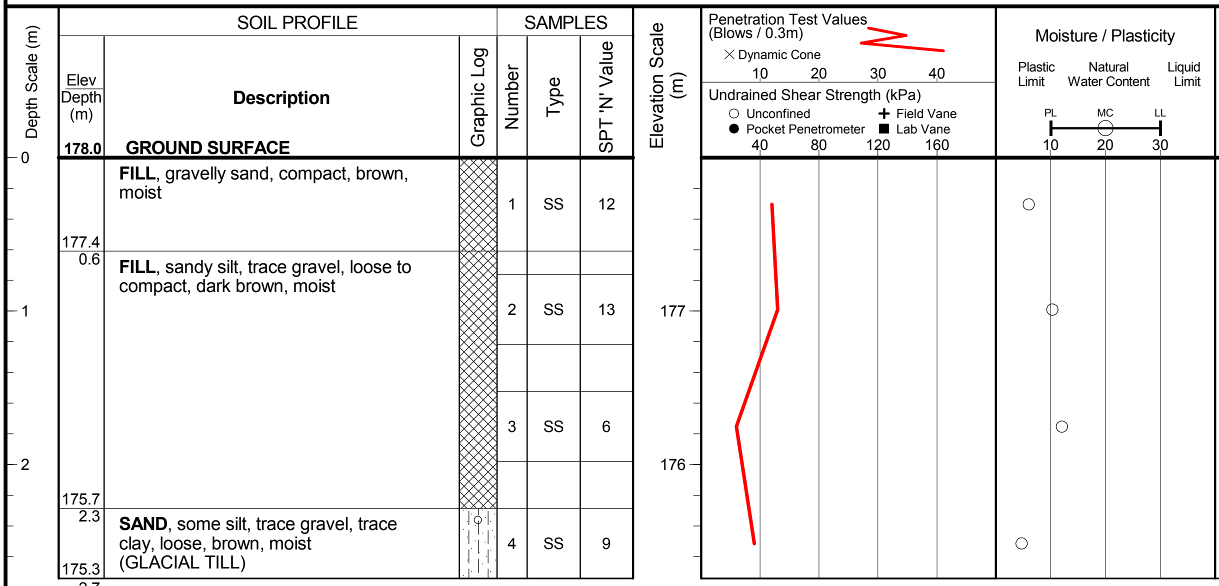
Client : IBI Group
Project : McLaughlin Road
Location : Mississauga, Ontario

Project No.: 11-12-2098
Date started : November 28, 2012
Sheet No. : 1 of 1

Position : E: 606772, N: 4829085 (UTM 17T)
Rig type : truck-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Elev / Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
178.0	**GROUND SURFACE**				
	FILL, gravelly sand, compact, brown, moist	▩	1	SS	12
177.4 0.6	**FILL**, sandy silt, trace gravel, loose to compact, dark brown, moist	▩	2	SS	13
			3	SS	6
175.7 2.3	**SAND**, some silt, trace gravel, trace clay, loose, brown, moist (GLACIAL TILL)		4	SS	9
175.3 2.7	**END OF BOREHOLE**				

Borehole was dry and open upon completion of drilling.



Terraprobe

BOREHOLE LOG BH20

Client : IBI Group
Project : McLaughlin Road
Location : Mississauga, Ontario

Project No.: 11-12-2098
Date started : November 28, 2012
Sheet No. : 1 of 1

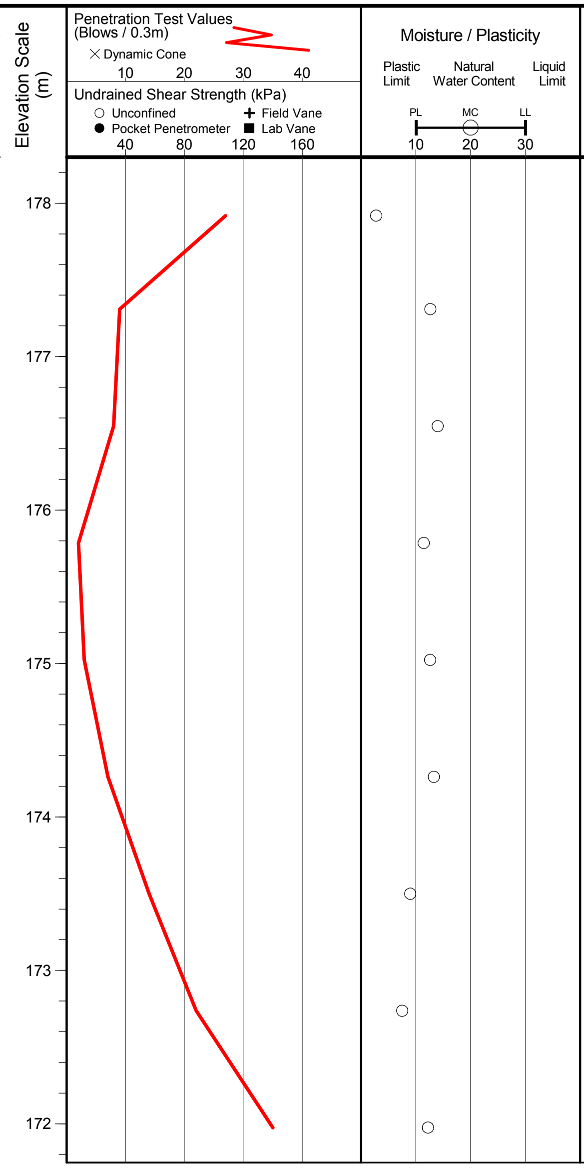
Position : E: 606794, N: 4829062 (UTM 17T)
Rig type : truck-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Elev Depth (m)	SOIL PROFILE Description	SAMPLES Number	Type	SPT 'N' Value	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
178.3	**GROUND SURFACE**				
	150mm **ASPHALTIC CONCRETE**				
178.1 0.2	560mm **GRANULAR BASE / SUBBASE**, compact, brown, dry	1	SS	27	
177.6 0.7	**FILL**, sandy silt to silty sand, trace gravel, very loose to loose, grey to brown, moist	2	SS	9	
		3	SS	8	
		4	SS	2	
		5	SS	3	
		6	SS	7	
173.7 4.6	**SAND**, some silt to silty, trace gravel, trace clay, very loose to dense, brown, moist (GLACIAL TILL)	7	SS	14	0 77 18 5
		8	SS	22	
		9	SS	35	
171.7 6.6	**END OF BOREHOLE**				

Depth Scale (m): 0, 1, 2, 3, 4, 5, 6

Graphic Log

Headspace Vapour | Instrument Details | Unstabilized Water Level



Borehole was dry and open upon completion of drilling.

Terraprobe

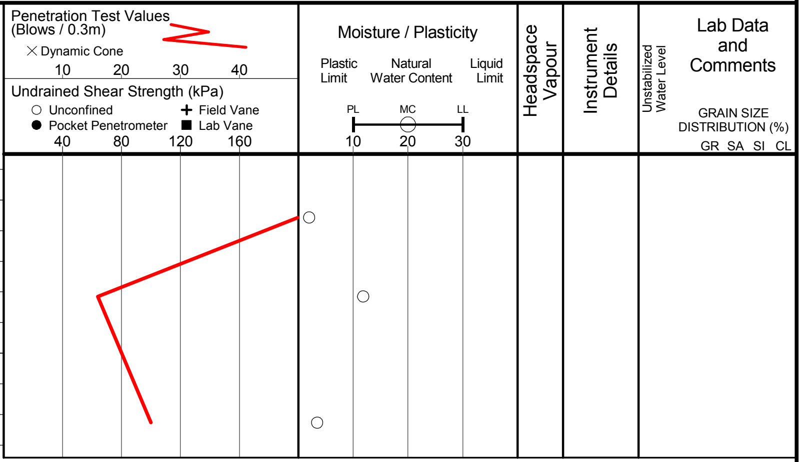
BOREHOLE LOG BH21

Client : IBI Group
Project : McLaughlin Road
Location : Mississauga, Ontario

Project No.: 11-12-2098
Date started : December 4, 2012
Sheet No. : 1 of 1

Position : E: 606824, N: 4829035 (UTM 17T)
Rig type : truck-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	Graphic Log	SAMPLES Number	SAMPLES Type	SPT 'N' Value	Elevation Scale (m)
	178.3	**GROUND SURFACE**					
0		125mm **ASPHALTIC CONCRETE**					
	177.6 0.7	585mm **GRANULAR BASE / SUBBASE**, brown, dry		1	AS	-	178
1	177.1 1.2	**FILL**, clayey silt, some sand, trace gravel, trace organics, very stiff, brown, moist		2	SS	16	
	176.3 2.0	**SILTY SAND**, trace clay, compact, brown, moist (GLACIAL TILL)		3	SS	25	177



END OF BOREHOLE

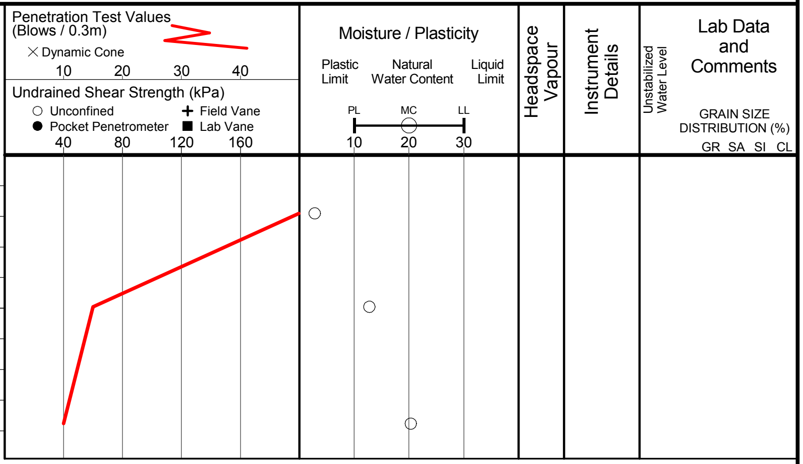
Borehole was dry and open upon completion of drilling.

BOREHOLE LOG BH22

Client	: IBI Group	Project No.:	11-12-2098
Project	: McLaughlin Road	Date started :	December 4, 2012
Location	: Mississauga, Ontario	Sheet No. :	1 of 1

Position	: E: 606879, N: 4828928 (UTM 17T)	Elevation Datum	: Geodetic
Rig type	: truck-mounted	Drilling Method	: Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	SAMPLES Number	Type	SPT 'N' Value	Elevation Scale (m)
	179.0	**GROUND SURFACE**				
0	178.8 0.2	150mm **ASPHALTIC CONCRETE**				
	178.2 0.8	610mm **GRANULAR BASE / SUBBASE**, brown, dry	1	AS	-	
1	177.2 1.8	**FILL**, silty sand, some gravel, compact, dark brown to brown, moist	2	SS	15	178
	177.0 2.0	**SAND**, some silt, trace clay, loose, brown, wet	3	SS	10	



END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

BOREHOLE LOG BH23

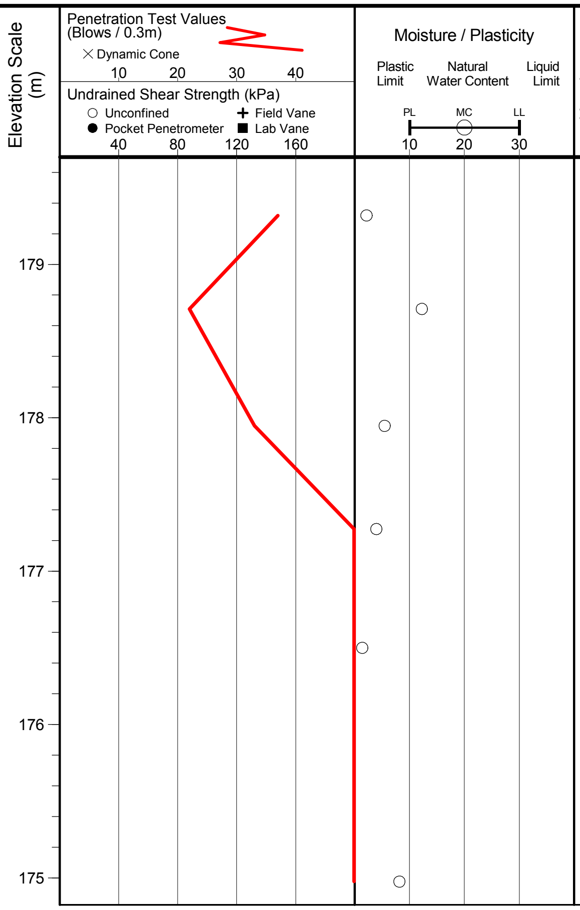
Client : IBI Group
Project : McLaughlin Road
Location : Mississauga, Ontario

Project No.: 11-12-2098
Date started : November 28, 2012
Sheet No. : 1 of 1

Position : E: 606935, N: 4828922 (UTM 17T)
Rig type : truck-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

SOIL PROFILE			SAMPLES		
Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
179.7	**GROUND SURFACE**				
179.5 0.2	150mm **ASPHALTIC CONCRETE**				
	585mm **GRANULAR BASE / SUBBASE**, dense, brown, dry		1	SS	37
179.0 0.7	**FILL**, sandy silt, trace gravel, compact, brown, moist		2	SS	22
178.6 1.1	**SAND**, some silt to silty, trace gravel, trace clay, compact to very dense, brown, moist (GLACIAL TILL)		3	SS	33
			4	SS	50 / 125mm
			5	SS	50 / 150mm
174.8 4.9			6	SS	50 / 150mm

Depth Scale (m): 0, 1, 2, 3, 4



Headspace Vapour | Instrument Details | Unstabilized Water Level | Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%)
GR SA SI CL

...at 4.9m, Auger light grinding

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

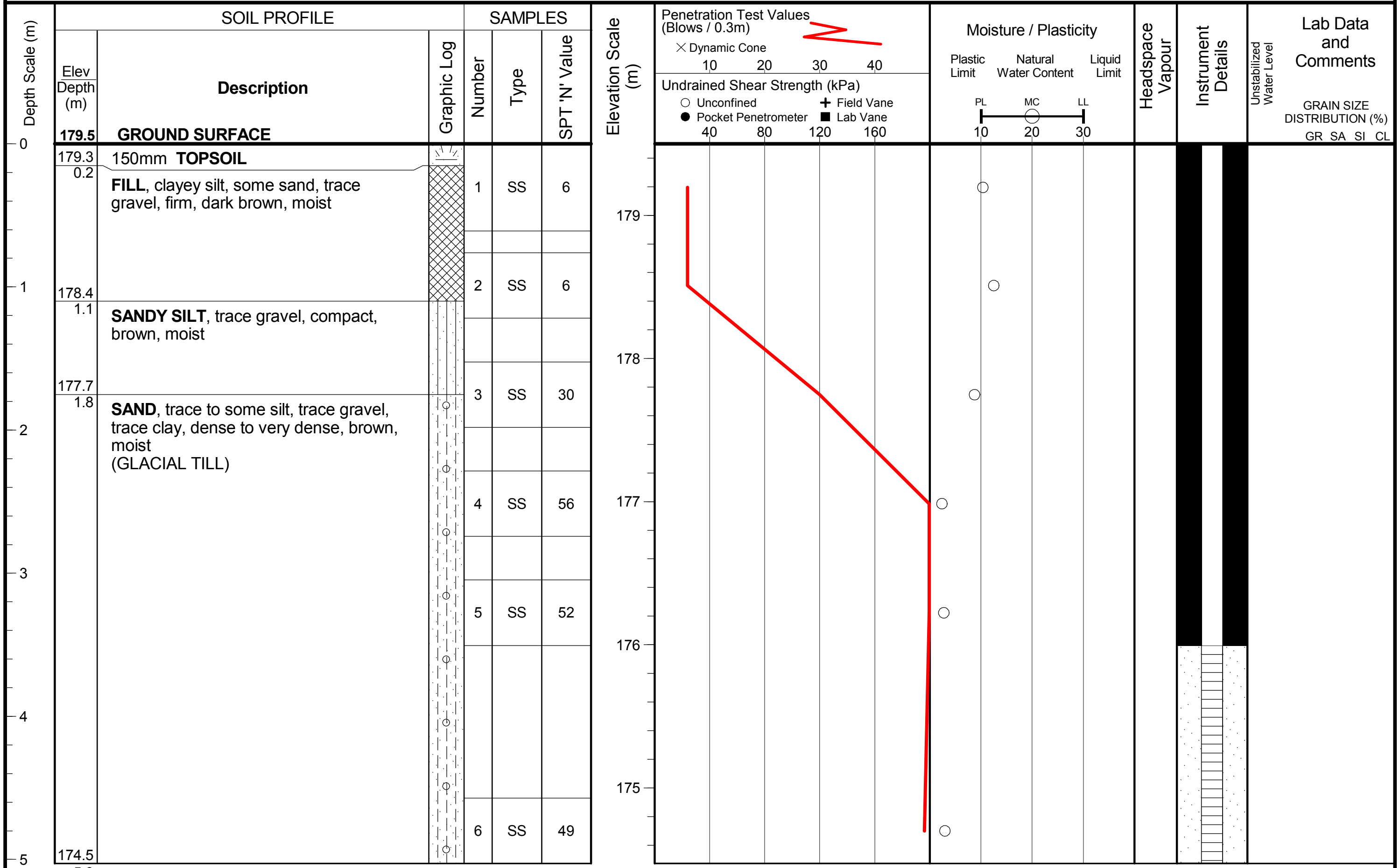
Terraprobe

BOREHOLE LOG BH24

Client : IBI Group
Project : McLaughlin Road
Location : Mississauga, Ontario

Project No.: 11-12-2098
Date started : November 28, 2012
Sheet No. : 1 of 1

Position : E: 607001, N: 4828847 (UTM 17T)
Rig type : truck-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers



SOIL PROFILE

Elev Depth (m)	Description
179.5	**GROUND SURFACE**
179.3 0.2	150mm **TOPSOIL**
	FILL, clayey silt, some sand, trace gravel, firm, dark brown, moist
178.4 1.1	**SANDY SILT**, trace gravel, compact, brown, moist
177.7 1.8	**SAND**, trace to some silt, trace gravel, trace clay, dense to very dense, brown, moist (GLACIAL TILL)
174.5 5.0	

SAMPLES

Number	Type	SPT 'N' Value
1	SS	6
2	SS	6
3	SS	30
4	SS	56
5	SS	52
6	SS	49

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Jan 18, 2013	dry	n/a

BOREHOLE LOG BH25

Client : IBI Group
Project : McLaughlin Road
Location : Mississauga, Ontario

Project No.: 11-12-2098
Date started : December 4, 2012
Sheet No. : 1 of 1

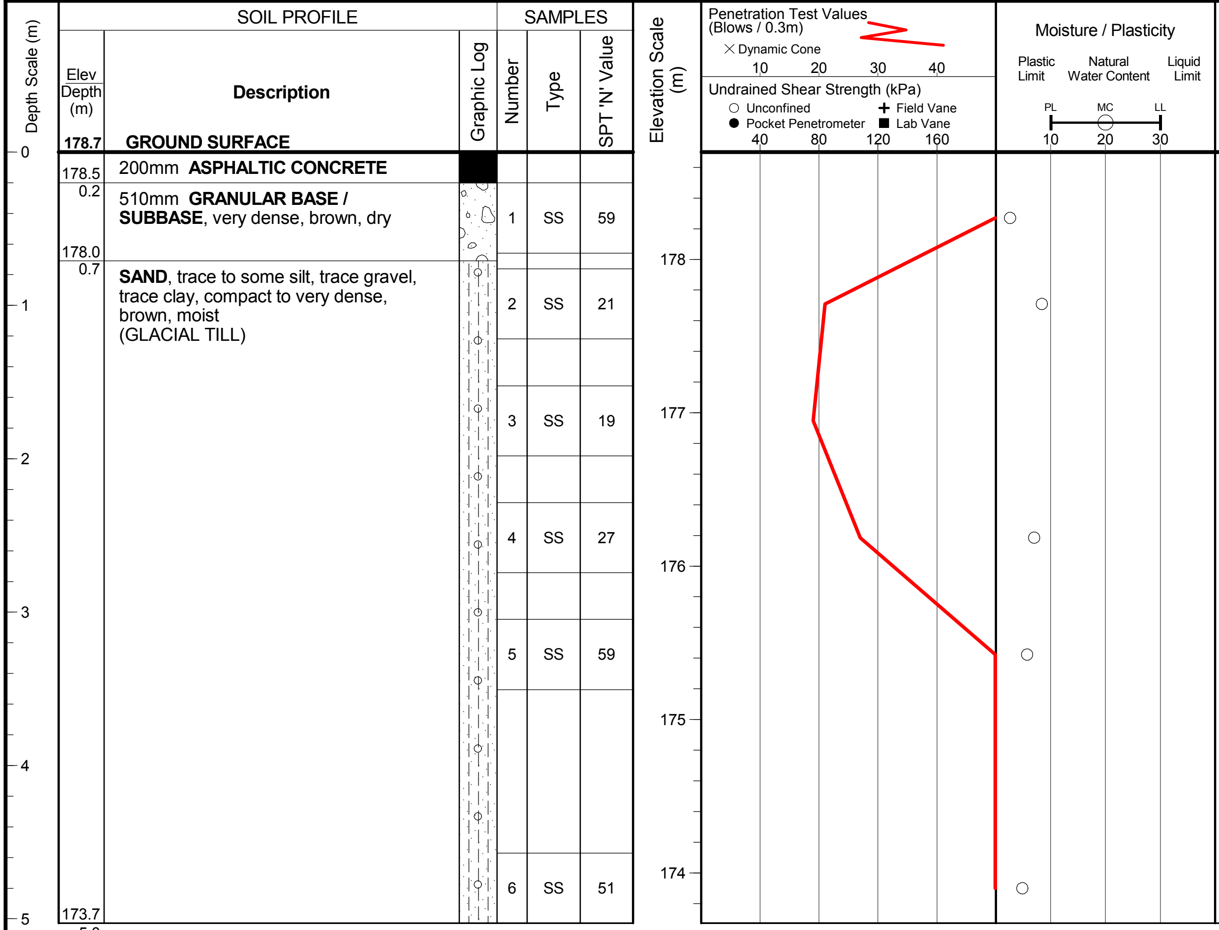
Position : E: 607052, N: 4828811 (UTM 17T)
Rig type : truck-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

SOIL PROFILE

Elev Depth (m)	Description
178.7	**GROUND SURFACE**
	200mm **ASPHALTIC CONCRETE**
178.5 0.2	510mm **GRANULAR BASE / SUBBASE**, very dense, brown, dry
178.0 0.7	**SAND**, trace to some silt, trace gravel, trace clay, compact to very dense, brown, moist (GLACIAL TILL)
173.7 5.0	**END OF BOREHOLE** Borehole was dry and open upon completion of drilling.

SAMPLES

Number	Type	SPT 'N' Value	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
1	SS	59	
2	SS	21	
3	SS	19	
4	SS	27	4 74 14 8
5	SS	59	
6	SS	51	



Headspace Vapour | Instrument Details | Unstabilized Water Level

BOREHOLE LOG BH26

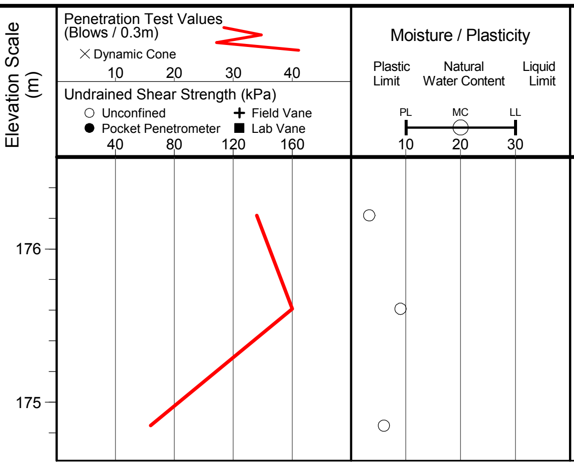
Client : IBI Group
Project : McLaughlin Road
Location : Mississauga, Ontario

Project No.: 11-12-2098
Date started : December 3, 2012
Sheet No. : 1 of 1

Position : E: 607116, N: 4828741 (UTM 17T)
Rig type : truck-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description
0	176.6	**GROUND SURFACE**
	176.4 0.2	150mm **ASPHALTIC CONCRETE**
	175.9 0.7	560mm **GRANULAR BASE / SUBBASE**, dense, brown, dry
1	174.6 2.0	**SILTY SAND**, trace gravel, trace clay, compact to dense, brown, moist (GLACIAL TILL)

Number	Type	SPT 'N' Value
1	SS	34
2	SS	40
3	SS	16



Headspace Vapour | Instrument Details | Unstabilized Water Level | Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

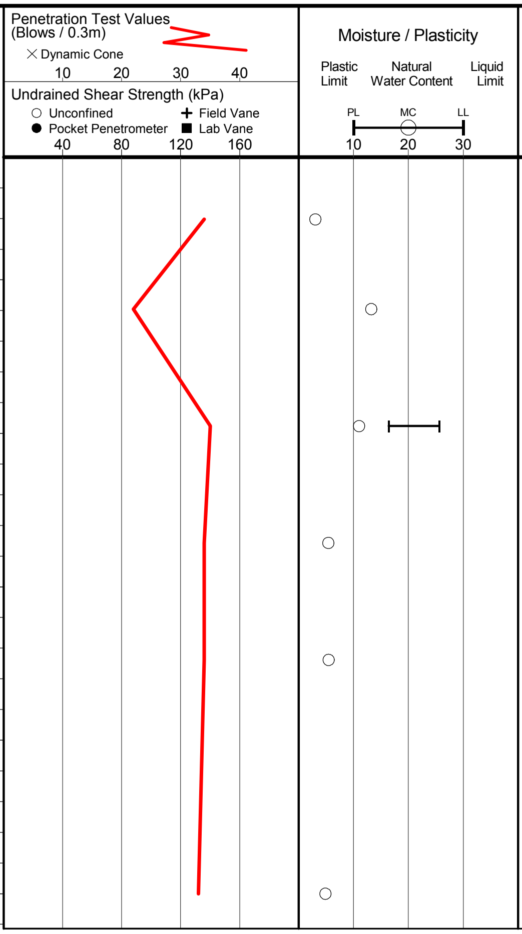
BOREHOLE LOG BH27

Client : IBI Group
Project : McLaughlin Road
Location : Mississauga, Ontario

Project No.: 11-12-2098
Date started : December 3, 2012
Sheet No. : 1 of 1

Position : E: 607194, N: 4828673 (UTM 17T)
Rig type : truck-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Elev Depth (m)	SOIL PROFILE Description	SAMPLES Number	Type	SPT 'N' Value	Elevation Scale (m)	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
175.8	**GROUND SURFACE**					
175.6 0.2	170mm **ASPHALTIC CONCRETE**					
175.2 0.6	380mm **GRANULAR BASE / SUBBASE**, dense, brown, dry	1	SS	34		
	CLAYEY SILT, sandy, trace to some gravel, very stiff to hard, brown, moist (GLACIAL TILL)	2	SS	22	175	
173.5 2.3		3	SS	35	174	8 28 45 19
	SAND, trace to some silt, trace gravel, trace clay, compact, brown, moist (GLACIAL TILL)	4	SS	34	173	
		5	SS	34	172	
170.8 5.0		6	SS	33	171	



Headspace Vapour | Instrument Details | Unstabilized Water Level

Depth Scale (m): 0, 1, 2, 3, 4, 5

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Terraprobe

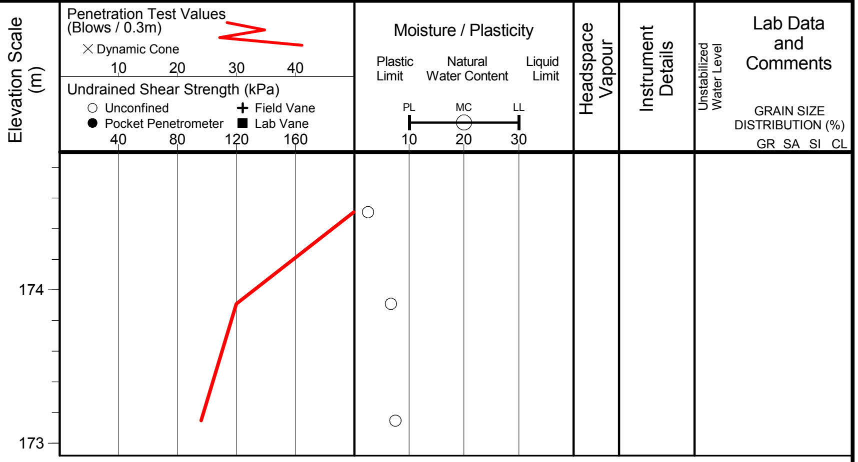
BOREHOLE LOG BH28

Client : IBI Group
Project : McLaughlin Road
Location : Mississauga, Ontario

Project No.: 11-12-2098
Date started : December 3, 2012
Sheet No. : 1 of 1

Position : E: 607273, N: 4828691 (UTM 17T)
Rig type : truck-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	Graphic Log	SAMPLES Number	Type	SPT 'N' Value
0	174.9	**GROUND SURFACE**				
	174.7	180mm **ASPHALTIC CONCRETE**	■			
	0.2 174.2	530mm **GRANULAR BASE / SUBBASE**, brown, dry		1	AS	-
1	0.7 173.4	**FILL**, silty sand, some gravel, compact, greyish brown, moist	▨	2	SS	30
	1.5 172.9	**SILTY SAND**, trace gravel, trace clay, compact, brown, moist (GLACIAL TILL)		3	SS	24
	2.0	**END OF BOREHOLE**				



Borehole was dry and open upon completion of drilling.

BOREHOLE LOG BH29

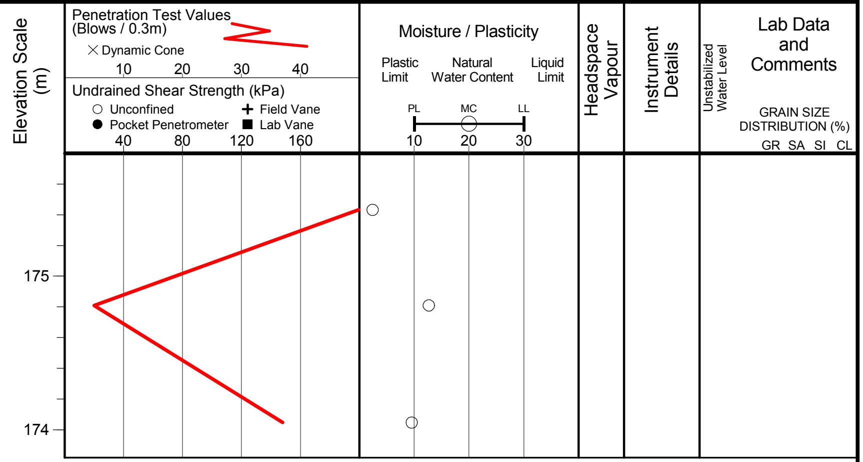
Client : IBI Group
Project : McLaughlin Road
Location : Mississauga, Ontario

Project No.: 11-12-2098
Date started : December 4, 2012
Sheet No. : 1 of 1

Position : E: 607182, N: 4828599 (UTM 17T)
Rig type : truck-mounted
Elevation Datum : Geodetic
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Number	Type	SPT 'N' Value
0	**175.8**	**GROUND SURFACE**			
		150mm **ASPHALTIC CONCRETE**			
	175.6 0.2	560mm **GRANULAR BASE / SUBBASE**, brown, dry	1	AS	-
1	175.1 0.7	**FILL**, clayey silt, some sand, trace gravel, firm, brown, moist	2	SS	5
	174.3 1.5	**SILTY SAND**, trace gravel, trace clay, dense, brown, moist (GLACIAL TILL)	3	SS	37
	173.8 2.0	**END OF BOREHOLE**			

Borehole was dry and open upon completion of drilling.



Terraprobe

BOREHOLE LOG BH30

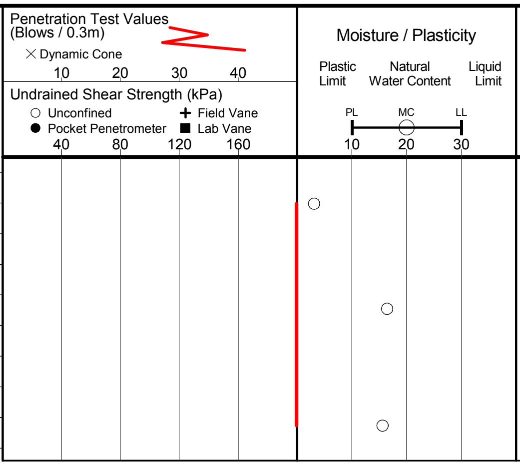
Client	: IBI Group	Project No.:	11-12-2098
Project	: McLaughlin Road	Date started :	December 4, 2012
Location	: Mississauga, Ontario	Sheet No. :	1 of 1

Position	: E: 607277, N: 4828597 (UTM 17T)	Elevation Datum	: Geodetic
Rig type	: truck-mounted	Drilling Method	: Solid stem augers

Depth Scale (m)	Elev Depth (m)	SOIL PROFILE Description	Graphic Log	SAMPLES Number	Type	SPT 'N' Value	Elevation Scale (m)
0	**174.7**	**GROUND SURFACE**					
	174.5 0.2	150mm **ASPHALTIC CONCRETE**					
		560mm **GRANULAR BASE / SUBBASE**, brown, dry		1	AS	-	
	174.0 0.7	**CLAYEY SILT**, some sand, trace gravel, very stiff, brown, moist (GLACIAL TILL)					174
1				2	AS	-	
				3	AS	-	173
	172.7 2.0						

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.



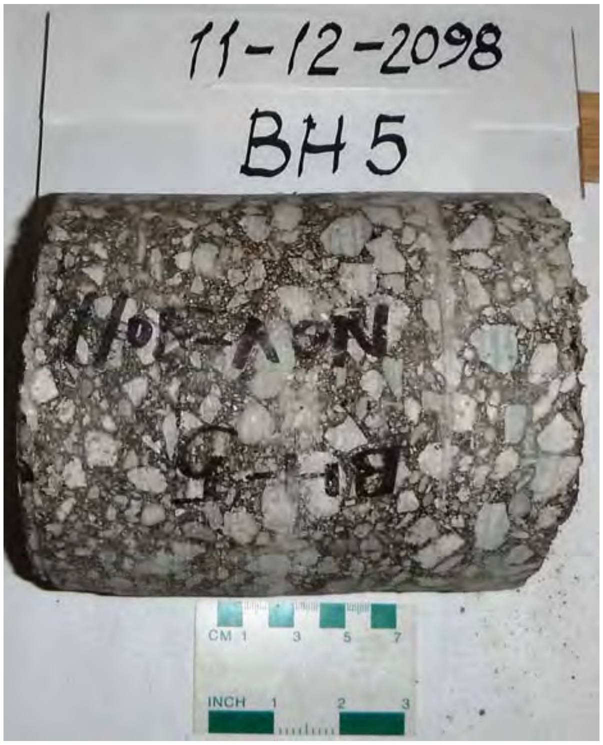
Headspace Vapour	Instrument Details	Unstabilized Water Level	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) GR SA SI CL

Borehole 3

90m S of Britannia Rd W

NB Passing lane

Lift	Thickness (mm)
HL3	50
HL8	60
HL8	60
Total	170



Borehole 5

70m N of Regal Drive

Centre Lane

Lift	Thickness (mm)
HL3	50
HL8	60
HL8	50
Total	160

Borehole 8

50m N of Matheson Blvd. W

SB Curb Lane

Lift	Thickness (mm)
HL3	40
HL8	50
HL8	40
Total	130

Borehole 12

160m S of Matheson Blvd W

NB Curb Lane

Lift	Thickness (mm)
HL3	30
HL8	50
HL8	60
Total	140

Borehole 15

100m S of Avonwick Ave.

Centre Lane

Lift	Thickness (mm)
HL3	30
HL8	50
HL8	70
Total	150

Borehole 17

170m N of Ceremonial Dr.

NB Turning lane

Lift	Thickness (mm)
HL3	30
HL8	50
HL8	40
Total	120

Borehole 25

40m North of Faith Dr.

SB Turning Lane

Lift	Thickness (mm)
Patchwork	50
HL3	40
HL8	50
HL8	60
Total	200

* debonded between Lifts 1 and 2

Borehole 27

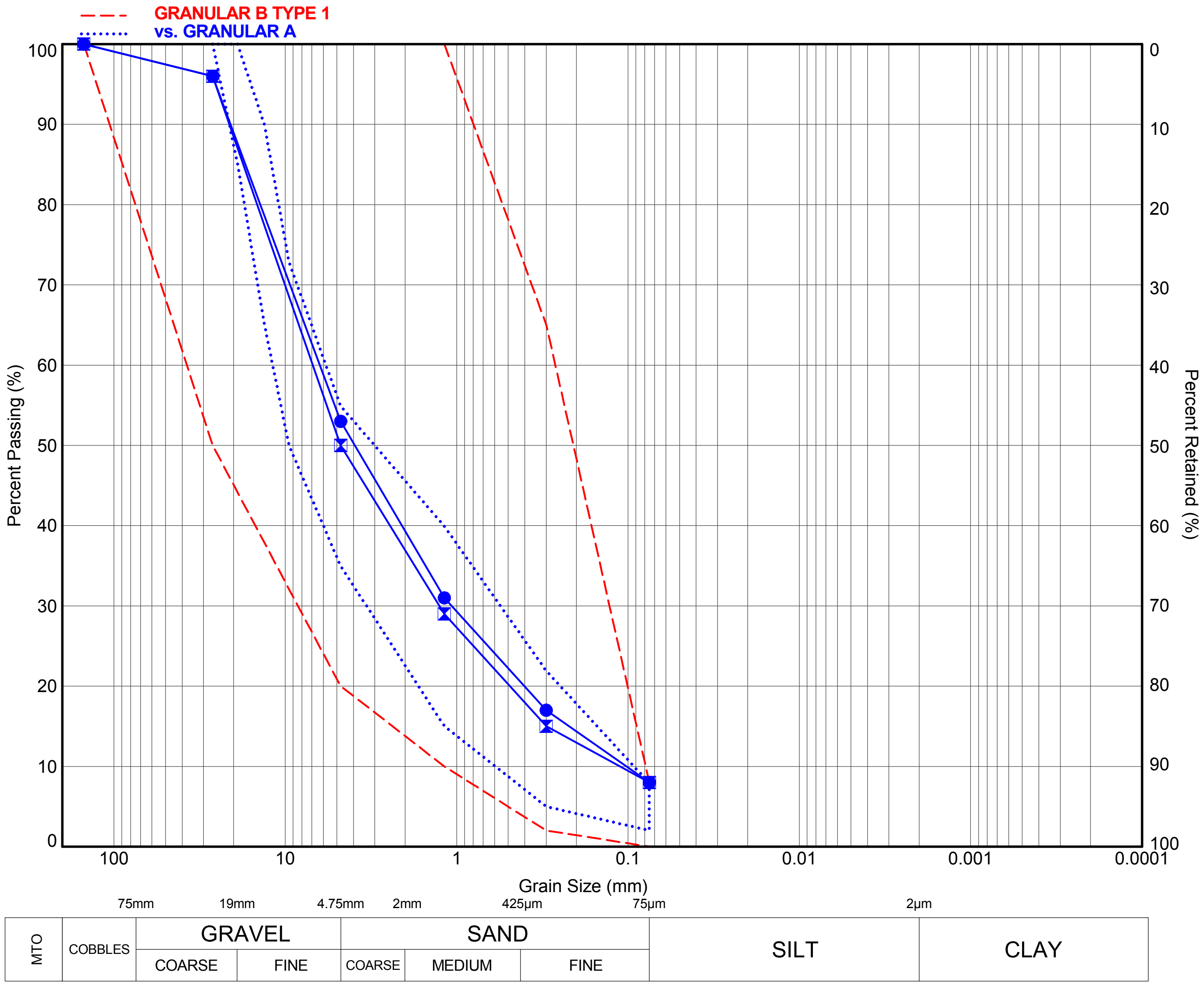
45m N of Bristol Road

NB Curb Lane

Lift	Thickness (mm)
HL3	30
HL8	70
HL8	70
Total	170

APPENDIX B

Laboratory Test Results



*refers to combined clay and silt percentage

	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)**
●	**3 8 12 15**	1	1.0		45	47			*(8)*
⧗	**16 20**	1	1.0		48	44			*(8)*

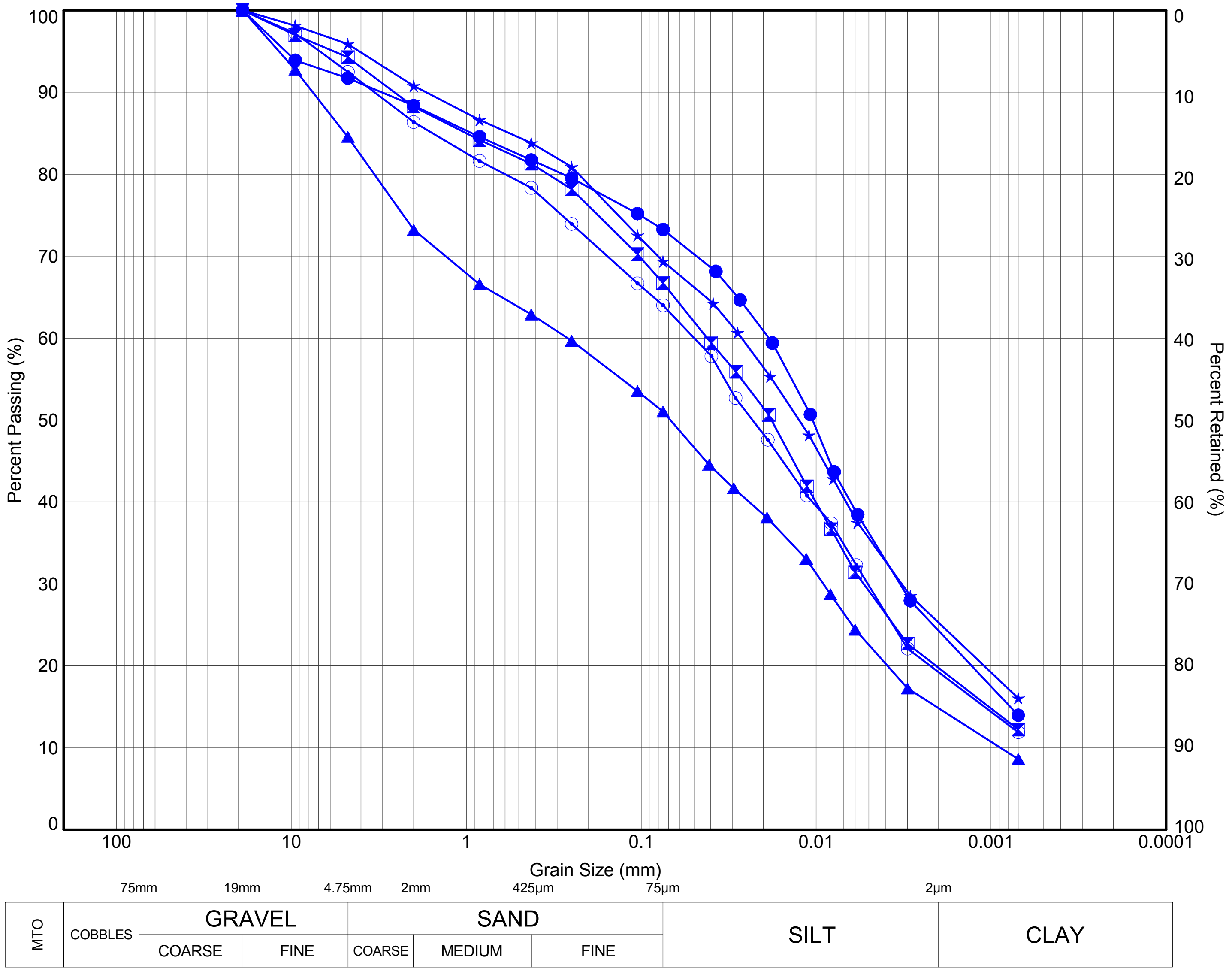
Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
FIGURE B1 - BASE / SUBBASE COURSES

File No.: **11-12-2098**



	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**BH2**	SS3	1.8	177.7	8	19	49	24	
⧗	**BH3**	SS5	3.3	176.0	6	27	47	20	
▲	**BH5**	SS4	2.4	175.9	15	34	36	15	
★	**BH9**	SS2	1.0	178.4	4	27	44	25	
⊙	**BH27**	SS3	1.8	174.0	8	28	45	19	

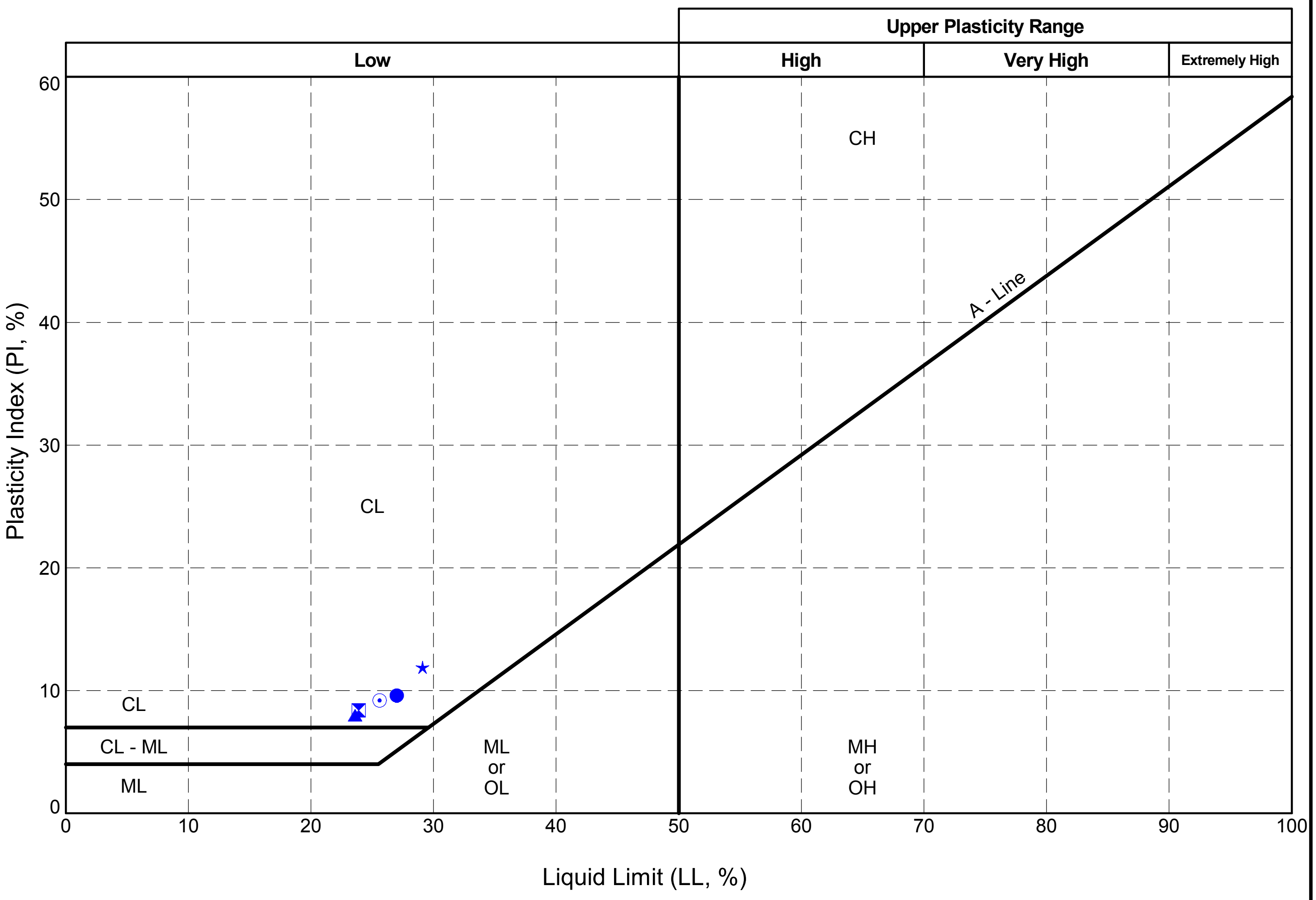
Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
FIGURE B2 - CLAYEY TO SILTY CLAY TILL

File No.: **11-12-2098**



	Borehole	Sample	Depth (m)	Elev. (m)	LL (%)	PL (%)	PI (%)
●	BH2	SS3	1.8	177.7	27	17	10
⧗	BH3	SS5	3.3	176.0	24	16	8
▲	BH5	SS4	2.4	175.9	24	16	8
★	BH9	SS2	1.0	178.4	29	17	12
⊙	BH27	SS3	1.8	174.0	26	16	10

Terraprobe

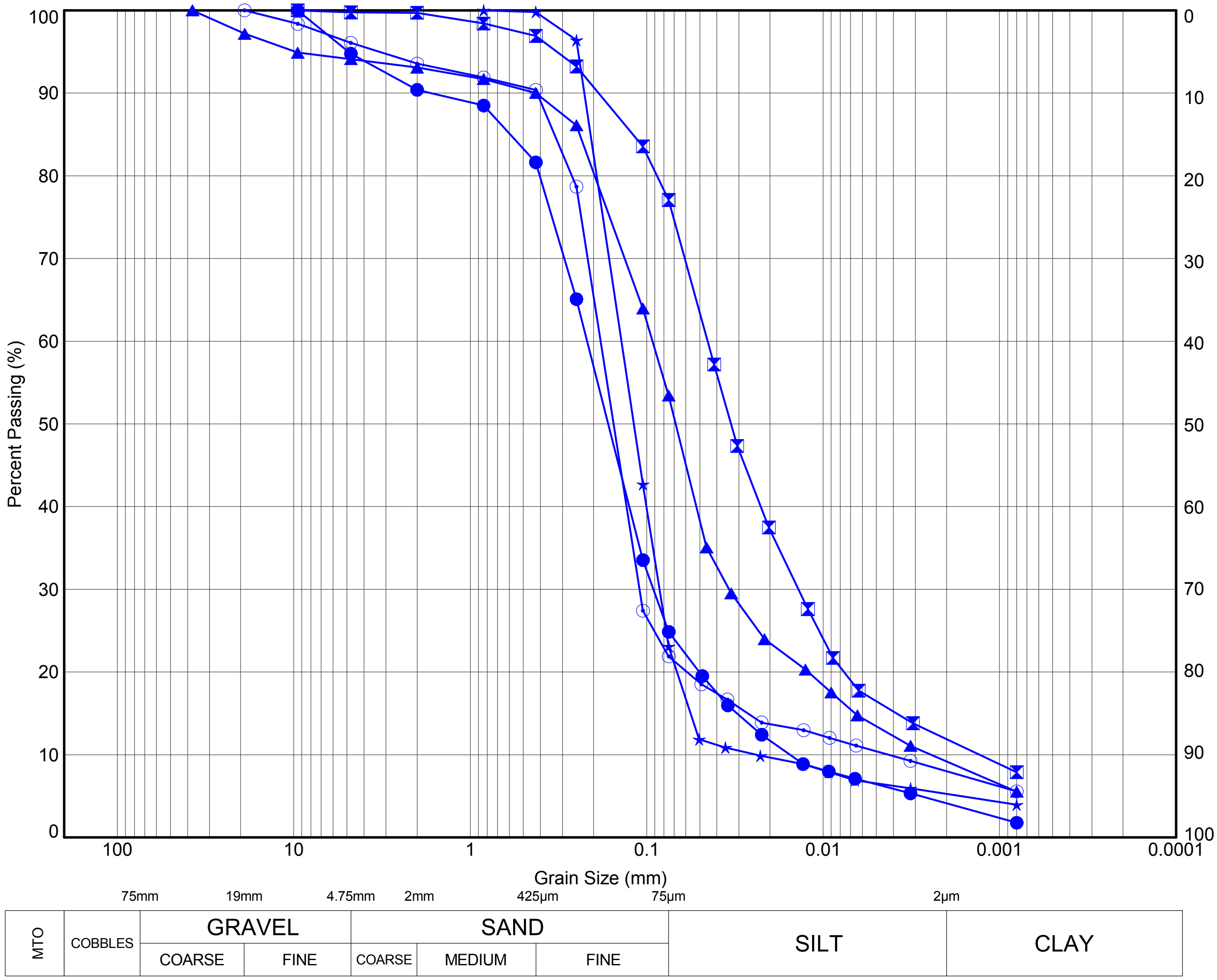
11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

ATTERBERG LIMITS CHART
FIGURE B3 - CLAYEY SILT TILL

File No.:

11-12-2098



	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**BH8**	SS2	1.0	177.0	5	70	21	4	
⧗	**BH11**	SS3	1.8	179.5	0	23	65	12	
▲	**BH15**	SS4	2.5	181.0	6	41	44	9	
★	**BH20**	SS7	4.8	173.5	0	77	18	5	
⊙	**BH25**	SS4	2.5	176.2	4	74	14	8	

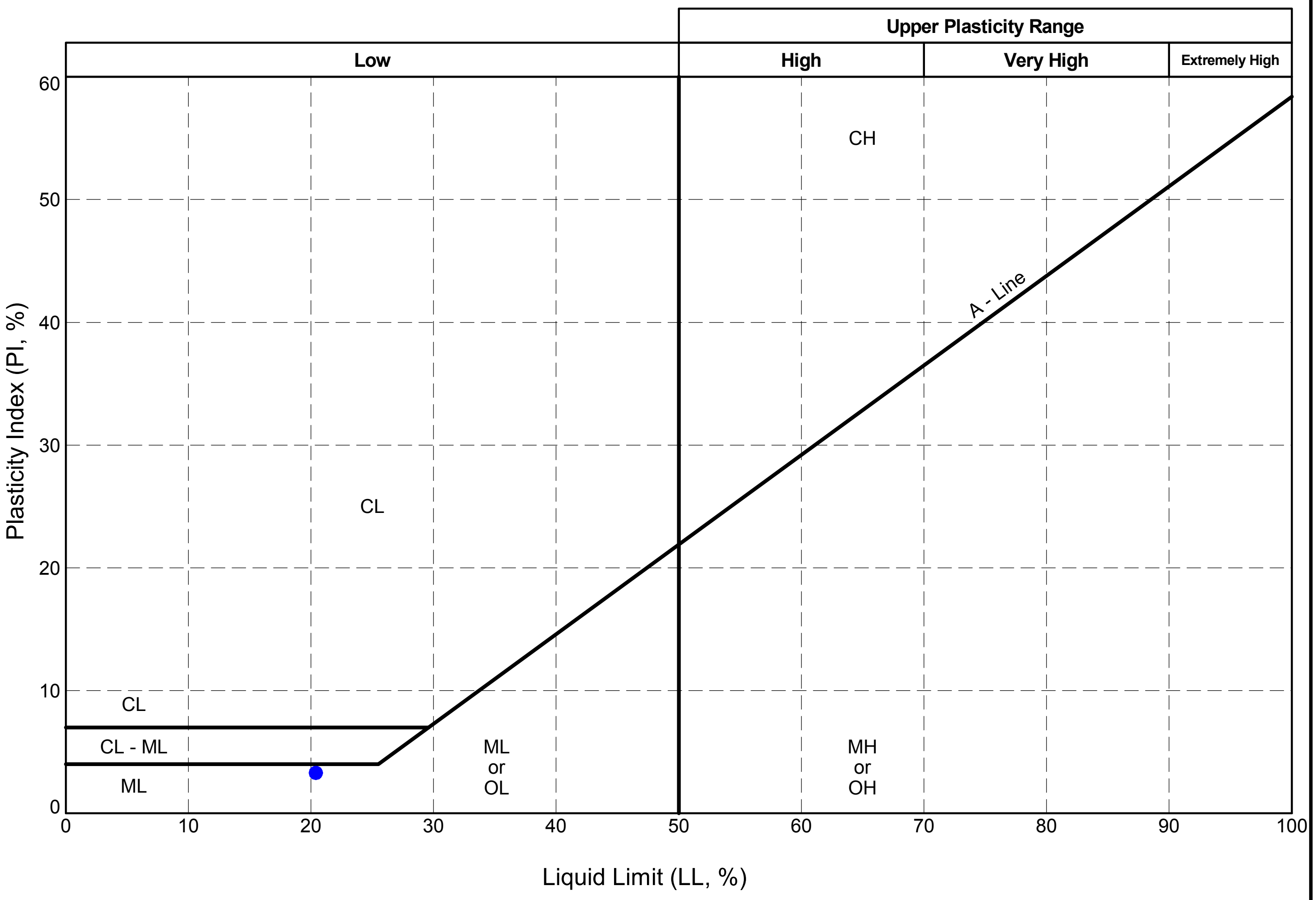
Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
FIGURE B4 - SILTY SAND TO SANDY SILT TILL

File No.: **11-12-2098**



	Borehole	Sample	Depth (m)	Elev. (m)	LL (%)	PL (%)	PI (%)	
●	BH11	SS3	1.8	179.5	20	17	3	,

Terraprobe

11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

PLASTICITY CHART
FIGURE B5 - SILTY SAND TO SANDY SILT TILL

File No.:

11-12-2098

APPENDIX C

Certificates of Chemical Analysis
(Soil Chemistry)

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

CLIENT NAME: TERRAPROBE INC.
11 INDELL LANE
BRAMPTON, ON L6T3Y3
(905) 796-2650

ATTENTION TO: Seth Zhang

PROJECT NO:

AGAT WORK ORDER: 13T676850

SOIL ANALYSIS REVIEWED BY: Elizabeth Polakowska, MSc (Animal Sci), PhD (Agri Sci), Inorganic Lab Supervisor

DATE REPORTED: Jan 07, 2013

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.

Certificate of Analysis

AGAT WORK ORDER: 13T676850
PROJECT NO:

CLIENT NAME: TERRAPROBE INC.
ATTENTION TO: Seth Zhang

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

DATE RECEIVED: 2013-01-02
DATE REPORTED: 2013-01-07

				SAMPLE DESCRIPTION:	BH1SS3	BH4SS3	BH7SS3	BH12SS5	BH17SS6	BH19SS4	BH23SS6
				SAMPLE TYPE:	Soil	Soil	Soil	Soil	Soil	Soil	Soil
				DATE SAMPLED:	12/3/2012	12/3/2012	11/30/2012	11/29/2012	11/28/2012	11/28/2012	12/28/2012
Parameter	Unit	G / S: A	G / S: B	RDL	4052945	4052952	4052955	4052957	4052959	4052961	4052965
Antimony	µg/g	1.3	50	0.8	<0.8[<A]	<0.8[<A]	<0.8[<A]	<0.8[<A]	<0.8[<A]	<0.8[<A]	<0.8[<A]
Arsenic	µg/g	18	18	1	7[<A]	6[<A]	7[<A]	6[<A]	2[<A]	1[<A]	2[<A]
Barium	µg/g	220	670	2	77[<A]	74[<A]	84[<A]	52[<A]	18[<A]	9[<A]	34[<A]
Beryllium	µg/g	2.5	10	0.5	0.8[<A]	0.7[<A]	0.8[<A]	0.6[<A]	<0.5[<A]	<0.5[<A]	<0.5[<A]
Boron	µg/g	36	120	5	11[<A]	9[<A]	8[<A]	9[<A]	5[<A]	<5[<A]	<5[<A]
Boron (Hot Water Soluble)	µg/g		2	0.10	0.12[<B]	0.13[<B]	0.25[<B]	<0.10[<B]	0.52[<B]	<0.10[<B]	<0.10[<B]
Cadmium	µg/g	1.2	1.9	0.5	<0.5[<A]	<0.5[<A]	<0.5[<A]	<0.5[<A]	<0.5[<A]	<0.5[<A]	<0.5[<A]
Chromium	µg/g	70	160	2	25[<A]	21[<A]	23[<A]	18[<A]	7[<A]	4[<A]	6[<A]
Cobalt	µg/g	21	100	0.5	18.0[<A]	12.9[<A]	12.9[<A]	13.3[<A]	3.6[<A]	1.9[<A]	3.3[<A]
Copper	µg/g	92	300	1	41[<A]	35[<A]	40[<A]	29[<A]	11[<A]	5[<A]	20[<A]
Lead	µg/g	120	120	1	15[<A]	11[<A]	15[<A]	7[<A]	13[<A]	3[<A]	5[<A]
Molybdenum	µg/g	2	40	0.5	<0.5[<A]	<0.5[<A]	<0.5[<A]	<0.5[<A]	<0.5[<A]	<0.5[<A]	<0.5[<A]
Nickel	µg/g	82	340	1	34[<A]	26[<A]	27[<A]	24[<A]	6[<A]	3[<A]	5[<A]
Selenium	µg/g	1.5	5.5	0.4	<0.4[<A]	<0.4[<A]	<0.4[<A]	<0.4[<A]	<0.4[<A]	<0.4[<A]	<0.4[<A]
Silver	µg/g	0.5	50	0.2	<0.2[<A]	<0.2[<A]	<0.2[<A]	<0.2[<A]	<0.2[<A]	<0.2[<A]	<0.2[<A]
Thallium	µg/g	1	3.3	0.4	<0.4[<A]	<0.4[<A]	<0.4[<A]	<0.4[<A]	<0.4[<A]	<0.4[<A]	<0.4[<A]
Uranium	µg/g	2.5	33	0.5	0.5[<A]	0.5[<A]	0.5[<A]	<0.5[<A]	<0.5[<A]	<0.5[<A]	<0.5[<A]
Vanadium	µg/g	86	86	1	31[<A]	28[<A]	32[<A]	25[<A]	12[<A]	6[<A]	11[<A]
Zinc	µg/g	290	340	5	79[<A]	64[<A]	74[<A]	65[<A]	30[<A]	9[<A]	19[<A]
Chromium VI	µg/g	0.66	10	0.2	<0.2[<A]	<0.2[<A]	<0.2[<A]	<0.2[<A]	<0.2[<A]	<0.2[<A]	<0.2[<A]
Cyanide	µg/g	0.051	0.051	0.040	<0.040[<A]	<0.040[<A]	<0.040[<A]	<0.040[<A]	<0.040[<A]	<0.040[<A]	<0.040[<A]
Mercury	µg/g	0.27	20	0.10	<0.10[<A]	<0.10[<A]	<0.10[<A]	<0.10[<A]	<0.10[<A]	<0.10[<A]	<0.10[<A]
Electrical Conductivity (2:1)	mS/cm	0.57	1.4	0.005	1.08[A-B]	3.30[>B]	0.471[<A]	0.604[A-B]	0.382[<A]	0.284[<A]	1.16[A-B]
Sodium Adsorption Ratio	NA	2.4	12	NA	8.78[A-B]	49.8[>B]	4.52[A-B]	14.4[>B]	11.1[A-B]	6.50[A-B]	4.07[A-B]
pH, 2:1 CaCl2 Extraction	pH Units			NA	7.75	7.80	7.28	7.91	8.09	8.04	7.91

Certified By: Elizabeth Rolakowska

Certificate of Analysis

AGAT WORK ORDER: 13T676850
PROJECT NO:

CLIENT NAME: TERRAPROBE INC.

ATTENTION TO: Seth Zhang

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

DATE RECEIVED: 2013-01-02

DATE REPORTED: 2013-01-07

				SAMPLE DESCRIPTION:	BH26SS3	BH29SS3
				SAMPLE TYPE:	Soil	Soil
				DATE SAMPLED:	12/3/2012	12/3/2012
Parameter	Unit	G / S: A	G / S: B	RDL	4052969	4052972
Antimony	µg/g	1.3	50	0.8	<0.8[<A]	<0.8[<A]
Arsenic	µg/g	18	18	1	2[<A]	3[<A]
Barium	µg/g	220	670	2	14[<A]	29[<A]
Beryllium	µg/g	2.5	10	0.5	<0.5[<A]	<0.5[<A]
Boron	µg/g	36	120	5	<5[<A]	<5[<A]
Boron (Hot Water Soluble)	µg/g		2	0.10	<0.10[<B]	<0.10[<B]
Cadmium	µg/g	1.2	1.9	0.5	<0.5[<A]	<0.5[<A]
Chromium	µg/g	70	160	2	6[<A]	9[<A]
Cobalt	µg/g	21	100	0.5	3.2[<A]	5.4[<A]
Copper	µg/g	92	300	1	7[<A]	20[<A]
Lead	µg/g	120	120	1	4[<A]	6[<A]
Molybdenum	µg/g	2	40	0.5	<0.5[<A]	<0.5[<A]
Nickel	µg/g	82	340	1	5[<A]	10[<A]
Selenium	µg/g	1.5	5.5	0.4	<0.4[<A]	<0.4[<A]
Silver	µg/g	0.5	50	0.2	<0.2[<A]	<0.2[<A]
Thallium	µg/g	1	3.3	0.4	<0.4[<A]	<0.4[<A]
Uranium	µg/g	2.5	33	0.5	<0.5[<A]	<0.5[<A]
Vanadium	µg/g	86	86	1	13[<A]	15[<A]
Zinc	µg/g	290	340	5	18[<A]	29[<A]
Chromium VI	µg/g	0.66	10	0.2	<0.2[<A]	<0.2[<A]
Cyanide	µg/g	0.051	0.051	0.040	<0.040[<A]	<0.040[<A]
Mercury	µg/g	0.27	20	0.10	<0.10[<A]	<0.10[<A]
Electrical Conductivity (2:1)	mS/cm	0.57	1.4	0.005	2.59[>B]	0.814[A-B]
Sodium Adsorption Ratio	NA	2.4	12	NA	32.5[>B]	20.1[>B]
pH, 2:1 CaCl2 Extraction	pH Units			NA	8.05	7.92

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: A Refers to T1(ALL) - Current, B Refers to T3(ICC,MFT) Current
4052945-4052972 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.

Certified By: Elizabeth Rolakowska

Guideline Violation

AGAT WORK ORDER: 13T676850
PROJECT NO:

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

CLIENT NAME: TERRAPROBE INC.

ATTENTION TO: Seth Zhang

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	GUIDEVALUE	RESULT
4052945	BH1SS3	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	0.57	1.08
4052945	BH1SS3	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	8.78
4052952	BH4SS3	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	0.57	3.30
4052952	BH4SS3	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	49.8
4052952	BH4SS3	T3(ICC,MFT) Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	1.4	3.30
4052952	BH4SS3	T3(ICC,MFT) Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	12	49.8
4052955	BH7SS3	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	4.52
4052957	BH12SS5	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	0.57	0.604
4052957	BH12SS5	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	14.4
4052957	BH12SS5	T3(ICC,MFT) Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	12	14.4
4052959	BH17SS6	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	11.1
4052961	BH19SS4	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	6.50
4052965	BH23SS6	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	0.57	1.16
4052965	BH23SS6	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	4.07
4052969	BH26SS3	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	0.57	2.59
4052969	BH26SS3	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	32.5
4052969	BH26SS3	T3(ICC,MFT) Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	1.4	2.59
4052969	BH26SS3	T3(ICC,MFT) Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	12	32.5
4052972	BH29SS3	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	0.57	0.814
4052972	BH29SS3	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	20.1
4052972	BH29SS3	T3(ICC,MFT) Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	12	20.1

Quality Assurance

CLIENT NAME: TERRAPROBE INC.
AGAT WORK ORDER: 13T676850

PROJECT NO:
ATTENTION TO: Seth Zhang

Soil Analysis

RPT Date: Jan 07, 2013			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	1	4052945	< 0.8	< 0.8	0.0%	< 0.8	99%	70%	130%	106%	80%	120%	100%	70%	130%
Arsenic	1	4052945	7	7	0.0%	< 1	110%	70%	130%	117%	80%	120%	106%	70%	130%
Barium	1	4052945	77	73	5.3%	< 2	108%	70%	130%	111%	80%	120%	108%	70%	130%
Beryllium	1	4052945	0.8	0.7	13.3%	< 0.5	86%	70%	130%	100%	80%	120%	93%	70%	130%
Boron	1	4052945	11	11	0.0%	< 5	81%	70%	130%	116%	80%	120%	99%	70%	130%
Boron (Hot Water Soluble)	1	4052945	0.12	0.14	10.9%	< 0.10	94%	60%	140%	94%	70%	130%	101%	60%	140%
Cadmium	1	4052945	< 0.5	< 0.5	0.0%	< 0.5	84%	70%	130%	106%	80%	120%	102%	70%	130%
Chromium	1	4052945	25	25	0.0%	< 2	86%	70%	130%	116%	80%	120%	105%	70%	130%
Cobalt	1	4052945	18.0	17.4	3.4%	< 0.5	97%	70%	130%	115%	80%	120%	99%	70%	130%
Copper	1	4052945	41	41	0.0%	< 1	98%	70%	130%	116%	80%	120%	96%	70%	130%
Lead	1	4052945	15	15	0.0%	< 1	114%	70%	130%	116%	80%	120%	103%	70%	130%
Molybdenum	1	4052945	< 0.5	< 0.5	0.0%	< 0.5	108%	70%	130%	104%	80%	120%	104%	70%	130%
Nickel	1	4052945	34	34	0.0%	< 1	94%	70%	130%	114%	80%	120%	95%	70%	130%
Selenium	1	4052945	< 0.4	< 0.4	0.0%	< 0.4	99%	70%	130%	99%	80%	120%	100%	70%	130%
Silver	1	4052945	< 0.2	< 0.2	0.0%	< 0.2	112%	70%	130%	114%	80%	120%	111%	70%	130%
Thallium	1	4052945	< 0.4	< 0.4	0.0%	< 0.4	93%	70%	130%	108%	80%	120%	98%	70%	130%
Uranium	1	4052945	0.5	0.5	0.0%	< 0.5	106%	70%	130%	104%	80%	120%	99%	70%	130%
Vanadium	1	4052945	31	30	3.3%	< 1	95%	70%	130%	115%	80%	120%	104%	70%	130%
Zinc	1	4052945	79	79	0.0%	< 5	102%	70%	130%	116%	80%	120%	101%	70%	130%
Chromium VI	1	4052961	< 0.2	< 0.2	0.0%	< 0.2	99%	70%	130%	108%	80%	120%	107%	70%	130%
Cyanide	1	4052945	< 0.040	< 0.040	0.0%	< 0.040	95%	70%	130%	110%	80%	120%	93%	70%	130%
Mercury	1	4052945	< 0.10	< 0.10	0.0%	< 0.10	99%	70%	130%	90%	80%	120%	85%	70%	130%
Electrical Conductivity (2:1)	1	4052945	1.08	1.07	0.9%	< 0.005	102%	90%	110%	NA			NA		
Sodium Adsorption Ratio	1	4052945	8.78	8.86	0.9%	NA	NA			NA			NA		
pH, 2:1 CaCl2 Extraction	1	4052961	8.04	7.94	1.3%	NA	102%	90%	110%	NA			NA		

Comments: NA signifies Not Applicable.

Certified By: Elizabeth Polakowska

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

Method Summary

CLIENT NAME: TERRAPROBE INC.

AGAT WORK ORDER: 13T676850

PROJECT NO:

ATTENTION TO: Seth Zhang

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 (2:1)	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 6010C	ICP/OES
pH, 2:1 CaCl2 Extraction	INOR-93-6031	MSA part 3 & SM 4500-H+ B	PH METER

APPENDIX D

Pavement Condition Survey

Ministry of Transportation
Ontario

Flexible Pavement Condition Evaluation Form

Location: McLaughlin Road

From: Britannia Road West **To:** Bristol Road West

LHRS ☐☐☐☐☐ begins ☐☐•☐ offset km **Section Length** 2 2 0 0 m

Survey Date 1 3 year 0 3 month **PCR** 6 6 **RCR** 5 • 0

Contract No. ☐☐ - ☐☐☐☐ **WP No.** ☐☐☐☐☐☐☐☐☐

District ☐☐

Highway ☐☐☐☐

Traffic Direction B — B - both directions; N - northbound; S - southbound; E - eastbound; W - westbound

Facility A — A - all lanes; C - collector; E - express; O - others (additional lanes)

Class C — F - freeway; A - arterial; C - collector; L - local; S - secondary

Ride Condition Rating (at 80 km/hr)

10	Excellent (smooth)
8	Good (comfortable)
6	Fair (uncomfortable)
4	Poor (v. rough/bumpy)
2	Very Poor, (dangerous, at 80 km/hr)
0	

				Severity of Distress					Density of Distress Extent of Occurrence %				
				Very Slight	Slight	Moderate	Severe	Very Severe	Few	Intermittent	Frequent	Extensive	Throughout
									<10	10-20	20-50	50-80	80-100
PAVEMENT				1	2	3	4	5	1	2	3	4	5
	Surface Defects	Ravelling & C. Agg. Loss	1				✓		✓				
		Flushing	2										
	Surface Deformations	Rippling and Shoving	3			✓			✓				
		Wheel Track Rutting	4										
		Distortion	5										
CRACKING	Longitudinal Wheel Track	Single and Multiple	6										
		Alligator	7										
	Centre Line	Single and Multiple	8										
		Alligator	9										
	Pavement Edge	Single and Multiple	10				✓			✓			
		Alligator	11										
	Transverse	Half, Full and Multiple	12				✓				✓		
		Alligator	13										
	Longitudinal Meander and Midlane		14				✓					✓	
	Random / Map		15										

PCI Value: 66

Distress Comments: (items not covered above)

Speed Limit: 50 km/hour

About 250 m south of Bristannia Road West was recently rehabilitated.

Shoulders			Severity of Distress				Density of Distress Extent of Occurrence, %			
Dominant Type		Distress	Right		Left		Right		Left	
			Mod.	Sev.	Mod.	Sev.	10-30	>30	10-30	>30
			1	2	1	2	1	2	1	2
Paved Full		Cracking								
		Pavement Edge/ Curb Separation								
Paved Partial		Distortion								
Surface Treated		Breakup/Separtion								
		Edge Break								
Primed		Breakup/Separtion								
Gravel										

Maintenance Treatment		EXTENT OF OCCURRENCE, %				
		<10	10-20	20-50	50-80	>80
		1	2	3	4	5
Pavement	Manual Patching	✓				
	Machine Patching			✓		
	Spray Patching					
	Rout and Seal Cracks					
	Chip Seal					
Shoulders	Manual Patching					
	Machine Patching					
	Rout and Seal Cracks					
	Chip Seal					

Other Comments: (e.g., subsections, additional contracts)

Evaluated by: **Seth/Matteo**

APPENDIX E

Pavement Design Data

File. No. 11-12-2098

Table E1
McLaughlin Road Class EA Study (Britannia Road West to Bristol Road West)
Ceremonial Drive to Matheson Boulevard
City of Mississauga
Equivalent Single Axle Load Calculations (AADT DATA)

Description - McLaughlin Road			**Year**	
Traffic Data Year		**2011**	**2016**	**2035**
Design Year		2016		
Analysis Period			20	
1a) Average Annual Daily Traffic (AADT)		20,600	21,513	25,364
Annual Growth Rate (%)			0.9	
1b) Truck fraction of total traffic			2%	
Number of lanes in one direction			2	
1c) Directional Factor			0.5	
1d) Lane distribution Factor			0.8	
	Daily Truck Volume		**172**	
Road Classification		**Collector and Local**		
2) Breakdown of Truck Proportions				
	Class 1		0.90	
	Class 2		0.02	
	Class 3		0.05	
	Class 4		0.03	
3) Daily Truck Volumes (4 Classes)			**2016 to 2035**	
	Class 1		155	
	Class 2		3	
	Class 3		9	
	Class 4		5	
4) Truck Factors (4 Classes)				
	Class 1		0.5	
	Class 2		2.3	
	Class 3		1.6	
	Class 4		5.5	
5) Daily ESALs per Truck Class (4 Classes)				
	Class 1		77	
	Class 2		8	
	Class 3		14	
	Class 4		28	
6) Total Daily ESALs in Design Lane			**128**	
7) Total Base Year ESALs			**2016**	
Number of Days of Truck Traffic			300	
	Total Base Year ESALs		**38,259**	
8) Cumulative ESALs for Design Period				
Design Period			20	
Annual Growth Rate (%)			0.9	
Geometric Growth Factor			21.8	
			834,040	
	Cumulative ESALs for the Design Period		**834,000**	

Note: ESAL Calculations are based on "Procedures for Estimating Traffic Loads for Pavement Design",Hajek, J., 1995, and "Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions" (MI-83), 2008.

File. No. 11-12-2098

Table E2
McLaughlin Road Class EA Study (Britannia Road West to Bristol Road West)
Matheson Boulevard to Britannia Road West
City of Mississauga
Equivalent Single Axle Load Calculations (AADT DATA)

Description -Britannia Road			**Year**	
Traffic Data Year		**2011**	**2016**	**2035**
Design Year		2016		
Analysis Period			20	
1a) Average Annual Daily Traffic (AADT)		18,600	19,614	23,998
Annual Growth Rate (%)			1.1	
1b) Truck fraction of total traffic			3%	
Number of lanes in one direction			2	
1c) Directional Factor			0.5	
1d) Lane distribution Factor			0.8	
	Daily Truck Volume		**235**	
Road Classification		**Collector and Local**		
2) Breakdown of Truck Proportions				
	Class 1		0.90	
	Class 2		0.02	
	Class 3		0.05	
	Class 4		0.03	
3) Daily Truck Volumes (4 Classes)			**2016 to 2035**	
	Class 1		212	
	Class 2		5	
	Class 3		12	
	Class 4		7	
4) Truck Factors (4 Classes)				
	Class 1		0.5	
	Class 2		2.3	
	Class 3		1.6	
	Class 4		5.5	
5) Daily ESALs per Truck Class (4 Classes)				
	Class 1		106	
	Class 2		11	
	Class 3		19	
	Class 4		39	
6) Total Daily ESALs in Design Lane			**174**	
7) Total Base Year ESALs			**2016**	
Number of Days of Truck Traffic			300	
	Total Base Year ESALs		**52,322**	
8) Cumulative ESALs for Design Period				
Design Period			20	
Annual Growth Rate (%)			1.1	
Geometric Growth Factor			22.2	
			1,161,555	
	Cumulative ESALs for the Design Period		**1,161,600**	

Note: ESAL Calculations are based on "Procedures for Estimating Traffic Loads for Pavement Design",Hajek, J., 1995, and "Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions" (MI-83), 2008.