Terraprobe

Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

GEOTECHNICAL INVESTIGATION
TRAFALGAR ROAD CLASS ENVIRONMENTAL ASSESSMENT (EA) STUDY
CORNWALL ROAD TO HIGHWAY 407
REGIONAL MUNICIPALITY OF HALTON, ONTARIO

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1 INTRODUCTION

Terraprobe Inc. was retained by AECOM to conduct a geotechnical investigation for the Trafalgar Road Class EA study for a section extending from Cornwall Road to Highway 407, located in the Town of Oakville, Regional Municipality of Halton, Ontario. A site location plan is provided as Figure 1.

The purposes of this investigation were to determine and report the condition and make-up of the existing pavement and subsurface conditions, and to develop cost-effective pavement improvement strategies and provide recommendations for widening lane pavement design and design of a storm sewer.

2 PROJECT AND SITE DESCRIPTION

The section of Trafalgar Road from Cornwall Road to Dundas Street East is generally a north-south oriented regional urban roadway, consisting of two to three through lanes in each direction, while the section from Dundas Street East to Highway 407 is generally a north-south oriented regional rural roadway, consisting of two through lanes in each direction.

It is understood that pavement improvements include widening of Trafalgar Road from Cornwall Road to Highway 407 to three lanes in each direction, consisting of one Bus Rapid Transit (BRT) lane or High Occupancy Vehicle (HOV) lane and two general purpose lanes with an urban cross section. It is also understood that no widening is required for the section from Cornwall Road to Iroquois Shore Road with only minor intersection improvement. The associated works include a storm sewer along Trafalgar Road from Dundas Street East to Highway 407.

Fifty three (53) boreholes were advanced to the depths of about 1.7 to 5.0 m below grade along Trafalgar Road from Iroquois Shore Road to Highway 407. Geotechnical and soil chemistry testing were undertaken on selected samples. Recommendations have been developed by Terraprobe for the BRT or HOV lane pavement design and rehabilitation alternatives for the existing pavements. Design recommendations are also provided for design of the storm sewer, including excavation, pipe bedding/embedment, and backfill considerations, temporary ground water control requirements and disposal of excess excavated materials.

Based on the existing roadway geometry, cross section and pavement surface conditions, Terraprobe has subdivided Trafalgar Road into three (3) sections:

Section 1 Iroquois Shore Road to Marlborough Court;

Section 2 Marlborough Court to Dundas Street East; and

Section 3 Dundas Street East to Highway 407.

3 INVESTIGATION PROCEDURE

The geotechnical investigation for Trafalgar Road Class EA Study consisted of the following tasks:

- Conducting a pavement condition survey;
- Analyzing traffic data provided by the AECOM;
- Advancing boreholes along with coring asphaltic concrete at selected locations;
- Conducting geotechnical and analytical laboratory testing; and
- Interpreting field and laboratory test results, analysis and report preparation.

3.1 Pavement Condition Survey

The site was visited on October 9, 2012 by a Terraprobe pavement engineer, who carried out a detailed visual inspection of the existing pavement within the study area. The survey was conducted in general accordance with the distress descriptions given in *MTO SP-022 Flexible Pavement Condition Rating Guidelines for Municipalities* [1]. During the site visit, the key pavement distresses were observed (noting the type, severity and general density of surface distresses), and the pavement drainage condition and riding condition were also noted.

The photographs and description of the typical pavement distresses as noted during our pavement condition survey are enclosed in Appendix A.

3.2 Traffic Data Analyses

AECOM provided 2008, 2021 and 2031 Annual Average Daily Traffic (AADT) for two (2) alternatives to the roadway widening, i.e. BRT and HOV lanes. The traffic data indicated that the subject roadway sections carried 1.0 to 2.0 percent truck traffic in 2008. The compound annual growth factor was calculated based on AADT data provided on the subject roadway sections. The bus traffic data was obtained based on 2012 Oakville Transit and Go Transit bus schedules.

The above traffic data was interpreted by Terraprobe to estimate the design Equivalent Single Axle Loads (ESALs). A typical combined truck factor of 1.93 was used to estimate the design ESALs on the general purpose lanes, while a truck factor of 2.0 was used to estimate the ESALs on BRT lane and HOV lane. The traffic loading repetitions were determined for a 20-year pavement design life, which is considered typical for pavements of this type. On this basis, the ESAL applications during the design period were calculated in accordance with the Appendix D of *MTO MI-183 Adaption and Verification of AASHTO Pavement Design Guide for Ontario Conditions* [2]. The total design ESALs anticipated over the 20-year design life period on general purpose lanes, BRT and HOV lanes are summarized in Tables 1, 2 and 3, respectively. The detailed traffic analysis and estimated ESALs for the 20-year pavement design life are given in Appendix B Traffic Data Analyses

Table 1 Traffic Data Analyses for BRT Lanes

Roadway Sections	Annual Bus Traffic			Truck Factor	Estimated Design ESALs (Year 2036)
	2012	2021	2031		
Section 1	100,516	138,808	138,808	2.0	5,457,600
Section 2	100,516	138,808	138,808	2.0	5,457,600
Section 3	18,980	26,211	26,211	2.0	1,030,300

Table 2 Traffic Data Analyses for HOV Lanes

Roadway Sections	AADT			Truck Factor	Estimated Design ESALs (Year 2036)
	2008	2021	2031		
Section 1	NA	8,226	8,465	2.0	5,511,700
Section 2	NA	7,364	7,452	2.0	5,636,100
Section 3	NA	9,493	8,762	2.0	1,298,100

Table 3 Traffic Data Analyses for General Purpose Lanes

Roadway Sections	Widening Alternatives	AADT			Truck Factor	Estimated Design ESALs (Year 2036)
		2008	2021	2031		
Section 1	BRT	35,190	46,588	39,488	1.93	4,718,700
	HOV		37,474	38,561	1.93	4,256,100
Section 2	BRT	41,920	35,738	32,263	1.93	3,818,600
	HOV		33,548	33,948	1.93	3,811,900
Section 3	BRT	27,130	45,775	36,438	1.93	4,431,800
	HOV		43,245	39,914	1.93	4,533,500

3.3 Borehole Investigation

Subsequent to obtaining service clearances and a regional roadway occupancy permit, a total of fifty three (53) boreholes were advanced to depths varying between about 1.7 and 5.0 m below grade. The borehole locations and depths were finalized in consultation with AECOM. Boreholes were advanced in terms of depths and locations generally as follows:

- Pavement boreholes were advanced to depths of about 1.7 to 2.0 m below grade on the existing pavement and in the shoulders and boulevards; and
- Boreholes for the storm sewer design from Dundas Street East to Highway 407 were advanced to depths of about 4.7 to 5.0 m below grade in the gravel shoulders and on the existing pavements.

The approximate locations of the boreholes are indicated on the Borehole Location Plans, Sheets 1 to 5 in Appendix C.

The ground surface elevations at the boreholes were inferred from the topographical contour drawing provided by AECOM. The elevations were assumed to have been referenced to geodetic datum. The elevations noted on the borehole logs are provided for the purpose of relating borehole soil stratigraphy and should not be used or relied on for other purposes.

The boreholes were completed between October 16 and 21, 2012 using truck-mounted continuous flight solid stem auger equipment supplied and operated by a specialist drilling contractor. The drilling and sampling operations were observed on a continuous basis by a member of our staff, who also logged the boreholes and cared for the samples recovered. Soil samples were recovered at regular intervals of depth in the boreholes using a 50 mm O.D. split-barrel sampler driven into the soil in accordance with the Standard Penetration Test (SPT) procedure described in *ASTM D1586 - 08a Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils* [3]. The recovered soil samples were visually examined in the field and then preserved and transported to the Terraprobe Brampton laboratory for examination and testing.

In addition, eight (8) asphaltic concrete cores were taken from selected locations using 150 mm diameter diamond core barrel for the laboratory examination and tests. The core logs are given in Appendix D.

Water level observations were completed in all of the open boreholes during and on completion of drilling.

Upon completion, all of the boreholes were backfilled and the pavement reinstated with compacted commercial grade cold mix asphalt patching material. The detailed results of the borehole investigation are presented in the Record of Borehole Sheets in Appendix E.

3.4 Laboratory Testing

The recovered soil samples were examined for visual and textural characteristics by the project engineer. Moisture content determinations were carried out on all of the soil samples. The results of the moisture content testing are shown on the Record of Borehole Sheets in Appendix E. In addition, sieve analyses of three (3) granular base/subbase samples and one (1) gravel shoulder sample, grain size analyses of seven

(7) selected soil samples and Atterberg Limits testing of five (5) selected soil samples were performed. The complete laboratory test results are attached in Appendix F Laboratory Test Results, and noted on the borehole logs at respective sampling depths. Details of laboratory testing plan are summarized in Table 4. The summary of the geotechnical laboratory testing results are included in Table 6, 7 and 8, respectively.

Nine (9) soil samples were selected by Terraprobe and submitted to AGAT Laboratories for soil chemistry analysis for a standard schedule of metals and inorganic parameters included in *Soil, Ground Water and Sediment Standards for Use under Part XV.1 of the Environmental Protection Act,* with recent amendments [4]. In addition, four (4) selected soil samples were also selected and submitted to AGAT for analyses of a suite of parameters designed to assess aggressiveness of subsurface conditions on buried metal plant. The parameters include concentrations of sulphide, chloride and sulphate, pH, electrical conductivity, resistivity and redox potential. The complete soil chemistry test results (Certificate of Analysis) are included in Appendix G.

Table 4 Laboratory Testing Plan

Tests	Samples	Standards
Moisture Content	All Granular and Fine-Grained Soil Samples	ASTM D2216
Sieve Analysis	C 1 (BH4, BH5, BH6 and BH8 Base/Subbase) C 2 (BH10, BH12, BH14, BH18, BH20 and BH22 Base/Subbase) C 3 (BH28, BH32, BH36, BH40 and BH48 Gravel Shoulders) C 4 (BH23, BH27, BH31, BH43 and BH46 Base/Subbase)	ASTM C136
Particle Size Analysis	BH6 SS2, BH13 SS3, BH22 SS2, BH30 SS4, BH38 SS5, BH42 SS5 and BH50 SS6	ASTM D422
Atterberg Limits	BH6 SS2, BH13 SS3, BH22 SS2, BH30 SS4 and BH38 SS5	ASTM D4318
Metals and Inorganics	BH7 SS3, BH12 SS1, BH21 SS3, BH34 SS4, BH44 SS5, BH4 SS1, BH9 SS3, BH30 AS2 and BH48 SS4	O.Reg. 153 Tables 1and 3
Corrosivity Analysis	BH30 SS3, BH38 SS6, BH46 SS4 and BH52 SS5	AWWA C105
Asphaltic Concrete Cores	BH4, BH8, BH12, BH16, BH24[1], BH35, BH47 and BH51	na

Note: 1. the asphaltic concrete core was taken on NB curb lane at Sta. 15+580.

4 PAVEMENT AND SUBSURFACE CONDITIONS

4.1 Pavement Conditions

The following descriptions are based on the surface conditions observed on October 9, 2012. It must be recognized that additional pavement distresses may develop before construction work is initiated.

4.1.1 Section 1 (Iroquois Shore Road to Marlborough Court)

In general, the pavement on Trafalgar Road Section 1 was in poor condition, showing extensive slight to moderate longitudinal and transverse cracking, intermittent moderate alligator (fatigue) cracking, extensive slight ravelling and potholes. It was observed that longitudinal construction joint cracking was saw cut and repaved with hot mix asphalt and intermittent patch/utility cuts were in good condition. The riding quality at the posted speed of 60 km/hour was rated to be good. The existing roadway was initially designed and constructed to an urban cross-section (concrete curb and gutter with catchbasins). The overall surface drainage was considered to be generally fair.

4.1.2 Section 2 (Marlborough Court to Dundas Street East)

The condition of the pavement on Trafalgar Road Section 2 was considered to be fair. The most significant distresses in the pavement surface were extensive slight to moderate longitudinal and transverse cracking (approaching severe severity between Oak Park Boulevard and Dundas Street East) and extensive slight edge cracking, with intermittent moderate to very severe edge cracking. Settlement and alligator cracking were observed around some of the manholes. The riding quality at the posted speed of 60 km/hour was rated to be fair. The existing roadway was generally designed and constructed to an urban cross-section (concrete curb and gutter with catchbasins), with rural cross section (gravel shoulders and side ditches) between Glenashton Drive and Oak Park Boulevard. The overall surface drainage was considered to be generally poor to fair. The side ditches were observed to be shallow and overgrown with vegetation at some locations.

4.1.3 Section 3 (Dundas Street East to Highway 407)

In general, the pavement on Trafalgar Road Section 3 was in poor to fair condition, showing extensive slight to moderate longitudinal and transverse cracking, intermittent severe longitudinal cracking, intermittent moderate alligator (fatigue) cracking, intermittent slight wheel track cracking and intermittent moderate lane and shoulder drop-off. The riding quality at the posted speed of 80 km/hour was rated to be good. It was observed that the southbound curb lane (including partial southbound passing lane) from about 350 m south of Oakville Carpool Lot entrance to about 200 m north of the entrance appeared to have been recently rehabilitated. The existing roadway was initially designed and constructed to a rural cross section, with concrete curb and gutter provided in a short section near the major intersections. The overall surface drainage was considered to be generally fair to good. The side ditches were overgrown with vegetation.

4.2 Subsurface Conditions

The specific soil conditions encountered at each borehole location are described in greater detail on the Record of Borehole Sheets in Appendix E, with the general soil conditions outlined briefly below.

It should be noted that the subsurface conditions are confirmed at the borehole locations only, and may vary at other locations, particularly with respect to depth and condition. The boundaries between the various strata as shown on the logs and sections are based on non-continuous sampling. These boundaries represent an inferred transition between the various strata, rather than a precise plane of geologic change.

4.2.1 Existing Pavement Structures

The average pavement structure of each roadway section is summarized in Table 5.

Table 5 Existing Pavement Structures

Pavement Structure	Section 1	Section 2	Section 3
Asphaltic Concrete (mm)	165	200	210
Base/ Subbase Course (mm)	570	595	570
Total Thickness (mm)	735	795	780

The pavement structure in Section 1 varied in total thickness between about 410 and 1,065 mm (average thickness of 735 mm). The asphaltic concrete thickness was about 165 mm. The base/subbase course, consisting of gravelly sand ranged in thickness from about 250 to 900 mm (average thickness of 570 mm).

The pavement structure in Section 2 varied in total thickness between about 370 and 1,975 mm (average thickness of 795 mm). The asphaltic concrete ranged in thickness from about 100 to 340 mm (average thickness of 200 mm). The base/subbase course, consisting of gravelly sand ranged in thickness from about 220 to 1,820 mm (average thickness of 595 mm). Based on visual examination of cores from Section 2, the existing asphalt pavement generally consisted of two to four lifts of asphaltic concrete, with each lift thickness ranging from 40 to 80 mm. Bonding between the lifts was in good condition.

The pavement structure on Section 3 varied in total thickness between about 450 and 1,220 mm (average thickness of 780 mm). The asphaltic concrete ranged in thickness from about 130 to 300 mm (average thickness of 210 mm). The base/subbase course, consisting of gravelly sand ranged in thickness from about 205 to 920 mm (average thickness of 570 mm). Based on visual examination of cores from Section 3, the existing asphalt pavement consisted of three to five lifts of asphaltic concrete, with each lift thickness ranging from 30 to 80 mm. Bonding between the lifts was in good condition.

The shoulders along Trafalgar Road, consisting of sand and gravel varied in thickness between 330 and 760 mm (average thickness of 610 mm).

The results of sieve analysis completed on four (4) granular base/subbase and gravel shoulder samples indicated that the granular samples did not meet the OPSS 1010 gradation requirements for Granular B Type I, with about 11 to 19 percent passing the 75 µm sieve (upper specification limit: 8 percent).

4.2.2 Topsoil

A topsoil layer was encountered in the boreholes located in the boulevard. The thickness of the topsoil varied between about 50 mm and 210 mm (BH25), with an average thickness of about 105 mm. The topsoil was dark brown in colour and was generally of a silt/sand make-up.

The topsoil thickness indicated on the borehole logs is approximate only and may vary between and beyond boreholes. The topsoil thickness information provided is not intended for estimating topsoil quantities for stripping purpose. A series of test pits should be excavated to better assess topsoil stripping depths and quantities.

4.2.3 Fill

Fill was encountered beneath pavement structure, gravel shoulder and topsoil layers, extending to depths of about 0.3 (BH53) to 2.6 m (BH46) below the grade. The fill materials consisted of silty clay/clayey silt with trace amounts of gravel and varying amounts of sand and sand and gravel/gravelly sand with varying amounts of silt. Sandy silt/silty sand fills were also observed at BH6, BH35 and BH37 locations.

N-values determined in the Standard Penetration Test carried out within silty clay/clayey silt fill generally ranged from 4 to 20 blows per 300 mm of penetration to 50 blows per 100 mm of penetration, indicating a generally soft to hard consistency. A relatively high N-value of 50 blows per 100 mm penetration (BH31 SS 1) was likely due to presence of obstruction/debris within the fill material and may not necessarily represent the consistency of the fill material. N-values determined on the sand and gravel/gravelly sand to silty sand/sandy silt fills ranged from 6 and 28 blows per 300 mm of penetration, indicating a loose to compact relative density.

The in-situ moisture contents of fill soil samples typically ranged from about 2 to 26 percent, indicating locally damp and locally wet (typically moist) conditions.

4.2.4 Glacial Till

Clayey silt till was encountered below pavement structure, gravel shoulder and fill layers, extending to the borehole termination depths at most borehole locations. Sandy silt to silty sand to silt and sand till was encountered below the cohesive till and to the depths explored in BH40, BH42, BH44, BH48, BH50 and BH52.

N-values obtained in the cohesive till generally ranged from 7 to 79 blows per 300 mm of penetration to 50 blows per 75 mm of penetration, indicating a generally firm to hard (typically very stiff to hard)

consistency. The N-values determined on the sandy silt to silty sand to sand and silt tills ranged from 59 to 94 blows per 300 mm to 50 blows per 125 mm of penetration, indicating a very dense relative density.

The natural moisture content of the till samples ranged from about 9 to 25 percent, indicating a moist condition.

The results of Atterberg Limits tests indicated that the Liquid Limit (LL) of the soil samples tested ranged from 24 to 35 percent , with Plasticity Index (PI) ranging from 7 to 15. Based on the results of particle size analysis and Atterberg Limit tests, clayey silt glacial till soils can generally be classified as Lean Clay (CL), with varying amounts of sand (with sand to sandy) in accordance with Unified Soil Classification System (USCS). The glacial till encountered in BH 30 can be classified as Silty Clay with Sand (CL-ML). The laboratory soil classification of glacial till (USCS) are also plotted on Plasticity Chart in Appendix F.

4.2.5 Shale Till Complex/Weathered Shale

The glacial till deposits graded into a shale-till complex/weathered shale (inferred Queenston Formation) in some of the shallow boreholes in Sections 1 and 2 (BH1, BH2, BH4, BH5) at depths of about 1.2 to 1.5m below the existing ground surface, and in deep boreholes in Section 3 (BH24, BH26, BH28 and BH30) at depths of about 1.5 to 3.1 m below the existing ground surface.

There is typically a zone of weathering at the contact between the rock of the Queenston Formation and the glacial soil overburden. In the Ontario Ministry of Transportation and Communications document RR229, *Evaluation of Shales for Construction Projects* [5], there is reproduced from Skempton, Davis and Chandler, of a *typical weathering profile of a low durability shale,* that characterizes the shale surface into three grades of weathering and four zones.

In the Greater Toronto Area (the surface of the rock having been scoured and involved by the base of glacial ice), Shale Zone IV is typically not present in an identifiable form. At the base of the overburden there is usually found a zone of ground rock with a clayey consistency and fragmented shale that corresponds to Zone III in the shale profile, but this zone also typically contains imported drift material. This zone of material can be interpreted as the lowest portion of the till (if present as overburden) or as partially weathered rock of Zone III. This zone of rock with a clayey consistency and fragmented shale appears to vary in thickness within the Greater Toronto area (typically on the order of 1 m). The distinction is subjective and depends on the investigator.

4.2.6 Geotechnical Laboratory Test Results

Moisture content determination was conducted on all samples, and appended and noted on the borehole logs at respective sampling depths.

A summary of the Sieve and Hydrometer (Particle Size) analysis results is presented in Table 6.

Table 6 Particle Size Analysis Results

Borehole No. Sample No.	Sampling Depth below Grade (m)	Percentage				Descriptions
		Gravel	Sand	Silt	Clay	
BH6 SS2	1.8	0	3	58	39	CLAYEY SILT (TILL) trace sand
BH13 SS3	1.5	2	11	60	27	CLAYEY SILT (TILL) some sand, trace gravel
BH22 SS2	1.8	4	27	47	22	CLAYEY SILT (TILL) sandy, trace gravel
BH30 SS4	2.5	1	23	59	17	CLAYEY SILT (TILL) sandy, trace gravel
BH38 SS5	3.3	3	24	42	31	CLAYEY SILT (TILL) sandy, trace gravel
BH42 SS5	4.6	7	53	34	6	SILTY SAND (TILL) trace gravel, trace clay
BH50 SS6	4.8	11	37	46	6	SAND AND SILT (TILL) some gravel, trace clay

Atterberg Limits Tests were also carried out on selected soil samples. The results were plotted on Plasticity Chart in Appendix F. The results of Atterberg Limits Tests are summarized in Table 7.

Table 7 Atterberg Limits Test Results

Borehole No. Sample No.	Sampling Depth below Grade (m)	Liquid Limit (W_L)	Plastic Limit (W_P)	Plasticity Index (I_P)	Natural Water Content	Plasticity
BH6 SS2	1.8	35	20	15	16%	Low Plasticity
BH13 SS3	1.5	28	20	8	13%	Low Plasticity
BH22 SS2	1.8	24	16	8	13%	Low Plasticity
BH30 SS4	2.5	24	17	7	11%	Low Plasticity
BH38 SS5	3.3	27	16	11	12%	Low Plasticity

Sieve Analysis tests were conducted on four (4) granular material samples. The detailed testing reports were given in Appendix F. The results of these tests are summarized in Table 8.

Table 8 Sieve Analysis Results

Sample No.	Locations	Soil Types (%)			Descriptions
		Gravel	Sand	Fines (finer than 75μm)	
C1	BH4, BH5, BH6 and BH8 Base/Subbase	22	59	19	GRAVELLY SAND some silt
C2	BH10, BH12, BH14, BH18, BH20 and BH22 Base/Subbase	29	53	18	GRAVELLY SAND some silt
C3	BH28, BH32, BH36, BH40 and BH48 Gravel Shoulders	46	43	11	SAND AND GRAVEL some silt
C4	BH23, BH27, BH31, BH43 and BH46 Base/Subbase	28	55	17	GRAVELLY SAND some silt

4.3 Ground Water Observations

Ground water measurements conducted in the open boreholes during and upon completion of drilling indicated that the ground water level ranged from about 3.7 m (BH48) to 4.6 m (BH38) below the grade.

It should be noted that the ground water conditions reported above may not necessarily represent stabilized conditions or conditions expected during construction. In addition, the ground water levels will fluctuate seasonally and with precipitation conditions.

5 DISCUSSIONS AND RECOMMENDATIONS

5.1 Pavements

The following discussion on the design of flexible pavement is provided based on the results of the traffic data analyses, subsurface investigation and laboratory testing carried out.

The subgrade soil was relatively uniform along the length of the subject roadway section, predominantly consisting of stiff to hard clayey silt (CL). It is assumed that the embankment fill for the widening lanes will be constructed as engineered fill with due consideration given to soil selection, placement, moisture content, lift thickness, degree of compaction etc. As such, the resilient modulus of subgrade has been assumed to be 35 MPa for design purposes. The pavement design parameters are summarized in Table 9.

The design ESALs of Section 2 in HOV lane scenario were used to design widening lanes for Sections 1, 2 and 3. The existing pavement structural adequacy of each section was evaluated based on the respective design ESALs in BRT lane scenario and then pavement rehabilitation strategy recommendation was provided accordingly.

The pavement designs were developed based on *1993 AASHTO Guide for Design of Pavement Structures* [6] and using AASHTOWare DARWin 3.1, proprietary pavement design software. Recommended pavement structures for BRT/HOV lanes and rehabilitation strategy of existing pavement are given in Tables 10 and 11.

Table 9 Pavement Design Parameters

Design Parameters	Values
Initial Serviceability Index (P_i)	4.4
Terminal Serviceability Index (P_t)	2.5
Serviceability Loss (ΔPSI)	1.9
Reliability Level, % (R)	90
Overall Standard Deviation (Z_R)	0.45
Design Subgrade Resilient Modulus, MPa (M_R)	35
Layer Coefficient of Hot Mix Asphalt Surface Course (a_1)	0.44
Layer Coefficient of Granular Base Course (a_2)	0.14
Layer Coefficient of Granular Subbase Course (a_3)	0.09
Drainage Coefficients of Base and Subbase Courses (m_2,m_3)	1.0
Layer Coefficient of Existing Asphaltic Concrete in Section 1	0.25
Layer Coefficient of Existing Asphaltic Concrete in Section 2	0.30
Layer Coefficient of Existing Asphaltic Concrete in Section 3	0.30
Layer Coefficient of Existing Granular Base/Subbase	0.09
Drainage Coefficients of Existing Base and Subbase Courses	0.9

Table 10 Recommended Pavement Structure for BRT/HOV Lanes

Pavement Structural Component	Material
HMA Surface Course	50 mm OPSS 1150 HL 1 or OPSS MUNI 1151 SP 12.5 FC1
HMA Binder Course	100 mm OPSS 1150 HDBC or OPSS MUNI 1151 SP 19.0
Base Course	150 mm OPSS 1010 Granular A
Subbase Course	550 mm OPSS 1010 Granular B Type I [1]
Total Thickness	850 mm
Constructed Pavement Structural Number	136
Design Structural Number	128

Note: 1 Minimum thickness of subbase; also the subbase thickness should match the existing subbase depth of the adjacent pavement.

Table 11 Recommended Pavement Rehabilitations for Existing Pavements

Pavement Components	Section 1		Section 2	Section 3
	Mill and Overlay	Full-Depth Removal and Overlay	Mill and Overlay	Mill and Overlay
HMA Surface Course	50 mm HL 1	50 mm HL 1	50 mm HL 1	50 mm HL 1
HMA Binder Course	50 mm HDBC	120 mm HDBC	50 mm HDBC	50 mm HDBC
Existing Asphaltic Concrete	65 mm [1]	0 mm [2]	100 mm [1]	110 mm [1]
Existing Granular Base/Subbase Course	570 mm	570 mm	595 mm	570 mm
Total Thickness	735 mm	740 mm	795 mm	780 mm
Grade Increase	0 mm	5 mm	0 mm	0 mm
Constructed Pavement Structural Number	112	126	128	128
Design Structural Number	125	125	121	124

Note: 1 Remaining asphaltic concrete after 100 mm of asphaltic concrete is milled.
2 Full-depth removal of the existing asphaltic concrete in Section 1.

5.1.1 Pavement Design for BRT/HOV Lanes

Based on the expected traffic on BRT/HOV lanes, and the type and strength of subgrade soil in combination with Terraprobe's pavement design experience of this type, the recommended pavement structure is shown in Table 10 and detailed as follows:

- Remove the existing topsoil and any other obviously deleterious materials;
- Excavate subgrade to the depth required to accommodate the new pavement structure; the prepared subgrade should be carefully proof- rolled in the presence of the geotechnical engineer, any soft or wet areas or other obviously deleterious materials must be excavated and properly replaced with suitable, approved material; note that the finished subgrade level in the widening lane must be at least at the same elevation or lower than the subgrade elevation of existing adjacent pavement in the case which the existing pavement is being rehabilitated;
- Backfilling of sub-excavated areas and fine grading may be carried out using the stockpiled recycled granular materials from the existing roadway shoulders, or OPSS 1010 Granular B Type I. All backfill materials should be placed in uniform lifts not exceeding 200 mm loose thickness and compacted to at least 95 percent Standard Proctor Maximum Dry Density (SPMDD). The finished subgrade should be provided with a continuous centre-to-edge cross fall of 3 percent;
- Install full-length subdrains in accordance with *OPSD 216.021Subdrain Pipe Connection and Outlet-Urban* [7]. Subdrains should consist of 150 mm diameter perforated subdrain pipe wrapped with knitted sock geotextile placed in a trench excavated 300 mm by 300 mm into the subgrade. The trench should be backfilled with 19 mm clear stone. A geotextile wrapping surrounding the stone is required where subgrade intrusion is a problem;
- Place a minimum of 550 mm OPSS 1010 Granular B Type I subbase course; place in loose lifts not exceeding 200 mm thickness, compact to 100 percent of SPMDD; the subbase thickness should match the existing subbase depth of the adjacent pavement;
- Place 150 mm of OPSS 1010 Granular A base course, compacted to 100 percent of SPMDD; and
- Place 100 mm of OPSS 1150 HDBC or OPSS MUNI 1151 SP19.0 hot mix asphalt binder course (two lifts); and
- Place 50 mm of OPSS 1150 HL1 or OPSS MUNI 1151 SP12.5 FC1 hot mix asphalt surface course. The surface of the completed pavement should also be provided with a minimum centre-to-edge cross fall of 2 percent.

The constructed pavement Structural Number is 136, which is greater than the Design Structural Numbers (128). As such, the pavements would be structurally adequate for the expected traffic loads in 20-year design period.

5.1.2 Rehabilitation Strategy for Existing Pavements

Considering that the subject roadway section is a busy major arterial road in the Town of Oakville and the existing asphaltic concrete asphalt is relatively thick, the most cost-effective and practical rehabilitation strategy would be a conventional mill and hot mix asphalt overlay. The recommended pavement structure is shown in Table 11 and details as follows:

- Remove the existing asphaltic concrete by milling to depth of about 100 mm;
- Place 50 mm of OPSS 1150 HDBC or OPSS MUNI 1151 SP19.0 hot mix asphalt binder course; and
- Place 50 mm of OPSS 1150 HL1 or OPSS MUNI 1151 SP12.5 FC1 hot mix asphalt surface course. The surface of the completed pavement should also be provided with a minimum centre-to-edge cross fall of 2 percent.

Adoption of this pavement rehabilitation treatment alternative will not result in a grade increase.

The average rehabilitated pavement Structural Number for Sections 2 and 3 is 128, which is greater than the Design Structural Number (121 and 124). As such, the pavement would be structurally adequate for the expected traffic loads in 20-year design period. However, the average rehabilitated pavement structural number for Section 1 is 112, which is less than the Design Structural Number (125). The service life for this rehabilitation alternative for this section is about 10 years. It is recommended that structural overlay be required to strengthen pavement structure and extend the service life of this pavement section at that time.

Alternatively, a full-depth asphaltic concrete removal and hot mix asphalt overly rehabilitation strategy could be considered for Section 1 as detailed below:

- Remove full-depth of the existing asphaltic concrete;
- Place 120 mm of OPSS 1150 HDBC or OPSS MUNI 1151 SP19.0 hot mix asphalt binder course in two lifts; and
- Place 50 mm of OPSS 1150 HL1 or OPSS MUNI 1151 SP12.5 FC1 hot mix asphalt surface course. The surface of the completed pavement should also be provided with a minimum centre-to-edge cross fall of 2 percent.

Adoption of this pavement rehabilitation treatment alternative will result in a grade increase of 5 mm which should be tolerable.

The average pavement Structural Number for Section 1 using this alternative rehabilitation strategy is 126, which is greater than the Design Structural Number (125). As such, the pavement would be structurally adequate for the expected traffic loads in a full 20-year design period.

Following completion of the milling, the exposed pavement surface should be inspected and any additional repairs (full-depth repairs to transverse and longitudinal cracked areas, for instance) should be completed prior to overlay placement. Any crossfall improvements that may be required should be addressed by placement of an OPSS 1150 HL3 HS levelling/padding course prior to placement of the HDBC binder course and HL1 surface course. The milled surface should be properly cleaned (power broomed and/or washed, as necessary) and tack coated using SS-1 emulsified asphalt prior to placement of any new hot mix asphalt.

This mill and overlay option should be adequate to restore the pavement ride quality and address the existing distresses. However, some reflective cracking should be expected to occur within the first two to three years that will require crack sealing to prevent the ingress of moisture into the pavement.

5.1.3 Frost Protection

The grain size analyses results indicated that the percentage of fine materials between 5 and 75 µm for the subgrade soil within frost penetration zone ranged from about 39 to 52 percent, indicating low to moderate susceptibility to frost heave in accordance with frost susceptibility category in MTO *Pavement Design and Rehabilitation Manual* [8].

The frost penetration depth in the Town of Oakville is determined to be approximately 1.2 m based on Figure 3.4 in the Reference 8. Generally, frost is allowed to penetrate a limited amount into the underlying frost susceptible subgrade.

5.1.4 General Recommendations and Construction Features

SP 12.5 FC1 and SP 19 hot mix asphalt types should be designed for Traffic Category C. These hot mix asphalt mixes should be designed, produced and placed in conformance with OPSS 1150, OPSS MUNI 1151 and OPSS 310 requirements.

Performance graded asphalt cement, PG 64-28, conforming to OPSS 1101 requirements, should be used in the HMA binder and surface courses.

Prior to completing any reconstruction work, drainage improvements are required for this roadway section and should be carried out as far in advance of the construction as possible. The full extent of improvements should be determined during detailed design to ensure proper drainage and function.

It is recommended that all construction joints at the ends of the pavement be cleaned with stiff bristle brooms and compressed air to remove all dust, dirt and other foreign matter.

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

A tack coat should be applied to all construction joints prior to the placement of hot mix asphalt to ensure an adequate bond between the old and new pavements.

Systematic routine preventative maintenance is strongly recommended for all newly constructed pavements. Crack routing and sealing will generally be required within 2 to 3 years after pavement construction. It will also be necessary to patch areas of medium to high severity distresses, for instance, potholes and ravelling. Routine maintenance should be considered to extend the serviceability of an existing section by several years. A mill and overlay program will be required within 10 to 15 years to maintain the serviceability over the design life..

5.2 Storm Sewer

It is understood that a storm sewer will be constructed using conventional open-cut techniques. Specific detailed design information of the underground services was not available at the time of preparation of this report. The following subsections provide geotechnical engineering information for the design of underground services with relatively shallow inverts. Trench excavation should be carried out in

accordance with the *Occupational Health and Safety Act (OHSA) and Regulations for Construction Projects* (O.Reg. 213/91 with recent amendments) [9], while trench bedding, backfilling and compaction should be carried out in accordance with *OPSD 802.010 Flexible Pipe Embedment and Backfill Earth Fill* [10] or *OPSD 802.031 Rigid Pipe Bedding, Cover and Backfill* [11] and *OPSS 401 Construction Specification for Trenching, Backfilling and Compacting* [12].

5.2.1 Excavation and Ground Water Control

All topsoil should be stripped from areas where storm sewers are to be located. Asphaltic concrete should be saw cut and removed from any existing pavements where the sewer installation is required. It is expected that excavations will generally penetrate topsoil/asphalt pavement/gravel shoulders, fill materials, glacial till soils, generally consisting of clayey silt to sandy silt/silty sand/silt and sand and possibly till shale complex/weathered shale.

OHSA designates four broad classifications of soils to stipulate appropriate measures for excavation safety. The granular materials and earth fill materials are classified as "Type 3 Soil" above and "Type 4 Soil" below the prevailing ground water level, while the glacial till soils (clayey silt and sandy silt to silty sand to silt and sand) soils are classified as "Type 1 to 3 Soils" depending on consistency or relative density. The conditions anticipated at this site can generally be regarded as "Type 3 Soil", provided that effective ground water control is achieved where required and surface water is directed away from open excavations. The soils encountered at this site are considered to be suitable for excavation using normal trenching and excavating equipment.

Where workmen must enter excavations advanced deeper than 1.2 m, the trench walls should be suitably sloped and/or braced in accordance with the OHSA. Minimum support system requirements for steeper excavations are stipulated in the OHSA, and include provisions for timbering, shoring and moveable trench boxes.

The soil deposits (particularly till soils) inherently contain cobbles and boulders that are not specifically identified on the borehole logs. The size and distribution of such potential obstructions cannot be predicted with borings, because the borehole sampler size is insufficient to secure representative samples of particles of this size. Provision should be made in excavation contracts to allocate risks associated with time spent and equipment utilized to remove or penetrate such obstructions when encountered.

The overburden soils can be removed by conventional excavation equipment. The Queenston Formation is a typically rippable rock that can be removed with conventional excavation equipment once it has been displaced by a ripper tooth or a hoe ram.

The ground water table may be expected to be encountered above the depth of excavation at some locations and adequate ground water control will be required to maintain sufficiently dry excavations to allow proper placement of underground services and construction of foundations and to help maintain the stability of the cut slopes. Ground water level measurements taken in the boreholes upon completion of drilling and in monitoring wells during our subsequent site visit are presented in Subsection 4.3 of this report.

Ground water seepage from permeable seams and layers within the glacial till should be expected. The volume of ground water expected can possibly be controlled by intermittent pumping from properly filtered sumps located as needed in the excavation. Aggressive dewatering for the construction of underground services is not anticipated.

5.2.2 Pipe Bedding and Cover

The undisturbed native materials will be suitable for the support of buried services that are properly bedded. Where disturbance of the trench base has occurred, due to ground water seepage, or construction traffic, the disturbed soils should be sub-excavated and replaced with suitably compacted granular material. Placement of the pipe bedding must be done in the dry condition.

Storm sewer pipe should be constructed in conformance with the OPSD 802.031 for rigid pipes or OPSD 802.010 for flexible pipes and/or the corresponding Region of Halton standards. The bedding/embedment materials as specified in OPSS 401would include OPSS 1010 Granular A, Granular B with 100 percent passing 26.5 mm sieve and unshrinkable fill. Cover materials for rigid pipe include the above noted bedding materials and native material. Further details on bedding/embedment and cover materials can be provided at the final design phase.

The bedding and cover materials should be placed in layers not exceeding 200 mm in thickness and uniformly compacted to a minimum of 95 percent SPMDD.

5.2.3 Backfill

The topsoil and earth fill materials containing excessive amounts of topsoil should not be reused as trench backfill. However, these materials may be stockpiled and reused for landscaping purposes. The selection and sorting of earth fill soils should be conducted under the guidance of a geotechnical engineer.

The native soils free from vegetation, organic matter, excessively wet soil, oversized particles and other deleterious materials are considered suitable for backfilling purposes provided the moisture content of these soils is close to the laboratory optimum moisture content for compaction (within 3 percent). Any excessively wet soil must be separated and allowed to dry, or be tilled to reduce the moisture content so that it can be effectively compacted. Alternatively, materials of higher moisture content and frozen soil could be wasted and be replaced with imported material which can be more readily compacted.

Trench backfill material should be placed in uniform layers not exceeding 300 mm in thickness for the full width of the trench and each layer should be uniformly compacted to a minimum of 95 percent SPMDD. The backfill materials should be placed and compacted under the direction of a geotechnical engineer. The upper 1 m of the backfill, forming the pavement subgrade must be uniformly compacted to a minimum of 98 percent of SPMDD.

It should be noted that the native soils encountered on the site are generally not free draining, and will be difficult to handle and compact should they become wetter as a result of inclement weather, seepage or frost. Hence, it can be expected that earthworks will be difficult during wet periods (i.e. spring and fall) of the year and may result in extra costs.

Post construction settlements on the order of 1 to 3 percent of the backfill depth is expected to occur over several months and may have an effect on the overlying pavement structures if present. In the case of deep services, provisions should be included in the contract for remedial work such as padding and resurfacing where required.

5.2.4 Trench Clay Plugs & Cutoff Collars

Clay plugs or cut off collars may be installed in trenches in accordance with *OPSD 802.095 Clay Seal for Pipe Trenches* [13] in order to prevent migration of the ground water along the relatively free draining bedding/embedment material and/or backfill material due to the "French Drain" effect. If the invert of the trench is below the water table and local drawdown of the groundwater level cannot be tolerated then clay plugs should be installed within the granular bedding and the granular zones of backfill material. It is considered unlikely that trench plugs would be needed for the storm sewers with relatively shallow inverts. However, they may be appropriate for deep services.

5.3 Soil Chemistry Analysis

Nine (9) soil samples were submitted to AGAT Laboratories and analysed for a suite of metals and other inorganic parameters commonly used in the construction industry. The complete environmental analysis results, including Certificates of Analysis, are given in Appendix G.

The bulk analysis results were compared with MOE Table 1 Standards (Full Depth Background Site Condition Standards for Residential/Parkland/Institutional/Industrial/Commercial/Commmunity Property Use) in Reference 5. Seven (7) of the nine (9) soil samples analyzed exceeded the MOE Table 1 standards for Electrical Conductivity (EC) and/or Sodium Absorption Ratio (SAR). The elevated EC and SAR are likely associated with the use of road salts.

It should be noted that five (5) samples (BH4 SS1, BH9 SS3, BH21 SS3, BH30 AS2 and BH34 SS4) also exceeded MOE Table 3 Standards (Full Depth Generic Site Condition in a Non-Potable Ground Water Standards for Industrial/Commercial/ Community Use) for EC and/or SAR.

Soil that does not meet the O. Reg. 153/04 Table 3 Standards will typically have to be managed as waste and will require further analyses to classify the soil in accordance with current legislation (this would include a TCLP analysis as set out in O.Reg. 347 with recent amendments) and for acceptance at a disposal site.

The analyses were conducted to provide general information on the soil quality for design purposes. Further sampling and analyses may be needed to develop a soil management plan for construction. The type of analyses and number of samples tested may not fulfil the current regulatory requirements to transport soil off-site, and further testing will likely be required. Soil to be transported to sites accepting fill must be monitored for any indication of variance or other chemical/environmental concerns. If conditions indicate, further chemical testing should be carried out. Sites accepting fill usually have aesthetic and/or engineering property requirements, in addition to the chemical requirements for soil acceptance. The responsibility for finding a site to accept excess material should be clearly allocated to the excavation contractor in the contract documents.

The analytical results contained in this report should not be considered a warranty with respect to the soil quality or the use of the soil for any specific purpose. This section provides the factual results of the chemical analysis only. No opinion is presented regarding the environmental suitability of the soil for any purpose.

5.4 Soil Corrosivity

Four (4) selected soil samples (BH30 SS3, BH38 SS6, BH46 SS4 and BH52 SS5) were also submitted to AGAT Laboratories for chemical analyses (corrosivity package) including sulphide, chloride and sulphate, pH, electrical conductivity, resistivity and redox potential. These parameters are used for assessing soil corrosivity applicable to cast iron alloys, according to the 10-points soil evaluation procedure described in Appendix A of *AWWA C105 Polyethylene Encasement for Ductile-Iron Pipe Systems* [14]. When the points are equal to or greater than ten (10), corrosion protective measures (such as cathodic protection) have been recommended for cast iron alloys. Based on this 10-points evaluation procedure, the severity ranking of the tested samples is tabulated in Table 8. The total points of these soil samples ranged from 5.5 to 11. As such, cast iron alloy pipes used in this project site will require corrosion protective measures. It should be noted that the analytical results only provide an indication of the potential for corrosion. It should also be noted that this rating scale remain relatively simplistic and subjective procedure. Therefore, it should be viewed as a broad indicator and should not be expected to accurately predict specific cases of corrosion damage.

Table 12 Soil Corrosivity

Soil Samples	BH30 SS3	BH38 SS6	BH46 SS4	BH52 SS5
Depth below Existing Surface (m)	1.5 to 2.0	4.5 to 5.0	3.0 to 3.5	3.0 to 3.5
Total Points	11	5.5	11	5.5

6 LIMITATIONS AND RISK

6.1 Procedures

This 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. Contractors bidding on or undertaking work on the project should be directed to draw their own conclusions as to how the subsurface conditions may affect them, based on their own investigations and their own interpretations of the factual investigation results, cognizant of the risks implicit in the subsurface investigation activities so that they may draw their own conclusions as to how the subsurface conditions may affect them.

6.2 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. Groundwater levels are particularly susceptible to seasonal fluctuations.

The discussion and recommendations are based on the factual data obtained from this investigation made at the site by Terraprobe and are intended for use by the owner and its retained designers in the design phase of the project. If there are changes to the project scope and development features, the interpretations made of the subsurface information, the 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.

It is recognized that the regulatory agencies in their capacities as the planning and building authorities under Provincial statues, will make use of and rely upon this report, cognizant of the limitations thereof, both expressed and implied.

We trust the foregoing information is sufficient for your present requirements. If you have any questions, or if we can be of further assistance, please do not hesitate to contact us.

Yours truly,
Terraprobe Inc.

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

J.G. Muckle, M.E.Sc., P.Eng.
Associate

LIST OF REFERENCES

1. MTO. Flexible Pavement Condition Rating Guidelines for Municipalities, August 1989.
2. MTO. MI-183 Adaption and Verification of AASHTO Pavement Design Guide for Ontario Conditions, 2008.
3. ASTM. D1586 - 08a Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils, 2008.
4. Ministry of Environment Ontario. Soil, Ground Water and Sediment Standards for Use under Part XV.1 of the Environmental Protection Act, April 15, 2011.
5. Ministry of Transportation and Communication. RR229 Evaluation of Shales for Construction Projects-An Ontario Shale Rating System, March 1983.
6. AASHTO. Guide for Design of Pavement Structures, 1993.
7. MTO. OPSD 216.021Subdrain Pipe Connection and Outlet-Urban, 2008.
8. MTO. Pavement Design and Rehabilitation Manual, 1990.
9. Ontario Regulation 213/91, Occupational Health and Safety Act (OHSA) and Regulations for Construction Projects, April 11, 2012.
10. MTO. OPSD 802.010 Flexible Pipe Embedment and Backfill Earth Fill, November 2010.
11. MTO. OPSD 802.031 Rigid Pipe Bedding, Cover and Backfill, November 2010.
12. MTO. OPSS 401 Construction Specification for Trenching, Backfilling and Compacting, November 2012.
13. MTO. OPSD 802.095 Clay Seal for Pipe Trenches, November 2011.
14. American Water Works Association. ANSI/AWWA Standard C105/A21.5-05 Polyethylene Encasement for Ductile-Iron Pipe Systems, 2005.

FIGURE

TERRAPROBE INC.

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

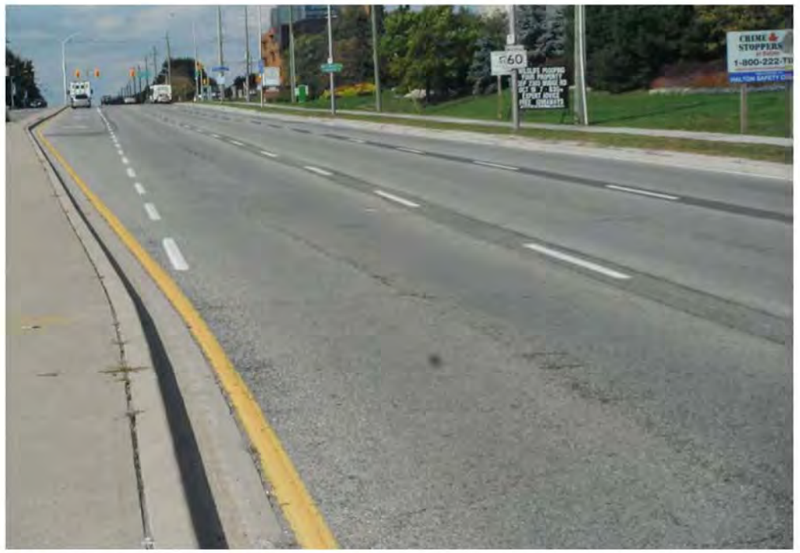
Title:	FIGURE :
SITE LOCATION PLAN	1
Proj. No. 11-12-2091	

\\PDC\Server1-Project files\11-Geotechnical\2012\11-12-2091 - 2099\11-12-2091A Dwgs Logs\AutoCAD\11-12-2091 Site Location Plan.dwg, Arctite PDF

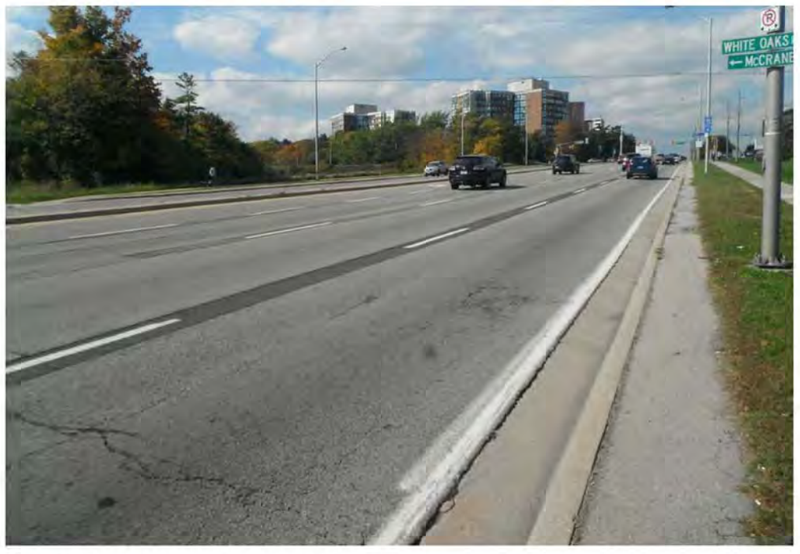
APPENDIX A

Pavement Condition Survey

TERRAPROBE INC.



PHOTOGRAPH 1. Trafalgar Road, Section 1, showing moderate longitudinal (loading associated) and transverse cracking, slight ravelling and patch repair for longitudinal construction joint cracking.

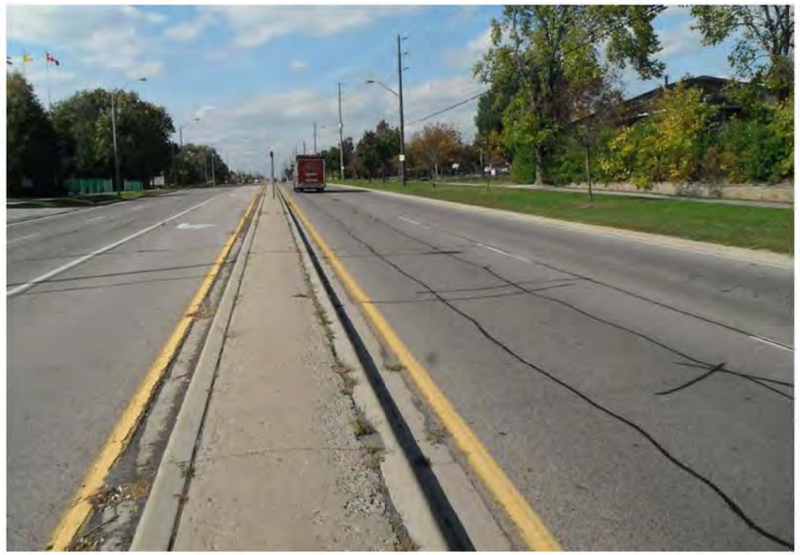


PHOTOGRAPH 2. Trafalgar Road, Section 1, showing moderate transverse cracking, slight ravelling and patch repair for longitudinal construction joint cracking and drainage in fair condition.

PAVEMENT CONDITION SURVEY
TYPICAL SITE PHOTOGRAPHS

PHOTOGRAPH 3. Trafalgar Road, Section 1, showing slight potholes and slight longitudinal cracking sealed and repaired with patching.

PHOTOGRAPH 4. Trafalgar Road, Section 2, showing slight longitudinal and transverse cracking sealed.



PHOTOGRAPH 5. Trafalgar Road, Section 2, showing slight longitudinal and transverse cracking sealed

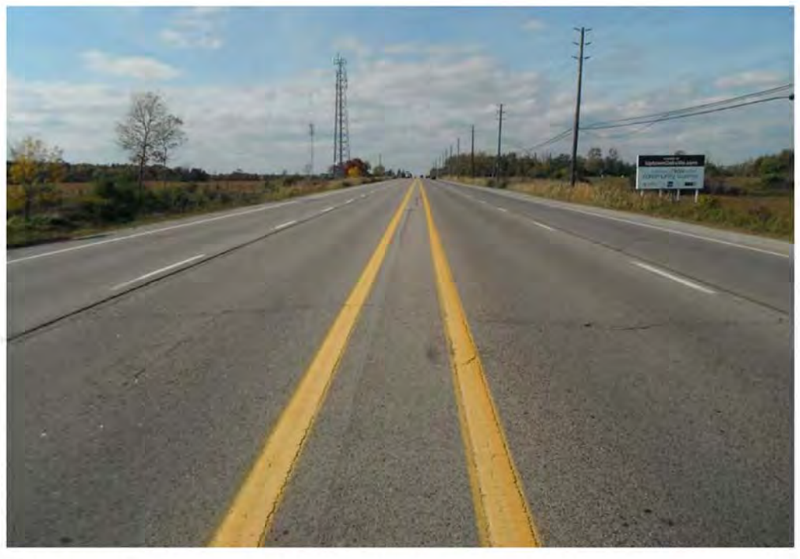
PHOTOGRAPH 6. Trafalgar Road, Section 2, showing pavement in fairly good condition.

PAVEMENT CONDITION SURVEY
TYPICAL SITE PHOTOGRAPHS

PHOTOGRAPH 7. Trafalgar Road, Section 2 approaching Dundas Street East, showing slight to moderate longitudinal and transverse cracking.

PHOTOGRAPH 8. Trafalgar Road, Section 3, showing slight to moderate longitudinal cracking

PHOTOGRAPH 9. Trafalgar Road, Section 3, showing moderate longitudinal construction joint cracking.



PHOTOGRAPH 10. Trafalgar Road, Section 3, showing slight to moderate longitudinal and transverse cracking.

PAVEMENT CONDITION SURVEY
TYPICAL SITE PHOTOGRAPHS

PHOTOGRAPH 11. Trafalgar Road, Section 3, showing moderate to severe longitudinal construction joint cracking.

PHOTOGRAPH 12. Trafalgar Road, Section 3, showing slight transverse cracking, slight pavement edge breaks and slight lane/shoulder drop-off, side ditch with overgrown vegetation.

APPENDIX B
Traffic Data Analyses

TERRAPROBE INC.

TABLE B1 TRAFFIC DATA AND ESTIMATED ESALs
SECTION 1 IROQUOIS SHORE ROAD TO MARBOROUGH COURT
BRT Lanes

Year	Annual Bus Traffic	Estimated Cumulative Annual ESALs
2012	100,516 [1]	-
2017	120,258	240,500
2018	124,649	489,800
2019	129,200	748,200
2020	133,918	1,016,000
2021	138,808	1,293,600
2022	138,808	1,571,200
2023	138,808	1,848,800
2024	138,808	2,126,400
2025	138,808	2,404,000
2026	138,808	2,681,600
2027	138,808	2,959,200
2028	138,808	3,236,800
2029	138,808	3,514,400
2030	138,808	3,792,000
2031	138,808	4,069,600
2032	138,808	4,347,200
2033	138,808	4,624,800
2034	138,808	4,902,400
2035	138,808	5,180,000
2036	138,808	**5,457,600**

Directional Factor (DF)	1.0
Lane Distribution Factor (LDF)	1.0
Combined Truck Factor (CTF)	2.00
Percent Buses	100.0%

1. Annual bus traffic was obtained based on Oakville Transit and Go Transit bus schedules.

TABLE B2 TRAFFIC DATA AND ESTIMATED ESALs

SECTION 2 MARBOROUGH COURT TO DUNDAS STREET EAST

BRT Lanes

Year	Annual Bus Traffic	Estimated Cumulative Annual ESALs
2012	100,516 [1]	-
2017	120,258	240,500
2018	124,649	489,800
2019	129,200	748,200
2020	133,918	1,016,000
2021	138,808	1,293,600
2022	138,808	1,571,200
2023	138,808	1,848,800
2024	138,808	2,126,400
2025	138,808	2,404,000
2026	138,808	2,681,600
2027	138,808	2,959,200
2028	138,808	3,236,800
2029	138,808	3,514,400
2030	138,808	3,792,000
2031	138,808	4,069,600
2032	138,808	4,347,200
2033	138,808	4,624,800
2034	138,808	4,902,400
2035	138,808	5,180,000
2036	138,808	**5,457,600**

Directional Factor (DF)	1.0
Lane Distribution Factor (LDF)	1.0
Combined Truck Factor (CTF)	2.00
Percent Buses	100.0%

1. Annual bus traffic was obtained based on Oakville Transit and Go Transit bus schedules.

TABLE B3 TRAFFIC DATA AND ESTIMATED ESALs

SECTION 3 DUNDAS STREET EAST TO HIGHWAY 407

BRT Lanes

Year	Annual Bus Traffic	Estimated Cumulative Annual ESALs
2012	18,980 [1]	-
2017	22,708	45,400
2018	23,537	92,500
2019	24,397	141,300
2020	25,288	191,900
2021	26,211	244,300
2022	26,211	296,700
2023	26,211	349,100
2024	26,211	401,500
2025	26,211	453,900
2026	26,211	506,300
2027	26,211	558,700
2028	26,211	611,100
2029	26,211	663,500
2030	26,211	715,900
2031	26,211	768,300
2032	26,211	820,700
2033	26,211	873,100
2034	26,211	925,500
2035	26,211	977,900
2036	26,211	**1,030,300**

Directional Factor (DF)	1.0
Lane Distribution Factor (LDF)	1.0
Combined Truck Factor (CTF)	2.00
Percent Buses	100.0%

1. Annual bus traffic was obtained based on Oakville Transit and Go Transit bus schedules.

TABLE B4 TRAFFIC DATA AND ESTIMATED ESALs
SECTION 1 IROQUOIS SHORE ROAD TO MARBOROUGH COURT
HOV Lanes

Year	Annual Average Daily Traffic	Estimated Cumulative Annual ESALs
2017	8,382	275,300
2018	8,343	549,400
2019	8,303	822,200
2020	8,265	1,093,700
2021	8,226 [1]	1,363,900
2022	8,250	1,634,900
2023	8,273	1,906,700
2024	8,297	2,179,300
2025	8,321	2,452,600
2026	8,345	2,726,700
2027	8,369	3,001,600
2028	8,393	3,277,300
2029	8,417	3,553,800
2030	8,441	3,831,100
2031	8,465 [1]	4,109,200
2032	8,489	4,388,100
2033	8,514	4,667,800
2034	8,538	4,948,300
2035	8,563	5,229,600
2036	8,587	**5,511,700**

Directional Factor (DF)	1.0
Lane Distribution Factor (LDF)	1.0
Combined Truck Factor (CTF)	2.00
Percent Trucks/Buses	4.5%
Days Per Year For Truck Traffic	365

1. 2021 and 2031 AADT are provided by the AECOM.

TABLE B5 TRAFFIC DATA AND ESTIMATED ESALs
SECTION 2 MARBOROUGH COURT TO DUNDAS STREET EAST
HOV Lanes

Year	Annual Average Daily Traffic	Estimated Cumulative Annual ESALs
2017	7,420	281,600
2018	7,406	562,700
2019	7,392	843,300
2020	7,378	1,123,400
2021	7,364 [1]	1,402,900
2022	7,373	1,682,800
2023	7,382	1,963,000
2024	7,390	2,243,500
2025	7,399	2,524,400
2026	7,408	2,805,600
2027	7,417	3,087,100
2028	7,426	3,369,000
2029	7,434	3,651,200
2030	7,443	3,933,700
2031	7,452 [1]	4,216,600
2032	7,461	4,499,800
2033	7,470	4,783,400
2034	7,479	5,067,300
2035	7,488	5,351,500
2036	7,497	**5,636,100**

Directional Factor (DF)	1.0
Lane Distribution Factor (LDF)	1.0
Combined Truck Factor (CTF)	2.00
Percent Trucks/Buses	5.2%
Days Per Year For Truck Traffic	365

1. 2021 and 2031 AADT are provided by the AECOM.

TABLE B6 TRAFFIC DATA AND ESTIMATED ESALs

SECTION 3 DUNDAS STREET EAST TO HIGHWAY 407

HOV Lanes

Year	Annual Average Daily Traffic	Estimated Cumulative Annual ESALs
2017	7,737	56,500
2018	8,143	115,900
2019	8,570	178,500
2020	9,020	244,300
2021	9,493 [1]	313,600
2022	9,417	382,300
2023	9,342	450,500
2024	9,268	518,200
2025	9,194	585,300
2026	9,120	651,900
2027	9,047	717,900
2028	8,975	783,400
2029	8,904	848,400
2030	8,832	912,900
2031	8,762 [1]	976,900
2032	8,692	1,040,400
2033	8,623	1,103,300
2034	8,554	1,165,700
2035	8,486	1,227,600
2036	8,418	**1,289,100**

Directional Factor (DF)	1.0
Lane Distribution Factor (LDF)	1.0
Combined Truck Factor (CTF)	2.00
Percent Trucks	1.0%
Days Per Year For Truck Traffic	365

1. 2021 and 2031 AADT are provided by the AECOM.

TABLE B7 TRAFFIC DATA AND ESTIMATED ESALs

SECTION 1 IROQUOIS SHORE ROAD TO MARBOROUGH COURT

General Purpose Lanes in BRT Alternative

Year	Annual Average Daily Traffic	Estimated Cumulative Annual ESALs
2008	35,190 [1]	-
2017	42,735	240,800
2018	43,667	486,900
2019	44,620	738,400
2020	45,593	995,300
2021	46,588 [1]	1,257,900
2022	45,827	1,516,200
2023	45,078	1,770,200
2024	44,342	2,020,100
2025	43,618	2,265,900
2026	42,905	2,507,700
2027	42,204	2,745,500
2028	41,515	2,979,500
2029	40,837	3,209,600
2030	40,170	3,436,000
2031	39,513 [1]	3,658,700
2032	38,868	3,877,700
2033	38,233	4,093,200
2034	37,609	4,305,100
2035	36,994	4,513,600
2036	36,390	**4,718,700**

Directional Factor (DF)	0.5
Lane Distribution Factor (LDF)	0.8
Combined Truck Factor (CTF)	1.93
Percent Trucks	2.0%
Days Per Year For Truck Traffic	365

1. 2008, 2021 and 2031 AADT are provided by the AECOM.

TABLE B8 TRAFFIC DATA AND ESTIMATED ESALs

SECTION 2 MARBOROUGH COURT TO DUNDAS STREET EAST

General Purpose Lanes in BRT Alternative

Year	Annual Average Daily Traffic	Estimated Cumulative Annual ESALs
2008	41,920 [1]	-
2017	37,536	211,500
2018	37,078	420,500
2019	36,626	626,900
2020	36,179	830,800
2021	35,738 [1]	1,032,200
2022	35,374	1,231,600
2023	35,014	1,428,900
2024	34,658	1,624,200
2025	34,305	1,817,500
2026	33,956	2,008,900
2027	33,610	2,198,300
2028	33,268	2,385,800
2029	32,930	2,571,400
2030	32,595	2,755,100
2031	32,263 [1]	2,936,900
2032	31,935	3,116,900
2033	31,610	3,295,000
2034	31,288	3,471,300
2035	30,970	3,645,800
2036	30,654	**3,818,600**

Directional Factor (DF)	0.5
Lane Distribution Factor (LDF)	0.8
Combined Truck Factor (CTF)	1.93
Percent Trucks	2.0%
Days Per Year For Truck Traffic	365

1. 2008, 2021 and 2031 AADT are provided by the AECOM.

TABLE B9 TRAFFIC DATA AND ESTIMATED ESALs

SECTION 3 DUNDAS STREET EAST TO HIGHWAY 407

General Purpose Lanes in BRT Alternative

Year	Annual Average Daily Traffic	Estimated Cumulative Annual ESALs
2008	27,130 [1]	-
2017	38,970	219,600
2018	40,570	448,200
2019	42,236	686,200
2020	43,970	934,000
2021	45,775 [1]	1,192,000
2022	44,743	1,444,200
2023	43,733	1,690,700
2024	42,747	1,931,600
2025	41,783	2,167,100
2026	40,841	2,397,300
2027	39,919	2,622,300
2028	39,019	2,842,200
2029	38,139	3,057,100
2030	37,279	3,267,200
2031	36,438 [1]	3,472,500
2032	35,616	3,673,200
2033	34,813	3,869,400
2034	34,028	4,061,200
2035	33,260	4,248,600
2036	32,510	**4,431,800**

Directional Factor (DF)	0.5
Lane Distribution Factor (LDF)	0.8
Combined Truck Factor (CTF)	1.93
Percent Trucks	2.0%
Days Per Year For Truck Traffic	365

1. 2008, 2021 and 2031 AADT are provided by the AECOM.

TABLE B10 TRAFFIC DATA AND ESTIMATED ESALs

SECTION 1 IROQUOIS SHORE ROAD TO MARBOROUGH COURT

General Purpose Lanes in HOV Alternative

Year	Annual Average Daily Traffic	Estimated Cumulative Annual ESALs
2008	35,190 [1]	-
2017	34,579	194,900
2018	35,281	393,700
2019	35,997	596,600
2020	36,728	803,600
2021	37,474 [1]	1,014,800
2022	37,581	1,226,600
2023	37,689	1,439,000
2024	37,797	1,652,000
2025	37,905	1,865,600
2026	38,014	2,079,800
2027	38,122	2,294,600
2028	38,232	2,510,100
2029	38,341	2,726,200
2030	38,451	2,942,900
2031	38,561 [1]	3,160,200
2032	38,671	3,378,100
2033	38,782	3,596,700
2034	38,893	3,815,900
2035	39,005	4,035,700
2036	39,116	**4,256,100**

Directional Factor (DF)	0.5
Lane Distribution Factor (LDF)	0.8
Combined Truck Factor (CTF)	1.93
Percent Trucks	2.0%
Days Per Year For Truck Traffic	365

1. 2008, 2021 and 2031 AADT are provided by the AECOM.

TABLE B11 TRAFFIC DATA AND ESTIMATED ESALs

SECTION 2 MARBOROUGH COURT TO DUNDAS STREET EAST

General Purpose Lanes in HOV Alternative

Year	Annual Average Daily Traffic	Estimated Cumulative Annual ESALs
2008	41,920 [1]	-
2017	33,801	190,500
2018	33,738	380,600
2019	33,674	570,400
2020	33,611	759,800
2021	33,548 [1]	948,900
2022	33,588	1,138,200
2023	33,628	1,327,700
2024	33,668	1,517,400
2025	33,707	1,707,400
2026	33,747	1,897,600
2027	33,787	2,088,000
2028	33,828	2,278,600
2029	33,868	2,469,500
2030	33,908	2,660,600
2031	33,948 [1]	2,851,900
2032	33,988	3,043,400
2033	34,029	3,235,200
2034	34,069	3,427,200
2035	34,109	3,619,400
2036	34,150	**3,811,900**

Directional Factor (DF)	0.5
Lane Distribution Factor (LDF)	0.8
Combined Truck Factor (CTF)	1.93
Percent Trucks	2.0%
Days Per Year For Truck Traffic	365

1. 2008, 2021 and 2031 AADT are provided by the AECOM.

TABLE B12 TRAFFIC DATA AND ESTIMATED ESALs
SECTION 3 DUNDAS STREET EAST TO HIGHWAY 407
General Purpose Lanes in HOV Alternative

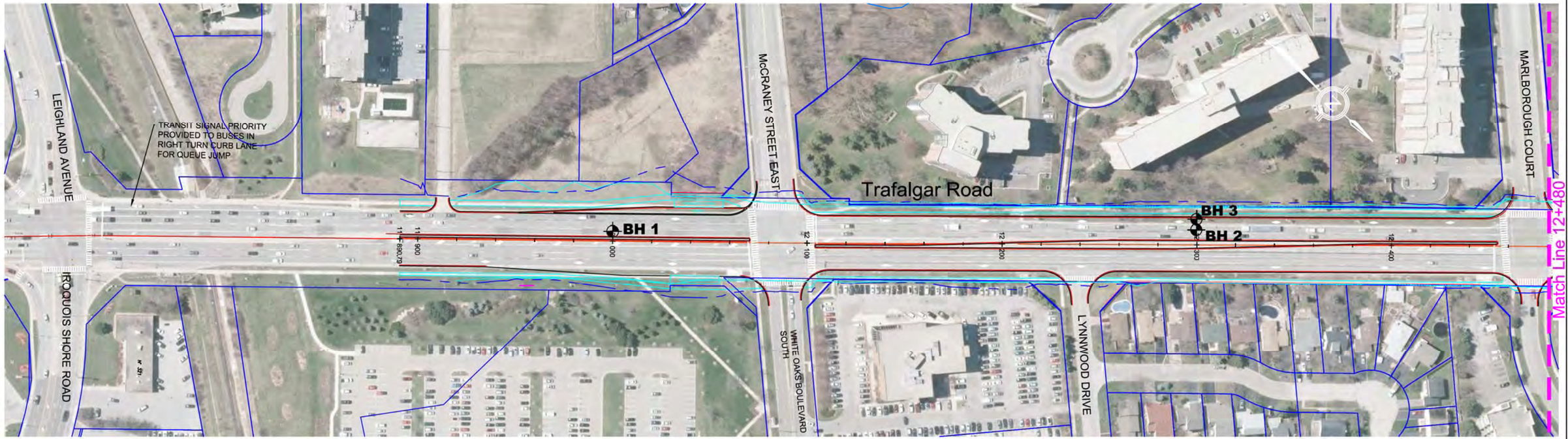
Year	Annual Average Daily Traffic	Estimated Cumulative Annual ESALs
2008	27,130 [1]	-
2017	35,246	198,600
2018	37,095	407,700
2019	39,041	627,700
2020	41,089	859,300
2021	43,245 [1]	1,103,000
2022	42,900	1,344,800
2023	42,557	1,584,600
2024	42,218	1,822,500
2025	41,880	2,058,500
2026	41,546	2,292,600
2027	41,214	2,524,900
2028	40,885	2,755,300
2029	40,559	2,983,900
2030	40,235	3,210,600
2031	39,914 [1]	3,435,500
2032	39,595	3,658,600
2033	39,279	3,880,000
2034	38,966	4,099,600
2035	38,655	4,317,400
2036	38,346	**4,533,500**

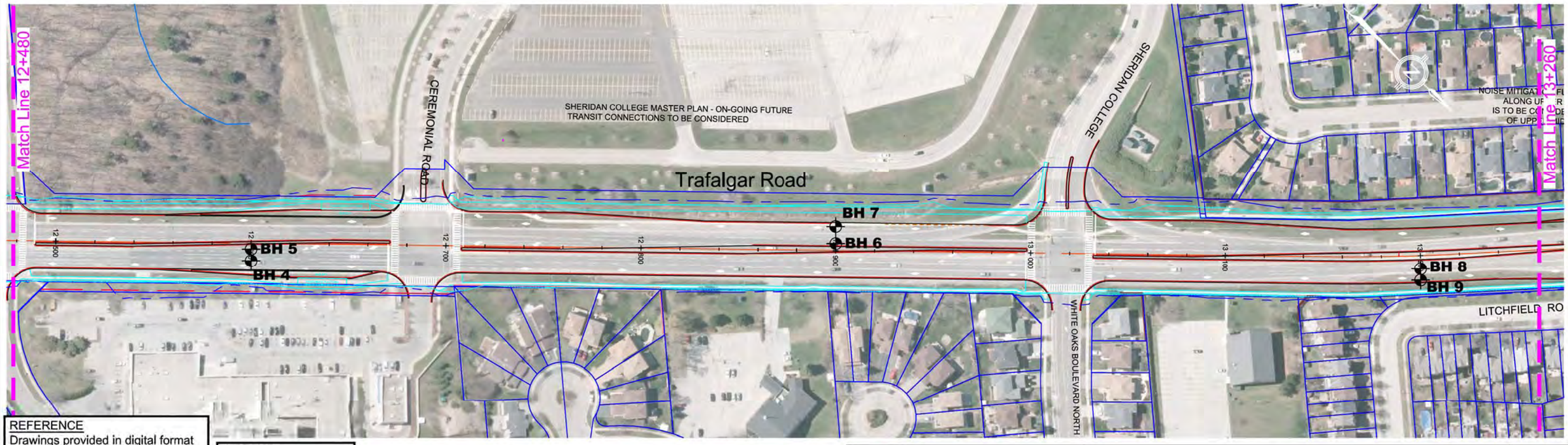
Directional Factor (DF)	0.5
Lane Distribution Factor (LDF)	0.8
Combined Truck Factor (CTF)	1.93
Percent Trucks	2.0%
Days Per Year For Truck Traffic	365

1. 2008, 2021 and 2031 AADT are provided by the AECOM.

APPENDIX C
Borehole Location Plans

TERRAPROBE INC.





REFERENCE
Drawings provided in digital format by AECOM, drawing files *60119993-DE-05, *Ex_property, *Trafalgar_combines _2013 sid file, received Dec. 03, 2013 by email.

LEGEND
Borehole

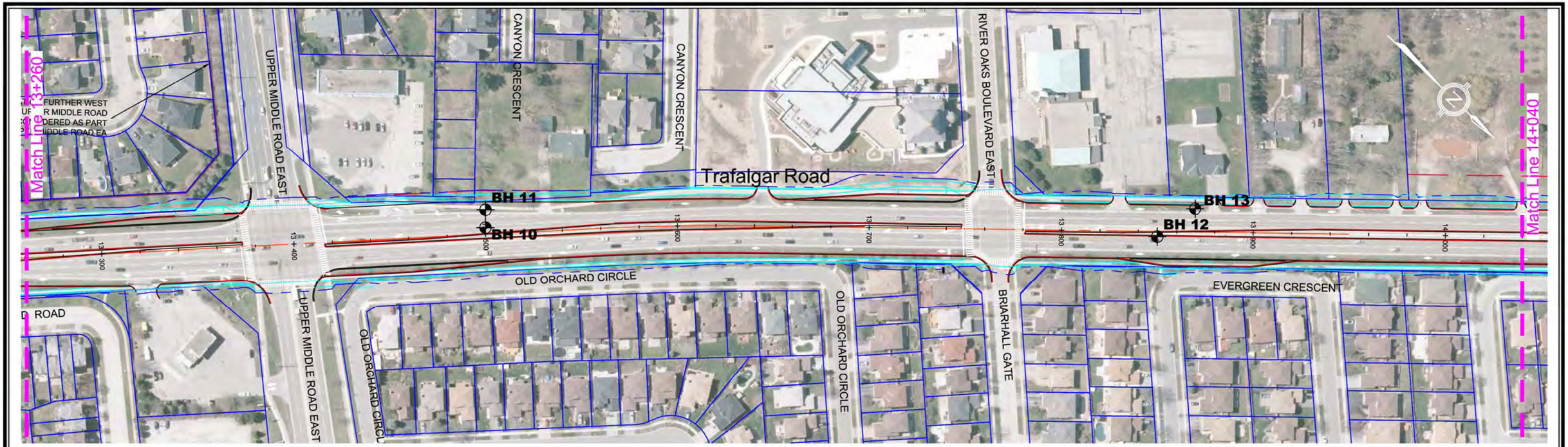
SCALE 1: 2000
20 10 0 10 20 30 40m

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

Title: **BOREHOLE LOCATION PLAN**

File No. 11-12-2091

Sheet No.: 1



REFERENCE

Drawings provided in digital format by AECOM, drawing files *60119993-DE-05, *Ex_property, *Trafalgar_combines _2013 sid file, received Dec. 03, 2013 by email.

LEGEND

Borehole

SCALE 1: 2000

20 10 0 10 20 30 40m

Terraprobe

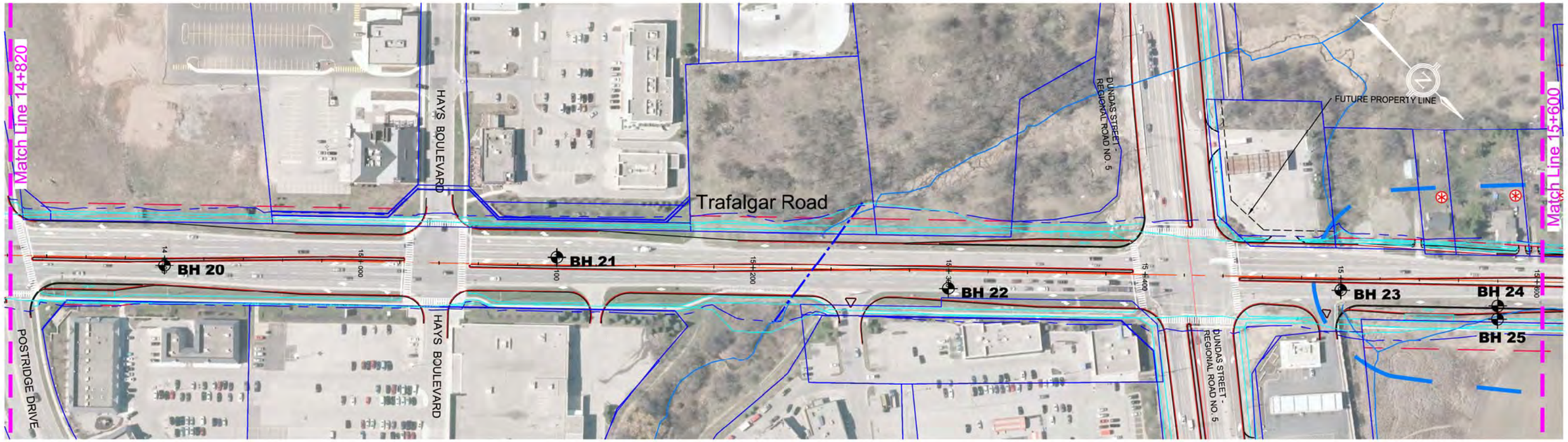
11 Indell Lane, Brampton, Ontario, L6T 3Y3

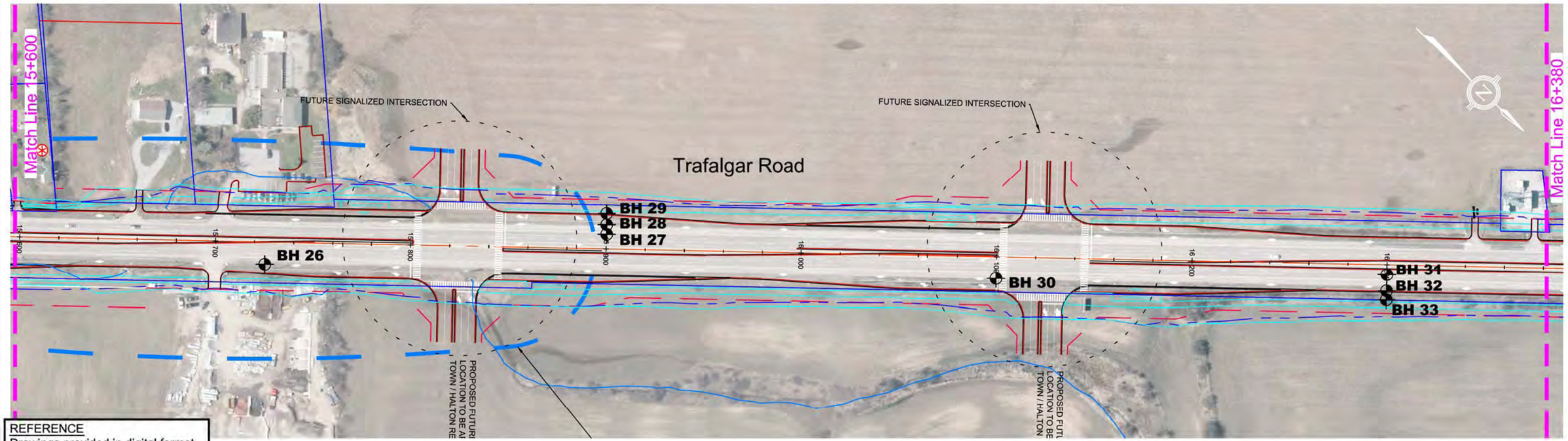
Tel: (905) 796-2650 Fax: (905) 796-2250

Title: **BOREHOLE LOCATION PLAN**

File No. 11-12-2091

Sheet No.: 2





REFERENCE
Drawings provided in digital format by AECOM, drawing files *60119993-DE-05, *Ex_property, *Trafalgar_combines _2013 sid file, received Dec. 03, 2013 by email.

LEGEND
Borehole

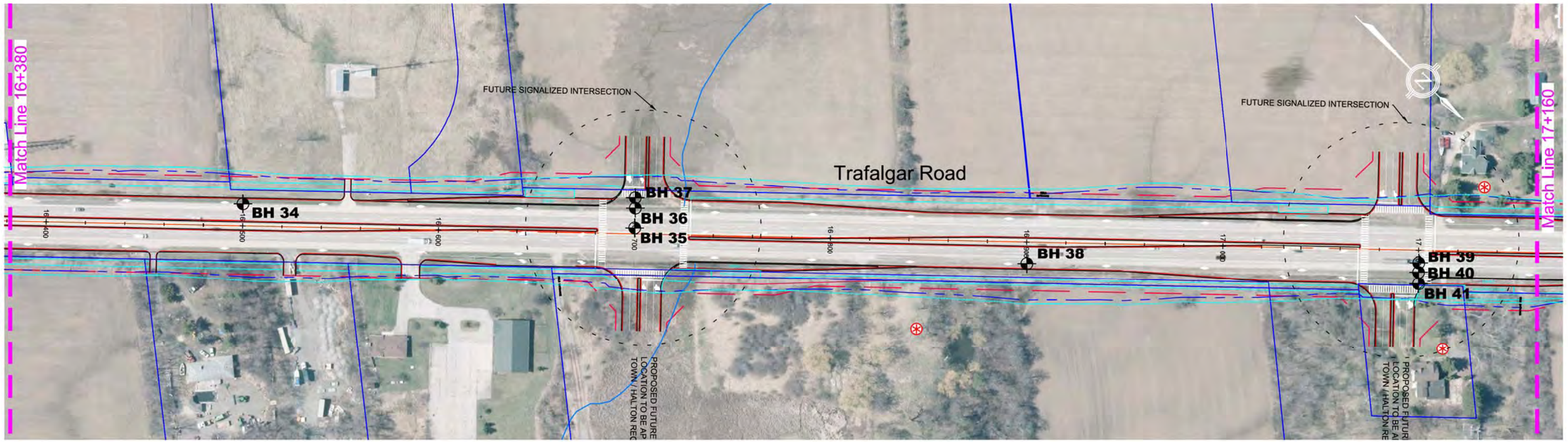
SCALE 1: 2000
20 10 0 10 20 30 40m

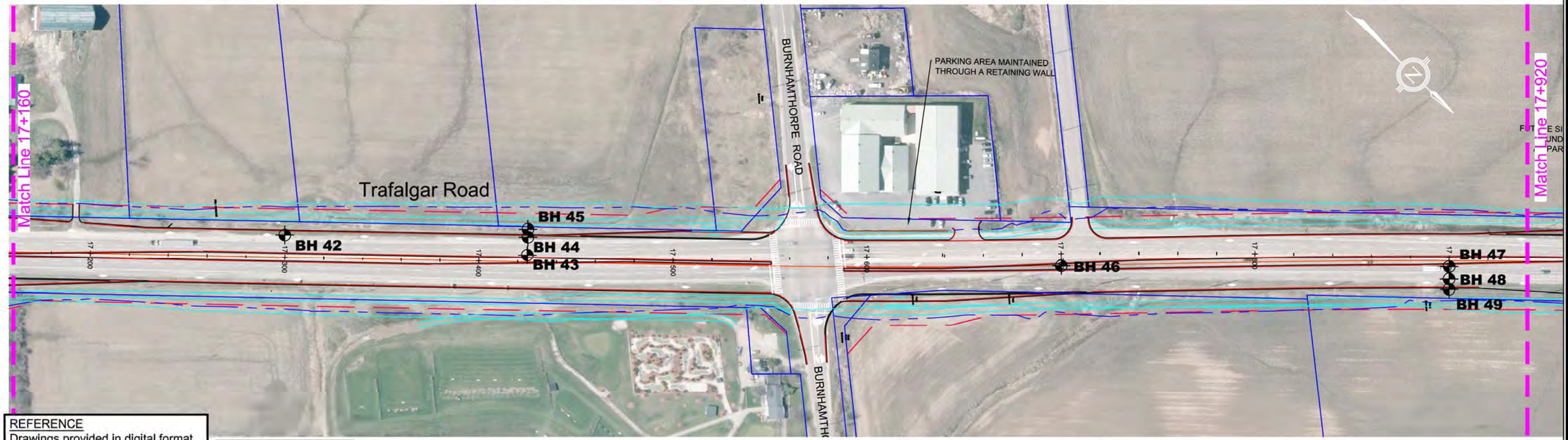
Terraprobe
11 Indell Lane, Brampton, Ontario, L6T 3Y3
Tel: (905) 796-2650 Fax: (905) 796-2250

Title: **BOREHOLE LOCATION PLAN**

File No. 11-12-2091

Sheet No.: 3





REFERENCE

Drawings provided in digital format by AECOM, drawing files *60119993-DE-05, *Ex_property, *Trafalgar_combines _2013 sid file, received Dec. 03, 2013 by email.

LEGEND

Borehole

SCALE 1: 2000

20 10 0 10 20 30 40m

Terraprobe
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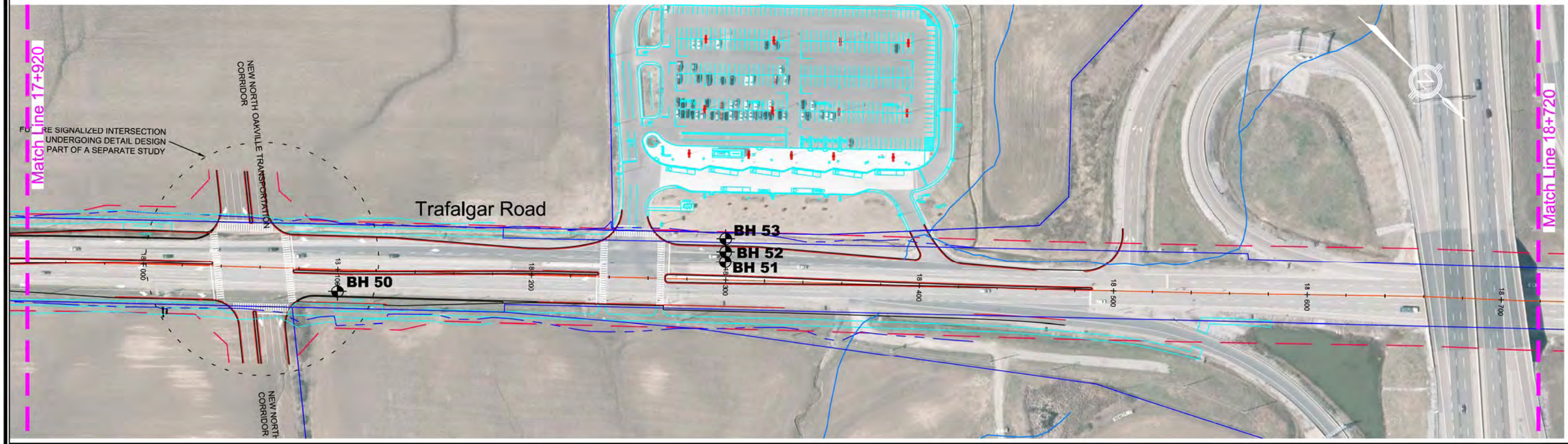
Title: **BOREHOLE LOCATION PLAN**

File No. 11-12-2091

Sheet No.: 4



REFERENCE
Drawings provided in digital format by AECOM, drawing files *60119993-DE-05, *Ex_property, *Trafalgar_combines _2013 sid file, received Dec. 03, 2013 by email.

LEGEND
Borehole

SCALE 1: 2000
20 10 0 10 20 30 40m

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

Title: **BOREHOLE LOCATION PLAN**

File No. 11-12-2091

Sheet No.: 5

APPENDIX D

Asphaltic Concrete Core Logs

TERRAPROBE INC.

Lift	Thickness (mm)
Lift 1	50
Lift 2	50
Lift 3	70
Total	170

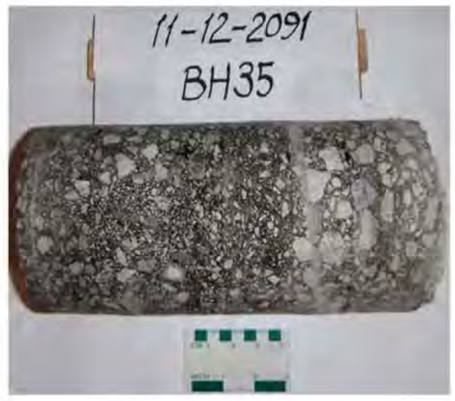
Lift	Thickness (mm)
Lift 1	40
Lift 2	50
Lift 3	40
Lift 4	80
Total	210

Lift	Thickness (mm)
Lift 1	70
Lift 2	70
Total	140

Lift	Thickness (mm)
Lift 1	65
Lift 2	50
Lift 3	40
Total	155

Lift	Thickness (mm)
Lift 1	60
Lift 2	70
Lift 3	60
Total	190

Note: This asphaltic concrete core was taken on NB curb lane at Sta. 15+580.



Lift	Thickness (mm)
Lift 1	50
Lift 2	80
Lift 3	40
Lift 4	40
Lift 5	70
Total	280

Lift	Thickness (mm)
Lift 1	40
Lift 2	60
Lift 3	40
Lift 4	60
Lift 5	60
Total	260

Lift	Thickness (mm)
Lift 1	30
Lift 2	40
Lift 3	60
Total	130

APPENDIX E
Record of Borehole Sheets

TERRAPROBE INC.

Terraprobe

ABBREVIATIONS AND TERMINOLOGY

SAMPLING METHODS

AS	auger sample
CORE	cored sample
DP	direct push
FV	field vane
GS	grab sample
SS	split spoon
ST	shelby tube
WS	wash sample

PENETRATION RESISTANCE

Standard Penetration Test (SPT) resistance ('N' values) is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a standard 50 mm (2 in.) diameter split spoon sampler for a distance of 0.3 m (12 in.).

Dynamic Cone Test (DCT) resistance is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a conical steel point of 50 mm (2 in.) diameter and with 60° sides on 'A' size drill rods for a distance of 0.3 m (12 in.)."

COHESIONLESS SOILS

Compactness	'N' value
very loose	< 4
loose	4 – 10
compact	10 – 30
dense	30 – 50
very dense	> 50

COHESIVE SOILS

Consistency	'N' value	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

COMPOSITION

Term (e.g)	% by weight
trace silt	< 10
some silt	10 – 20
silt*y*	20 – 35
sand *and* silt	> 35

TESTS AND SYMBOLS

MH	mechanical sieve and hydrometer analysis
w, w_c	water content
w_L, LL	liquid limit
w_P, PL	plastic limit
I_P, PI	plasticity index
k	coefficient of permeability
γ	soil unit weight, bulk
G_s	specific gravity
φ'	internal friction angle
c'	effective cohesion
c_u	undrained shear strength

▽	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
c_v	coefficient of consolidation
m_v	coefficient of compressibility
e	void ratio

FIELD MOISTURE DESCRIPTIONS

Damp	refers to a soil sample that does not exhibit any observable pore water from field/hand inspection.
Moist	refers to a soil sample that exhibits evidence of existing pore water (e.g. sample feels cool, cohesive soil is at plastic limit) but does not have visible pore water
Wet	refers to a soil sample that has visible pore water

Terraprobe

BOREHOLE LOG 1

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 19, 2012
Sheet No. : 1 of 1

Position : E: 605989, N: 4813418 (UTM 17T)
Rig type : truck-mounted

Elevation Datum : Geodetic (NAD83)
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
0	123.7	**GROUND SURFACE**					
	123.5 / 0.2	165mm **ASPHALTIC CONCRETE**					
	123.3 / 0.4	245mm **GRANULAR BASE/SUBBASE**					
		CLAYEY SILT, trace gravel, trace sand, very stiff, reddish brown, moist (GLACIAL TILL)		1	SS	22	123
1	122.2 / 1.5	Shale - till complex		2	SS	50 / 150mm	122
	121.7 / 2.0	**END OF BOREHOLE**					

Borehole was dry and open upon completion of drilling.

Penetration Test Values (Blows / 0.3m) — × Dynamic Cone — 10 20 30 40
Undrained Shear Strength (kPa) — ○ Unconfined ✚ Field Vane ● Pocket Penetrometer ■ Lab Vane — 40 80 120 160
Moisture / Plasticity — Plastic Limit | Natural Water Content | Liquid Limit — PL MC LL — 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT) — GR SA SI CL

BOREHOLE LOG 2

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 19, 2012
Sheet No. : 1 of 1

Position : E: 605779, N: 4813618 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Samples: Number	Samples: Type	Samples: SPT 'N' Value	Elevation Scale (m)
0	130.5	**GROUND SURFACE**					
	130.3 / 0.2	165mm **ASPHALTIC CONCRETE**					
		900mm **GRANULAR BASE/SUBBASE**		1A	SS	11	130
1	129.4 / 1.1			1B			
	129.3 / 1.2	**CLAYEY SILT**, trace gravel, trace sand, stiff, reddish brown, moist (GLACIAL TILL)		2	SS	50 / 125mm	
	128.9 / 1.7	Shale - till complex					129

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40
Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40 80 120 160
Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit — PL MC LL — 10 20 30
Headspace Vapour | Instrument Details | Unstabilized Water Level | Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

BOREHOLE LOG 3

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 19, 2012
Sheet No. : 1 of 1

Position : E: 605776, N: 4813608 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Samples: Number	Samples: Type	Samples: SPT 'N' Value	Elevation Scale (m)
0	130.5	**GROUND SURFACE**					
	130.4 / 0.2	150mm **TOPSOIL**					
		FILL, silty clay, trace gravel, trace sand, trace rootlets, stiff, dark brown, wet		1	SS	11	130
	129.7 / 0.8						
1		**FILL**, sand and gravel, loose, greyish brown, moist		2	SS	8	
	129.0 / 1.5						
		CLAYEY SILT, trace gravel, trace sand, hard, reddish brown, moist (GLACIAL TILL)		3	SS	49	129
	128.5 / 2.0						

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40
Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40 80 120 160
Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit — PL MC LL — 10 20 30
Headspace Vapour | Instrument Details | Unstabilized Water Level | Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Terraprobe

BOREHOLE LOG 4

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 19, 2012
Sheet No. : 1 of 1

Position : E: 605578, N: 4813840 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
	134.5	**GROUND SURFACE**					
0	134.3	170mm **ASPHALTIC CONCRETE**					
	0.2	590mm **GRANULAR BASE/SUBBASE**					
	133.7						134
	0.8	**CLAYEY SILT**, trace gravel, trace sand, hard, reddish brown, moist (GLACIAL TILL)		1	SS	46	
1	133.0						
	1.5	Shale - till complex		2	SS	50 / 100mm	133
	132.7						
	1.8	**END OF BOREHOLE**					

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL): 10 20 30
Headspace Vapour | Instrument Details | Unstabilized Water Level | Lab Data and Comments | GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Borehole was dry and open upon completion of drilling.

library: library - terraprobe.gint.gtb report: terraprobe soil log file: 11-12-2091 bh logs.gpj

Terraprobe

BOREHOLE LOG 5

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 19, 2012
Sheet No. : 1 of 1

Position : E: 605570, N: 4813833 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
	134.5	**GROUND SURFACE**					
0		100mm **ASPHALTIC CONCRETE**					
		270mm **GRANULAR BASE/SUBBASE**					
	133.9						134
	0.6	**CLAYEY SILT**, trace gravel, trace sand, hard, reddish brown, moist (GLACIAL TILL)		1	SS	34	
1	133.0						
	1.5	Shale - till complex		2	SS	50 / 150mm	133
	132.7						
	1.8	**END OF BOREHOLE**					

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL): 10 20 30
Headspace Vapour | Instrument Details | Unstabilized Water Level | Lab Data and Comments | GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Borehole was dry and open upon completion of drilling.

library: library - terraprobe.gint.gtb report: terraprobe soil log file: 11-12-2091 bh logs.gpj

BOREHOLE LOG 6

Terraprobe

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 19, 2012
Sheet No. : 1 of 1

Position : E: 605347, N: 4814055 (UTM 17T)
Rig type : truck-mounted

Elevation Datum : Geodetic (NAD83)
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) Dynamic Cone 10 20 30 40 / Undrained Shear Strength (kPa) Unconfined, Pocket Penetrometer, Field Vane, Lab Vane 40 80 120 160	Moisture / Plasticity PL MC LL 10 20 30	Headspace Vapour	Instrument Details	Unstabilized Water Level	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
0	138.3	**GROUND SURFACE**											
	137.9 0.4	340mm **ASPHALTIC CONCRETE**											
	137.5 0.8	420mm **GRANULAR BASE/SUBBASE**					138						
1		**FILL**, sandy silt, trace gravel, compact, brown, moist		1	SS	24							
	136.8 1.5						137						
	136.3 2.0	**CLAYEY SILT**, trace sand, very stiff, reddish brown, moist (GLACIAL TILL)		2	SS	22							0 3 58 39

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

library: library - terraprobe.gint.gtb **report:** terraprobe soil log **file:** 11-12-2091 bh logs.gpj

BOREHOLE LOG 7

Terraprobe

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 19, 2012
Sheet No. : 1 of 1

Position : E: 605338, N: 4814038 (UTM 17T)
Rig type : truck-mounted

Elevation Datum : Geodetic (NAD83)
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) Dynamic Cone 10 20 30 40 / Undrained Shear Strength (kPa) Unconfined, Pocket Penetrometer, Field Vane, Lab Vane 40 80 120 160	Moisture / Plasticity PL MC LL 10 20 30	Headspace Vapour	Instrument Details	Unstabilized Water Level	Lab Data and Comments GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
0	138.3	**GROUND SURFACE**											
		50mm **TOPSOIL**											
		FILL, gravelly sand, some silt, compact, brown, moist		1	SS	16	138						
1	137.3 1.0	**FILL**, clayey silt, some sand, trace gravel, trace organic matters, very stiff, dark brown, moist		2	SS	18							
	136.8 1.5						137						
	136.3 2.0	**CLAYEY SILT**, trace gravel, trace sand, very stiff, brown, moist (GLACIAL TILL)		3	SS	20							

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

library: library - terraprobe.gint.gtb **report:** terraprobe soil log **file:** 11-12-2091 bh logs.gpj

Terraprobe

BOREHOLE LOG 8

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 19, 2012
Sheet No. : 1 of 1

Position : E: 605143, N: 4814251 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation Scale (m)
0	144.5	**GROUND SURFACE**					144
	144.3	210mm **ASPHALTIC CONCRETE**					
	0.2	560mm **GRANULAR BASE/SUBBASE**					
	143.7						
	0.8	**CLAYEY SILT**, trace gravel, trace sand, very stiff, reddish brown, moist (GLACIAL TILL)		1	SS	19	
1		...trace rootlets		2	SS	28	143
	142.5						
	2.0	**END OF BOREHOLE**					

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined / Pocket Penetrometer / Field Vane / Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit (PL) / Natural Water Content (MC) / Liquid Limit (LL): 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

Borehole was dry and open upon completion of drilling.

Terraprobe

BOREHOLE LOG 9

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 19, 2012
Sheet No. : 1 of 1

Position : E: 605143, N: 4814262 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation Scale (m)
0	144.5	**GROUND SURFACE**					144
		50mm **TOPSOIL**		1	SS	50 / 125mm	
		FILL, clayey silt, trace gravel, trace sand, trace organic matters, hard, dark brown, moist					
	143.7						
	0.8	**FILL**, sand and gravel, some silt, compact, brown, moist		2	SS	16	
1	143.0						143
	1.5	**FILL**, silty clay, trace gravel, trace sand, firm, brown, wet		3	SS	8	
	142.5						
	2.0	**END OF BOREHOLE**					

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined / Pocket Penetrometer / Field Vane / Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit (PL) / Natural Water Content (MC) / Liquid Limit (LL): 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

Borehole was dry and open upon completion of drilling.

BOREHOLE LOG 10

Terraprobe

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 19, 2012
Sheet No. : 1 of 1

Position : E: 606263, N: 4814469 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation Scale (m)
0	150.7	**GROUND SURFACE**					150
	150.4	340mm **ASPHALTIC CONCRETE**					
	0.3						
	150.1	270mm **GRANULAR BASE/SUBBASE**					
	0.6	**FILL**, clayey silt, trace gravel, trace sand, stiff, brown, moist		1	SS	11	
1	149.5						
	1.2	**CLAYEY SILT**, trace gravel, trace sand, very stiff, reddish brown, moist (GLACIAL TILL)		2	SS	30	149
	148.7						
	2.0	**END OF BOREHOLE**					

Borehole was dry and open upon completion of drilling.

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined / Pocket Penetrometer / Field Vane / Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit (PL) / Natural Water Content (MC) / Liquid Limit (LL): 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

BOREHOLE LOG 11

Terraprobe

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 19, 2012
Sheet No. : 1 of 1

Position : E: 604904, N: 4814436 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation Scale (m)
0	150.7	**GROUND SURFACE**					150
		80mm **TOPSOIL**					
		FILL, sand and gravel, some silt, trace organic matters, compact, brown, damp to wet		1	SS	13	
1	149.5			2	SS	23	
	1.2	**CLAYEY SILT**, trace gravel, trace sand, very stiff, reddish green, moist (GLACIAL TILL)					149
	148.7			3	SS	19	
	2.0	**END OF BOREHOLE**					

Borehole was dry and open upon completion of drilling.

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined / Pocket Penetrometer / Field Vane / Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit (PL) / Natural Water Content (MC) / Liquid Limit (LL): 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

Terraprobe

BOREHOLE LOG 12

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 19, 2012
Sheet No. : 1 of 1

Position : E: 604659, N: 4814692 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
	156.3	**GROUND SURFACE**				
0		140mm **ASPHALTIC CONCRETE**				
		775mm **GRANULAR BASE/SUBBASE**				
	155.4					
1	0.9	**FILL**, silty clay, trace gravel, trace sand, stiff, dark brown, wet		1	SS	9
	155.1					
	1.2	**CLAYEY SILT**, trace gravel, trace sand, hard, reddish brown, moist (GLACIAL TILL)				
				2	SS	47
	154.3					
	2.0					

Elevation Scale (m): 156, 155

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit, Natural Water Content, Liquid Limit: PL MC LL; 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Terraprobe

BOREHOLE LOG 13

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 18, 2012
Sheet No. : 1 of 1

Position : E: 604634, N: 4814695 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
	156.5	**GROUND SURFACE**				
0		80mm **TOPSOIL**				
		FILL, sand and gravel, some silt, compact, brown, moist		1	SS	12
	155.9					
	0.6	**FILL**, clayey silt, trace gravel, trace sand, stiff, mottled, moist		2	SS	9
1	155.3					
	1.2	**CLAYEY SILT**, some sand, trace gravel, hard, reddish brown, moist (GLACIAL TILL)		3	SS	32
	154.7					
	1.8					

Elevation Scale (m): 156, 155

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit, Natural Water Content, Liquid Limit: PL MC LL; 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL: 2 11 60 27

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Terraprobe

BOREHOLE LOG 14

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 18, 2012
Sheet No. : 1 of 1

Position : E: 604477, N: 4814856 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation Scale (m)
0	159.3	**GROUND SURFACE**					
	159.1	190mm **ASPHALTIC CONCRETE**					159
	0.2						
	158.9	240mm **GRANULAR BASE/SUBBASE**					
	0.4	**FILL**, clayey silt, some sand, trace gravel, stiff, brown, moist		1	SS	15	
1							158
	157.8						
	1.5	**CLAYEY SILT**, trace gravel, trace sand, very stiff, reddish brown, moist (GLACIAL TILL)		2	SS	22	
	157.3						
	2.0						

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined / Pocket Penetrometer / Field Vane / Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit (PL) / Natural Water Content (MC) / Liquid Limit (LL): 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Terraprobe

BOREHOLE LOG 15

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 18, 2012
Sheet No. : 1 of 1

Position : E: 604469, N: 4814853 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation Scale (m)
0	159.0	**GROUND SURFACE**					
		60mm **ASPHALTIC CONCRETE**					
		490mm **GRANULAR BASE/SUBBASE**					
	158.4						
	0.6	**FILL**, silty clay, trace gravel, trace sand, soft, brown, wet		1	SS	4	
1							158
	157.5						
	1.5	**CLAYEY SILT**, trace gravel, trace sand, very stiff, reddish brown, moist (GLACIAL TILL)		2	SS	20	
	157.0						
	2.0						

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined / Pocket Penetrometer / Field Vane / Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit (PL) / Natural Water Content (MC) / Liquid Limit (LL): 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

BOREHOLE LOG 16

Terraprobe

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 19, 2012
Sheet No. : 1 of 1

Position : E: 604234, N: 4815110 (UTM 17T)
Rig type : truck-mounted

Elevation Datum : Geodetic (NAD83)
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Samples: Number	Samples: Type	Samples: SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity	Headspace Vapour	Instrument Details	Unstabilized Water Level	Lab Data and Comments
0	164.5	GROUND SURFACE											
	164.3	155mm ASPHALTIC CONCRETE											
	0.2	1820mm GRANULAR BASE/SUBBASE											
1				1	SS	68	164						
							163						
				2	SS	90							
	162.5												
	2.0												

Penetration Test Values (Blows / 0.3m): Dynamic Cone — 10 20 30 40
Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40 80 120 160
Moisture / Plasticity: Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL) — 10 20 30
Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

BOREHOLE LOG 17

Terraprobe

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 19, 2012
Sheet No. : 1 of 1

Position : E: 604234, N: 4815108 (UTM 17T)
Rig type : truck-mounted

Elevation Datum : Geodetic (NAD83)
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Samples: Number	Samples: Type	Samples: SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity	Headspace Vapour	Instrument Details	Unstabilized Water Level	Lab Data and Comments
0	164.5	GROUND SURFACE											
		100mm TOPSOIL		1A									
		FILL, sand and gravel, some silt, compact, brown, damp		1B	SS	11	164						
1				2	SS	25							
	163.3						163						
	1.2	CLAYEY SILT, trace gravel, trace sand, very stiff, reddish brown, moist (GLACIAL TILL)		3	SS	17							
	162.7												
	1.8												

Penetration Test Values (Blows / 0.3m): Dynamic Cone — 10 20 30 40
Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40 80 120 160
Moisture / Plasticity: Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL) — 10 20 30
Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Terraprobe

BOREHOLE LOG 18

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 16, 2012
Sheet No. : 1 of 1

Position : E: 604025, N: 4815294 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev / Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	164.5	**GROUND SURFACE**				
	164.3 / 0.2	190mm **ASPHALTIC CONCRETE**				
		570mm **GRANULAR BASE/SUBBASE**				
	163.7 / 0.8	**FILL**, silty clay, trace gravel, trace sand, stiff, dark brown, moist		1	SS	12
1	163.0 / 1.5	**CLAYEY SILT**, trace gravel, trace sand, hard, reddish green, moist (GLACIAL TILL)		2	SS	34
	162.5 / 2.0	**END OF BOREHOLE**				

Borehole was dry and open upon completion of drilling.

Elevation Scale (m): 164, 163

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit, Natural Water Content, Liquid Limit: PL MC LL; 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

Terraprobe

BOREHOLE LOG 19

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 16, 2012
Sheet No. : 1 of 1

Position : E: 604024, N: 4815294 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev / Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	164.5	**GROUND SURFACE**				
		90mm **TOPSOIL**				
		FILL, sand and gravel, some silt, compact, brown, moist		1	SS	25
1				2	SS	28
	163.0 / 1.5	**CLAYEY SILT**, trace gravel, trace sand, hard, reddish brown, moist (GLACIAL TILL)		3	SS	66 / 275mm
	162.5 / 2.0	**END OF BOREHOLE**				

Borehole was dry and open upon completion of drilling.

Elevation Scale (m): 164, 163

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit, Natural Water Content, Liquid Limit: PL MC LL; 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

Terraprobe

BOREHOLE LOG 20

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 21, 2012
Sheet No. : 1 of 1

Position : E: 603907, N: 4815430 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	166.2	**GROUND SURFACE**				
	166.0	180mm **ASPHALTIC CONCRETE**				
	0.2	470mm **GRANULAR BASE/SUBBASE**				
	165.5					
	0.7	**CLAYEY SILT**, trace gravel, trace to some sand, very stiff to hard, reddish brown, moist (GLACIAL TILL)		1	SS	27
1				2	SS	44
	164.2					
	2.0	**END OF BOREHOLE**				

Borehole was dry and open upon completion of drilling.

Elevation Scale (m): 166, 165

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160

Moisture / Plasticity — Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL): 10 20 30

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

Terraprobe

BOREHOLE LOG 21

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 18, 2012
Sheet No. : 1 of 1

Position : E: 603757, N: 4815569 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value
0	168.2	**GROUND SURFACE**				
	167.9	280mm **ASPHALTIC CONCRETE**				
	0.3	220mm **GRANULAR BASE/SUBBASE**		1	AS	
	167.7					
	0.5	**CLAYEY SILT**, trace gravel, trace to some sand, very stiff, brown, moist (GLACIAL TILL)		2	SS	18
1				3	SS	30
	166.2					
	2.0	**END OF BOREHOLE**				

Borehole was dry and open upon completion of drilling.

Elevation Scale (m): 168, 167

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160

Moisture / Plasticity — Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL): 10 20 30

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

BOREHOLE LOG 22

Terraprobe

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 21, 2012
Sheet No. : 1 of 1

Position : E: 603629, N: 4815711 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity (Plastic Limit, Natural Water Content, Liquid Limit)	Headspace Vapour	Instrument Details	Unstabilized Water Level	Lab Data and Comments
0	169.5	**GROUND SURFACE**					169	Dynamic Cone: 10 20 30 40; Unconfined / Pocket Penetrometer; Field Vane / Lab Vane: 40 80 120 160	PL MC LL: 10 20 30				
	169.4 0.2	140mm **ASPHALTIC CONCRETE**											
		930mm **GRANULAR BASE/SUBBASE**											
1	168.4 1.1	**CLAYEY SILT**, sandy, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		1	SS	31							
				2	SS	28	168						GRAIN SIZE DISTRIBUTION (%) (MIT): GR 4 SA 27 SI 47 CL 22
	167.5 2.0	**END OF BOREHOLE**											

Borehole was dry and open upon completion of drilling.

library: library - terraprobe.gint.gtb report: terraprobe soil log file: 11-12-2091 bh logs.gpj

BOREHOLE LOG 23

Terraprobe

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 16, 2012
Sheet No. : 1 of 1

Position : E: 603478, N: 4815862 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity (Plastic Limit, Natural Water Content, Liquid Limit)	Headspace Vapour	Instrument Details	Unstabilized Water Level	Lab Data and Comments
0	169.0	**GROUND SURFACE**					168	Dynamic Cone: 10 20 30 40; Unconfined / Pocket Penetrometer; Field Vane / Lab Vane: 40 80 120 160	PL MC LL: 10 20 30				
	168.7 0.3	300mm **ASPHALTIC CONCRETE**											
		920mm **GRANULAR BASE/SUBBASE**		1	AS								
1	167.8 1.2	**FILL**, clayey silt, some sand, trace gravel, firm, dark brown, moist		2	SS	43							
	167.0 2.0	**END OF BOREHOLE**		3	SS	8							GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

Borehole was dry and open upon completion of drilling.

library: library - terraprobe.gint.gtb report: terraprobe soil log file: 11-12-2091 bh logs.gpj

BOREHOLE LOG 24

Terraprobe

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 16, 2012
Sheet No. : 1 of 1

Position : E: 603417, N: 4815908 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
	167.0	**GROUND SURFACE**				
0		600mm **GRAVEL SHOULDER**		1	AS	
	166.4					
	0.6	**FILL**, silty clay, trace gravel, trace sand, stiff, brown, moist		2	AS	11
1	165.5					
	1.5	**CLAYEY SILT**, trace gravel, trace sand, very stiff, reddish brown, moist (GLACIAL TILL)		3	SS	24
2	164.7					
	2.3	Shale - till complex		4	SS	50 / 125mm
3				5	SS	50 / 25mm
4						
	162.4			6	SS	50 / 75mm
	4.7					

Elevation Scale (m): 166, 165, 164, 163

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160

Moisture / Plasticity — Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL): 10 20 30

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

...at 4.6m, wet spoon

END OF BOREHOLE

Borehole was dry and caved to 3.9m below grade upon completion of drilling.

BOREHOLE LOG 25

Terraprobe

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 16, 2012
Sheet No. : 1 of 1

Position : E: 603420, N: 4815910 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
	167.0	**GROUND SURFACE**				
0	166.8	210mm **TOPSOIL**				
	0.2	**FILL**, sand and gravel, some silt, compact, brown, damp		1	SS	19
	166.2					
1	0.8	**CLAYEY SILT**, trace gravel, trace sand, stiff to very stiff, brown to reddish brown, moist (GLACIAL TILL)		2	SS	15
	165.0			3	SS	22
	2.0					

Elevation Scale (m): 166

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160

Moisture / Plasticity — Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL): 10 20 30

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

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

BOREHOLE LOG 26

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 16, 2012
Sheet No. : 1 of 1

Position : E: 603330, N: 4816009 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
0	169.5	**GROUND SURFACE**					169
		750mm **GRAVEL SHOULDER**		1	SS	22	
	168.7 0.8	**CLAYEY SILT**, trace gravel, trace sand, stiff, brown to reddish brown, moist		2	SS	11	
1	168.0 1.5	Shale - till complex		3	SS	50 / 100mm	168
2				4	SS	50 / 75mm	167
3				5	SS	50 / 100mm	166
4	164.9 4.7			6	SS	50 / 75mm	165

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL): 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

END OF BOREHOLE

Borehole was dry and caved to 3.4m below grade upon completion of drilling.

BOREHOLE LOG 27

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 18, 2012
Sheet No. : 1 of 1

Position : E: 603190, N: 4816126 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
0	172.0	**GROUND SURFACE**					172
	171.8 0.2	230mm **ASPHALTIC CONCRETE**					
		840mm **GRANULAR BASE/SUBBASE**					
1	170.9 1.1	**FILL**, silty clay, trace gravel, trace sand, very stiff, dark brown, moist		1	SS	16	171
	170.2			2	SS	17	
	170.0 2.0	**CLAYEY SILT**, trace gravel, trace sand, very stiff, reddish brown to grey, moist (GLACIAL TILL)					

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL): 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Terraprobe

BOREHOLE LOG 28

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 18, 2012
Sheet No. : 1 of 1

Position : E: 603186, N: 4816120 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation Scale (m)
	171.5	**GROUND SURFACE**					
0		530mm **GRAVEL SHOULDER**		1	SS	25	171
	171.0 / 0.5	**FILL**, silty clay, trace gravel, trace sand, stiff, dark brown, moist		2	SS	12	
1	170.0 / 1.5	**CLAYEY SILT**, trace gravel, trace sand, very stiff, reddish brown, moist (GLACIAL TILL)		3	SS	22	170
2	169.2 / 2.3	Shale - till complex		4	SS	50 / 150mm	169
3				5	SS	50 / 50mm	168
4	166.8 / 4.7			6	SS	50 / 100mm	167

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined / Pocket Penetrometer / Field Vane / Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit (PL) / Natural Water Content (MC) / Liquid Limit (LL): 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

END OF BOREHOLE

Borehole was dry and caved to 4.5m below grade upon completion of drilling.

Terraprobe

BOREHOLE LOG 29

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 18, 2012
Sheet No. : 1 of 1

Position : E: 603184, N: 4816099 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation Scale (m)
	171.0	**GROUND SURFACE**					
0		130mm **TOPSOIL**					171
		FILL, sand and gravel, some silt, compact, brown, moist		1	SS	11	
	170.2 / 0.8	**FILL**, silty clay, trace gravel, trace sand, stiff, greyish brown, moist		2	SS	11	170
1	169.8 / 1.2	**CLAYEY SILT**, trace gravel, trace sand, stiff, reddish brown, moist (GLACIAL TILL)		3	SS	15	
	169.0 / 2.0						

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined / Pocket Penetrometer / Field Vane / Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit (PL) / Natural Water Content (MC) / Liquid Limit (LL): 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Terraprobe

BOREHOLE LOG 30

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 16, 2012
Sheet No. : 1 of 1

Position : E: 603061, N: 4816271 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
0	174.5	**GROUND SURFACE**					174
		750mm **GRAVEL SHOULDER**		1	SS	23	
	173.7 / 0.8	**FILL**, silty clay, trace sand, trace gravel, stiff, greyish brown, moist		2	AS	10	173
1	173.0 / 1.5	**CLAYEY SILT**, some sand to sandy, trace gravel, hard, brown to reddish brown, moist (GLACIAL TILL)		3	SS	37	
				4	SS	77 / 225mm	172
2							
3	171.5 / 3.1	Shale - till complex		5	SS	50 / 100mm	171
4	169.8 / 4.7			6	SS	50 / 100mm	170

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL): 10 20 30
Headspace Vapour | Instrument Details | Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

1 23 59 17

END OF BOREHOLE

Borehole was dry and caved to 3.8m below grade upon completion of drilling.

Terraprobe

BOREHOLE LOG 31

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 16, 2012
Sheet No. : 1 of 1

Position : E: 602913, N: 4816427 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
0	178.5	**GROUND SURFACE**					178
	178.3 / 0.2	190mm **ASPHALTIC CONCRETE**					
	177.9 / 0.6	420mm **GRANULAR BASE/SUBBASE**					
1		**FILL**, silty clay, trace gravel, trace sand, hard, greyish brown, moist		1	SS	50 / 100mm	177
	177.0 / 1.5	**CLAYEY SILT**, trace gravel, trace sand, very stiff, brown, moist (GLACIAL TILL)		2	SS	21	
	176.5 / 2.0						

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL): 10 20 30
Headspace Vapour | Instrument Details | Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT)

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Terraprobe

BOREHOLE LOG 32

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 16, 2012
Sheet No. : 1 of 1

Position : E: 602920, N: 4816414 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
0	177.0	**GROUND SURFACE**					
		80mm **GRAVEL SHOULDER**					
		FILL, clayey silt, some sand, trace gravel, stiff to very stiff, brown, moist		1	SS	17	
1				2	AS	15	176
	175.5						
	1.5	**CLAYEY SILT**, trace gravel, trace sand, very stiff, brown, moist (GLACIAL TILL)		3	SS	28	
	175.0						
	2.0	**END OF BOREHOLE**					

Borehole was dry and open upon completion of drilling.

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit, Natural Water Content, Liquid Limit: PL MC LL; 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

Terraprobe

BOREHOLE LOG 33

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 16, 2012
Sheet No. : 1 of 1

Position : E: 602926, N: 4816416 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
0	177.0	**GROUND SURFACE**					
		130mm **TOPSOIL**					
		FILL, sand and gravel, some silt, compact, brown, moist		1	SS	15	
	176.2						
	0.8	**FILL**, silty clay, some sand, trace gravel, stiff, brown, moist		2	SS	9	
1							176
	175.5						
	1.5	**CLAYEY SILT**, some sand, trace gravel, hard, brown, moist (GLACIAL TILL)		3	SS	31	
	175.0						
	2.0	**END OF BOREHOLE**					

Borehole was dry and open upon completion of drilling.

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit, Natural Water Content, Liquid Limit: PL MC LL; 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

BOREHOLE LOG 34

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 18, 2012
Sheet No. : 1 of 1

Position : E: 602759, N: 4816543 (UTM 17T)
Rig type : truck-mounted

Elevation Datum : Geodetic (NAD83)
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
	181.0	**GROUND SURFACE**					181
0		40mm **ASPHALTIC CONCRETE**					
		580mm **GRANULAR BASE/SUBBASE**					
	180.4						
	0.6	**CLAYEY SILT**, some sand to sandy, trace gravel, firm to hard, brown to grey, moist (GLACIAL TILL)		1	SS	8	180
1							
				2	SS	15	179
2							
				3	SS	30	178
3							
				4	SS	43	177
4							
				5	SS	79	176
5	176.0						
	5.0	**END OF BOREHOLE**					

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined / Pocket Penetrometer / Field Vane / Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit (PL) / Natural Water Content (MC) / Liquid Limit (LL): 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

Borehole was dry and open upon completion of drilling.

BOREHOLE LOG 35

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 18, 2012
Sheet No. : 1 of 1

Position : E: 602628, N: 4816688 (UTM 17T)
Rig type : truck-mounted

Elevation Datum : Geodetic (NAD83)
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
	181.0	**GROUND SURFACE**					181
0		280mm **ASPHALTIC CONCRETE**					
	180.7						
	0.3	205mm **GRANULAR BASE/SUBBASE**					
	180.5						
	0.5	**FILL**, sandy silt, trace gravel, trace clay, compact, dark brown, moist		1	SS	20	180
1	179.8						
	1.2	**CLAYEY SILT**, some sand, trace gravel, very stiff, brown, moist (GLACIAL TILL)		2	SS	19	
	179.0						
	2.0	**END OF BOREHOLE**					

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined / Pocket Penetrometer / Field Vane / Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit (PL) / Natural Water Content (MC) / Liquid Limit (LL): 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

Borehole was dry and open upon completion of drilling.

Terraprobe

BOREHOLE LOG 36

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 18, 2012
Sheet No. : 1 of 1

Position : E: 602620, N: 4816682 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
	181.0	**GROUND SURFACE**					181
0		600mm **GRAVEL SHOULDER**		1	SS	20	
	180.4						
	0.6	**FILL**, clayey silt, some sand, trace gravel, firm, brown, moist		2	SS	8	180
1							
	179.5						
	1.5	**CLAYEY SILT**, some sand, trace gravel, very stiff, brown, moist (GLACIAL TILL)		3	SS	18	
	179.0						
	2.0	**END OF BOREHOLE**					

Borehole was dry and open upon completion of drilling.

Penetration Test Values (Blows / 0.3m): Dynamic Cone; 10 20 30 40
Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160
Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL; 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

Terraprobe

BOREHOLE LOG 37

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 18, 2012
Sheet No. : 1 of 1

Position : E: 602622, N: 4816679 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
	179.5	**GROUND SURFACE**					179
0		130mm **TOPSOIL**					
		FILL, sand and gravel, some silt, compact, brown, moist		1	SS	12	
	178.9						
	0.6	**FILL**, silty sand, some clay, trace gravel, firm, brown, moist		2	AS	6	178
1							
	178.0						
	1.5	**CLAYEY SILT**, some sand, trace gravel, stiff, brown, moist (GLACIAL TILL)		3	SS	15	
	177.5						
	2.0	**END OF BOREHOLE**					

Borehole was dry and open upon completion of drilling.

Penetration Test Values (Blows / 0.3m): Dynamic Cone; 10 20 30 40
Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160
Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL; 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

BOREHOLE LOG 38

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 16, 2012
Sheet No. : 1 of 1

Position : E: 602492, N: 4816841 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
	182.0	**GROUND SURFACE**					182
0		760mm **GRAVEL SHOULDER**		1	SS	19	
	181.2						
	0.8	**FILL**, clayey silt, some sand, trace gravel, stiff, greyish brown, moist		2	SS	12	181
1	180.5						
	1.5	**CLAYEY SILT**, some sand to sandy, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		3	SS	16	
2							180
				4	SS	29	
3							179
				5	SS	40	
4							178
				6	SS	40	
5	177.0						177
	5.0						

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10, 20, 30, 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40, 80, 120, 160
Moisture / Plasticity — Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL): 10, 20, 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

END OF BOREHOLE

Unstabilized water level measured at 4.6m below grade; borehole was open upon completion of drilling.

BOREHOLE LOG 39

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 21, 2012
Sheet No. : 1 of 1

Position : E: 602347, N: 4816982 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
	184.5	**GROUND SURFACE**					
0	184.3	170mm **ASPHALTIC CONCRETE**					
	0.2	430mm **GRANULAR BASE/SUBBASE**					184
	183.9						
	0.6	**CLAYEY SILT**, some sand, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		1	SS	26	
1							183
				2	SS	70	
	182.5						
	2.0						

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10, 20, 30, 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40, 80, 120, 160
Moisture / Plasticity — Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL): 10, 20, 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Terraprobe

BOREHOLE LOG 40

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 17, 2012
Sheet No. : 1 of 1

Position : E: 602349, N: 4816981 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation Scale (m)
0	184.5	**GROUND SURFACE**					184
		35mm **ASPHALTIC CONCRETE**					
		555mm **GRANULAR BASE/SUBBASE**					
	183.9						
	0.6	**CLAYEY SILT**, some sand to sandy, trace gravel, stiff to hard, brown, moist (GLACIAL TILL)		1	SS	11	
1							183
				2	SS	51	
2							
				3	SS	50 / 75mm	182
3	181.5						
	3.1	**SILTY SAND to SANDY SILT**, trace gravel, trace clay, very dense, brown, moist		4	SS	50 / 125mm	181
4							
	179.8			5	SS	50 / 125mm	180
	4.7						

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL): 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Terraprobe

BOREHOLE LOG 41

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 16, 2012
Sheet No. : 1 of 1

Position : E: 602350, N: 4816980 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation Scale (m)
0	184.5	**GROUND SURFACE**					184
		100mm **TOPSOIL**					
		CLAYEY SILT, some sand to sandy, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		1	SS	18	
1				2	SS	45	183
	182.5			3	SS	52	
	2.0						

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL): 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Terraprobe

BOREHOLE LOG 42

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 17, 2012
Sheet No. : 1 of 1

Position : E: 602194, N: 4817117 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
0	181.5	**GROUND SURFACE**					181
	181.3	30mm **ASPHALTIC CONCRETE**					
	0.2	210mm **GRANULAR BASE/SUBBASE**					
1		**CLAYEY SILT**, some sand to sandy, trace gravel, stiff to hard, brown, moist (GLACIAL TILL)		1	SS	9	
				2	SS	22	180
2							
				3	SS	39	179
3							
				4	SS	47	178
4							
	176.9						
	4.6	**SILTY SAND**, trace gravel, trace clay, very dense, grey, moist		5	SS	50 / 150mm	177
5	176.5						
	5.0						

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit, Natural Water Content, Liquid Limit: PL MC LL; 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

7 53 34 6

END OF BOREHOLE

Unstabilized water level measured at 4.0m below grade; borehole caved to 4.3m below grade upon completion of drilling.

Terraprobe

BOREHOLE LOG 43

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 16, 2012
Sheet No. : 1 of 1

Position : E: 602108, N: 4817202 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
0	183.0	**GROUND SURFACE**					183
	182.8	160mm **ASPHALTIC CONCRETE**					
	0.2	290mm **GRANULAR BASE/SUBBASE**					
	182.5						
	0.5	**FILL**, silty clay, trace gravel, trace sand, trace organic matters, stiff, dark brown, moist		1	SS	9	182
1							
	181.3						
	1.7	**CLAYEY SILT**, some sand, trace gravel, stiff, brown, moist (GLACIAL TILL)		2	SS	10	
	181.0						
	2.0						

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit, Natural Water Content, Liquid Limit: PL MC LL; 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Terraprobe

BOREHOLE LOG 44

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 17, 2012
Sheet No. : 1 of 1

Position : E: 602104, N: 4817195 (UTM 17T)
Rig type : truck-mounted

Elevation Datum : Geodetic (NAD83)
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation Scale (m)
0	183.0	**GROUND SURFACE**					183
		45mm **ASPHALTIC CONCRETE**					
		485mm **GRANULAR BASE/SUBBASE**					
	182.5 / 0.5	**CLAYEY SILT**, some sand to sandy, trace gravel, stiff to hard, brown, moist		1	SS	7	
1							182
				2	SS	11	
2							181
				3	SS	19	
3							180
				4	SS	32	
4							179
	178.4 / 4.6	**SILTY SAND**, trace gravel, trace clay, very dense, grey, moist		5	SS	94	
5	178.0 / 5.0						178

Penetration Test Values (Blows / 0.3m) — × Dynamic Cone — 10 20 30 40
Undrained Shear Strength (kPa) — ○ Unconfined ● Pocket Penetrometer + Field Vane ■ Lab Vane — 40 80 120 160
Moisture / Plasticity — Plastic Limit (PL) Natural Water Content (MC) Liquid Limit (LL) — 10 20 30
Headspace Vapour | Instrument Details | Unstabilized Water Level | Lab Data and Comments | GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

Terraprobe

BOREHOLE LOG 45

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 16, 2012
Sheet No. : 1 of 1

Position : E: 602102, N: 4817192 (UTM 17T)
Rig type : truck-mounted

Elevation Datum : Geodetic (NAD83)
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation Scale (m)
0	181.5	**GROUND SURFACE**					181
		50mm **TOPSOIL**					
	181.0 / 0.5	**FILL**, sand and gravel, some silt, compact, brown, damp		1	SS	15	
		CLAYEY SILT, some sand, trace gravel, stiff, brown, moist (GLACIAL TILL)		2	SS	15	180
1	179.5 / 2.0			3	SS	15	

Penetration Test Values (Blows / 0.3m) — × Dynamic Cone — 10 20 30 40
Undrained Shear Strength (kPa) — ○ Unconfined ● Pocket Penetrometer + Field Vane ■ Lab Vane — 40 80 120 160
Moisture / Plasticity — Plastic Limit (PL) Natural Water Content (MC) Liquid Limit (LL) — 10 20 30
Headspace Vapour | Instrument Details | Unstabilized Water Level | Lab Data and Comments | GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

BOREHOLE LOG 46

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 21, 2012
Sheet No. : 1 of 1

Position : E: 601918, N: 4817386 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
0	184.5	**GROUND SURFACE**					184
	184.3	180mm **ASPHALTIC CONCRETE**					
	0.2	735mm **GRANULAR BASE/SUBBASE**					
	183.6						
1	0.9	**FILL**, clayey silt, trace gravel, trace sand, very stiff, brown, moist		1	SS	20	183
	183.0						
	1.5	**FILL**, sand and gravel, some silt, compact, brown, moist		2	SS	21	
2	182.2						182
	2.3	**FILL**, silty clay, trace gravel, trace sand, trace organic matters, stiff, dark brown, wet		3	SS	14	
	181.9						
	2.6	**CLAYEY SILT**, some sand to sandy, trace gravel, very stiff to hard, brown, moist (GLACIAL TILL)		4	SS	25	181
3							
4							180
5	179.5			5	SS	38	
	5.0						

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10, 20, 30, 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40, 80, 120, 160
Moisture / Plasticity — Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL): 10, 20, 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR, SA, SI, CL

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

BOREHOLE LOG 47

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 21, 2012
Sheet No. : 1 of 1

Position : E: 601776, N: 4817521 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
0	184.5	**GROUND SURFACE**					184
	184.2	260mm **ASPHALTIC CONCRETE**					
	0.3	810mm **GRANULAR BASE/SUBBASE**					
1	183.5			1	SS	13	183
	1.0	**CLAYEY SILT**, some sand, trace gravel, stiff to very stiff, brown, moist (GLACIAL TILL)					
	182.5			2	SS	23	
	2.0						

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10, 20, 30, 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40, 80, 120, 160
Moisture / Plasticity — Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL): 10, 20, 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR, SA, SI, CL

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

BOREHOLE LOG 48

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 17, 2012
Sheet No. : 1 of 1

Position : E: 601777, N: 4817541 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
	184.5	**GROUND SURFACE**					
0		600mm **GRAVEL SHOULDER**		1	SS	26	184
	183.9						
	0.6	**CLAYEY SILT**, some sand, trace gravel, stiff to very stiff, brown, moist (GLACIAL TILL)		2	AS	14	
1							183
				3	SS	24	
2	182.2						
	2.3	**SILTY SAND to SANDY SILT**, trace gravel, trace clay, very dense, brown, moist to wet		4	SS	59	182
3							
				5	SS	50 / 150mm	181
4							
				6	SS	78	180
5	179.5						
	5.0						

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL): 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

...at 4.6m, wet spoon

END OF BOREHOLE

Unstabilized water level measured at 3.7m below grade; borehole caved to 4.3m below grade upon completion of drilling.

BOREHOLE LOG 49

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 16, 2012
Sheet No. : 1 of 1

Position : E: 601782, N: 4817547 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
	184.5	**GROUND SURFACE**					
0		50mm **TOPSOIL**					
		FILL, sand and gravel, some silt, loose, brown, moist		1	SS	7	
	184.0						184
	0.5	**CLAYEY SILT**, some sand, trace gravel, stiff to very stiff, brown, moist (GLACIAL TILL)		2	SS	10	
1							
				3	SS	23	183
	182.5						
	2.0						

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL): 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

END OF BOREHOLE

Borehole was dry and open upon completion of drilling.

BOREHOLE LOG 50

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 17, 2012
Sheet No. : 1 of 1

Position : E: 601636, N: 4817676 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
0	186.0	**GROUND SURFACE**					186
		600mm **GRAVEL SHOULDER**		1	SS	26	
	185.4						
	0.6	**CLAYEY SILT**, some sand to sandy, trace gravel, stiff to hard, brown, moist (GLACIAL TILL)		2	SS	14	185
1							
				3	SS	27	
2							184
				4	SS	69	
3							183
				5	SS	62	
4							182
	181.4						
	4.6	**SAND AND SILT**, some gravel, trace clay, very dense, brown, moist		6	SS	94	
5	181.0						181
	5.0	**END OF BOREHOLE**					

Borehole was dry and caved to 4.5m below grade upon completion of drilling.

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit, Natural Water Content, Liquid Limit: 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

11 37 48 8

library: library - terraprobe gint.glb report: terraprobe soil log file: 11-12-2091 bh logs.gpj

BOREHOLE LOG 51

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 21, 2012
Sheet No. : 1 of 1

Position : E: 601474, N: 4847807 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
0	186.0	**GROUND SURFACE**					186
		130mm **ASPHALTIC CONCRETE**					
		485mm **GRANULAR BASE/SUBBASE**					
	185.4						
	0.6	**CLAYEY SILT**, some sand, trace gravel, stiff to very stiff, green, moist (GLACIAL TILL)		1	SS	13	185
1							
				2	SS	30	
	184.0						
	2.0	**END OF BOREHOLE**					

Borehole was dry and open upon completion of drilling.

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit, Natural Water Content, Liquid Limit: 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments
GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI

library: library - terraprobe gint.glb report: terraprobe soil log file: 11-12-2091 bh logs.gpj

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BOREHOLE LOG 52

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 17, 2012
Sheet No. : 1 of 1

Position : E: 602365, N: 4817814 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation Scale (m)
0	185.5	**GROUND SURFACE**					
		330mm **GRAVEL SHOULDER**		1A	SS	13	
	185.2 / 0.3	**CLAYEY SILT**, some sand to sandy, trace gravel, stiff to hard, brown, moist (GLACIAL TILL)		1B			185
1				2	SS	31	
							184
2				3	SS	47	
							183
3		...become grey		4	SS	56	
				5	SS	24	182
4	180.9 / 4.6	**SANDY SILT**, trace gravel, trace clay, very dense, brown, wet		6	SS	82	181
5	180.5 / 5.0	**END OF BOREHOLE**					

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit, Natural Water Content, Liquid Limit: PL MC LL; 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

Borehole was dry and open upon completion of drilling.

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BOREHOLE LOG 53

Client : AECOM
Project : Trafalgar Road Class EA Study
Location : Halton Region, Ontario

Project No. : 11-12-2091
Date started : October 16, 2012
Sheet No. : 1 of 1

Position : E: 601466, N: 4817804 (UTM 17T)
Elevation Datum : Geodetic (NAD83)
Rig type : truck-mounted
Drilling Method : Solid stem augers

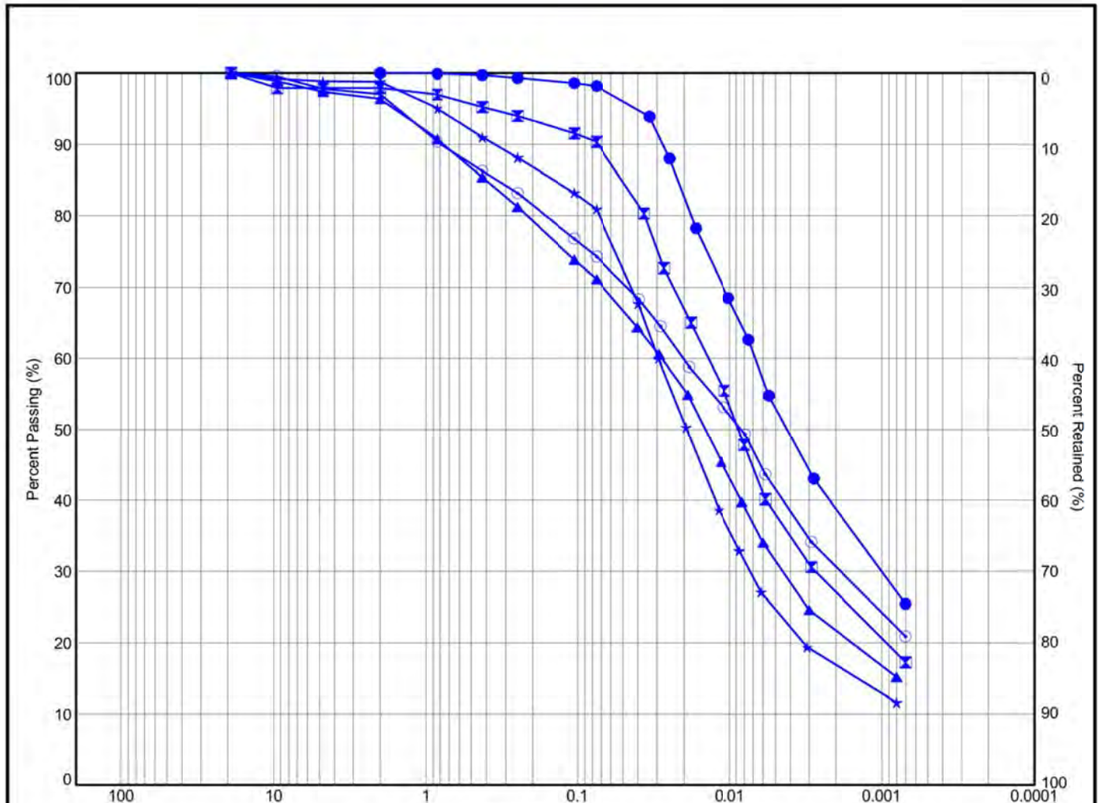
Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation Scale (m)
0	187.0	**GROUND SURFACE**					
	186.9 / 0.2	150mm **TOPSOIL**		1A			
	186.8 / 0.3	**FILL**, sand and gravel, some silt, compact, brown, moist		1B	SS	12	
1		**CLAYEY SILT**, some sand, trace gravel, hard, brown, moist (GLACIAL TILL)		2	SS	37	186
	185.0 / 2.0	**END OF BOREHOLE**		3	SS	65	

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10 20 30 40
Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40 80 120 160
Moisture / Plasticity — Plastic Limit, Natural Water Content, Liquid Limit: PL MC LL; 10 20 30
Headspace Vapour
Instrument Details
Unstabilized Water Level
Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT): GR SA SI CL

Borehole was dry and open upon completion of drilling.

APPENDIX F
Laboratory Test Results

TERRAPROBE INC.



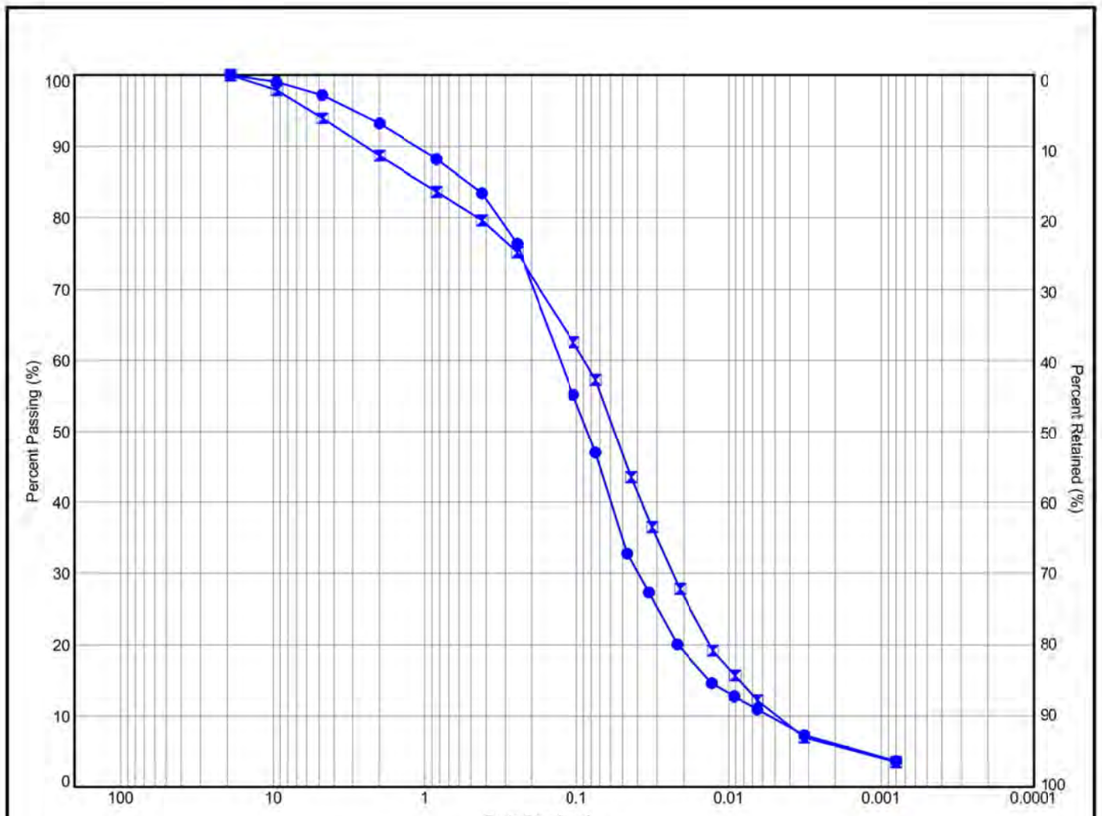
MIT SYSTEM

	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**6**	SS2	1.8	136.5	0	3	58	39	
⧗	**13**	SS3	1.5	155.0	2	11	60	27	
▲	**22**	SS2	1.8	167.7	4	27	47	22	
★	**30**	SS4	2.5	172.0	1	23	59	17	
⊡	**38**	SS5	3.3	178.7	3	24	42	31	

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

Title: **GRAIN SIZE DISTRIBUTION**
CLAYEY SILT TILL

File No.: **11-12-2091**



MIT SYSTEM

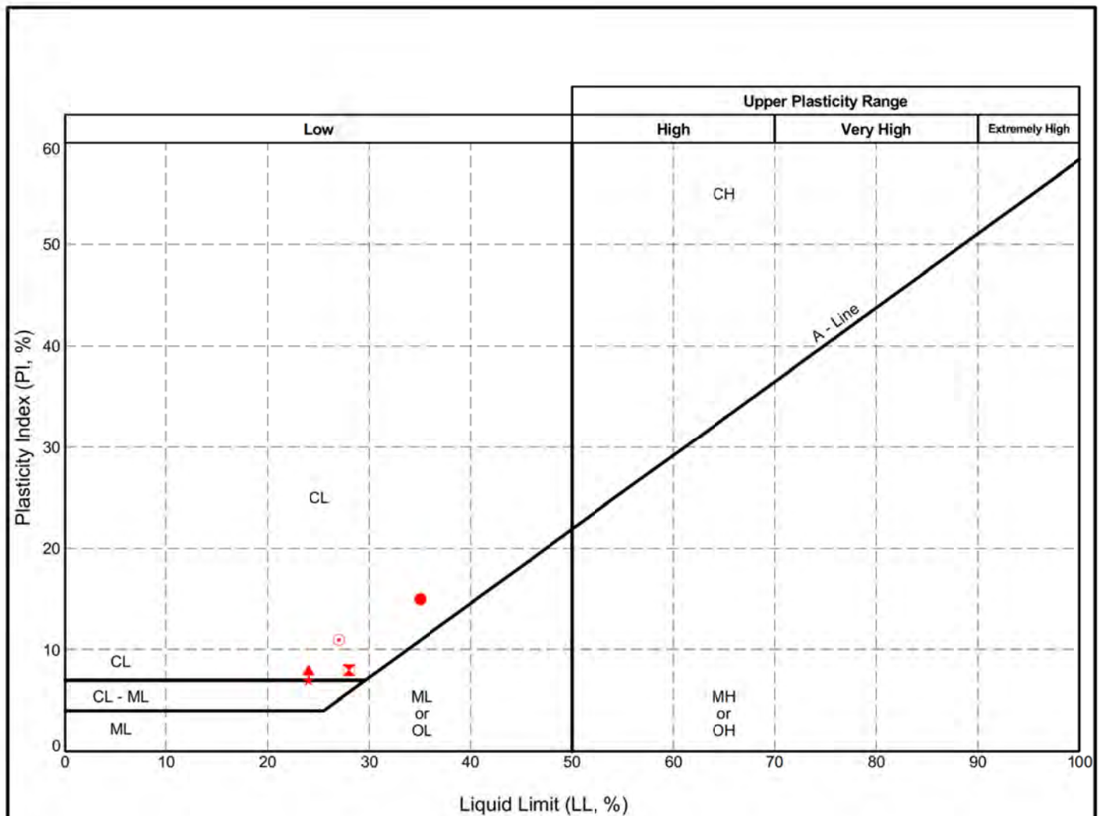
	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**42**	SS5	4.6	176.9	7	53	34	6	
⧗	**50**	SS6	4.8	181.2	11	37	46	6	

Terraprobe

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

Title: **GRAIN SIZE DISTRIBUTION**
SILTY SAND AND SILT AND SAND

File No.: **11-12-2091**



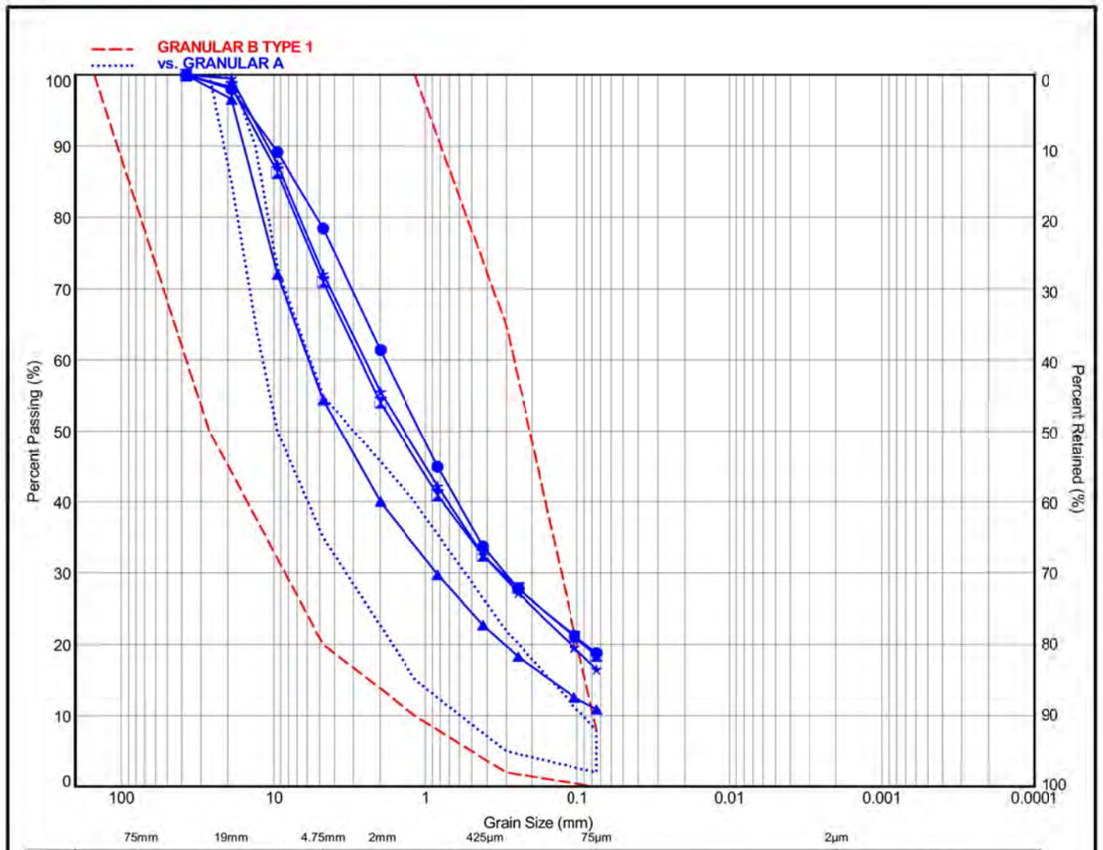
	Borehole	Sample	Depth (m)	LL (%)	PL (%)	PI (%)	USCS Description
●	6	SS2	1.8	35	20	15	.
⧗	13	SS3	1.5	28	20	8	.
▲	22	SS2	1.8	24	16	8	.
★	30	SS4	2.5	24	17	7	.
⊙	38	SS5	3.3	27	16	11	.

Terraprobe

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

Title: **ATTERBERG LIMITS CHART**

File No.: **11-12-2091**



	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**C1**	AS			22	59			*(19)*
⧗	**C2**	AS			29	53			*(18)*
▲	**C3**	AS			46	43			*(11)*
★	**C4**	AS			28	55			*(17)*

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

Title: **GRAIN SIZE DISTRIBUTION GRANULAR MATERIALS**

File No.: **11-12-2091**

APPENDIX G

Certificates of Analysis (Soil Chemistry)

TERRAPROBE INC.

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: 11-12-2091

AGAT WORK ORDER: 12T658890

SOIL ANALYSIS REVIEWED BY: Anthony Dapaah, PhD (Chem), Inorganic Lab Manager

DATE REPORTED: Nov 07, 2012

PAGES (INCLUDING COVER): 5

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: 12T658890
PROJECT NO: 11-12-2091

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

CLIENT NAME: TERRAPROBE INC. ATTENTION TO: Seth Zhang

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

DATE RECEIVED: 2012-11-01 DATE REPORTED: 2012-11-07

Parameter	Unit	G / S: A	G / S: B	RDL	BH7 SS3	BH12 SS1	BH21 SS3	BH34 SS4	BH44 SS5
SAMPLE TYPE:					Soil	Soil	Soil	Soil	Soil
DATE SAMPLED:					2012-10-19	2012-10-19	2012-10-18	2012-10-18	2012-10-17
					3881245	3881254	3881255	3881256	3881257
Antimony	µg/g	1.3	40	0.8	<0.8[<A]	<0.8[<A]	<0.8[<A]	<0.8[<A]	<0.8[<A]
Arsenic	µg/g	18	18	1	9[<A]	6[<A]	5[<A]	6[<A]	3[<A]
Barium	µg/g	220	670	2	180[<A]	128[<A]	180[<A]	104[<A]	26[<A]
Beryllium	µg/g	2.5	8	0.5	1.0[<A]	0.8[<A]	0.6[<A]	0.7[<A]	<0.5[<A]
Boron	µg/g	36	120	5	6[<A]	11[<A]	11[<A]	10[<A]	6[<A]
Boron (Hot Water Soluble)	µg/g		2	0.10	<0.10[<B]	0.41[<B]	<0.10[<B]	<0.10[<B]	0.42[<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]
Chromium	µg/g	70	160	2	26[<A]	21[<A]	20[<A]	19[<A]	8[<A]
Cobalt	µg/g	21	80	0.5	17.7[<A]	12.7[<A]	12.2[<A]	13.2[<A]	4.2[<A]
Copper	µg/g	92	230	1	11[<A]	16[<A]	26[<A]	36[<A]	16[<A]
Lead	µg/g	120	120	1	14[<A]	21[<A]	12[<A]	14[<A]	4[<A]
Molybdenum	µg/g	2	40	0.5	1.5[<A]	0.8[<A]	0.7[<A]	0.6[<A]	<0.5[<A]
Nickel	µg/g	82	270	1	27[<A]	25[<A]	26[<A]	26[<A]	8[<A]
Selenium	µg/g	1.5	5.5	0.4	0.8[<A]	<0.4[<A]	<0.4[<A]	<0.4[<A]	<0.4[<A]
Silver	µg/g	0.5	40	0.2	<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]
Uranium	µg/g	2.5	33	0.5	2.5[A]	0.6[<A]	0.6[<A]	0.7[<A]	<0.5[<A]
Vanadium	µg/g	86	86	1	43[<A]	32[<A]	28[<A]	27[<A]	15[<A]
Zinc	µg/g	290	340	5	64[<A]	96[<A]	62[<A]	68[<A]	40[<A]
Chromium VI	µg/g	0.66	8	0.2	<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]
Mercury	µg/g	0.27	3.9	0.10	<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	0.886[A-B]	0.633[A-B]	4.73[>B]	1.83[>B]	0.275[<A]
Sodium Adsorption Ratio	NA	2.4	12	NA	3.58[A-B]	10.6[A-B]	22.8[>B]	6.39[A-B]	0.503[<A]
pH, 2:1 CaCl2 Extraction	pH Units			NA	5.61	7.21	7.82	7.72	8.29

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

3881245-3881257 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:

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http://www.agatlabs.com

Guideline Violation

AGAT WORK ORDER: 12T658890

PROJECT NO: 11-12-2091

ATTENTION TO: Seth Zhang

CLIENT NAME: TERRAPROBE INC.

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	GUIDEVALUE	RESULT
3881245	BH7 SS3	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	0.57	0.886
3881245	BH7 SS3	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	3.58
3881254	BH12 SS1	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	0.57	0.633
3881254	BH12 SS1	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	10.6
3881255	BH21 SS3	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	0.57	4.73
3881255	BH21 SS3	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	22.8
3881255	BH21 SS3	T3(ICC) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	1.4	4.73
3881255	BH21 SS3	T3(ICC) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	12	22.8
3881256	BH34 SS4	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	0.57	1.83
3881256	BH34 SS4	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	6.39
3881256	BH34 SS4	T3(ICC) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	1.4	1.83

Results relate only to the items tested and to all the items tested

AGAT GUIDELINE VIOLATION (V1)

5835 COOPERS AVENUE
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http://www.agatlabs.com

Quality Assurance

CLIENT NAME: TERRAPROBE INC.

AGAT WORK ORDER: 12T658890

PROJECT NO: 11-12-2091

ATTENTION TO: Seth Zhang

Soil Analysis

RPT Date: Nov 07, 2012

PARAMETER	Batch	Sample Id	DUPLICATE Dup #1	Dup #2	RPD	Methcd Blank	REFERENCE MATERIAL Measured Value	Acceptable Limits Lower	Upper	METHOD BLANK SPIKE Recovery	Acceptable Limits Lower	Upper	MATRIX SPIKE Recovery	Acceptable Limits Lower	Upper
O. Reg. 153(511) - Metals & Inorganics (Soil)															
Antimony	1	3881255	< 0.8	< 0.8	0.0%	< 0.8	119%	70%	130%	94%	80%	120%	97%	70%	130%
Arsenic	1	3881255	5	5	0.0%	< 1	104%	70%	130%	103%	80%	120%	96%	70%	130%
Barium	1	3881255	180	181	0.6%	< 2	104%	70%	130%	104%	80%	120%	101%	70%	130%
Beryllium	1	3881255	0.6	0.7	15.4%	< 0.5	94%	70%	130%	96%	80%	120%	96%	70%	130%
Boron	1	3881255	11	11	0.0%	< 5	80%	70%	130%	108%	80%	120%	98%	70%	130%
Boron (Hot Water Soluble)	1	3881255	<0.10	<0.10	0.0%	< 0.10	113%	60%	140%	101%	70%	130%	102%	60%	140%
Cadmium	1	3881255	< 0.5	< 0.5	0.0%	< 0.5	98%	70%	130%	100%	80%	120%	101%	70%	130%
Chromium	1	3881255	20	20	0.0%	< 2	104%	70%	130%	99%	80%	120%	93%	70%	130%
Cobalt	1	3881255	12.2	12.2	0.0%	< 0.5	92%	70%	130%	100%	80%	120%	92%	70%	130%
Copper	1	3881255	26	26	0.0%	< 1	93%	70%	130%	109%	80%	120%	96%	70%	130%
Lead	1	3881255	12	12	0.0%	< 1	104%	70%	130%	103%	80%	120%	100%	70%	130%
Molybdenum	1	3881255	0.7	0.7	0.0%	< 0.5	106%	70%	130%	98%	80%	120%	105%	70%	130%
Nickel	1	3881255	26	26	0.0%	< 1	94%	70%	130%	103%	80%	120%	89%	70%	130%
Selenium	1	3881255	< 0.4	0.7	NA	< 0.4	108%	70%	130%	101%	80%	120%	95%	70%	130%
Silver	1	3881255	< 0.2	< 0.2	0.0%	< 0.2	110%	70%	130%	108%	80%	120%	108%	70%	130%
Thallium	1	3881255	< 0.4	< 0.4	0.0%	< 0.4	94%	70%	130%	100%	80%	120%	93%	70%	130%
Uranium	1	3881255	0.6	0.6	0.0%	< 0.5	95%	70%	130%	95%	80%	120%	95%	70%	130%
Vanadium	1	3881255	28	29	3.5%	< 1	92%	70%	130%	99%	80%	120%	99%	70%	130%
Zinc	1	3881255	62	63	1.6%	< 5	99%	70%	130%	114%	80%	120%	113%	70%	130%
Chromium VI	1		< 0.2	< 0.2	0.0%	< 0.2	101%	70%	130%	99%	80%	120%	98%	70%	130%
Cyanide	1		< 0.040	< 0.040	0.0%	< 0.040	99%	70%	130%	99%	80%	120%	85%	70%	130%
Mercury	1	3881255	< 0.10	< 0.10	0.0%	< 0.10	98%	70%	130%	101%	80%	120%	100%	70%	130%
Electrical Conductivity (2:1)	1	3881255	4.73	4.99	5.3%	< 0.005	96%	90%	110%	NA			NA		
Sodium Adsorption Ratio	1	3881255	22.8	22.9	0.7%	NA	NA			NA			NA		
pH, 2:1 CaCl2 Extraction	1		7.21	7.20	0.1%	NA	97%	90%	110%	NA			NA		

Comments: NA signifies Not Applicable. As the average value (Se) for the sample and a duplicate is less than 5X RDL, lab's RPD acceptance criteria is not applicable.

Certified By:

Results relate only to the items tested and to all the items tested

AGAT Laboratories
5835 COOPERS AVENUE
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Method Summary

CLIENT NAME: TERRAPROBE INC. **AGAT WORK ORDER: 12T658890**

PROJECT NO: 11-12-2091 **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

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

ATTENTION TO: Seth Zhang

PROJECT NO: 11-12-2091

AGAT WORK ORDER: 12T666437

SOIL ANALYSIS REVIEWED BY: Mike Muneswar, BSc (Chem), Senior Inorganic Analyst

DATE REPORTED: Nov 28, 2012

PAGES (INCLUDING COVER): 6

VERSION*: 1

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

*NOTES

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

AGAT Laboratories
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Certificate of Analysis

AGAT WORK ORDER: 12T666437
PROJECT NO: 11-12-2091

CLIENT NAME: TERRAPROBE INC.

ATTENTION TO: Seth Zhang

Corrosivity Package

DATE RECEIVED: 2012-11-23

DATE REPORTED: 2012-11-28

SAMPLE DESCRIPTION:					BH30 SS3	BH38 SS6	BH46 SS4	BH52 SS5
SAMPLE TYPE:					Soil	Soil	Soil	Soil
DATE SAMPLED:								
Parameter	Unit	G / S: A	G / S: B	RDL	3958233	3958235	3958238	3958240
Sulphide*	%			0.01	0.03	0.29	0.03	0.28
Chloride (2:1)	µg/g			2	643	187	409	9
Sulphate (2:1)	µg/g			2	25	225	445	552
pH (2:1)	pH Units			N/A	8.14	8.14	7.93	8.14
Electrical Conductivity (2:1)	mS/cm	0.57	1.4	0.005	1.10[A-B]	0.604[A-B]	1.11[A-B]	0.631[A-B]
Resistivity (2:1)	ohm.cm			1	909	1660	901	1580
Redox Potential (2:1)	mV			5	212	214	225	210

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: A Refers to T1(ALL) - Current, B Refers to T3(ICC) - Current
3958233-3958240 * Analysis was performed at AGAT's Mining Division.

EC, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the extraction procedure at 2:1 ratio (2 parts DI water: 1 part soil).

Certified By:

AGAT Laboratories
5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
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Certificate of Analysis

AGAT WORK ORDER: 12T666437
PROJECT NO: 11-12-2091

CLIENT NAME: TERRAPROBE INC.

ATTENTION TO: Seth Zhang

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

DATE RECEIVED: 2012-11-23

DATE REPORTED: 2012-11-28

SAMPLE DESCRIPTION:					BH4 SS1	BH9 SS3	BH30 AS2	BH48 SS4
SAMPLE TYPE:					Soil	Soil	Soil	Soil
DATE SAMPLED:								
Parameter	Unit	G / S: A	G / S: B	RDL	3958227	3958230	3958231	3958232
Antimony	µg/g	1.3	40	0.8	<0.8[<A]	<0.8[<A]	<0.8[<A]	<0.8[<A]
Arsenic	µg/g	18	18	1	6[<A]	3[<A]	6[<A]	4[<A]
Barium	µg/g	220	670	2	74[<A]	70[<A]	84[<A]	44[<A]
Beryllium	µg/g	2.5	8	0.5	0.8[<A]	<0.5[<A]	0.7[<A]	<0.5[<A]
Boron	µg/g	36	120	5	19[<A]	5[<A]	10[<A]	7[<A]
Boron (Hot Water Soluble)	µg/g		2	0.10	0.72[<B]	0.53[<B]	0.18[<B]	0.22[<B]
Cadmium	µg/g	1.2	1.9	0.5	<0.5[<A]	<0.5[<A]	<0.5[<A]	<0.5[<A]
Chromium	µg/g	70	160	2	22[<A]	13[<A]	20[<A]	12[<A]
Cobalt	µg/g	21	80	0.5	13.3[<A]	7.7[<A]	10.4[<A]	7.6[<A]
Copper	µg/g	92	230	1	9[<A]	9[<A]	27[<A]	23[<A]
Lead	µg/g	120	120	1	10[<A]	9[<A]	24[<A]	7[<A]
Molybdenum	µg/g	2	40	0.5	1.2[<A]	0.5[<A]	0.9[<A]	0.5[<A]
Nickel	µg/g	82	270	1	29[<A]	13[<A]	21[<A]	13[<A]
Selenium	µg/g	1.5	5.5	0.4	<0.4[<A]	<0.4[<A]	<0.4[<A]	<0.4[<A]
Silver	µg/g	0.5	40	0.2	<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]
Uranium	µg/g	2.5	33	0.5	0.6[<A]	<0.5[<A]	0.6[<A]	<0.5[<A]
Vanadium	µg/g	86	86	1	28[<A]	22[<A]	30[<A]	17[<A]
Zinc	µg/g	290	340	5	57[<A]	44[<A]	97[<A]	37[<A]
Chromium VI	µg/g	0.66	8	0.2	<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]
Mercury	µg/g	0.27	3.9	0.10	<0.10[<A]	<0.10[<A]	<0.10[<A]	<0.10[<A]
Electrical Conductivity (2:1)	mS/cm	0.57	1.4	0.005	1.62[>B]	1.73[>B]	1.52[>B]	0.362[<A]
Sodium Adsorption Ratio	NA	2.4	12	NA	35.2[>B]	12.5[>B]	12.4[>B]	2.02[<A]
pH, 2:1 CaCl2 Extraction	pH Units			NA	8.04	7.47	7.79	7.92

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: A Refers to T1(ALL) - Current, B Refers to T3(ICC) - Current
3958227-3958232 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.

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Guideline Violation

AGAT WORK ORDER: 12T666437
PROJECT NO: 11-12-2091

ATTENTION TO: Seth Zhang

CLIENT NAME: TERRAPROBE INC.

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	GUIDEVALUE	RESULT
3958227	BH4 SS1	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	0.57	1.62
3958227	BH4 SS1	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	35.2
3958227	BH4 SS1	T3(ICC) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	1.4	1.62
3958227	BH4 SS1	T3(ICC) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	12	35.2
3958230	BH9 SS3	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	0.57	1.73
3958230	BH9 SS3	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	12.5
3958230	BH9 SS3	T3(ICC) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	1.4	1.73
3958230	BH9 SS3	T3(ICC) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	12	12.5
3958231	BH30 AS2	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	0.57	1.52
3958231	BH30 AS2	T1(ALL) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	2.4	12.4
3958231	BH30 AS2	T3(ICC) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity (2:1)	1.4	1.52
3958231	BH30 AS2	T3(ICC) - Current	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	12	12.4
3958233	BH30 SS3	T1(ALL) - Current	Corrosivity Package	Electrical Conductivity (2:1)	0.57	1.10
3958235	BH38 SS6	T1(ALL) - Current	Corrosivity Package	Electrical Conductivity (2:1)	0.57	0.604
3958238	BH46 SS4	T1(ALL) - Current	Corrosivity Package	Electrical Conductivity (2:1)	0.57	1.11
3958240	BH52 SS5	T1(ALL) - Current	Corrosivity Package	Electrical Conductivity (2:1)	0.57	0.631

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Quality Assurance

CLIENT NAME: TERRAPROBE INC.

AGAT WORK ORDER: 12T666437

PROJECT NO: 11-12-2091

ATTENTION TO: Seth Zhang

Soil Analysis

RPT Date: Nov 28, 2012

PARAMETER	Batch	Sample Id	DUPLICATE Dup #1	Dup #2	RPD	Methcd Blank	REFERENCE MATERIAL Measured Value	Acceptable Limits Lower	Upper	METHOD BLANK SPIKE Recovery	Acceptable Limits Lower	Upper	MATRIX SPIKE Recovery	Acceptable Limits Lower	Upper
O. Reg. 153(511) - Metals & Inorganics (Soil)															
Antimony	1	3958227	< 0.8	< 0.8	0.0%	< 0.8	113%	70%	130%	98%	80%	120%	97%	70%	130%
Arsenic	1	3958227	6	7	15.4%	< 1	108%	70%	130%	104%	80%	120%	99%	70%	130%
Barium	1	3958227	74	73	1.4%	< 2	102%	70%	130%	106%	80%	120%	105%	70%	130%
Beryllium	1	3958227	0.8	0.9	11.8%	< 0.5	95%	70%	130%	107%	80%	120%	101%	70%	130%
Boron	1	3958227	19	20	5.1%	< 5	94%	70%	130%	106%	80%	120%	111%	70%	130%
Boron (Hot Water Soluble)	1		0.27	0.28	2.9%	< 0.10	101%	60%	140%	92%	70%	130%	98%	60%	140%
Cadmium	1	3958227	< 0.5	< 0.5	0.0%	< 0.5	96%	70%	130%	99%	80%	120%	107%	70%	130%
Chromium	1	3958227	22	22	0.0%	< 2	95%	70%	130%	102%	80%	120%	105%	70%	130%
Cobalt	1	3958227	13.3	13.4	0.7%	< 0.5	102%	70%	130%	108%	80%	120%	106%	70%	130%
Copper	1	3958227	9	9	0.0%	< 1	104%	70%	130%	110%	80%	120%	104%	70%	130%
Lead	1	3958227	10	10	0.0%	< 1	105%	70%	130%	97%	80%	120%	94%	70%	130%
Molybdenum	1	3958227	1.3	1.3	0.0%	< 0.5	104%	70%	130%	101%	80%	120%	105%	70%	130%
Nickel	1	3958227	29	30	3.4%	< 1	100%	70%	130%	104%	80%	120%	100%	70%	130%
Selenium	1	3958227	< 0.4	< 0.4	0.0%	< 0.4	91%	70%	130%	96%	80%	120%	100%	70%	130%
Silver	1	3958227	< 0.2	< 0.2	0.0%	< 0.2	99%	70%	130%	107%	80%	120%	108%	70%	130%
Thallium	1	3958227	< 0.4	< 0.4	0.0%	< 0.4	103%	70%	130%	94%	80%	120%	102%	70%	130%
Uranium	1	3958227	0.6	0.6	0.0%	< 0.5	100%	70%	130%	97%	80%	120%	97%	70%	130%
Vanadium	1	3958227	28	28	0.0%	< 1	96%	70%	130%	107%	80%	120%	103%	70%	130%
Zinc	1	3958227	57	59	3.4%	< 5	100%	70%	130%	108%	80%	120%	114%	70%	130%
Chromium VI	1	3958232	< 0.2	< 0.2	0.0%	< 0.2	96%	70%	130%	102%	80%	120%	96%	70%	130%
Cyanide	1		< 0.040	< 0.040	0.0%	< 0.040	105%	70%	130%	106%	80%	120%	103%	70%	130%
Mercury	1	3958227	< 0.10	< 0.10	0.0%	< 0.10	105%	70%	130%	87%	80%	120%	86%	70%	130%
Electrical Conductivity (2:1)	1		0.245	0.244	0.4%	< 0.005	97%	90%	110%	NA			NA		
Sodium Adsorption Ratio	1		6.07	5.81	4.4%	NA	NA			NA			NA		
pH, 2:1 CaCl2 Extraction	1		7.43	7.49	0.8%	NA	100%	90%	110%	NA			NA		
Corrosivity Package															
Sulphide*	1		< 0.01	< 0.01	0.0%	< 0.01	102%	80%	120%	NA			NA		
Chloride (2:1)	1		355	360	1.4%	< 2	98%	80%	120%	94%	80%	120%	104%	70%	130%
Sulphate (2:1)	1		970	1000	3.0%	< 2	101%	80%	120%	97%	80%	120%	95%	70%	130%
pH (2:1)	1		7.96	8.00	0.5%	N/A	106%	90%	110%	NA			NA		
Redox Potential (2:1)	1		226	223	1.3%	< 5	100%	70%	130%	NA			NA		

Comments: NA - Not Applicable.

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Method Summary

CLIENT NAME: TERRAPROBE INC.

AGAT WORK ORDER: 12T666437

PROJECT NO: 11-12-2091

ATTENTION TO: Seth Zhang

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Sulphide*	MIN-200-12000	ASTM E1915-07a	LECO C_S
Chloride (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	MSA part 3 & SM 4500-H+ B	PH METER
Electrical Conductivity (2:1)	INOR 1036	McKeague 4.12, SM 2510 B	EC METER
Resistivity (2:1)	INOR 1036		CALCULATION
Redox Potential (2:1)		McKeague 4.12 & SM 2510 B	REDOX POTENTIAL ELECTRODE
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