THURBER ENGINEERING LTD.

PRELIMINARY GEOTECHNICAL INVESTIGATION
TRAFALGAR ROAD IMPROVEMENTS
FROM STEELES AVENUE TO HIGHWAY 7
HALTON REGION, ONTARIO

Report Submitted

To

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1.0 INTRODUCTION

This report presents the results of a preliminary geotechnical investigation carried out by Thurber Engineering Ltd. in support of the Class Environmental Assessment Study underway for proposed improvements to the Trafalgar Road transportation corridor between Steeles Avenue and Highway 7 in the Region of Halton, Ontario. The project corridor is approximately 12.8 km in length.

The purpose of this investigation was to obtain subsurface information along the roadway corridor and based on the findings, to provide preliminary geotechnical recommendations for roadway widening, pavement design, municipal service installation, culvert extensions, bridge widening and potential rail grade separations.

The geotechnical investigation was carried out in general accordance with Thurber's proposal letter No. 113-3787 dated November 4, 2013.

It is a condition of this report that Thurber's performance of its professional services will be subject to the attached Statement of Limitations and Conditions.

2.0 PROJECT AND SITE DESCRIPTION

Trafalgar Road is a major arterial road primarily comprising a two lane rural cross section with localized widening to four lanes at the intersections with Steeles Avenue and 5 Side Road. An urban curb and gutter section is present from 15 Side Road to north of 17 Side Road. The roadway generally passes through agricultural lands, and borders the west side of Georgetown at the north end of the study area between 15 Side Road and Highway 7. The ground surface is typically flat to undulating, with overall grades generally falling towards the south.

Structures/crossings within the corridor include the following:

- Two concrete culverts located approximately 400 and 1,000 m north of Steeles Avenue;
- The Black Creek bridge located approximately 500 m north of 15 Side Road;
- A level crossing of the Canadian National Railway (CNR) approximately 150 m north of 17 Side Road/Maple Avenue; and
- A level crossing of the Metrolinx transit rail located approximately 300 m south of Highway 7.

Photographs from the site are provided in Appendix D.

The anticipated corridor improvements include pavement widening to four lanes, potential grade separations at the railway crossings, intersection improvements, and alignment adjustments where necessary.

The study area is located within the South Slope physiographic region, a gently rolling till plain generally comprising silty clay to clayey silt till (Halton Till) underlain by reddish brown shale bedrock of the Queenston Formation. Surficial deposits of glaciolacustrine silts and clays, outwash sands and gravels (north of 15 Side Road), and recent alluvium are expected to overlie the Halton Till locally. The south end of the corridor extends into the Peel Plain region, where surficial deposits of glaciolacustrine clay become more prevalent.

The depth to bedrock is expected to be highly variable, with depths of about 5 to 25 m indicated on maps of drift thickness. A poorly defined bedrock valley is believed to exist below the approximate alignment of Black Creek, and bedrock depths greater than 30m have been reported. In addition, a bedrock exposure is indicated on the south side of Black Creek immediately east of Trafalgar Road.

3.0 INVESTIGATION PROCEDURES

3.1 Field Investigation

The field investigation was carried out during the period February 4 to 17, 2016 and comprised 21 boreholes drilled at approximate 500 m intervals along Trafalgar Road. Boreholes 15-01 to 15-05 were drilled to 2.1 m depth in the section south of 5 Side Road where existing borehole information was available from a previous investigation. At the bridge and railway crossing locations, Boreholes 15-15 and 15-17 were terminated in shale at 9.3 and 12.3 m depth, and Borehole 15-20 was drilled to 15.9 m depth. The remaining boreholes were terminated at depths of 4.7 to 5.2 m.

The borehole locations are shown on Drawings 19-1351-253-1 to 4, Appendix A. The borehole locations were established by Thurber relative to existing site features. The locations were subsequently tied in using a GPS unit with an accuracy of 0.5 m. The ground elevations at the boreholes were interpreted from a base plan provided by MMM Group Limited.

All borehole locations were cleared of utilities and road occupancy permits were obtained prior to commencement of drilling. The boreholes were repositioned as necessary in consideration of

the utility locations and surface features. Traffic control was provided during drilling on the roadway.

The boreholes were advanced using a truck-mounted CME-55 drill rig supplied and operated by DBW Drilling Limited. Solid stem augers were employed to advance all boreholes except the three deeper boreholes in which hollow stem augers were employed, and soil samples were obtained in conjunction with the Standard Penetration Test (SPT).

The field investigation was carried out under the full-time supervision of Thurber technical staff. All boreholes were logged in the field. Soil samples were identified, placed in labelled containers and transported back to Thurber's laboratory for further examination and testing.

Groundwater conditions in the open boreholes were observed during drilling. Standpipe piezometers were installed in selected boreholes to measure groundwater levels. All boreholes without standpipes were backfilled with auger cuttings or bentonite holeplug upon completion in general accordance with MOE Regulation 903.

Results of the field drilling, sampling and testing are presented on the Record of Borehole sheets in Appendix B.

3.2 Laboratory Testing

Geotechnical laboratory testing consisted of natural moisture content determinations, visual classification and description of all soil samples. Grain size distribution analyses were carried out on selected samples of the pavement granular materials and subgrade soils, and Atterberg Limits tests were completed on several samples exhibiting plasticity.

Results of the geotechnical laboratory testing are presented on the Record of Borehole sheets included in Appendix B and are presented on the figures included in Appendix C.

4.0 SUMMARY OF SUBSURFACE CONDITIONS

A generalized description of the subsurface conditions encountered in the boreholes drilled at the site is given below. The Record of Borehole sheets in Appendix B provide detailed descriptions of the soil conditions at specific locations drilled, and must be used in preference to these generalized descriptions. It should be recognized that soil conditions may vary between and beyond borehole locations.

The subsurface stratigraphy encountered in the boreholes generally comprises a surficial pavement structure and discontinuous fill layers, overlying till deposits comprising silty clay to sand and silt, and locally zones of sand to silt. Shale bedrock was contacted in three boreholes.

4.1 Pavement Structure

The pavement structure revealed in the boreholes drilled on Trafalgar Road comprised 150 to 175 mm of asphalt overlying 455 to 735 mm of granular material. The total pavement thickness varied from 610 to 900 mm.

The results of particle size distribution analyses conducted on samples of the granular material are presented on Figures C1 and C2 in Appendix C. The gradation of the samples generally meets the OPSS Granular B Type I gradation specification with the exception of the measured fines content (percentage passing the 75 μm sieve) of 10 to 25%. The fines content may reflect the effects of compaction, auger sampling procedures, infiltration of fines with road runoff, or deterioration of the granular material over time.

Moisture contents in the granular material ranged from 2 to 5%.

4.2 Fill

Fill was encountered below the pavement structure in 13 of the 21 boreholes. In general, the fill layer was 0.6 to 1.5 m thick and consisted of silty sand, trace clay to clayey, trace to some gravel. Locally at the Black Creek bridge (Borehole 15-15) and Metrolinx crossing (Borehole 15-20), the fill thickness was 1.8 and 3.7 m, respectively. Clay fill was encountered at two locations (Boreholes 15-06 and 15-17), and gravelly sand fill was encountered south of Highway 7 (Borehole 15-21).

The lower boundary of the fill was encountered at depths of 1.4 to 4.4 m (Elev. 229.0 to 274.4 m).

Standard Penetration Test N-values obtained in the fill generally varied from 10 to 27 blows/0.3 m, indicating a compact or stiff to very stiff condition. Higher N-values of 60 blows/0.3 m to 50 blows/0.1 m were obtained in Boreholes 15-06, 15-09, 15-11 and 15-13 where a buried asphalt layer was encountered, believed to be a former road surface. Moisture contents ranged from 4 to 12%.

The results of grain size distribution analyses conducted on samples of the fill are presented on Figure C3 of Appendix C. The results are summarized as follows:

Gravel %	5 to 23
Sand %	40 to 53
Silt %	18 to 36
Clay %	9 to 19

4.3 Silty Clay

A layer of silty clay with trace to some sand was encountered below the pavement structure and fill in Boreholes 15-15, 15-18 and 15-21. The clay layer was 0.8 to 2.1 m thick, with a lower boundary at depths of 2.3 to 4.6 m (Elev. 237.9 to 273.7). The clay was firm to stiff, with N-values of 4 to 12 blows/0.3 m. Moisture contents of 9% to 24% were measured. The clay in Borehole 15-15 was dark brown and contained organics, and presumably comprised alluvial material adjacent to Black Creek.

4.4 Silty Sand Till to Silty Clay Till

A major glacial till deposit was encountered in all boreholes except Boreholes 15-15, 15-19 and 15-21. The composition of the till varied from silty clay, some sand, to silty sand, trace clay, and contained trace to some gravel. The majority of the boreholes were terminated in the till at depths of 2.1 to 5.2 m (Elev. 202.4 to 259.8 m). Where penetrated, the till deposit was 1.5 to 2.9 m thick, locally 9.8 m in Borehole 15-17, with a lower boundary at depths of 2.3 to 11.3 m (Elev. 251.4 and 270.2 m).

SPT N-values recorded in the till varied widely from 5 blows/0.3 m to 50 blows/0.125 m, indicating a loose/firm to very dense/hard condition. The N-values less than 15 blows/0.3 m were typically obtained immediately below the upper boundary of the till, indicating some surficial softening of this deposit. Moisture contents generally ranged from 6 to 20%, with one value of 28%.

The results of grain size distribution analyses conducted on samples of the till are presented on Figures C4 and C5 of Appendix C. The results are summarized as follows:

Gravel %	0 to 16
Sand %	23 to 58
Silt %	26 to 53
Clay %	11 to 24

Till soils frequently contain cobbles, boulders and shale slabs, and these should be anticipated when excavating during construction.

The results of Atterberg Limits testing carried out on three samples of the till exhibiting plasticity are presented on Figure C8 in Appendix C. The results indicate that the till has low plasticity with a group symbol of CL.

4.5 Sand to Silt

Cohesionless deposits varying from sand, trace silt, to silt, some sand, were encountered below the fill and pavement structure in Boreholes 15-15, 15-19 and 15-20, below the clay layer in Borehole 15-21, and below the till in Boreholes 15-07, 15-13 and 15-18. Boreholes 15-07, 15-13, 15-18, 15-19 and 15-21 were terminated in the sand/silt at depths of 4.7 to 5.2 m (Elev. 255.8 to 271.5). The sand and silt was underlain by shale at 7.6 m depth (Elev. 234.9) in Borehole 15-15, indicating a layer thickness of 3.1 m. In Borehole 15-20, an upper 1.7 m thick layer of silty sand was encountered below the fill, overlying a 1.5 m thick till layer, and an underlying sand deposit extending to the borehole termination depth of 15.9 m (Elev. 261.7).

The cohesionless deposits were typically compact to very dense with SPT N-values ranging from 20 blows/0.3 m to 50 blows/0.075 m. Isolated N-values of 4 to 8 blows/0.3 m were obtained in in Boreholes 15-13, 15-20 and 15-21, indicating loose zones. Moisture contents of 3% to 21% were recorded.

The results of grain size distribution analyses conducted on samples of the sand and silt are presented on Figures C6 and C7 of Appendix C. The results are summarized as follows:

	Silt/Sand	Sand
Gravel %	0	3 to 16
Sand %	19 to 45	68 to 90
Silt %	47 to 69	7 to 16
Clay %	8 to 12	

4.6 Shale Bedrock

Shale bedrock was contacted below the till in Boreholes 15-08 and 15-17, and below the sand and silt in Borehole 15-15. The depth to bedrock and the bedrock surface elevation encountered in the boreholes are summarized in Table 4.1.

Table 4.1 – Depth/Elevation of Bedrock Surface

Borehole No.	Bedrock Surface Level	
	Depth (m)	Elevation (m)
15-08	4.6	251.4
15-15	7.6	234.9
15-17	11.3	256.2

Borehole 15-08 was terminated essentially at the bedrock surface. Boreholes 15-15 and 15-17 were advanced to total depths of 9.3 and 12.3 m by augering 1.7 and 1.1 m into the bedrock.

4.7 Groundwater Levels

Water was observed in Borehole 15-10 upon completion of drilling. Standpipe piezometers were installed in Boreholes 15-06, 15-09, 15-12, 15-15, 15-17 and 15-20 upon completion. The depths and elevations of water levels measured in the boreholes upon completion and in the piezometers installed are summarized in Table 4.2.

Table 4.2 – Measured Groundwater Levels

Borehole No.	Measured Water Levels		Date	Comment
	Depth (m)	Elevation (m)		
15-06	Dry Dry	- -	Feb 09, 2016 Mar 15, 2016	Upon completion In piezometer
15-09	2.1 1.6	251.4 251.9	Feb 09, 2016 Mar 15, 2016	Upon completion In piezometer
15-10	1.7	251.7	Feb 12, 2016	Upon completion
15-12	Dry 1.2	- 256.6	Feb 11, 2016 Mar 15, 2016	Upon completion In piezometer
15-15	2.4	240.1	Mar 15, 2016	In piezometer
15-17	0.7	266.8	Mar 15, 2016	In piezometer
15-20	8.9	268.7	Mar 15, 2016	In piezometer

The recorded levels are short-term readings and seasonal fluctuations are to be expected. The groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

5.0 EXISTING GEOTECHNICAL DATA

Existing geotechnical information was available from two previous investigations carried out within the project corridor:

1. Geotechnical Investigation, Trafalgar Road / Stewarttown Road Watermain, Halton Hills, Ontario. Thurber Report No. 17-550-137 dated July 6, 2001.
2. Geotechnical Data Report, Zone 4 Feedermains, Trafalgar Road and Derry Road, Regional Municipality of Halton. Thurber Report No. 17-123-902 dated November 9, 2015.

The Record of Borehole sheets from the previous investigations are included in Appendix E. The locations of the previous boreholes are included on the Borehole Location Plan drawings in Appendix A. A brief summary of the borehole findings is presented below.

5.1 Trafalgar/Stewarttown Watermain

In June 2001, two boreholes designated 01-3 and 01-4 were drilled along Trafalgar Road between 15 Side Road and Stewarttown Road. The subsurface stratigraphy encountered in one borehole consisted of a pavement structure overlying firm to soft silty clay (possible fill) underlain by compact sandy silt. In the other borehole, the pavement structure was underlain by very stiff to hard clayey silt till overlying sand. Both boreholes were terminated at 5.0 m depth.

5.2 Zone 4 Feedermain

During the period January to August 2015, a series of 21 boreholes designated 14-073 to 14-103 were drilled to depths of 6.2 to 18.4 m along Trafalgar Road from between Steeles Avenue and 1.0 km north of 5 Side Road. The subsurface stratigraphy encountered in the boreholes was generally consistent with the current information, comprising a pavement structure or granular shoulder material overlying discontinuous fill layers, underlain by predominant till deposits with intermittent layers of silt, sand and clay. Shale was contacted below the till deposits at depths of 9.9 to 12.2 m in boreholes drilled between Steeles Avenue and 700 m north.

The pavement structure recorded in the boreholes consisted of 150 to 200 mm of asphalt over approximately 550 to 1900 mm of granular material. An approximate 700 to 2200 mm thick layer of granular material was encountered in the roadway shoulders.

Boreholes 14-076 and 14-099 were drilled adjacent to the culvert located approximately 400 m north of Steeles Avenue. The stratigraphy encountered in these boreholes consisted of a pavement/shoulder structure overlying firm to very stiff clay fill and loose to compact sand fill, underlain by hard silty sandy clay till contacted at depths of 4.1 and 4.3 m (Elev. 201.3 and 201.2). The till deposit graded to sand and silt (very dense) with depth, and then back to clay till

in Borehole 14-076. Shale bedrock was contacted at 9.9 m depth (Elev. 195.6) in Borehole 14-099. Water was measured at 2.8 m depth (Elev. 202.6) in a piezometer installed in Borehole 14-076.

Boreholes 14-080/80A and 14-103 were drilled adjacent to the culvert located approximately 1.0 km north of Steeles Avenue. The stratigraphy encountered in these boreholes consisted of shoulder granular material primarily overlying very stiff to hard clay till, underlain by compact to very dense sand and silt deposits contacted at depths of 7.4 and 7.8 m (Elev. 195.2 and 195.7). The boreholes were terminated in the sand at depths of 14.3 and 17.0 m (Elev. 188.6 and 186.0). Water was measured at depths of 0.7 to 1.0 m (Elev. 202.4 to 201.9) in piezometers installed in the boreholes.

6.0 EXISTING PAVEMENT CONDITIONS

A visual examination of the roadway surface was carried out in March 2016 to obtain a general overview of the existing pavement conditions. In general, the existing roadway pavement is in good condition with relatively few distresses. The following localized conditions were noted:

- The intersections at Steeles Avenue and 5 Side Road have been widened and reconstructed relatively recently.
- Slight to moderate longitudinal cracking is evident intermittently, and is particularly noted in an approximate 600 m long section north of Hornby Road.
- Two sections of pavement, approximately 200 m long and located about 200 m to the north and south of 10 Side Road, exhibit more severe distresses (cracking and distortion), and appear to have been omitted from resurfacing works at the 10 Side Road intersection and along Trafalgar Road to the north and south.
- Extensive routing and sealing of longitudinal and transverse cracks has been carried out between the CNR crossing and Highway 7.

Representative photographs of the existing pavement are provided in Appendix D.

7.0 GEOTECHNICAL EVALUATION AND PRELIMINARY RECOMMENDATIONS

This section provides preliminary geotechnical recommendations for widening and rehabilitation of the pavement structure within the project limits, extension of two culverts if required, bridge widening, potential railway grade separations, and underground municipal services.

The preliminary recommendations are based on the subsurface soil and groundwater conditions encountered during the investigation. The soil conditions may vary between and beyond the borehole locations. A detailed geotechnical investigation is required to further define the subsurface conditions and confirm the preliminary recommendations when details of the design are established.

7.1 Pavement Structure Design

It is anticipated that Trafalgar Road will be widened to four lanes from the current two lane configuration. Pavement structural design analysis and recommendations for a 20 year design life are discussed in the ensuing sections.

7.1.1 Design Methodology

Traffic projections for Trafalgar Road were provided by MMM Group based on midblock 8-hour volume counts. The information is summarized in Table 7.1.

Table 7.1 – Trafalgar Road Traffic Information

Section	Estimated 2015 24-hr Traffic	Estimated 2031 24-hr Traffic	Growth Rate (Compound)	2013 Truck %		
				Small	Medium	Heavy
South of 5 Side Road	13707	20348	2.5%	4.0	3.7	2.7
North of 5 Side Road	18458	27401	2.5%	2.1	2.1	2.2
North of 10 Side Road	16997	25231	2.5%	2.7	2.0	1.8
200m South of Maple Avenue	18086	26852	2.5%	2.3	1.5	2.3
North of Maple Avenue (north of CNR)	11277	16742	2.5%	-	-	-
Between 20 Side Road and Highway 7	9859	14638	2.5%	3.2	2.5	2.9

Typical truck factors were assigned to each vehicle class, as per the MTO publication *Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions*. The assumed truck factors are summarized in Table 7.2.

Table 7.2 – Design Truck Factors

Vehicle Type	Average Truck Factor
Small Trucks	0.5
Medium Trucks	4.0
Heavy Trucks	2.0

The traffic data was used to determine the pavement damage caused by the anticipated traffic volumes. Using the truck factors, the pavement damage caused by different truck classes are converted to a standard axle load known as an Equivalent Single Axle Loads (ESALs). The ESALs calculation was completed in accordance with the MTO *Procedures for Estimating Traffic Loads for Pavement Designs*. The 20-year design ESALs computed for each section of Trafalgar Road, based on construction in 2018 south of 10 Side Road and 2020 north of 10 Side Road, are as follows:

Table 7.3 – Calculated Design ESALs

Section	20-Year ESALs
South of 5 Side Road	12,195,000
North of 5 Side Road	10,248,000
North of 10 Side Road	8,712,000
200m South of Maple Avenue	8,440,000
North of Maple Avenue (north of CNR)	8,601,000
Between 20 Side Road and Highway 7	9,031,000

Flexible pavement designs were developed using the AASHTO procedure as outlined in the 1993 Guide for Design of Pavement Structures. The AASHTO procedure for the design of flexible pavements determines a required Structural Number (SN) that characterizes the structural capacity of the pavement layers, for a given set of inputs. This structural number is then distributed in terms of thickness among the various pavement layers (asphalt and granular base/subbase) according to the structural coefficients for each layer, as well as the materials drainage characteristics. The AASHTO design methodology was adapted and verified for pavement design in Ontario, as outlined in the 2001 Ministry of Transportation, Ontario (MTO) publication MI-183.

The following inputs were used in calculating the required structural number for Trafalgar Road:

- Design period = 20 years
- Initial serviceability, (P_i) = 4.5

- Terminal serviceability (P_t) = 2.5
- Mean soil resilient modulus (M_R) = 32 MPa (Stiff Clay Till Subgrade)
- Reliability level (R) = 90 percent
- Overall standard of deviation (S_o) = 0.44

Based on the selected input values and the calculated ESALs, the required design SN (SN_{Des}) values for Trafalgar Road were determined to range from 140 to 143 mm south of 10 Side Road and 136 to 138 mm north of this intersection. The new pavement structures to support the calculated SN_{Des} are as follows:

	South of 10 Side Road	North of 10 Side Road
Hot Mix Asphalt	175 mm	160 mm
Granular A Base	150 mm	150 mm
Granular B, Type II Subbase	550 mm	550 mm

7.1.2 Recommended Pavement Design

Based on the borehole data, the anticipated traffic volumes, and assuming adequate subgrade drainage, the following preliminary pavement design is recommended for reconstruction of Trafalgar Road:

	South of 10 Side Road	North of 10 Side Road
HL1	50 mm	50 mm
HDBC (2 lifts)	125 mm	110 mm
Granular A Base (19mm crusher run limestone)	150 mm	150 mm
Granular B Type II Subbase (50mm crusher run limestone)	550 mm	550 mm

All Hot Mix Asphalt (HMA) material should meet the requirements of OPSS 310, as modified by the Region of Halton Specifications for Hot Mix Asphalt Paving, Materials, Sampling, and Testing. An asphalt cement binder grade of PG 64-28 is recommended for all asphalt mixes. All granular base material shall consist of OPSS Granular A or 19 mm crusher run limestone, while the granular subbase material shall consist of OPSS Granular B, Type II or 50 mm crusher run limestone.

If grades permit rehabilitation of the existing pavement structure for reuse in the final pavement, a hot mix overlay of 140 mm would be required over the existing pavement to carry the predicted 20-year ESALs (following a 40 mm milling of the existing surface). This overlay would

require a grade raise of 100 mm and would not fully prevent distresses in the existing pavement from reflecting through the overlay to the new pavement surface. Pulverizing (full depth in-place reclamation) of the existing hot mix, followed by regrading, compacting and placement of the hot mix thicknesses outlined above for new pavements could be considered in order to eliminate reflection cracking, provided a grade raise of 160 to 175 mm can be accommodated.

7.1.3 Pavement Subgrade Preparation

Pavement subgrade preparation should include removal of the existing pavement structure and all surficial vegetation, topsoil, organic or compressible material. Grading to the new top of subgrade should match or exceed the thickness of the existing pavement to maintain lateral drainage at the top of subgrade. The exposed subgrade should be compacted and proof-rolled with a heavy roller and examined to identify areas of unstable subgrade. Any soft/wet areas identified shall be subexcavated and replaced with approved material within 2% of Optimum Moisture Content (OMC), and compacted to at least 98% of Standard Proctor Maximum Dry Density (SPMDD).

Bulk fill used to raise the road grade should be constructed as engineered fill, consisting of approved inorganic material, placed in maximum 200 mm thick lifts, within 2% of optimum moisture content, and compacted to at least 98% of SPMDD. Standard side slopes of 2H:1V or flatter should be suitable for embankment construction. Exposed embankment surfaces should be provided with a vegetation cover or otherwise protected against erosion in accordance with OPSS 804.

The top of the compacted subgrade should be graded smooth with a minimum crossfall of 3% towards side ditches or subdrains. Continuity of drainage should be maintained at transitions from existing pavement to new pavement.

7.2 Culvert Extension – 400 m North of Steeles Avenue

The existing box culvert located approximately 400 m north of Steeles Avenue will require extension to accommodate the widened four lane cross-section.

The stratigraphy encountered in Boreholes 14-076 and 14-099 drilled adjacent to the culvert consisted of a pavement/shoulder structure overlying firm to very stiff clay fill and loose to compact sand fill, underlain by hard silty sandy clay till contacted at depths of 4.1 and 4.3 m (Elev. 201.3 and 201.2). The till deposit graded to sand and silt (very dense) with depth. Shale bedrock was contacted at 9.9 m depth (Elev. 195.6) in one borehole. Water was measured at 2.8 m depth (Elev. 202.6).

The base of the box culvert extensions should be placed at the same level as the existing culvert base. All existing fill, topsoil, organic/streambed deposits and soft/loose soils should be removed from the culvert subgrade prior to placement of the culvert bedding material.

Based on the borehole data, the highest recommended level for the underside of the granular bedding material is Elev. 201.2 m. A factored bearing resistance at ULS of 450 kPa and a bearing resistance at SLS of 300 kPa is recommended for preliminary assessment of a culvert base founded on undisturbed native silty sandy clay till at this level.

Backfill to the culvert and any headwalls should consist of free-draining, non-frost susceptible granular materials conforming to OPS Granular A or Granular B Type II requirements. Reference should be made to the backfill arrangements stipulated in OPSD 803.010, 3121.150 and 3190.100, as appropriate.

Erosion protection should be provided at the new culvert inlet and outlet areas. Vegetation cover, riprap or other protective measures should be established on the creek banks to protect against surficial erosion and seepage-induced material loss.

7.3 Culvert Extension and Addition – 1.0 km North of Steeles Avenue

The existing twin box culvert located approximately 1.0 km north of Steeles Avenue will require extension to accommodate the widened four lane cross-section. A third cell will also be added to accommodate future drainage conditions and avoid flooding under Regional storm events.

The stratigraphy encountered in Boreholes 14-080/080A and 14-103 drilled adjacent to the culvert consisted of a shoulder structure overlying very stiff to hard clayey silt and silty sandy clay till contacted at depths of 1.4 and 1.2 m (Elev. 201.5 and 201.8). Compact to very dense sand and silt deposits were contacted at depths of 7.4 and 7.8 m (Elev. 195.2 and 195.7). Water was measured at depths of 0.7 to 1.0 m (Elev. 202.4 to 201.9).

The base of the box culvert extensions and addition should be placed at the same level as the existing culvert base. All existing fill, topsoil, organic/streambed deposits and soft/loose soils should be removed from the culvert subgrade prior to placement of the culvert bedding material.

Based on the borehole data, the highest recommended level for the underside of the granular bedding material is Elev. 201.5 m. A factored bearing resistance at ULS of 300 kPa and a bearing resistance at SLS of 200 kPa is recommended for preliminary assessment of a culvert base founded on undisturbed native clayey silt and silty sandy clay till at this level.

Backfill to the culvert and any headwalls should consist of free-draining, non-frost susceptible granular materials conforming to OPS Granular A or Granular B Type II requirements. Reference should be made to the backfill arrangements stipulated in OPSD 803.010, 3121.150 and 3190.100, as appropriate.

Erosion protection should be provided at the new culvert inlet and outlet areas. Vegetation cover, riprap or other protective measures should be established on the creek banks to protect against surficial erosion and seepage-induced material loss.

7.4 Black Creek Bridge Replacement

The existing Black Creek bridge will require replacement to accommodate the widened four lane cross-section and a grade raise to avoid overtopping of Trafalgar Road under Regional storm events.

The stratigraphy encountered in Borehole 15-15 drilled at the bridge location consisted of a pavement structure overlying compact silty sand fill and a silty clay alluvial layer, underlain by very dense native sand and silt contacted at 4.6 m depth (Elev. 237.9). Shale bedrock was contacted below the sand and silt at 7.6 m depth (Elev. 234.9). Water was measured at a depth of 2.4 m below the road surface (Elev. 240.1).

The preliminary profile drawing provided by MMM Group indicates that the base of the creek channel is at about Elev. 238.8.

Based on the borehole data, supporting the replacement bridge on spread footings extended down to the very dense sand and silt encountered at 4.6 m depth, below the level of all fill and organic material, could be considered. It is noted however that excavation for footing construction would extend approximately 2.0 m below the measured groundwater level, and installation of a cofferdam and dewatering system would be required to enable construction of footings in the dry and prevent base instability in the cohesionless foundation subgrade. Installation of a driven sheet pile cofferdam may not be practical due to the very dense condition of the underlying sand and silt, and therefore spread footings are not the preferred foundation option based on the preliminary borehole information.

The use of steel H-piles driven to refusal in the very dense sand and silt or shale bedrock may be considered. For preliminary design purposes, a factored geotechnical resistance at ULS of 1,400 kN and a geotechnical reaction at SLS of 1,200 kN are recommended for HP310x110 piles driven to refusal in the sand/silt or shale. Considering the shallow depth to very dense

native soil, pre-augering may be required to advance the piles to an adequate depth to achieve lateral fixity.

Augered caissons socketed into the underlying bedrock are considered feasible provided a steel liner is sealed into the bedrock to cut off water inflow and support the caisson sidewalls in the alluvial deposits and cohesionless sand and silt below the water level. The axial resistance of the caisson will depend upon the diameter and length of the rock socket. For preliminary planning purposes, factored axial resistances at ULS of 2,500 and 4,000 kN may be assumed for 0.9 and 1.2 m diameter caissons socketed 2.5 m into the bedrock. The SLS reaction will not govern for design of caissons founded in bedrock.

It must be noted that the thickness of alluvial deposits and the depth to bedrock may vary significantly over short distances at the site. Supplementary drilling within the footprint of the proposed foundation units will be necessary to further assess the preferred foundation type and confirm geotechnical parameters for design.

Vegetation cover, riprap or other protective measures should be established on the creek banks to protect against surficial erosion and scour. Scour protection is particularly important if spread footings are employed.

7.5 CNR Grade Separation

The preliminary profile drawing provided by MMM Group indicates that the proposed grade separation at the CNR crossing will entail a road cut to carry Trafalgar Road under the CNR. The base of the road cut will be near Elev. 260.0 beneath the rail alignment.

The stratigraphy encountered in Borehole 15-17 drilled near the rail crossing location consisted of a pavement structure overlying silty clay fill to 1.5 m depth, underlain by stiff to very stiff silty clay till and very dense sand and silt till. Shale bedrock was contacted below the sand and silt till at 11.3 m depth (Elev. 256.2). Water was measured at a depth of 0.7 m below the road surface (Elev. 266.8).

Based on the borehole data, the road cut is expected to extend through the silty clay till and into the underlying sand and silt till. In general, the base and sidewalls of the road cut excavated in the till deposits are expected to be stable with permanent cut slopes designed at inclinations not exceeding 2H : 1V. Considering the relatively low permeability of the till, dewatering from within the excavation should be feasible and permanent drainage via the storm sewer system should be adequate.

The recommended foundation type for support of the grade separation structure comprises spread footings founded on the very dense sand and silt till encountered at 4.6 m depth. A factored geotechnical resistance at ULS of 600 kPa and a geotechnical reaction at SLS of 400 kPa are recommended for preliminary design of spread footings founded on the very dense till.

The use of steel H-piles driven to refusal in the very dense sand and silt till or shale bedrock may also be considered. Pre-augering and/or socketing the piles will be required to provide an adequate depth of pile embedment to provide lateral fixity. For preliminary design purposes, a factored geotechnical resistance at ULS of 1,400 kN and a geotechnical reaction at SLS of 1,200 kN are recommended for HP310x110 piles driven to refusal in the very dense till or shale.

Considering the high geotechnical resistance available in the very dense till at the anticipated founding level for spread footings, the use of augered caissons is not expected to be a cos-effective foundation alternative.

7.6 Metrolinx Grade Separation

The preliminary profile drawing provided by MMM Group indicates that the proposed grade separation at the Metrolinx rail crossing will entail a relatively shallow road cut under the railway, primarily involving excavation through the existing raised track embankment. The base of the road cut will near Elev. 272.0 beneath the rail alignment.

The stratigraphy encountered in Borehole 15-20 drilled near the rail crossing location consisted of a pavement structure overlying compact silty sand fill to 4.4 m depth, underlain by a 1.7 m thick layer of loose silty sand, a 1.5 m thick layer of very stiff silty sandy clay till, and compact to dense sand contacted at 7.6 m depth (Elev. 270.0). Water was measured at a depth of 8.9 m below the road surface (Elev. 268.7).

Based on the borehole data, the road cut is expected to extend through the silty sand embankment fill, silty sand layer and into the underlying silty clay till. In general, the base and sidewalls of the road cut excavated in these deposits are expected to be stable with permanent cut slopes designed at inclinations not exceeding 2H:1V. The groundwater level was measured to be below the proposed base of cut, and therefore groundwater is not expected to be an issue.

Consideration may be given to supporting the proposed grade separation structure on spread footings founded on the dense to compact sand encountered at 7.6 m depth. A factored geotechnical resistance at ULS of 400 kPa and a geotechnical reaction at SLS of 250 kPa are recommended for preliminary design of spread footings founded on the dense sand.

In view of the potentially large footing dimensions necessitated by the available bearing resistance, the use of driven steel H-piles may be preferred. For preliminary design purposes, a factored geotechnical resistance at ULS of 1,200 kN and a geotechnical reaction at SLS of 1,000 kN are recommended for HP310x110 piles driven into the very dense sand below a depth of at least 16.0 m (Elev. 261.6). Additional drilling to greater depth will be required to confirm the recommended pile tip elevation and the axial resistance of pile foundations.

Considering the thick deposit of cohesionless sand below the water table, the use of augered caissons is not recommended to support the proposed grade separation structure at this site due to the potential for sidewall and base instability, dewatering issues and the inability to examine the competency of the caisson base.

7.7 Retaining Wall South of Black Creek

We understand that the existing concrete retaining wall on the east side of Trafalgar Road opposite Stewarttown Road South will be replaced and relocated to the east of the existing alignment. The existing wall appears to be performing well.

Boreholes were drilled to the north (Borehole 15-15) and south (previous Borehole 01-3) of the retaining wall. The borehole drilled to the north at Black Creek encountered fill and probable alluvial soils over very dense native sand and silt a depth of 4.6 m. The borehole located to the south encountered fill overlying compact native sandy silt at 3.7 m depth.

Based on the available information, replacement of the existing retaining wall with a concrete cantilever wall, a soldier pile wall or a reinforced soil structure (RSS) is considered feasible from a geotechnical perspective. An RSS wall or spread footings for a cantilever wall should be founded on the compact to very dense native sand/silt below the level of all fill, alluvial/organic materials or loose/soft soils. Soldier piles if employed should be socketed into the very dense native sand and silt and/or the underlying shale bedrock.

A borehole investigation will be required adjacent to the wall during detailed design to establish the depth to competent native material and bedrock at the wall location, and to determine appropriate geotechnical resistance values for foundation design.

7.8 Embankment North of Black Creek

It is anticipated that grades on Trafalgar Road will be raised by up to 5 m between Black Creek and Stewarttown Road North. The information from Borehole 15-15 at the Black Creek bridge approach indicates that the existing embankment is underlain by a layer of firm to stiff dark

brown silty clay, presumably comprising alluvial materials deposited in the Black Creek floodplain. Visual examination of the lands adjacent to the embankment appear to be low and wet, and soft organic/alluvial materials are probable in these areas.

Where soft/organic soils are present under the existing embankment fill or embankment widening areas, remedial measures may be required to address the stability of embankment slopes and potential long-term settlement due to the increased embankment loading. Potential measures may include subexcavation of organic deposits, flattening of embankment side slopes, and/or preloading/surcharging of the embankment to minimize post-construction settlement. Further investigation is required during detailed design to determine the thickness and extent of soft, organic soils, and evaluate the need for remedial measures.

7.9 Backfill and Lateral Earth Pressures

Backfill to the grade separation abutments, bridges and any retaining walls should consist of free-draining, non-frost susceptible granular materials conforming to OPS Granular A or Granular B Type II requirements.

The lateral earth pressures acting on the walls, assuming full drainage from behind the walls, may be computed using the following pressure distribution:

$$p = K(\gamma H + q)$$

where p = lateral earth pressure acting at depth H, kPa

K = earth pressure coefficient

γ = unit weight of retained soil or backfill, kN/m^3

H = depth below top of wall where pressure is computed, m

q = surcharge pressure including traffic loads, kPa

Table 7.4 lists the unfactored parameters recommended for design, assuming an essentially level ground surface behind and in front of the walls:

Table 7.4 – Earth Pressure Parameters

Parameter	Retained Material	
	OPSS Granular A or Granular B Type II	OPSS Granular B Type I
Unit Weight, kN/m^3	22.8	21.2
Friction Angle, degrees	35	32
Active Pressure Coefficient, K_a	0.27	0.31
At-Rest Pressure Coefficient, K_0	0.43	0.47
Passive Pressure Coefficient, K_p	3.7	3.3

If lateral movement is not permissible and/or the wall is restrained from lateral yielding, the at-rest earth pressure coefficient, K_o, should be used. If the wall design allows lateral yielding (non-rigid structure), the active earth pressure coefficient, K_a, may be used.

The earth pressure coefficients in the table above do not include potential compaction effects that must be included in the design. Compaction effects should be considered as per the CHBDC.

Design of the structures must incorporate measures such as weepholes to permit drainage of the backfill and avoid potential build-up of hydrostatic pressures behind the walls.

7.10 Municipal Service Installation

Excavation for open cut installation of municipal services within urban sections of roadway will primarily extend through the existing roadway pavement structure and embankment fill, and into native silty clay till and localized sand deposits. Use of a hydraulic excavator should be suitable for trench excavation within these materials.

All temporary excavations must be carried out in accordance with the current Occupational Health and Safety Act (OHSA) of Ontario and local regulations. In general, the fill and native soils are classified as Type 3 soils above the groundwater level, and Type 4 soils if excavation extends below the water level without prior dewatering. Groundwater is not expected to pose construction issues during excavation of relatively shallow trenches.

Prior to placement of the pipe bedding, the base of the trench should be maintained in a dry condition, free of loose or disturbed material. The pipe must be placed on a uniformly competent

subgrade. Pipe bedding materials, compaction and cover should follow OPSD 802.030 to 803.034, and/or Halton Region specifications.

Trench backfill materials should be placed in loose lift thicknesses not exceeding 200 mm and compacted to at least 98% of its SPMMD. Where utility trenches are located beneath the roadway, OPSS Granular A or B material, or unshrinkable fill should be employed as backfill.

For trenches located outside of the roadway, the portion of the trench above the pipe cover can be backfilled with excavated soil provided it is unfrozen and free of organics, debris and other deleterious materials. The placement moisture content should be within about 2% of the optimum moisture content for efficient compaction, and the till must be adequately broken down and compacted in the trench.

7.11 Detailed Geotechnical Investigation

The information presented in this report is provided for preliminary design and planning purposes only. Detailed geotechnical investigation will be required to confirm the subsurface conditions and recommendations. This work should include:

- additional boreholes within the existing roadway pavement and widening areas to confirm the subgrade conditions and preliminary pavement design recommendations;
- deflection testing (FWD) and Ground Penetrating Radar (GPR) testing of the existing roadway if sections of the existing pavement are to be rehabilitated;
- additional boreholes at the proposed bridge, grade separation structures, retaining walls and fill embankments to confirm geotechnical recommendations for foundation design, roadway cut excavations, temporary track and road protection requirements, and embankment design.
- additional boreholes along proposed underground utility alignments, if applicable, when further details regarding the alignment and depth of these services are established;
- further assessment of dewatering requirements and the need for a PTTW; and
- chemical testing to evaluate excess material disposal.

THURBER

STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.

d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

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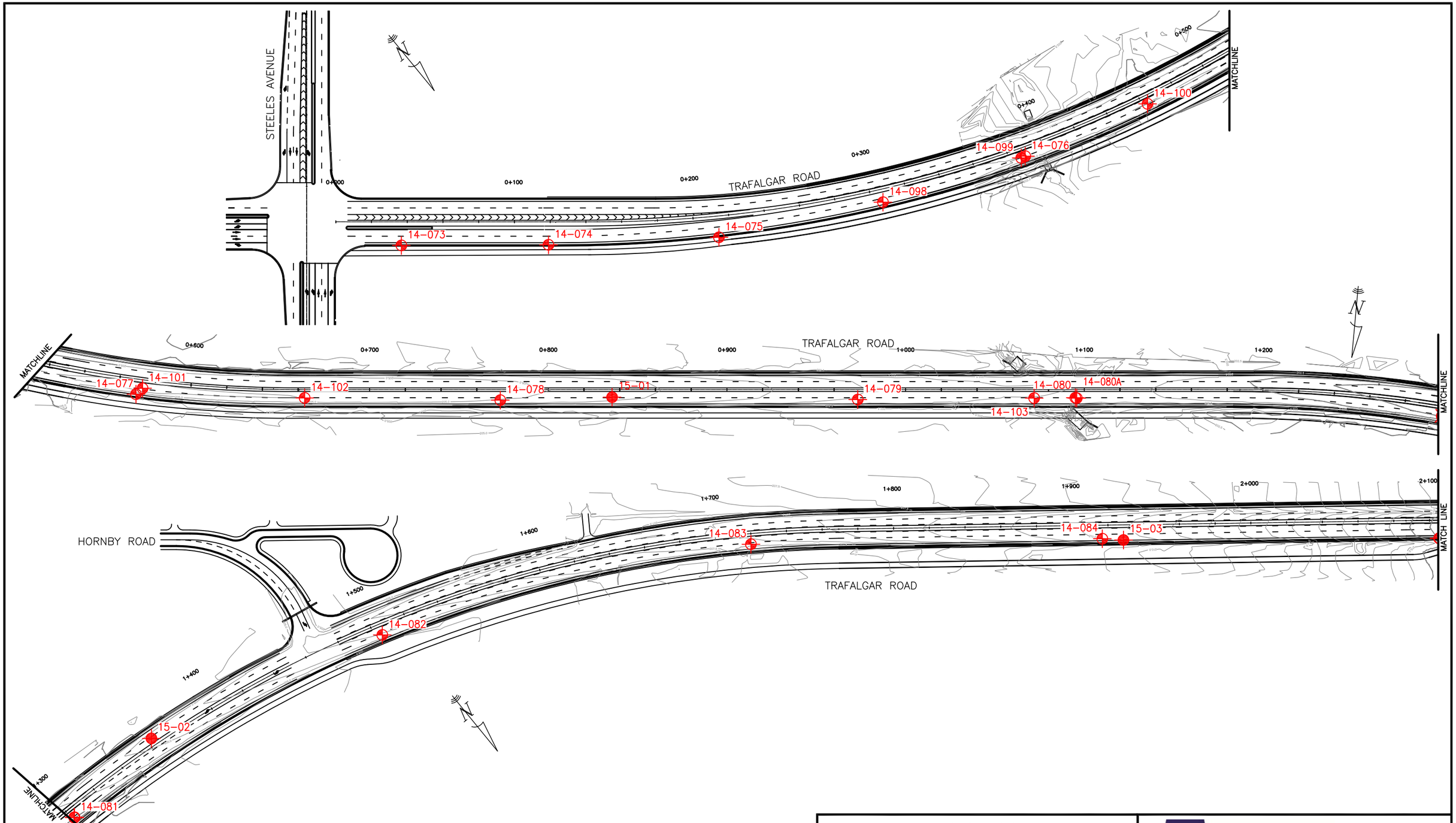
APPENDIX A

BOREHOLE LOCATION PLANS



LEGEND:

- BOREHOLE LOCATION
- THURBER BOREHOLE (PROJECT NO. 17-123-902)
- THURBER BOREHOLE (PROJECT NO. 17-550-137)

MMM GROUP LIMITED

TRAFALGAR ROAD
EA STUDY
HALTON HILLS, ON

BOREHOLE LOCATIONS PLAN

JOB# 19-1351-253

THURBER ENGINEERING LTD.

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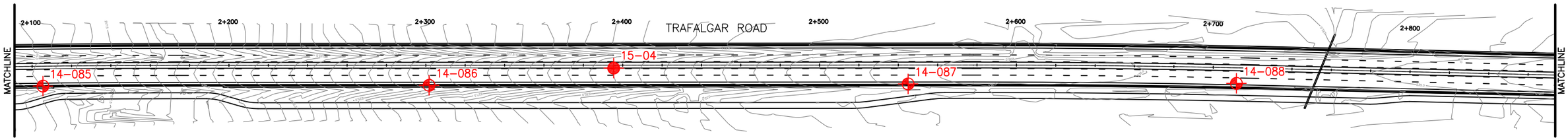

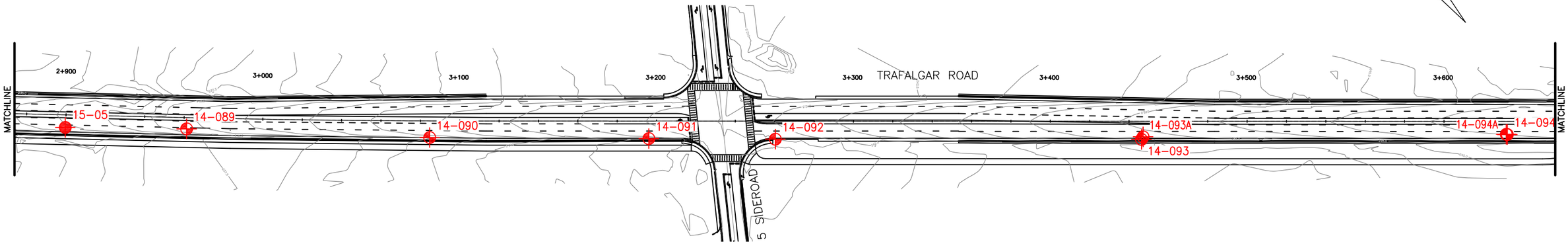

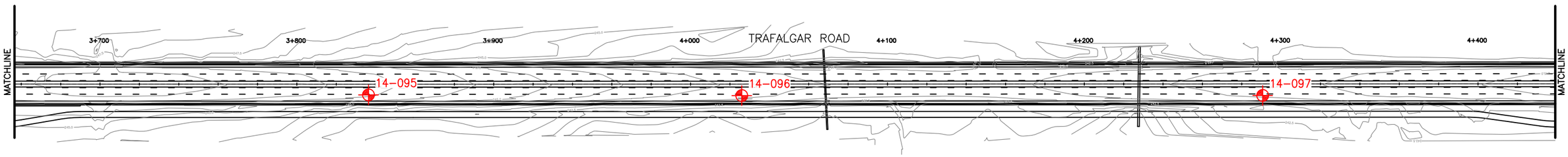

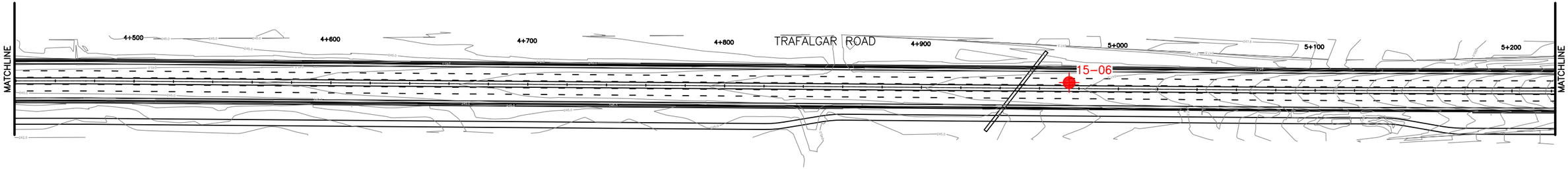

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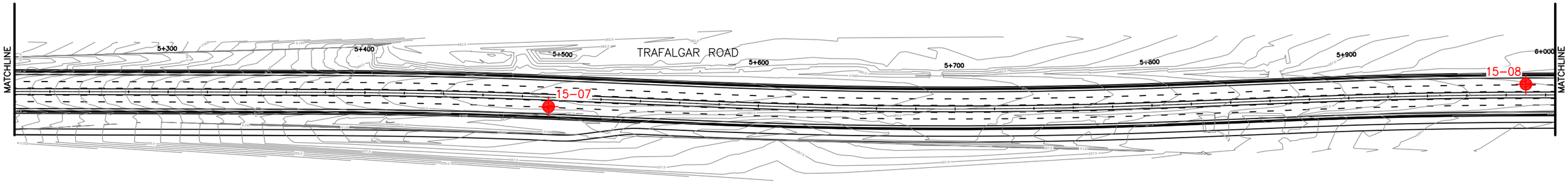

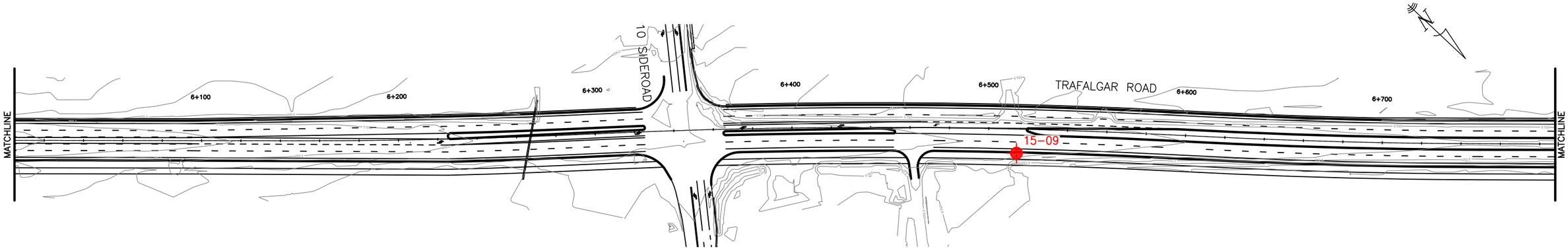

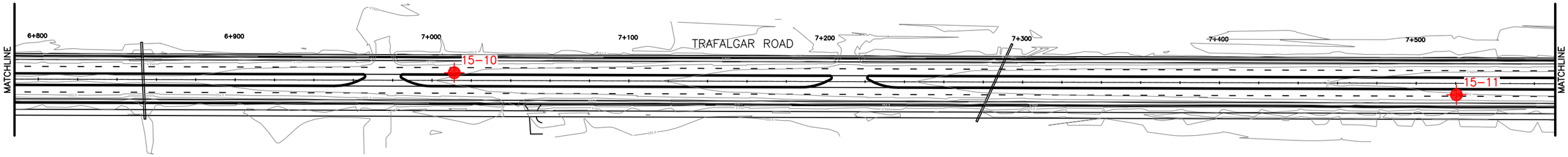

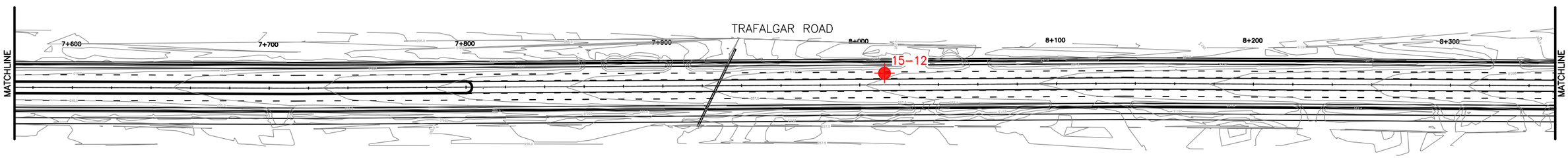

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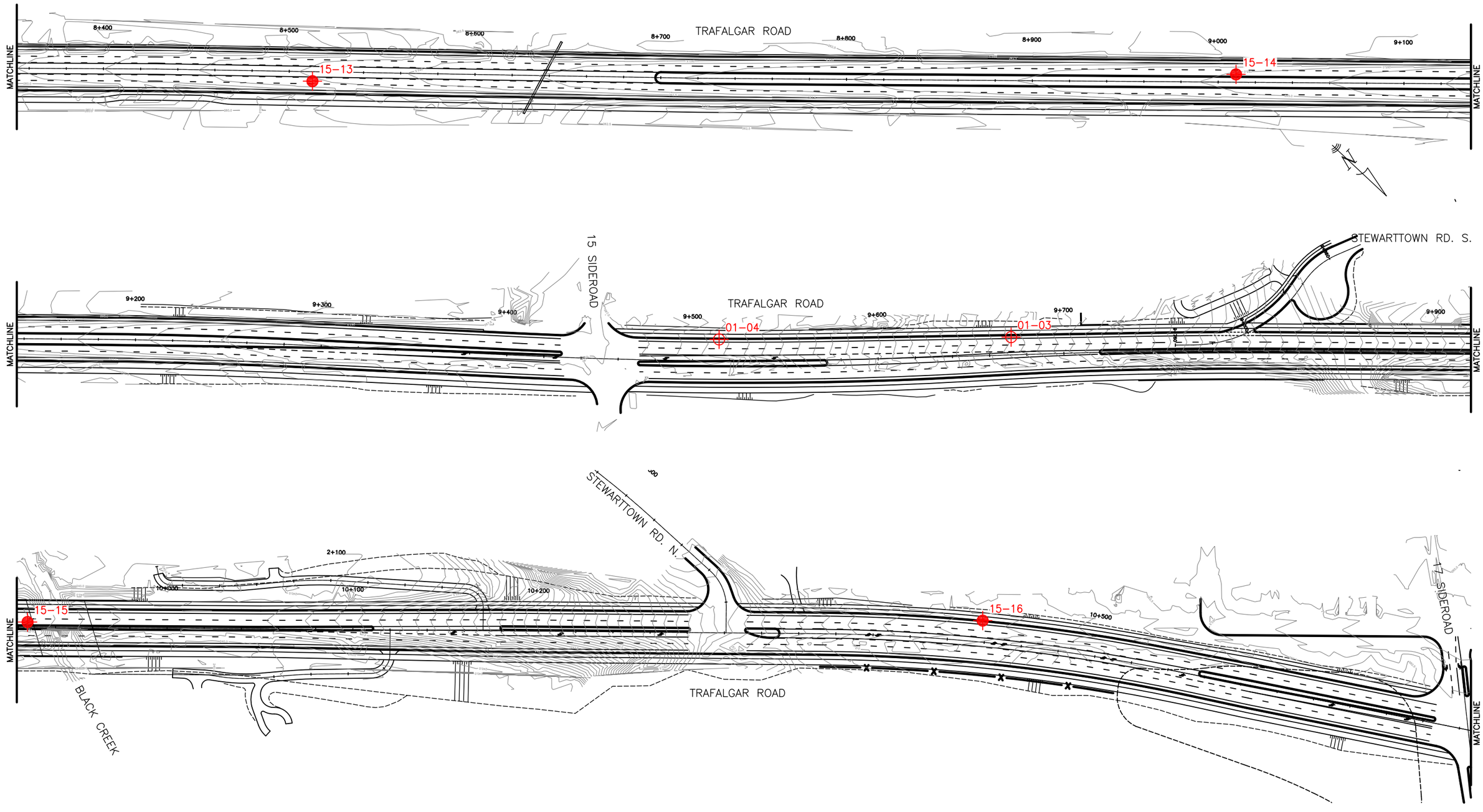

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MMM GROUP LIMITED

TRAFALGAR ROAD
EA STUDY
HALTON HILLS, ON

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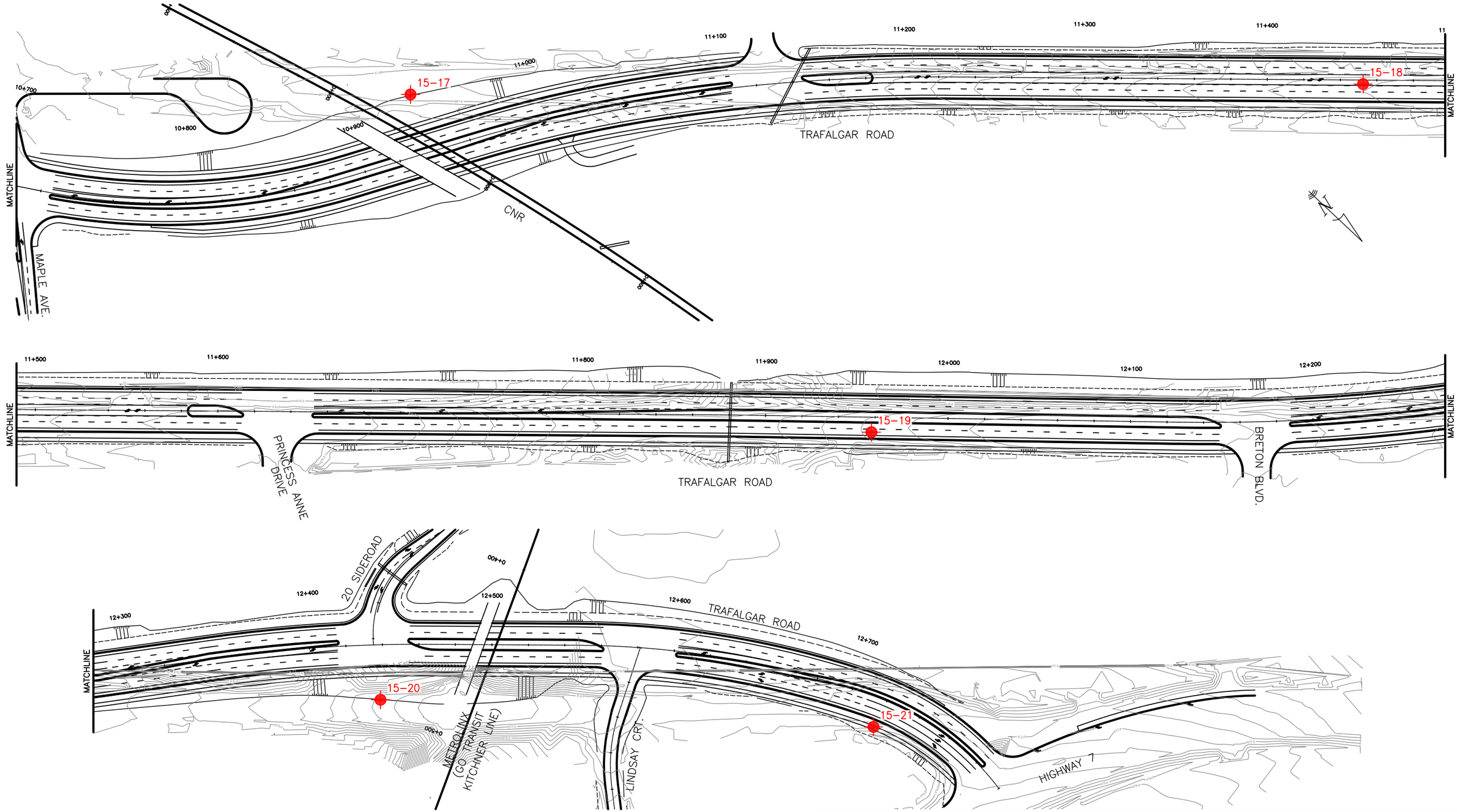

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APPENDIX B

RECORD OF BOREHOLE SHEETS

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

CLASSIFICATION	PARTICLE SIZE	VISUAL IDENTIFICATION
Boulders	Greater than 200mm	same
Cobbles	75 to 200mm	same
Gravel	4.75 to 75mm	5 to 75mm
Sand	0.075 to 4.75mm	Not visible particles to 5mm
Silt	0.002 to 0.075mm	Non-plastic particles, not visible to the naked eye
Clay	Less than 0.002mm	Plastic particles, not visible to the naked eye

2. COARSE GRAIN SOIL DESCRIPTION (50% greater than 0.075mm)

TERMINOLOGY	PROPORTION
Trace or Occasional	Less than 10%
Some	10 to 20%
Adjective (e.g. silty or sandy)	20 to 35%
And (e.g. sand and gravel)	35 to 50%

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT[(1)] 'N' VALUE
Very Soft	12 or less	Less than 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	Greater than 200	Greater than 30

NOTE: Hierarchy of Soil Strength Prediction

1) Laboratory Triaxial Testing
2) Field Insitu Vane Testing
3) Laboratory Vane Testing
4) SPT value
5) Pocket Penetrometer

4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

DESCRIPTIVE TERM	SPT "N" VALUE
Very Loose	Less than 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	Greater than 50

5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE	SS Split Spoon Sample	WS Wash Sample	AS Auger (Grab) Sample
	TW Thin Wall Shelby Tube Sample		TP Thin Wall Piston Sample
	PH Sampler Advanced by Hydraulic Pressure		PM Sampler Advanced by Manual Pressure
	WH Sampler Advanced by Self Static Weight	RC Rock Core	SC Soil Core

$$\text{Sensitivity} = \frac{\text{Undisturbed Shear Strength}}{\text{Remoulded Shear Strength}}$$

▼ Water Level

C_{pen} Shear Strength Determination by Pocket Penetrometer

(1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.

(2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

EXPLANATION OF ROCK LOGGING TERMS

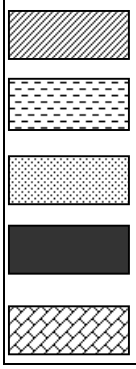
ROCK WEATHERING CLASSIFICATION

Fresh (FR)	No visible signs of weathering.
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.

DISCONTINUITY SPACING

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

SYMBOLS



STRENGTH CLASSIFICATION

Rock Strength	**Approximate Uniaxial Compressive Strength (MPa)**	**(psi)**	**Field Estimation of Hardness***
Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

TERMS

Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length
Solid Core Recovery:(SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run
Rock Quality Designation:(RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a % of total core run length.
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen
Fracture Index:(FI)	Frequency of natural fractures per 0.3m of core run.

UNIFIED SOILS CLASSIFICATION

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS $W_L < 50\%$	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. ($W_L < 30\%$).
		CI	Inorganic clays of medium plasticity, silty clays. ($30\% < W_L < 50\%$).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

RECORD OF BOREHOLE 15-01

PROJECT : Trafalgar Road EA Study
LOCATION : Halton Hills, ON
STARTED : February 12, 2016
COMPLETED : February 12, 2016

Project No. 19-1351-253
SHEET 1 OF 1
DATUM Geodetic

N 4 825 535.0 E 593 323.0

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT wp w wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		204.50							
		ASPHALT: (175mm)		0.00 204.32							
		SAND, some silt, some gravel, brown, moist: (FILL)		0.18							
	Solid Stem Augers			203.84							
1		**CLAY**, silty, sandy, trace gravel, very stiff, brown, moist: (TILL)		0.66							
					1	SS	22		○ (w)		
2				202.37							
		END OF BOREHOLE AT 2.13m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO 0.2m, THEN ASPHALT COLD PATCH TO SURFACE.		2.13							
3											
4											
5											
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AHF
CHECKED : MRA

THURBER

THURBER2S 19-1351-253.GPJ 3/22/16

RECORD OF BOREHOLE 15-02

PROJECT : Trafalgar Road EA Study
LOCATION : Halton Hills, ON
STARTED : February 12, 2016
COMPLETED : February 12, 2016
N 4 825 515.0 E 592 797.0

Project No. 19-1351-253
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲; 40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl; 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		205.00							
	Solid Stem Augers	**ASPHALT:** (150mm)		204.85 0.00							
		SAND, gravelly, some silt, brown, moist: (FILL)		0.15	1	GS			○		
1		**CLAY**, silty, sandy, trace gravel, very stiff, brown, moist: (TILL)		204.16 0.84							
2					2	SS	22		○		
		END OF BOREHOLE AT 2.13m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO 0.2m, THEN ASPHALT COLD PATCH TO SURFACE.		202.87 2.13							
3											
4											
5											
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AHF
CHECKED : MRA

THURBER

THURBER2S 19-1351-253.GPJ 3/22/16

RECORD OF BOREHOLE 15-03

PROJECT : Trafalgar Road EA Study
LOCATION : Halton Hills, ON
STARTED : February 12, 2016
COMPLETED : February 12, 2016

Project No. 19-1351-253
SHEET 1 OF 1
DATUM Geodetic

N 4 825 820.0 E 592 333.0

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲) (40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		210.00							
	Solid Stem Augers	**ASPHALT:** (175mm)		0.00 / 209.82							
		SAND, gravelly, some silt, brown, moist: (FILL)		0.18	1	GS		Grain Size Analysis: Gr 28%/Sa 62%/ Si & Cl 10%	○		
1		**CLAY**, silty, sandy, trace gravel, very stiff, brown, moist: (TILL)		209.26 / 0.74							
2					2	SS	21		○		
		END OF BOREHOLE AT 2.13m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO 0.2m, THEN ASPHALT COLD PATCH TO SURFACE.		207.87 / 2.13							
3											
4											
5											
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AHF
CHECKED : MRA

THURBER

THURBER2S 19-1351-253.GPJ 3/22/16

RECORD OF BOREHOLE 15-04

PROJECT : Trafalgar Road EA Study
LOCATION : Halton Hills, ON
STARTED : February 12, 2016
COMPLETED : February 12, 2016

Project No. 19-1351-253
SHEET 1 OF 1
DATUM Geodetic

N 4 826 142.0 E 591 995.0

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲) (40 80 120 160); WATER CONTENT, PERCENT (wp, w, wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		230.50							
		ASPHALT: (165mm)		230.34 0.00							
		SAND, gravelly, silty, brown, moist: (FILL)		0.16							
	Solid Stem Augers				1	GS			○		
				229.71							
1		**SAND**, silty, some gravel, brown, moist: (FILL) Asphalt layer at 0.9m		0.79							
				228.98							
		CLAY, silty, sandy, trace gravel, hard, brown, moist: (TILL)		1.52							
2					2	SS	47		○		
				228.37							
		END OF BOREHOLE AT 2.13m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO 0.2m, THEN ASPHALT COLD PATCH TO SURFACE.		2.13							
3											
4											
5											
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AHF
CHECKED : MRA

THURBER

THURBER2S 19-1351-253.GPJ 3/22/16

RECORD OF BOREHOLE 15-05

PROJECT : Trafalgar Road EA Study
LOCATION : Halton Hills, ON
STARTED : February 12, 2016
COMPLETED : February 12, 2016
N 4 826 505.0 E 591 645.0

Project No. 19-1351-253
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲) (40 80 120 160) / WATER CONTENT, PERCENT (wp, w ○, wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		236.30							
		ASPHALT: (150mm)		236.15 0.00							
		SAND, gravelly, some silt, brown, moist: (FILL)		0.15	1	GS			○		
1	Solid Stem Augers	**CLAY**, silty, sandy, trace gravel, stiff, brown, moist: (TILL)		235.49 0.81							
2					2	SS	12		○		
		END OF BOREHOLE AT 2.13m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH CUTTINGS TO 0.2m, THEN ASPHALT COLD PATCH TO SURFACE.		234.17 2.13							
3											
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7											
8											
9											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AHF
CHECKED : MRA

THURBER

THURBER2S 19-1351-253.GPJ 3/22/16

RECORD OF BOREHOLE 15-06

PROJECT : Trafalgar Road EA Study
LOCATION : Halton Hills, ON
STARTED : February 9, 2016
COMPLETED : February 9, 2016

Project No. 19-1351-253
SHEET 1 OF 1
DATUM Geodetic

N 4 827 967.0 E 590 172.0

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS
		GROUND SURFACE		247.00				
		ASPHALT: (150mm)		246.85 0.00				
		SAND, gravelly, silty, brown, moist: (FILL)		0.15	1	GS		Grain Size Analysis: Gr 28%/Sa 47%/ Si & Cl 25%
		SAND, silty, some gravel, very dense, brown, moist: (FILL) Asphalt layer at 0.9m		246.24 0.76	2	SS	72	
		CLAY, silty, trace sand and gravel, some organics, stiff, dark brown, moist: (FILL)		245.48 1.52	3	SS	10	
	Solid Stem Augers	**CLAY**, silty, some sand, trace gravel, firm, brown, moist: (TILL)		244.71 2.29	4	SS	5	
		SAND, silty, some gravel, trace clay, loose, brown, moist: (TILL)		244.03 2.97	5	SS	8	Grain Size Analysis: Gr 16%/Sa 58%/ Si & Cl 26%
		Becoming very dense		242.15 4.85	6	SS	50/ 0.125	
		END OF BOREHOLE AT 4.85m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.						

WATER LEVEL READINGS:

DATE	DEPTH(m)	ELEV.(m)
Feb09/2016	Dry	-
Mar15/2016	Dry	-

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲): 40 80 120 160

WATER CONTENT, PERCENT: wp w wl; 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION: Cement; Filter Sand; Bentonite; Filter Sand; Slotted Screen

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AHF
CHECKED : MRA

THURBER

THURBER2S 19-1351-253.GPJ 3/22/16

RECORD OF BOREHOLE 15-07

PROJECT : Trafalgar Road EA Study
LOCATION : Halton Hills, ON
STARTED : February 9, 2016
COMPLETED : February 9, 2016

Project No. 19-1351-253
SHEET 1 OF 1
DATUM Geodetic

N 4 828 341.0 E 589 813.0

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS
		GROUND SURFACE		260.80				
		ASPHALT: (150mm)		260.65 0.00				
		SAND, gravelly, some silt, brown, moist: (FILL)		0.15	1	GS		
				260.14				
		CLAY, silty, sandy, trace gravel, very stiff, brown, moist: (TILL)		0.66	2	SS	18	Grain Size Analysis: Gr 0%/ Sa 38%/ Si 39%/ Cl 23%
					3	SS	27	
				258.51				
		SAND, silty, very dense, light brown, moist		2.29	4	SS	50	
				257.83				
		SILT, trace to some sand, very dense, light brown, moist		2.97	5	SS	74/ 0.225	
		Becoming grey			6	SS	90/ 0.225	
				255.80				
		END OF BOREHOLE AT 5.00m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.2m, THEN ASPHALT COLD PATCH TO SURFACE.		5.00				

BORING METHOD: Solid Stem Augers

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲): 40 80 120 160

WATER CONTENT, PERCENT: wp w wl; 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AHF
CHECKED : MRA

THURBER

THURBER2S 19-1351-253.GPJ 3/22/16

RECORD OF BOREHOLE 15-08

PROJECT : Trafalgar Road EA Study
LOCATION : Halton Hills, ON
STARTED : February 9, 2016
COMPLETED : February 9, 2016

Project No. 19-1351-253
SHEET 1 OF 1
DATUM Geodetic

N 4 828 683.0 E 589 453.0

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤ rem V - ● Q - ✖ Cpen ▲) (40 80 120 160) / WATER CONTENT, PERCENT (wp w wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		256.00							
		ASPHALT: (150mm)		255.85 0.00							
		SAND, gravelly, some silt, brown, moist: (FILL)		0.15	1	GS			○		
1		**SAND**, silty, some gravel, trace clay, compact, brown, moist: (FILL) Asphalt layer at 0.8m		255.16 0.84	2	SS	13		○		
2	Solid Stem Augers	**CLAY**, silty, sandy, trace gravel, trace organics, firm, grey, moist: (TILL)		254.32 1.68	3	SS	8		○		
3		Becoming very stiff to hard, brown			4	SS	27		○		
					5	SS	35		○		
4				251.43							
		SHALE, highly weathered, reddish brown		4.67	6	SS	50/ 0.100		○		
5		END OF BOREHOLE AT 4.67m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.2m, THEN ASPHALT COLD PATCH TO SURFACE.									
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AHF
CHECKED : MRA

THURBER

THURBER2S 19-1351-253.GPJ 3/22/16

RECORD OF BOREHOLE 15-09

PROJECT : Trafalgar Road EA Study
LOCATION : Halton Hills, ON
STARTED : February 9, 2016
COMPLETED : February 9, 2016
N 4 829 061.0 E 589 090.0

Project No. 19-1351-253
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT wp w wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		253.50							
		ASPHALT: (165mm)		0.00							
		SAND, gravelly, some silt, brown: (FILL)		253.34 0.16	1	GS		Grain Size Analysis: Gr 25%/Sa 55%/ Si & Cl 20%	○		Cement
											Filter Sand
1		**SAND**, silty, some gravel, occasional asphalt particles, very dense to compact, brown, moist: (FILL)		252.60 0.90	2	SS	60		○		
		Becoming dark brown, trace organics			3	SS	11		○		Bentonite
2	Solid Stem Augers	**CLAY**, silty, sandy, trace gravel, firm, grey, moist: (TILL)		251.37 2.13	4	SS	7		○		
											Filter Sand
3		Becoming very stiff, brown			5	SS	20		○		
											Slotted Screen
4		**SAND**, silty, some clay, trace gravel, very dense, brown, moist: (TILL)		249.39 4.11							
				248.70 4.80	6	SS	50/ 0.075		○		
5		END OF BOREHOLE AT 4.80m. Piezometer installation consists of 125mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.									
		WATER LEVEL READINGS: DATE / DEPTH(m) / ELEV.(m)									
6		Feb09/2016 2.06 251.44									
		Mar15/2016 1.63 251.87									
7											
8											
9											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
March 15, 2016

LOGGED : AHF
CHECKED : MRA

THURBER

THURBER2S 19-1351-253.GPJ 3/22/16

RECORD OF BOREHOLE 15-10

PROJECT : Trafalgar Road EA Study
LOCATION : Halton Hills, ON
STARTED : February 12, 2016
COMPLETED : February 12, 2016
N 4 829 406.0 E 588 732.0

Project No. 19-1351-253
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS
		GROUND SURFACE		253.40				
		ASPHALT: (150mm)		253.25 0.00				
		SAND, gravelly, some silt, brown, moist: (FILL)		0.15	1	GS		
				252.79				
		SAND and **SILT**, clayey, trace gravel, compact, brown, moist: (FILL)		0.61	2	SS	21	Grain Size Analysis: Gr 5%/ Sa 40%/ Si 36%/ Cl 19%
				252.03				
		CLAY, silty, sandy, trace gravel, trace organics, firm, grey, moist: (TILL)		1.37	3	SS	8	
	Solid Stem Augers	Becoming very stiff to hard, brown			4	SS	18	
					5	SS	72/ 0.275	
				249.29				
		SAND, silty, some clay, trace gravel, dense, grey, moist: (TILL)		4.11	6	SS	32	
				248.22				
		END OF BOREHOLE AT 5.18m. BOREHOLE OPEN AND WATER LEVEL AT 1.67m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.2m, THEN ASPHALT COLD PATCH SURFACE.		5.18				

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲): 40 80 120 160

WATER CONTENT, PERCENT: wp w wl; 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AHF
CHECKED : MRA

THURBER

THURBER2S 19-1351-253.GPJ 3/22/16

RECORD OF BOREHOLE 15-11

PROJECT : Trafalgar Road EA Study
LOCATION : Halton Hills, ON
STARTED : February 11, 2016
COMPLETED : February 11, 2016

Project No. 19-1351-253
SHEET 1 OF 1
DATUM Geodetic

N 4 829 773.0 E 588 379.0

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS
		GROUND SURFACE		255.00				
		ASPHALT: (150mm)		254.85 0.00				
		SAND, gravelly, some silt, brown, moist: (FILL)		0.15	1	GS		
				254.24				
1		**SAND**, silty, clayey, brown, moist: (FILL)		0.76	2	SS	50/ 0.125	
		Asphalt layer		253.48				
2	Solid Stem Augers	**SAND** and **SILT**, clayey, trace gravel, firm to stiff, brown, moist: (TILL)		1.52	3	SS	6	Grain Size Analysis: Gr 10%/Sa 48%/ Si 28%/ Cl 14%
					4	SS	11	
3		Becoming hard			5	SS	32	
4		**SAND**, silty, some clay, trace gravel, compact, brown, moist: (TILL)		250.89 4.11				
5					6	SS	28	
		END OF BOREHOLE AT 5.18m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.2m, THEN ASPHALT COLD PATCH TO SURFACE.		249.82 5.18				
6								
7								
8								
9								

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✤ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AHF
CHECKED : MRA

THURBER

THURBER2S 19-1351-253.GPJ 3/22/16

RECORD OF BOREHOLE 15-12

PROJECT : Trafalgar Road EA Study
LOCATION : Halton Hills, ON
STARTED : February 11, 2016
COMPLETED : February 11, 2016
N 4 830 111.0 E 588 021.0

Project No. 19-1351-253
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS / DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT wp w wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		257.80							
		ASPHALT: (165mm)		257.64 0.00							
		SAND, gravelly, some silt, brown, moist: (FILL)		0.16	1	GS		Grain Size Analysis: Gr 29%/Sa 55%/ Si & Cl 16%	○		Cement
				257.03							Filter Sand
1		**SAND**, silty, clayey, trace gravel, compact, brown, moist: (FILL)		0.77	2	SS	27		○		▼
				256.43							
2	Solid Stem Augers	**CLAY**, silty, sandy, trace gravel, very stiff to hard, brown, moist: (TILL)		1.37	3	SS	26		○		Bentonite
					4	SS	46		○		
3					5	SS	46		○		Filter Sand
4											Slotted Screen
					6	SS	28		○		
5				252.62							
		END OF BOREHOLE AT 5.18m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.		5.18							
6		WATER LEVEL READINGS: DATE / DEPTH(m) / ELEV.(m) Feb11/2016 Dry - Mar15/2016 1.20 256.60									
7											
8											
9											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
March 15, 2016

LOGGED : AHF
CHECKED : MRA

THURBER

THURBER2S 19-1351-253.GPJ 3/22/16

RECORD OF BOREHOLE 15-13

PROJECT : Trafalgar Road EA Study
LOCATION : Halton Hills, ON
STARTED : February 11, 2016
COMPLETED : February 11, 2016
N 4 830 473.0 E 587 676.0

Project No. 19-1351-253
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
		GROUND SURFACE		261.80				
		ASPHALT: (150mm)		261.65 0.00				
		SAND, gravelly, some silt, brown, moist: (FILL)		0.15	1	GS		
		SAND, silty, some clay, trace gravel, brown, moist: (FILL)		261.17 0.63	2	SS	50/ 0.100	
1		Asphalt layer at 0.8m						
		SAND and **SILT**, clayey, trace gravel, very stiff, brown, moist: (TILL)		260.43 1.37	3	SS	18	
2	Solid Stem Augers				4	SS	14	
		SILT, some sand, some clay, loose to compact, brown, moist		258.98 2.82	5	SS	8	Grain Size Analysis: Gr 0%/ Sa 19%/ Si 69%/ Cl 12%
3								
4								
					6	SS	26	
5				256.62				
		END OF BOREHOLE AT 5.18m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.2m, THEN ASPHALT COLD PATCH TO SURFACE.		5.18				
6								
7								
8								
9								

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AHF
CHECKED : MRA

THURBER

THURBER2S 19-1351-253.GPJ 3/22/16

RECORD OF BOREHOLE 15-14

PROJECT : Trafalgar Road EA Study
LOCATION : Halton Hills, ON
STARTED : February 17, 2016
COMPLETED : February 17, 2016
N 4 830 821.0 E 587 321.0

Project No. 19-1351-253
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS / DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲; 40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl; 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		265.00							
		ASPHALT: (150mm)		264.85 0.00							
		SAND, gravelly, some silt, brown, moist: (FILL)		0.15	1	GS			○		
				264.39							
		SAND, silty, some clay, compact, reddish brown, moist: (FILL)		0.61	1	SS	19		○		
1											
				263.48							
		SAND and **SILT**, clayey, trace gravel, stiff to very stiff, brown, moist: (TILL)		1.52	2	SS	12		○		
2											
	Solid Stem Augers	25mm sand seam at 2.6m			3	SS	25	Grain Size Analysis: Gr 7%/ Sa 41%/ Si 35%/ Cl 17%	○ —		
3					4	SS	27		○		
4											
		Becoming wet			5	SS	29		○		
5				259.82							
		END OF BOREHOLE AT 5.18m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.2m, THEN ASPHALT COLD PATCH TO SURFACE.		5.18							
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : RMT
CHECKED : MRA

THURBER

THURBER2S 19-1351-253.GPJ 3/22/16

RECORD OF BOREHOLE 15-15

PROJECT : Trafalgar Road EA Study
LOCATION : Halton Hills, ON
STARTED : February 4, 2016
COMPLETED : February 4, 2016
N 4 831 473.0 E 586 679.0

Project No. 19-1351-253
SHEET 1 OF 2
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
		GROUND SURFACE		242.50				
		ASPHALT: (150mm)		242.35 0.00				
		SAND, gravelly, some silt, brown: (FILL)		0.15				
					1	GS		
				241.89				
		SAND, silty, some clay, compact, brown, moist: (FILL)		0.61				
1					2	SS	26	Grain Size Analysis: Gr 11%/Sa 51%/Si 26%/ Cl 12%
2					3	SS	20	
				240.05				
		CLAY, silty, some sand, with organics, firm to stiff, dark brown, moist		2.45	4	SS	5	
3								
					5	SS	12	
4	Hollow Stem Augers							
				237.93				
		SAND and **SILT**, trace clay, trace gravel, very dense, brown, moist		4.57	6	SS	50/ 0.075	
5								
6					7	SS	50/ 0.075	Grain Size Analysis: Gr 0%/ Sa 45%/ Si 47%/ Cl 8%
7								
				234.88				
		SHALE, highly weathered, reddish brown		7.62	8	SS	25/ 0.100	
8								
9								
				233.23	9	SS	50/ 0.125	
		END OF BOREHOLE AT 9.27m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.		9.27				

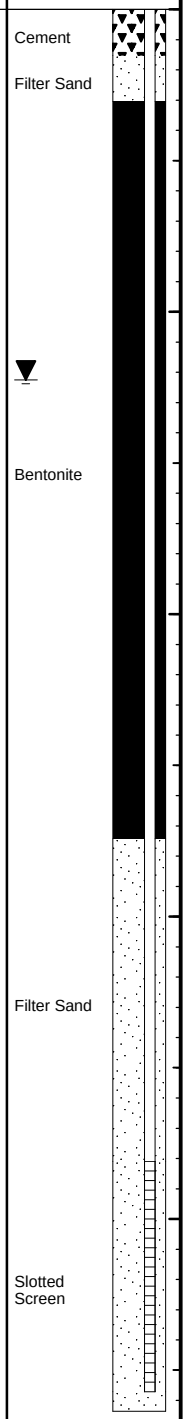
SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
March 15, 2016

LOGGED : AHF
CHECKED : MRA

THURBER

THURBER2S 19-1351-253.GPJ 3/22/16

RECORD OF BOREHOLE 15-15

PROJECT : Trafalgar Road EA Study
LOCATION : Halton Hills, ON
STARTED : February 4, 2016
COMPLETED : February 4, 2016

Project No. 19-1351-253
SHEET 2 OF 2
DATUM Geodetic

N 4 831 473.0 E 586 679.0

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲; 40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl; 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) Mar15/2016 2.45 240.05									
11											
12											
13											
14											
15											
16											
17											
18											
19											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
March 15, 2016

LOGGED : AHF
CHECKED : MRA

THURBER

THURBER2S 19-1351-253.GPJ 3/22/16

RECORD OF BOREHOLE 15-16

PROJECT : Trafalgar Road EA Study
LOCATION : Halton Hills, ON
STARTED : February 4, 2016
COMPLETED : February 4, 2016

Project No. 19-1351-253
SHEET 1 OF 1
DATUM Geodetic

N 4 831 835.0 E 586 314.0

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS
		GROUND SURFACE		260.60				
		ASPHALT: (175mm)		0.00 / 260.42				
		SAND, gravelly, some silt, brown, moist: (FILL)		0.18	1	GS		Grain Size Analysis: Gr 26%/Sa 55%/ Si & Cl 19%
				259.97				
		CLAY, silty, sandy, trace gravel, stiff to hard, brown, moist: (TILL)		0.63	2	SS	14	
1	Solid Stem Augers				3	SS	38	
2					4	SS	50	
3					5	SS	70	
4					6	SS	54	
5				255.42				
		END OF BOREHOLE AT 5.18m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.2m, THEN ASPHALT COLD PATCH TO SURFACE.		5.18				
6								
7								
8								
9								

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : AHF
CHECKED : MRA

THURBER

THURBER2S 19-1351-253.GPJ 3/22/16

RECORD OF BOREHOLE 15-17

PROJECT : Trafalgar Road EA Study
LOCATION : Halton Hills, ON
STARTED : February 5, 2016
COMPLETED : February 5, 2016

Project No. 19-1351-253
SHEET 1 OF 2
DATUM Geodetic

N 4 832 179.0 E 585 981.0

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS	SHEAR STRENGTH: Cu, KPa (nat V - ✚ Q - ✖ / rem V - ● Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT wp w wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		267.50				DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100			
		ASPHALT: (150mm)		267.35 0.00							
		SAND, gravelly, some silt, compact, brown, dry: (FILL)		0.15	1	SS	24				Concrete
				266.81							
1		**CLAY**, silty, trace sand, very stiff, brown: (FILL)		0.69	2	SS	22				
				265.98							
2		**CLAY**, silty, sandy, trace gravel, stiff to very stiff, brown: (TILL)		1.52	3	SS	8	Grain Size Analysis: Gr 0%/ Sa 28%/ Si 51%/ Cl 21%			
					4	SS	27				
3					5	SS	29				
4				262.93							
		SAND and **SILT**, some clay, trace to some gravel, very dense, brown to grey, damp: (TILL)		4.57	6	SS	90	Grain Size Analysis: Gr 10%/Sa 40%/ Si 39%/ Cl 11%			Bentonite
5	Hollow Stem Augers	Becoming wet									
6					7	SS	92				
7											
					8	SS	114				
8											
9		Becoming reddish brown, damp, with shale fragments			9	SS	139	Grain Size Analysis: Gr 0%/ Sa 37%/ Si 50%/ Cl 13%			

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER

March 15, 2016

LOGGED : GA
CHECKED : MRA

THURBER

THURBER2S 19-1351-253.GPJ 3/22/16

RECORD OF BOREHOLE 15-17

PROJECT : Trafalgar Road EA Study
LOCATION : Halton Hills, ON
STARTED : February 5, 2016
COMPLETED : February 5, 2016

Project No. 19-1351-253
SHEET 2 OF 2
DATUM Geodetic

N 4 832 179.0 E 585 981.0

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲) (40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
11					10	SS	121		○		Filter Sand
		SHALE, highly weathered, reddish brown		256.22 11.28							
12											Slotted Screen
				255.16 12.34	11	SS	109/ 0.150		○		
		END OF BOREHOLE AT 12.34m. BOREHOLE OPEN AND DRY UPON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.									
13		WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) Mar15/2016 0.70 266.80									
14											
15											
16											
17											
18											
19											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
March 15, 2016

LOGGED : GA
CHECKED : MRA

THURBER

THURBER2S 19-1351-253.GPJ 3/22/16

RECORD OF BOREHOLE 15-18

PROJECT : Trafalgar Road EA Study
LOCATION : Halton Hills, ON
STARTED : February 17, 2016
COMPLETED : February 17, 2016
N 4 832 543.0 E 585 607.0

Project No. 19-1351-253
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
		GROUND SURFACE		274.30				
		ASPHALT: (150mm)		274.15 0.00				
		SAND, gravelly, some silt, brown: (FILL)		273.69 0.15	1	GS		
1	Solid Stem Augers	**CLAY**, silty, some sand, trace gravel, firm, brown, moist		0.61	1	SS	6	
					2	SS	4	
2		**SILT**, sandy, clayey, trace gravel, compact to dense, brown, moist: (TILL)		272.01 2.29	3	SS	22	Grain Size Analysis: Gr 8%/ Sa 33%/ Si 42%/ Cl 17%
3					4	SS	32	
4		**SAND**, some silt, very dense, brown, moist		270.19 4.11				
				269.58	5	SS	50/ 0.150	
5		END OF BOREHOLE AT 4.72m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.2m, THEN ASPHALT COLD PATCH TO SURFACE.		4.72				
6								
7								
8								
9								

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : RMT
CHECKED : MRA

THURBER

THURBER2S 19-1351-253.GPJ 3/22/16

RECORD OF BOREHOLE 15-19

PROJECT : Trafalgar Road EA Study
LOCATION : Halton Hills, ON
STARTED : February 17, 2016
COMPLETED : February 17, 2016

Project No. 19-1351-253
SHEET 1 OF 1
DATUM Geodetic

N 4 832 907.0 E 585 256.0

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT wp ○w wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		273.60				DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100			
		ASPHALT: (150mm)		273.45 0.00							
		SAND, gravelly, some silt, brown: (FILL)		0.15	1	GS		Grain Size Analysis: Gr 28%/Sa 59%/ Si & Cl 13%	○		
				272.89							
1	Solid Stem Augers	**SAND**, some gravel, some silt, very dense to compact, brown, moist		0.71	1	SS	60		○		
2					2	SS	48	Grain Size Analysis: Gr 16%/Sa 68%/ Si & Cl 16%	○		
3					3	SS	20		○		
					4	SS	24		○		
4											
5					5	SS	21		○		
				268.42							
		END OF BOREHOLE AT 5.18m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.2m, THEN ASPHALT COLD PATCH TO SURFACE.		5.18							
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : RMT
CHECKED : MRA

THURBER

THURBER2S 19-1351-253.GPJ 3/22/16

RECORD OF BOREHOLE 15-20

PROJECT : Trafalgar Road EA Study
LOCATION : Halton Hills, ON
STARTED : February 10, 2016
COMPLETED : February 10, 2016

Project No. 19-1351-253
SHEET 1 OF 2
DATUM Geodetic

N 4 833 244.0 E 584 915.0

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT wp ○w wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		277.60				DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100			
		ASPHALT: (150mm)		277.45 0.00							Concrete
		SAND, some silt, some gravel, brown, moist: (FILL)		0.15	1	GS			○		Filter Sand
				276.84							
1		**SAND**, silty, some gravel, pieces of asphalt, compact, dark brown, moist: (FILL)		0.76	2	SS	12		○		
					3	SS	26		○		
2					4	SS	12	Grain Size Analysis: Gr 14%/Sa 53%/Si 23%/ Cl 10%	○		
3					5	SS	22		○		
4											
		SAND, silty, trace gravel, loose, brown, moist		273.18 4.42	6	SS	5		○		
5	Hollow Stem Augers										
6		**CLAY**, silty, sandy, very stiff, brown, moist: (TILL)		271.50 6.10	7	SS	17	Grain Size Analysis: Gr 0%/ Sa 23%/ Si 53%/ Cl 24%	○—○		
7											Bentonite
		SAND, trace silt, trace gravel, dense to compact, brown, moist		269.98 7.62	8	SS	37		○		
8											
9					9	SS	34		○		▼

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
March 15, 2016

LOGGED : AHF/OA
CHECKED : MRA

THURBER

THURBER2S 19-1351-253.GPJ 3/22/16

RECORD OF BOREHOLE 15-20

PROJECT : Trafalgar Road EA Study
LOCATION : Halton Hills, ON
STARTED : February 10, 2016
COMPLETED : February 10, 2016

Project No. 19-1351-253
SHEET 2 OF 2
DATUM Geodetic

N 4 833 244.0 E 584 915.0

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✤, rem V - ●, Q - ✖, Cpen ▲) (40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
11	Hollow Stem Augers				10	SS	23	Grain Size Analysis: Gr 3%/ Sa 90%/ Si & Cl 7%	○		
12		Beocming loose to compact, wet			11	SS	6		○		
13											Filter Sand
14					12	SS	26		○		
15											Slotted Screen
		Becoming dense			13	SS	40		○		
16		END OF BOREHOLE AT 15.85m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.		261.75 15.85							
17		WATER LEVEL READINGS: DATE / DEPTH(m) / ELEV.(m) — Mar15/2016 8.90 268.70									
18											
19											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
March 15, 2016

LOGGED : AHF/OA
CHECKED : MRA

THURBER

THURBER2S 19-1351-253.GPJ 3/22/16

RECORD OF BOREHOLE 15-21

PROJECT : Trafalgar Road EA Study
LOCATION : Halton Hills, ON
STARTED : February 17, 2016
COMPLETED : February 17, 2016

Project No. 19-1351-253
SHEET 1 OF 1
DATUM Geodetic

N 4 833 445.0 E 584 734.0

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
		GROUND SURFACE		276.70				
		ASPHALT: (150mm)		276.55 0.00				
		SAND, gravelly, some silt, brown: (FILL)		0.15	1	GS		Grain Size Analysis: Gr 27%/Sa 60%/ Si & Cl 13%
				276.04				
		SAND, gravelly, some silt, trace clay, dense to compact, brown to dark brown, moist: (FILL)		0.66	2	SS	38	Grain Size Analysis: Gr 23%/Sa 50%/ Si 18%/ Cl 9%
1								
					3	SS	14	
2								
				274.41				
		CLAY, silty, trace sand, firm, brown, moist		2.29	4	SS	5	
3	Solid Stem Augers			273.65				
		SAND, trace silt, loose, brown, moist		3.05	5	SS	4	
4								
		Beocming dense			6	SS	32	
5				271.52				
		END OF BOREHOLE AT 5.18m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO 0.2m, THEN ASPHALT COLD PATCH TO SURFACE.		5.18				
6								
7								
8								
9								

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : RMT
CHECKED : MRA

THURBER

THURBER2S 19-1351-253.GPJ 3/22/16

THURBER

APPENDIX C

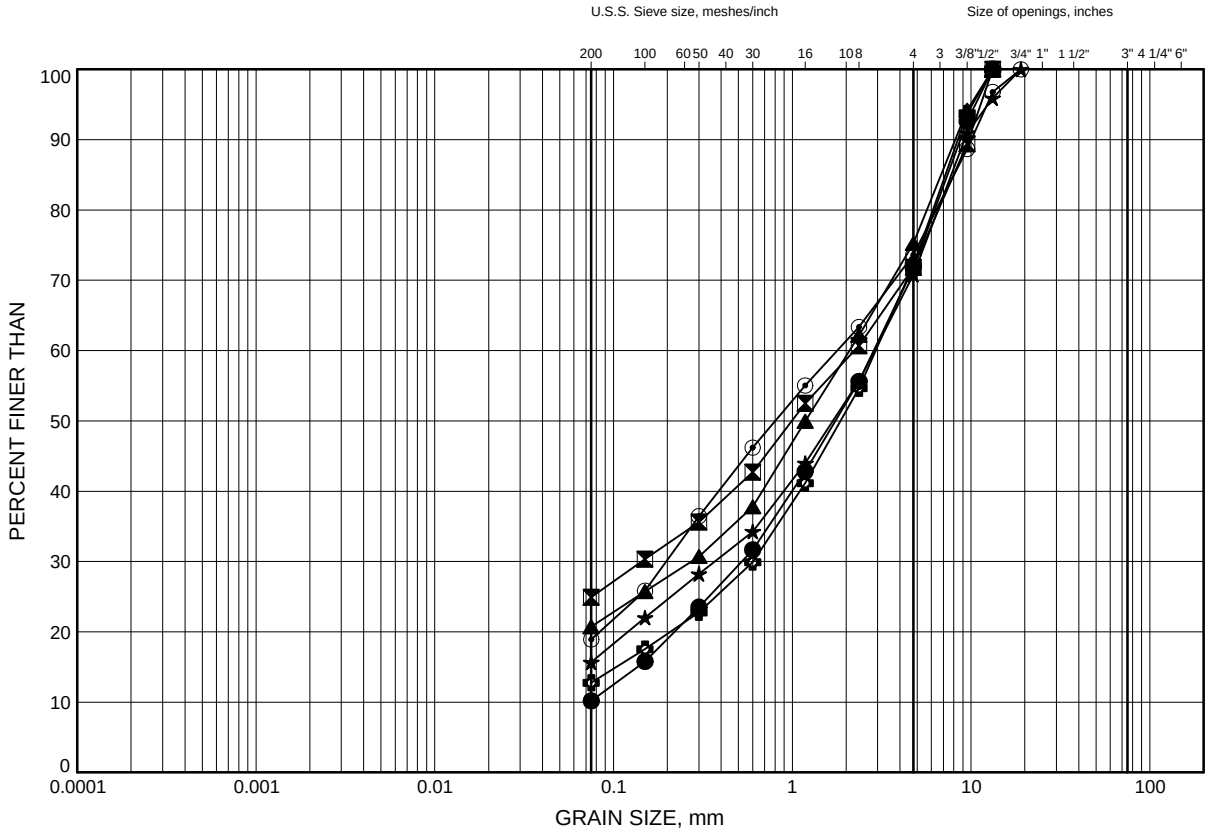
GEOTECHNICAL LABORATORY TEST RESULTS

Trafalgar Road EA Study

GRAIN SIZE DISTRIBUTION

FIGURE C1

GRANULAR MATERIAL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	15-03	0.46	209.54
⊠	15-06	0.46	246.54
▲	15-09	0.46	253.04
★	15-12	0.46	257.34
⊙	15-16	0.46	260.14
✿	15-19	0.46	273.14

Date March 2016

Project 19-1351-253

THURBER

Prep'd AN

Chkd. MRA

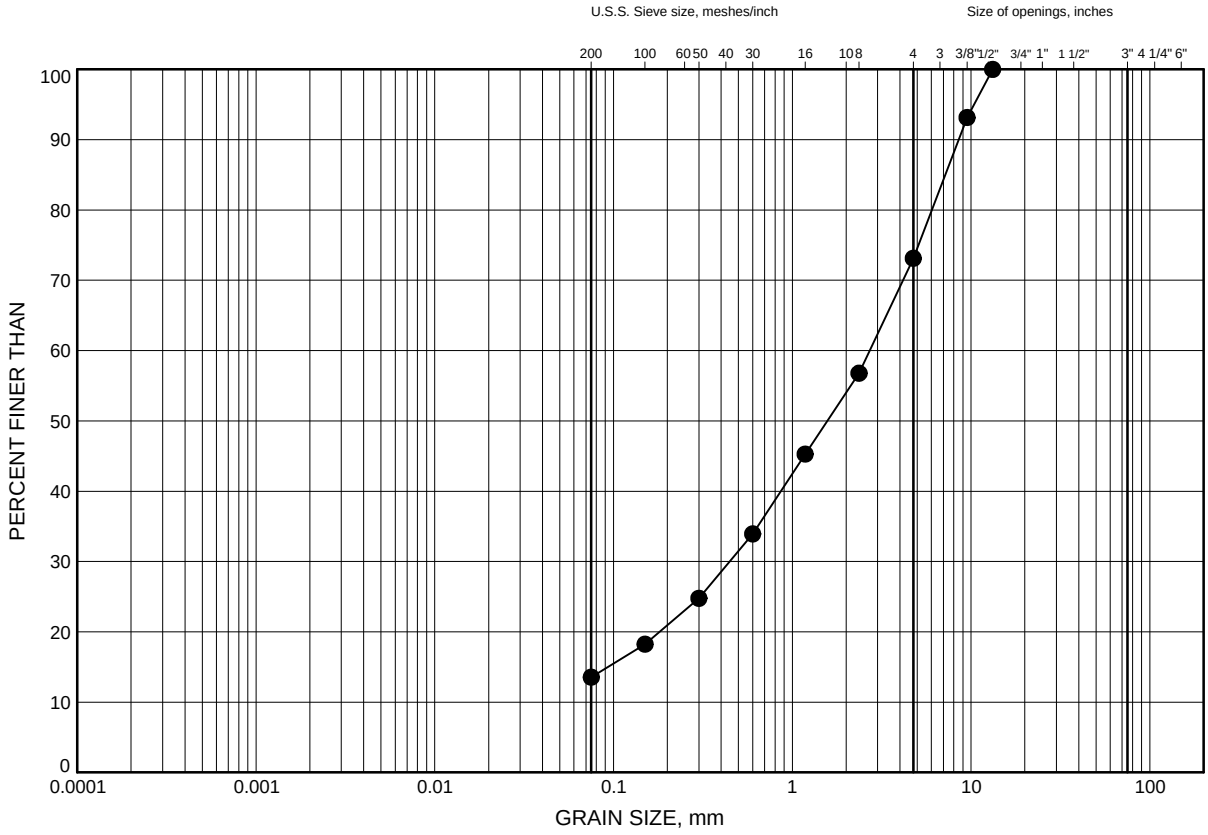
GRAIN SIZE DISTRIBUTION - THURBER 19-1351-253.GPJ 3/22/16

Trafalgar Road EA Study

GRAIN SIZE DISTRIBUTION

FIGURE C2

GRANULAR MATERIAL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	15-21	0.46	276.24

Date March 2016

Project 19-1351-253

THURBER

Prep'd AN

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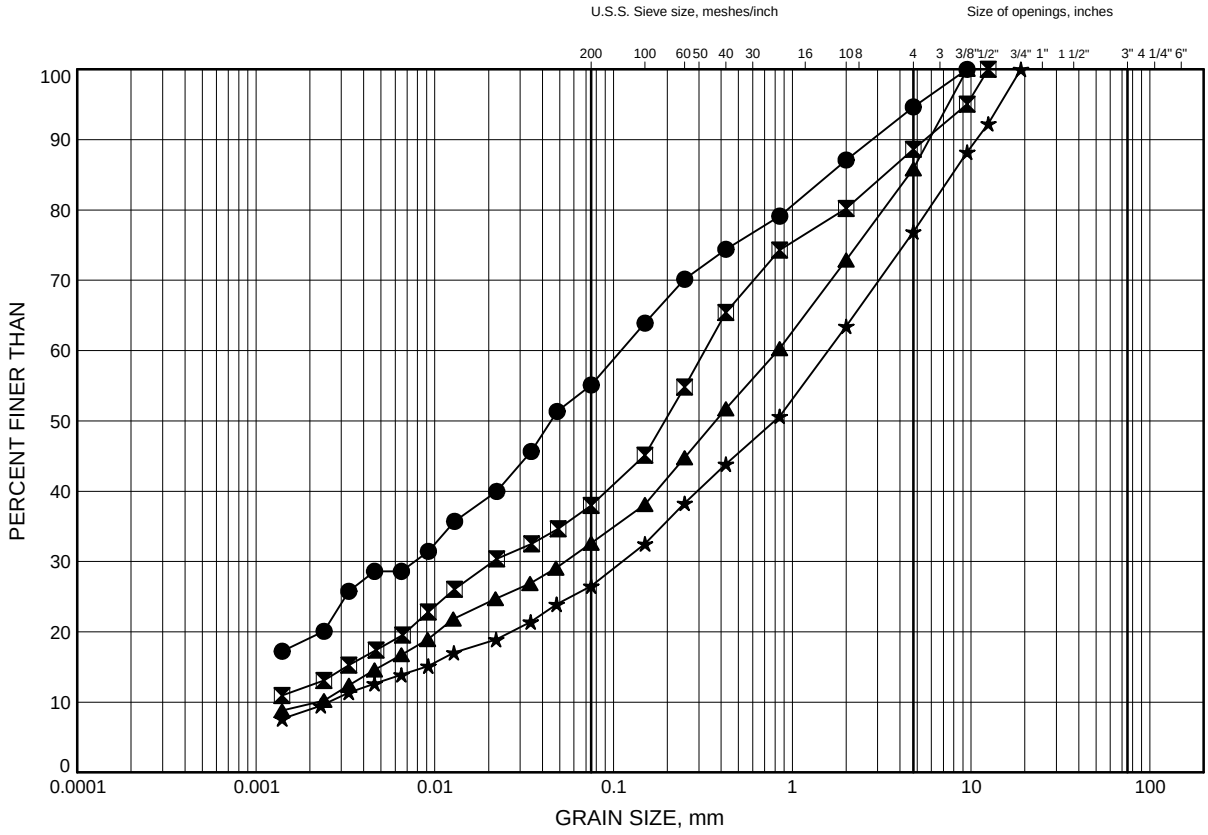
GRAIN SIZE DISTRIBUTION - THURBER 19-1351-253.GPJ 3/22/16

Trafalgar Road EA Study

GRAIN SIZE DISTRIBUTION

FIGURE C3

GRAVELLY SAND to CLAYEY SAND & SILT FILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	15-10	1.07	252.33
⊠	15-15	1.07	241.43
▲	15-20	2.59	275.01
★	15-21	1.07	275.63

Date March 2016

Project 19-1351-253

THURBER

Prep'd AN

Chkd. MRA

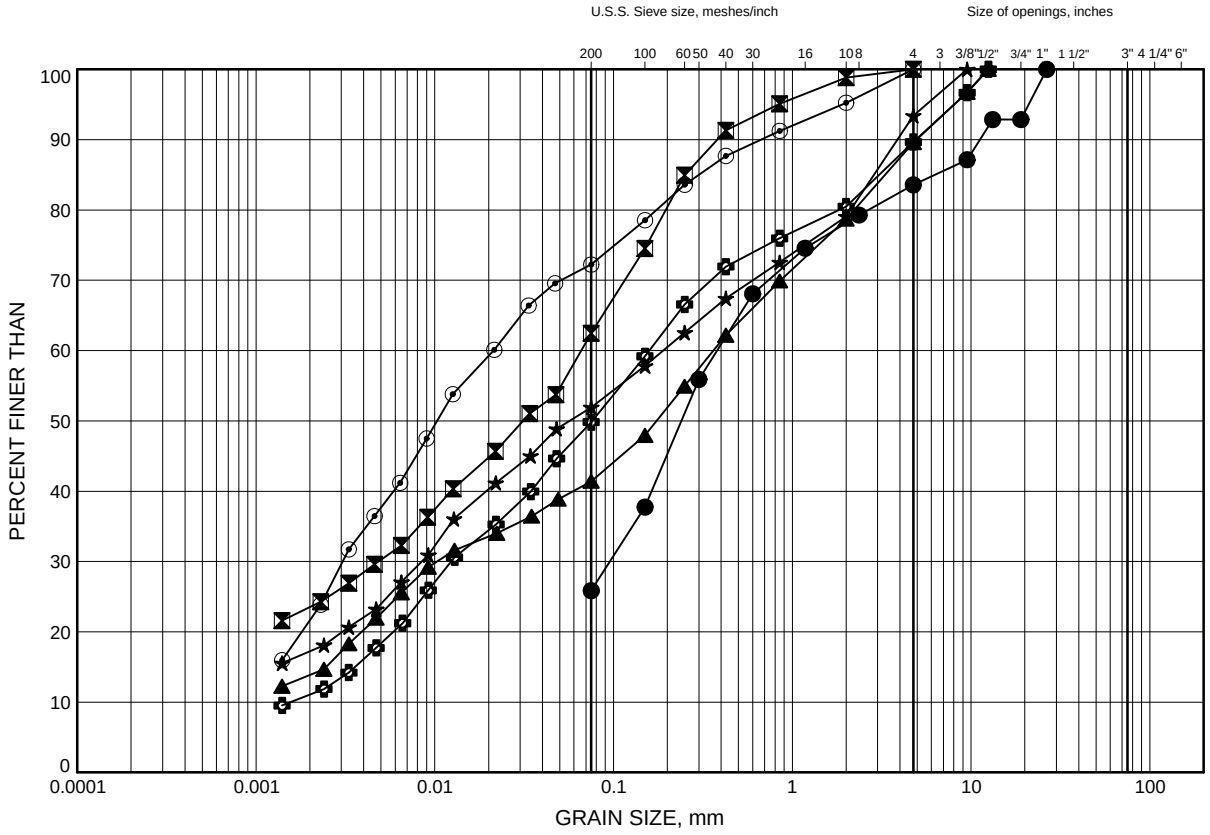
GRAIN SIZE DISTRIBUTION - THURBER 19-1351-253.GPJ 3/22/16

Trafalgar Road EA Study

GRAIN SIZE DISTRIBUTION

FIGURE C4

SILTY SAND to SANDY SILTY CLAY TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	15-06	3.35	243.65
⊠	15-07	1.07	259.73
▲	15-11	1.83	253.17
★	15-14	2.59	262.41
⊙	15-17	1.83	265.67
✿	15-17	4.88	262.62

Date March 2016

Project 19-1351-253

THURBER

Prep'd AN

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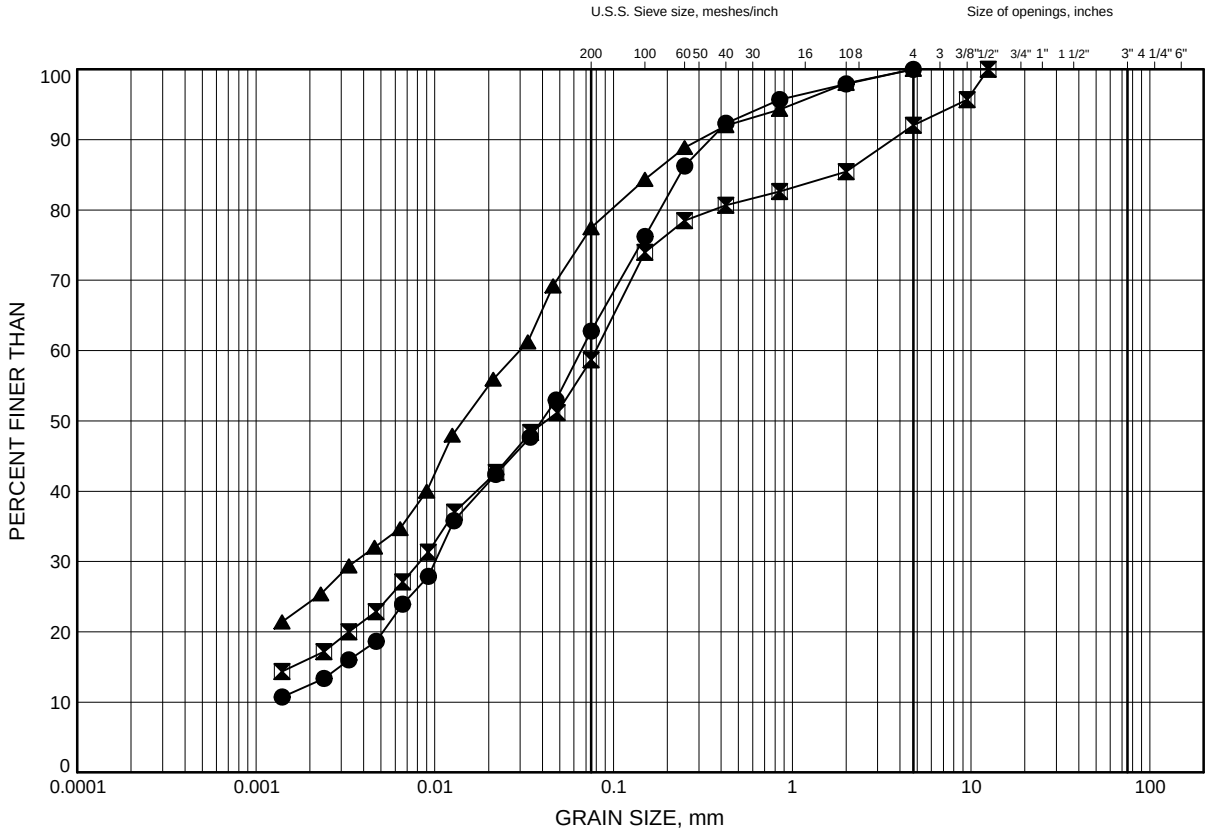
GRAIN SIZE DISTRIBUTION - THURBER 19-1351-253.GPJ 3/22/16

Trafalgar Road EA Study

GRAIN SIZE DISTRIBUTION

FIGURE C5

SILTY SAND to SANDY SILTY CLAY TILL



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	15-17	9.45	258.05
⊠	15-18	2.59	271.71
▲	15-20	6.40	271.20

Date March 2016

Project 19-1351-253

THURBER

Prep'd AN

Chkd. MRA

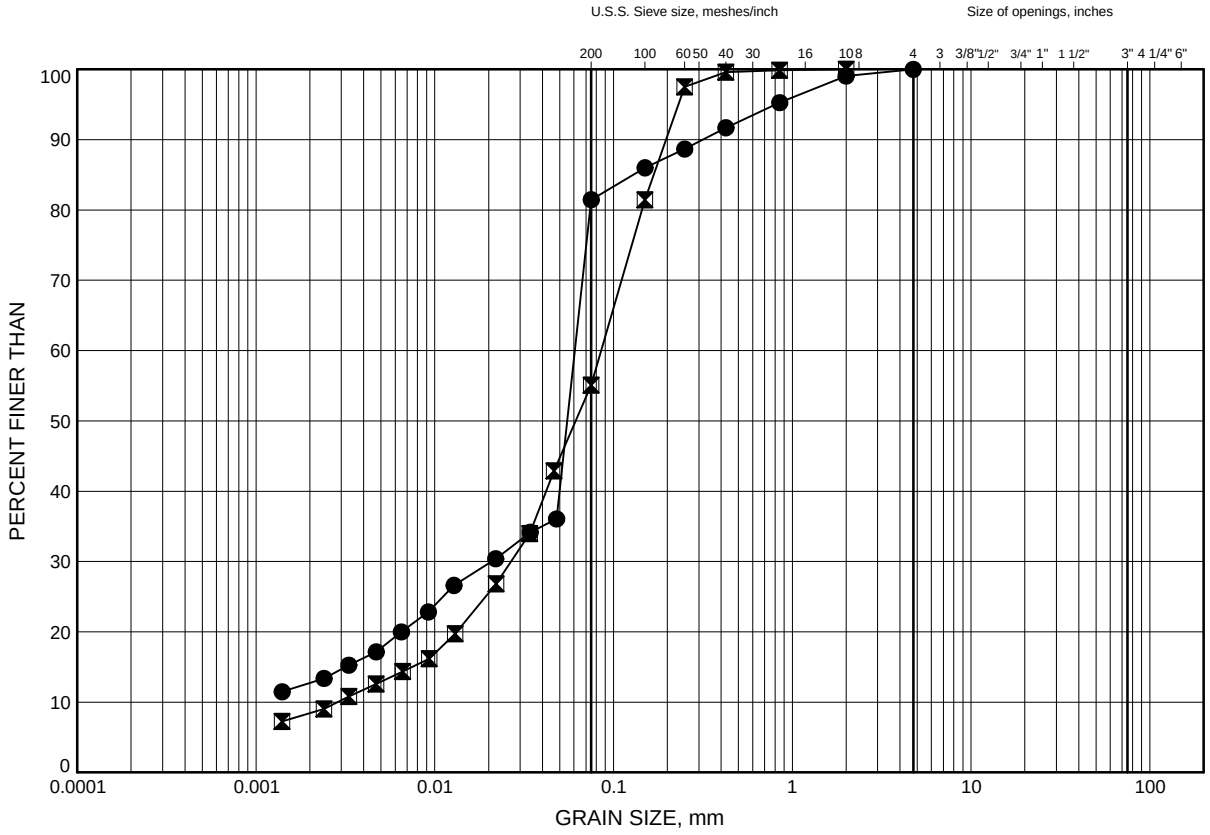
GRAIN SIZE DISTRIBUTION - THURBER 19-1351-253.GPJ 3/22/16

Trafalgar Road EA Study

GRAIN SIZE DISTRIBUTION

FIGURE C6

SILT to SILT & SAND



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	15-13	3.35	258.45
⊠	15-15	6.21	236.29

Date March 2016

Project 19-1351-253

THURBER

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Chkd. MRA

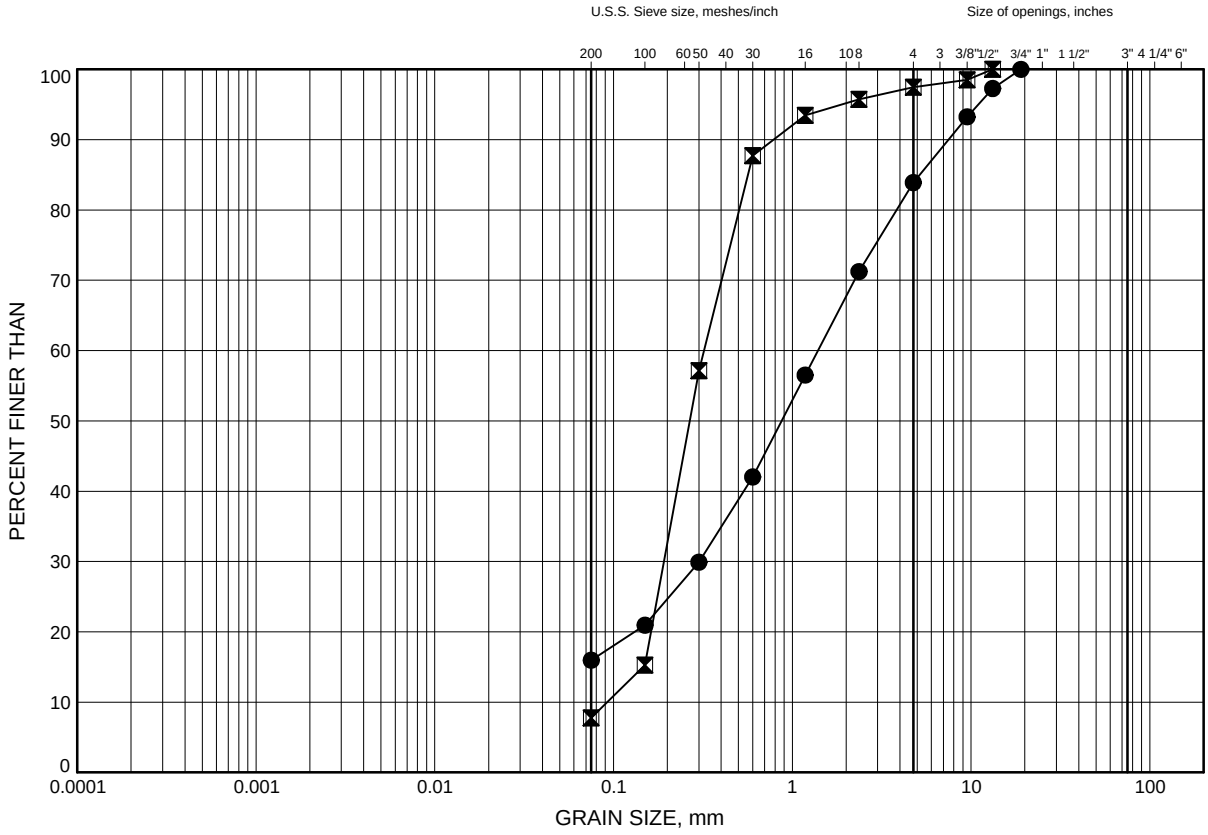
GRAIN SIZE DISTRIBUTION - THURBER 19-1351-253.GPJ 3/22/16

Trafalgar Road EA Study

GRAIN SIZE DISTRIBUTION

FIGURE C7

SAND



SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	15-19	1.83	271.77
⧓	15-20	10.97	266.63

Date March 2016

Project 19-1351-253

THURBER

Prep'd AN

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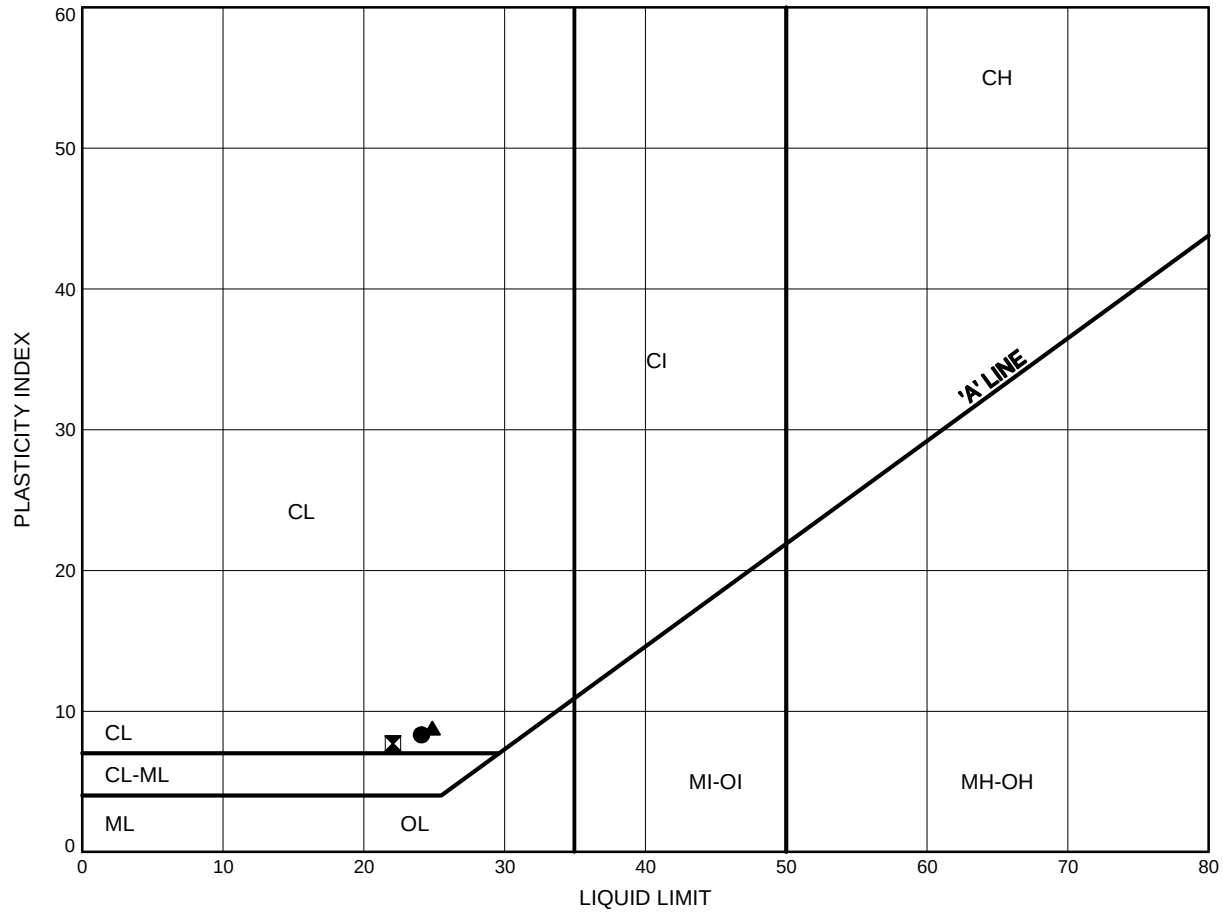
GRAIN SIZE DISTRIBUTION - THURBER 19-1351-253.GPJ 3/22/16

Trafalgar Road EA Study

ATTERBERG LIMITS TEST RESULTS

FIGURE C8

SILT & SAND to SANDY SILTY CLAY TILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	15-14	2.59	262.41
⊠	15-17	2.59	264.91
▲	15-20	6.40	271.20

Date March 2016

Project 19-1351-253

THURBER

Prep'd AN

Chkd. MRA

THURBALT 19-1351-253.GPJ 3/22/16

THURBER

APPENDIX D

SITE PHOTOGRAPHS

Photograph 1 – Inlet of Culvert at 400 m North of Steeles Avenue

Photograph 2 – Outlet of Culvert at 400 m North of Steeles Avenue

Photograph 3 – Inlet of Culvert at 1.0 km North of Steeles Avenue

Photograph 4 – Outlet of Culvert at 1.0 km North of Steeles Avenue

Photograph 5 – Pavement Condition South of Hornby Road

Photograph 6 – Pavement Condition North of Hornby Road

Photograph 7 – Deteriorated Pavement Condition South of 10 Side Road

Photograph 8 – Deteriorated Pavement Condition North of 10 Side Road

Photograph 9 – Pavement Condition South of 15 Side Road

Photograph 10 – Pavement Condition at Black Creek

Photograph 11 – Upstream Side of Black Creek Bridge

Photograph 12 – Downstream Side of Black Creek Bridge

Photograph 13 – Pavement Condition North of CNR Crossing

Photograph 14 – Trafalgar Road Embankment at Metrolinx Crossing, looking east from Side Road 20, railway at left

THURBER

APPENDIX E

RECORD OF BOREHOLE SHEETS

FROM PREVIOUS INVESTIGATIONS

RECORD OF BOREHOLE 14-073

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : February 18, 2015
COMPLETED : February 19, 2015
N 4 825 334.0 E 594 071.9

Project No. 17-123-902
SHEET 1 OF 2
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS / DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT (wp, w, wl) 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		207.80							
		ASPHALT: (150mm)		207.65							
		SAND, gravelly, compact, brown, moist: (FILL)		0.15	1	GS					
1		**CLAY**, silty, sandy, trace gravel, trace rootlets, stiff, black to brown, moist: (FILL)		206.73 1.07	1	SS	18				
2					2	SS	11				
		trace brick fragments, very stiff			3	SS	27				
3					4	SS	45				
4		**SAND** and **SILT**, trace clay, trace gravel, very dense, brown, moist: (TILL)		203.69 4.11							
					5	SS	50/ 0.075				
5					6	SS	50/ 0.125				
6		becoming grey			7	SS	50/ 0.125	Grain Size Analysis: Gr 4%/ Sa 45%/ Si 45%/ Cl 6%			
7					8	SS	50/ 0.100				
		some cobbles			9	SS	50/ 0.025	no recovery			
8					10	SS	50/ 0.075				
9					11	SS	50/ 0.050				
10					12	SS	50/ 0.100				
		SILT, trace clay, trace gravel, very dense, grey, moist		197.39 10.41	13	SS	50/ 0.050				
11					14	SS	50/ 0.125	Grain Size Analysis: Gr 0%/ Sa 7%/ Si 85%/ Cl 8%			
12					15	SS	50/ 0.150				
13				194.39 13.41							
		CLAY, silty, sandy, trace gravel, trace siltstone and shale fragments, hard, grey, moist: (TILL)			16	SS	50/ 0.125				
14											

Hollow Stem Augers

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : ME
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-073

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : February 18, 2015
COMPLETED : February 19, 2015
N 4 825 334.0 E 594 071.9

Project No. 17-123-902
SHEET 2 OF 2
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) (40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
16					17	SS	50/ 0.100				
17					18	SS	50/ 0.125				
18				189.38	19	SS	50/ 0.125				
		END OF BOREHOLE AT 18.42m. BOREHOLE BACKFILLED WITH GROUT TO 1.83m, BENTONITE HOLEPLUG TO 0.61m, CONCRETE TO 0.15m, THEN ASPHALT TO SURFACE.		18.42							
19											
20											
21											
22											
23											
24											
25											
26											
27											
28											
29											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : ME
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-074

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : February 19, 2015
COMPLETED : February 19, 2015

Project No. 17-123-902
SHEET 1 OF 2
DATUM Geodetic

N 4 825 384.9 E 594 007.2

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) (40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		206.88							
		ASPHALT: (200mm)		206.68 0.20							
		SAND, trace gravel, very dense, brown, frozen: (FILL)			1	GS					
1					1	SS	50/ 0.050				
				205.66 1.22							
		CLAY, silty, sandy, trace gravel, very stiff to hard, brown: (FILL)			2	SS	24				
2											
					3	SS	62				
3											
					4	SS	54				
				203.22 3.66							
		SAND and **SILT**, trace gravel, trace clay, very dense, brown, moist: (TILL)			5	SS	50/ 0.100	Grain Size Analysis: Gr 7%/ Sa 43%/ Si 42%/ Cl 8%			
4											
					6	SS	50/ 0.125				
5											
					7	SS	50/ 0.075				
6											
					8	SS	50/ 0.075				
					9	SS	50/ 0.075				
7											
				199.26 7.62	10	SS	50/ 0.075				
		CLAY, silty, sandy, trace gravel, hard, grey, damp: (TILL)									
8					11	SS	50/ 0.050				
9					12	SS	50/ 0.100				
								Grain Size Analysis: Gr 3%/ Sa 31%/ Si 48%/ Cl 18%			
10					13	SS	50/ 0.125				
					14	SS	50/ 0.050				
11											
12					15	SS	50/ 0.075				
13											
					16	SS	50/ 0.125				
14											

Solid Stem Auger

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION February 19, 2015

▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : ES
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-074

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : February 19, 2015
COMPLETED : February 19, 2015
N 4 825 384.9 E 594 007.2

Project No. 17-123-902
SHEET 2 OF 2
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) (40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
16					17	SS	50/ 0.075		○		
		SAND, fine grained, trace silt, trace gravel, very dense, brown, wet		190.57 16.31							
17		END OF BOREHOLE AT 16.86m. BOREHOLE OPEN TO 10.97m AND WATER LEVEL AT 3.66m UPON COMPLETION. BOREHOLE BACKFILLED WITH CEMENT GROUT TO 1.22m, BENTONITE HOLEPLUG TO 0.30m, CEMENT TO 0.08m, THEN ASPHALT TO SURFACE.		190.02 16.86	18	SS	50/ 0.100		○		
18											
19											
20											
21											
22											
23											
24											
25											
26											
27											
28											
29											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION
February 19, 2015

▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : ES
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-075

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : February 19, 2015
COMPLETED : February 20, 2015

Project No. 17-123-902
SHEET 1 OF 2
DATUM Geodetic

N 4 825 440.9 E 593 929.8

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT wp w wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		206.42				20 40 60 80 100			
		ASPHALT: (150mm)		206.27							
		SAND, silty, some gravel, trace asphalt fragments, very dense, brown, dry: (FILL)		0.15	1	GS					Concrete
1					1	SS	50/ 0.150	Grain Size Analysis: Gr 11%/ Sa 56%/ Si & Cl 33%			Filter Sand
		some silt, some clay			2	SS	50/ 0.100				
2		**CLAY**, silty, sandy, trace to some gravel, very stiff to hard, brown, moist: (FILL)		204.36 2.06							Bentonite
3					3	SS	19				
					4	SS	27				
4					5	SS	32	Grain Size Analysis: Gr 2%/ Sa 32%/ Si 44%/ Cl 22%			
		SAND and **SILT**, trace clay, trace gravel, trace cobbles, very dense, brown, moist: (TILL)		201.92 4.50	6	SS	96/ 0.275	Grain Size Analysis: Gr 6%/ Sa 42%/ Si 43%/ Cl 9%			Grout
5					7	SS	50/ 0.125				
6					8	SS	50/ 0.100				
7		occasional oxide staining			9	SS	50/ 0.125				
					10	SS	98/ 0.275	Grain Size Analysis: Gr 9%/ Sa 43%/ Si 40%/ Cl 8%			
8					11	SS	50/ 0.150				
9					12	SS	50/ 0.075				
10					13	SS	50/ 0.125				Bentonite
											Filter Sand
		CLAY, silty, sandy, trace gravel, hard, reddish brown, moist: (TILL)		195.75 10.67	14	SS	50/ 0.125				
11											
12		**SHALE**, highly weathered, trace siltstone, weak, red: (Queenston Formation)		194.23 12.19	15	SS	50/ 0.075				Slotted Screen
13											
				192.63 13.79	16	SS	50/ 0.075				
14		END OF BOREHOLE AT 13.79m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 3.02m slotted screen.									

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

April 28, 2015

LOGGED : ME
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-075

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : February 19, 2015
COMPLETED : February 20, 2015
N 4 825 440.9 E 593 929.8

Project No. 17-123-902
SHEET 2 OF 2
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲; 40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl; 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) Mar. 10/15 3.10 203.32 Apr. 28/15 2.32 204.10									
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											
26											
27											
28											
29											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
April 28, 2015

LOGGED : ME
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-076

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : January 27, 2015
COMPLETED : January 27, 2015
N 4 825 511.9 E 593 767.3

Project No. 17-123-902
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) (40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		205.44							
		ASPHALT: (50mm)		205.39 0.05							Concrete
		SAND, silty, some gravel, compact, brown, damp: (FILL)			1	GS					
1				204.32 1.12	1	SS	29				
		CLAY, silty, some sand, trace gravel, very stiff, dark brown to brown: (FILL)									
2					2	SS	19				
				203.15 2.29							
		SAND, gravelly, some silt, compact, brown, damp: (FILL)			3	SS	26	Grain Size Analysis: Gr 30%/ Sa 53%/ Si & Cl 17%			
3					4	SS	13				
4				201.33 4.11							Bentonite
		CLAY, silty, sandy, trace gravel, occasional cobbles, hard, brown: (TILL)									
		occasional sandy silt lenses			5	SS	50/ 0.075				
5	Solid Stem Augers										
6				199.34 6.10				Grain Size Analysis:			
		SAND and **SILT**, trace clay, trace gravel, very dense, grey, moist: (TILL)			6	SS	50/ 0.100	Gr 4%/ Sa 43%/ Si 45%/ Cl 8%			
7											
					7	SS	50/ 0.125				
8											
9					8	SS	50/ 0.100				Filter Sand
				195.53 9.91							
10		**CLAY**, silty, sandy, trace gravel, hard, reddish brown: (TILL)									Slotted Screen
				194.70 10.74	9	SS	50/ 0.075				
11		END OF BOREHOLE AT 10.74m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.									
12		WATER LEVEL READINGS: DATE / DEPTH(m) / ELEV.(m) Mar. 10/15 3.50 201.94 Apr. 28/15 2.84 202.60									
13											
14											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER April 28, 2015

LOGGED : ES
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-077

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : January 27, 2015
COMPLETED : January 27, 2015

Project No. 17-123-902
SHEET 1 OF 1
DATUM Geodetic

N 4 825 550.4 E 593 589.1

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT wp w wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		205.89				20 40 60 80 100			
0	Solid Stem Augers	**SAND**, silty, some gravel, compact, brown, damp: (FILL)		0.00	1	GS		Grain Size Analysis: Gr 17%/ Sa 54%/ Si & Cl 29%	○		
1					1	SS	23		○		
		CLAY, silty, sandy, trace gravel, hard, brown: (TILL)(CL)		204.62 1.27					○		
2		occasional sandy silt lenses			2	SS	48	Grain Size Analysis: Gr 5%/ Sa 32%/ Si 43%/ Cl 20%	○ ⊢		
		occasional black sand seams			3	SS	98/ 0.250		○		
3					4	SS	50/ 0.125		○		▽
4											
					5	SS	50/ 0.100		○		
5											
6		becoming grey			6	SS	51/ 0.150		○		
7											
				198.14	7	SS	50/ 0.125		○		
8		END OF BOREHOLE AT 7.75m. WATER LEVEL AT 3.35m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.		7.75							
9											
10											
11											
12											
13											
14											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION January 27, 2015

▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : ES
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-078

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : January 28, 2015
COMPLETED : January 28, 2015
N 4 825 540.6 E 593 385.3

Project No. 17-123-902
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
		GROUND SURFACE		205.47				
0	Solid Stem Augers	**SAND**, silty, some gravel, dense, brown, damp: (FILL)		0.00	1	GS		
1					1	SS	45	
				203.59	2	SS	42	
2		**CLAY**, silty, sandy, trace gravel, hard, brown: (TILL)		1.88				
3					3	SS	54	
					4	SS	64	
4								
5		becoming grey, occasional sandy silt lenses			5	SS	90/ 0.275	Grain Size Analysis: Gr 0%/ Sa 32%/ Si 49%/ Cl 19%
6		becoming brown		199.09	6	SS	50/ 0.125	
		END OF BOREHOLE AT 6.38m. WATER LEVEL AT 4.42m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.		6.38				
7								
8								
9								
10								
11								
12								
13								
14								

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION January 28, 2015

▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : ES
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-079

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : January 28, 2015
COMPLETED : January 28, 2015

Project No. 17-123-902
SHEET 1 OF 1
DATUM Geodetic

N 4 825 527.5 E 593 185.7

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS
		GROUND SURFACE		203.86				
0	Solid Stem Augers	**SAND**, silty, trace gravel, very dense, brown: (FILL)		0.00	1	GS		
1					1	SS	50/ 0.100	
				202.49				
		CLAY, silty, some sand to sandy, trace gravel, occasional sandy silt seams, hard, brown: (TILL)		1.37				
2					2	SS	37	
					3	SS	73	
3		becoming grey			4	SS	58	Grain Size Analysis: Gr 0%/ Sa 16%/ Si 65%/ Cl 19%
4								
5		occasional cobbles			5	SS	59/ 0.150	
6				197.66	6	SS	50/ 0.100	
		END OF BOREHOLE AT 6.20m. WATER LEVEL AT 3.12m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.		6.20				
7								
8								
9								
10								
11								
12								
13								
14								

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION
January 28, 2015

▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : ES
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-080

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : January 28, 2015
COMPLETED : January 28, 2015

Project No. 17-123-902
SHEET 1 OF 1
DATUM Geodetic

N 4 825 518.7 E 593 064.2

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) (40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		202.91							
0	Solid Stem Augers	**SAND**, silty, trace to some gravel, very dense, brown, damp: (FILL)		0.00	1	GS			○		Concrete
1					1	SS	72/ 0.150		○		▼
				201.54							
2		**CLAY**, silty, sandy, trace gravel, very stiff to hard, grey to brown: (TILL)(CL)		1.37	2	SS	30		○		
3					3	SS	23	Grain Size Analysis: Gr 3%/ Sa 34%/ Si 47%/ Cl 16%	○——		
					4	SS	51		○		Bentonite
4											
5					5	SS	73	Grain Size Analysis: Gr 5%/ Sa 38%/ Si 43%/ Cl 14%	○		
6		occasional cobble			6	SS	98/ 0.250		○		Filter Sand
7											Slotted Screen
				195.16							
8		**SILT**, sandy, trace clay, dense, brown, moist		7.75	7	SS	46		○		
				194.68							
		END OF BOREHOLE AT 8.23m. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.		8.23							
9											
10											
11											
12											
13											
14											

WATER LEVEL READINGS:

DATE	DEPTH(m)	ELEV.(m)
Mar. 17/15 (Frozen)	1.20	201.71
Apr. 28/15	0.98	201.93
Apr. 29/15	0.85	202.06

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
April 29, 2015

LOGGED : ES
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-080A

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : August 19, 2015
COMPLETED : August 19, 2015

Project No. 17-123-902
SHEET 1 OF 2
DATUM Geodetic

N 4 825 518.9 E 593 063.4

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✚ Q - ✖ rem V - ● Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT (wp w wl) 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		202.91							
		No sampling		0.00							
1											
2											
3											
4											
5											
6											
7	Tricone										
		CLAY, silty, sandy, trace gravel, hard, brown: (TILL)		195.29							
		SILT, sandy, trace clay, very dense, brown, moist		7.62	1	SS	53				
8				7.75							
		SAND, trace to some silt, trace gravel, very dense to dense, brown, moist		194.22 8.69							
9					2	SS	52	Grain Size Analysis: Gr 4%/ Sa 85%/ Si & Cl 11%			
		becoming fine grained sand, reddish brown at 9.45m									
10											
		becoming dense			3	SS	46				
11											
12		becoming silty, trace clay			4	SS	32	Grain Size Analysis: Gr 0%/ Sa 71%/ Si 25%/ Cl 4%			
13				189.65							
		SAND, some gravel, trace silt, very dense, grey, moist		13.26							
14					5	SS	62				
		END OF BOREHOLE AT 14.33m.		188.58 14.33							
		BOREHOLE BACKFILLED WITH CEMENT BENTONITE GROUT TO 1.00m,									

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : DJP
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-080A

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : August 19, 2015
COMPLETED : August 19, 2015

Project No. 17-123-902
SHEET 2 OF 2
DATUM Geodetic

N 4 825 518.9 E 593 063.4

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT wp w wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		BENTONITE HOLEPLUG TO 0.20m, THEN GRANULAR TO SURFACE.									
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											
26											
27											
28											
29											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : DJP
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-081

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : February 5, 2015
COMPLETED : February 5, 2015

Project No. 17-123-902
SHEET 1 OF 1
N 4 825 516.0 E 592 858.8
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) (40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		204.02							
0	Solid Stem Augers	**SAND**, some silt, trace gravel, very dense, brown, damp: (FILL)		0.00	1	GS			○		
1					1	SS	50/ 0.100		○		
2		**CLAY**, silty, sandy, trace gravel, very stiff to hard, brown: (TILL)(CL)		202.27 1.75	2	SS	18		○		
		occasional rootlets to 2.4m			3	SS	43	Grain Size Analysis: Gr 0%/ Sa 32%/ Si 47%/ Cl 21%	○		
3					4	SS	50		○		
4											
5					5	SS	46		○		
6					6	SS	85		○		
7											
8		occasional siltstone			7	SS	57		○		
		END OF BOREHOLE AT 8.23m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.		195.79 8.23							
9											
10											
11											
12											
13											
14											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : ES
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-082

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : February 5, 2015
COMPLETED : February 5, 2015

Project No. 17-123-902
SHEET 1 OF 1
DATUM Geodetic

N 4 825 565.1 E 592 664.6

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS
		GROUND SURFACE		205.57				
	Solid Stem Augers	**SAND**, some silt, trace gravel, brown, damp: (FILL)		0.00	1	GS		
1		**CLAY**, silty, sandy, trace gravel, very stiff to hard, dark brown to brown: (TILL)		204.61 0.96	1	SS	22	
		occasional topsoil and rootlets to 1.5m			2	SS	57	
2								
					3	SS	35	
3								
					4	SS	42	
4								
					5	SS	35	Grain Size Analysis: Gr 0%/ Sa 26%/ Si 46%/ Cl 28%
5		becoming grey						
6					6	SS	34	
7								
				197.67	7	SS	50/0.125	
8		END OF BOREHOLE AT 7.90m. WATER LEVEL AT 5.79m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.		7.90				
9								
10								
11								
12								
13								
14								

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION February 5, 2015

▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : ES
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-083

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : January 30, 2015
COMPLETED : January 30, 2015

Project No. 17-123-902
SHEET 1 OF 1
DATUM Geodetic

N 4 825 674.7 E 592 482.5

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✚ Q - ✖ / rem V - ● Cpen ▲) (40 80 120 160) / WATER CONTENT, PERCENT (wp w wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		207.61							
0	Solid Stem Augers	**SAND**, some gravel, some silt, very dense to compact, brown: (FILL)		0.00	1	GS					
1					1	SS	50/ 0.125				
2				205.53	2	SS	22				
		CLAY, silty, sandy, trace gravel, hard, brown: (TILL)(CL)		2.08							
3					3	SS	50				
4					4	SS	85				
5					5	SS	51	Grain Size Analysis: Gr 6%/ Sa 29%/ Si 44%/ Cl 21%			
6					6	SS	50/ 0.125				
7				199.89	7	SS	50/ 0.100				
8		END OF BOREHOLE AT 7.72m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.		7.72							
9											
10											
11											
12											
13											
14											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : ES
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-084

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : January 30, 2015
COMPLETED : January 30, 2015

Project No. 17-123-902
SHEET 1 OF 1
DATUM Geodetic

N 4 825 811.2 E 592 340.9

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT wp w wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		209.74				20 40 60 80 100			
	Solid Stem Augers	**SAND**, silty, gravelly, very dense, brown: (FILL)		0.00	1	GS		Grain Size Analysis: Gr 23%/ Sa 52%/ Si & Cl 25%	○		
1					1	SS	50/ 0.075		○		
		CLAY, silty, sandy, trace gravel, very stiff to hard, brown: (TILL)		208.09 1.65	2	SS	27	Grain Size Analysis: Gr 6%/ Sa 32%/ Si 53%/ Cl 9%	○		
2											
					3	SS	50		○		
3		possible cobble			4	SS	50/ 0.050		○		
		becoming reddish brown									
4											
					5	SS	50/ 0.100		○		
5											▽
6		occasional cobbles			6	SS	50/ 0.100		○		
7											
				202.02 7.72	7	SS	50/ 0.100		○		
8		END OF BOREHOLE AT 7.72m. WATER LEVEL AT 5.49m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.									
9											
10											
11											
12											
13											
14											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION January 30, 2015

▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : ES
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-085

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : January 30, 2015
COMPLETED : January 30, 2015

Project No. 17-123-902
SHEET 1 OF 1
DATUM Geodetic

N 4 825 944.0 E 592 207.0

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) (40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		215.81							
0	Solid Stem Augers	**SAND**, silty, some gravel, very dense, brown, damp: (FILL)		0.00	1	GS			○		Concrete
1					1	SS	50/0.125		○		
				214.24							
		CLAY, silty, some sand, trace gravel, occasional cobble, hard, brown: (FILL)		1.57	2	SS	40		○		
2				213.52							▼
		CLAY, silty, sandy, some gravel, occasional cobbles, hard, reddish brown: (TILL)		2.29	3	SS	50/0.125		○		Bentonite
3					4	SS	50/0.125		○		
4											
		some rock fragments below 5.0m			5	SS	81	Grain Size Analysis: Gr 17%/ Sa 36%/ Si 33%/ Cl 14%	○		
5											
6					6	SS	50/0.125		○		Filter Sand
7											Slotted Screen
				208.06	7	SS	50/0.125		○		
8		END OF BOREHOLE AT 7.75m. WATER LEVEL AT 2.74m UPON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.		7.75							
9											
10											
11											
12											
13											
14											

WATER LEVEL READINGS:

DATE	DEPTH(m)	ELEV.(m)
Mar. 10/15	2.60	213.21
Apr. 28/15	2.28	213.53

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER

April 28, 2015

LOGGED : ES
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-086

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : February 3, 2015
COMPLETED : February 3, 2015

Project No. 17-123-902
SHEET 1 OF 1
DATUM Geodetic

N 4 826 082.1 E 592 067.6

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
		GROUND SURFACE		226.04				
	Solid Stem Augers	**SAND**, silty, some gravel, very dense, brown: (FILL)		0.00	1	GS		
1		**CLAY**, silty, some sand, trace gravel, hard, brown: (FILL)		224.92 1.12	1	SS	78	
		CLAY, silty, sandy, trace gravel, hard, brown, damp: (TILL)		224.47 1.57	2	SS	67/ 0.150	Grain Size Analysis: Gr 7%/ Sa 36%/ Si 43%/ Cl 14%
2					3	SS	50/ 0.125	
		SAND and **SILT**, some gravel, trace clay, very dense, brown, moist: (TILL)		223.31 2.73				
3					4	SS	50/ 0.100	
4								
					5	SS	50/ 0.100	
5								
6		possible cobble			6	SS	50/ 0.025	
7								
		END OF BOREHOLE AT 7.67m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.		218.37 7.67	7	SS	50/ 0.050	
8								
9								
10								
11								
12								
13								
14								

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : ES
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-087

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : February 3, 2015
COMPLETED : February 3, 2015

Project No. 17-123-902
SHEET 1 OF 1
DATUM Geodetic

N 4 826 253.2 E 591 894.6

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) / WATER CONTENT, PERCENT (wp, w, wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		234.27							
0	Solid Stem Augers	**SAND**, silty, some gravel, very dense, damp: (FILL)		0.00	1	GS					Concrete
1					1	SS	55/ 0.150				Cuttings
2					2	SS	31				
				232.06							
		SAND and **SILT**, trace clay, trace gravel, hard, brown: (TILL)		2.21	3	SS	49	Grain Size Analysis: Gr 4%/ Sa 48%/ Si 40%/ Cl 8%			
3		occasional sand pockets, becoming very dense			4	SS	50/ 0.125				Bentonite
4											
					5	SS	50/ 0.125				▼
5											Filter Sand
6					6	SS	50/ 0.100				
7											Slotted Screen
				226.52	7	SS	50/ 0.125				
8		END OF BOREHOLE AT 7.75m. BOREHOLE DRY UPON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.		7.75							
9		WATER LEVEL READINGS: DATE / DEPTH(m) / ELEV.(m) Mar. 10/15 6.10 228.17 Apr. 28/15 5.13 229.14									
10											
11											
12											
13											
14											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER April 28, 2015

LOGGED : ES
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-088

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : February 3, 2015
COMPLETED : February 3, 2015

Project No. 17-123-902
SHEET 1 OF 1
DATUM Geodetic

N 4 826 370.6 E 591 776.2

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) (40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		234.38							
0	Solid Stem Augers	**SAND**, silty, some gravel, very dense, brown: (FILL)		0.00	1	GS					
1					1	SS	50/ 0.075				
		CLAY, silty, sandy, trace gravel, very stiff, brown: (CL)(TILL)		233.16 1.22							
2					2	SS	18	Grain Size Analysis: Gr 0%/ Sa 30%/ Si 47%/ Cl 23%			
		SAND and **SILT**, trace clay, trace gravel, compact to very dense, brown, moist: (TILL)		232.17 2.21							
3					3	SS	36				
					4	SS	70				
4											
5					5	SS	50/ 0.125				
6				228.28							
		SAND, silty, trace gravel, very dense, brown, damp		6.10	6	SS	50/ 0.125				
7											
				226.66	7	SS	50/ 0.100				
8		END OF BOREHOLE AT 7.72m. BOREHOLE DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.		7.72							
9											
10											
11											
12											
13											
14											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : ES
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-089

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : February 5, 2015
COMPLETED : February 5, 2015

Project No. 17-123-902
SHEET 1 OF 1
N 4 826 549.0 E 591 601.8
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT wp w wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		237.69				20 40 60 80 100			
0	Solid Stem Augers	**ASPHALT:** (65mm)		237.69 0.00							Concrete
		SAND, some gravel, very dense, brown, damp: (FILL)			1	GS			○		
1		**CLAY**, silty, sandy, trace gravel, hard, brown: (TILL)		236.65 1.04	1	SS	70		○		
2					2	SS	46		○		Bentonite
		SAND and **SILT**, some clay, some gravel, very dense, brown, damp: (TILL)		235.40 2.29	3	SS	93		○		
3					4	SS	50/ 0.125	Grain Size Analysis: Gr 11%/ Sa 34%/ Si 43%/ Cl 12%	○		
4											Filter Sand
					5	SS	50/ 0.100		○		
5											Slotted Screen
6					6	SS	50/ 0.100		○		▼
7		occasional fine sand layer		229.94 7.75	7	SS	50/ 0.125		○		
8		END OF BOREHOLE AT 7.75m. BOREHOLE DRY UPON COMPLETION. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.									
9		WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) Mar. 10/15 (Dry) Apr. 28/15 6.23 231.46 Sep. 05/15 (Dry)									
10											
11											
12											
13											
14											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER April 28, 2015

LOGGED : ES
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-090

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : March 27, 2015
COMPLETED : March 27, 2015

Project No. 17-123-902
SHEET 1 OF 1
DATUM Geodetic

N 4 826 639.2 E 591 517.4

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
		GROUND SURFACE		239.64				
		ASPHALT: (150mm)		239.49				
		SAND, gravelly, trace silt, grey, moist: (FILL)		0.15	1	GS		
1		compact		238.58	1	SS	16	
		SILT, clayey, trace sand, trace gravel, trace organic material, very stiff to stiff, brown, most: (FILL)		1.07				
2					2	SS	15	
				237.43				
		SILT, clayey, sandy, trace gravel, firm to very stiff, brown, moist: (TILL)		2.21	3	SS	8	
3					4	SS	30	Grain Size Analysis: Gr 0%/ Sa 32%/ Si 54%/ Cl 14%
4	Solid Stem Augers			235.53				
		CLAY, silty, some sand, hard, grey, moist: (TILL)		4.11				
5					5	SS	50	Grain Size Analysis: Gr 0%/ Sa 18%/ Si 41%/ Cl 41%
6					6	SS	56	
7								
				231.87	7	SS	50/ 0.125	
8		**SILT**, sandy, trace gravel, very dense, brown, moist: (TILL)		231.74 7.77				
		END OF BOREHOLE AT 7.90m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG MIXED WITH CUTTINGS TO 0.91m, SAND TO 0.15m, THEN ASPHALT TO SURFACE.		7.90				
9								
10								
11								
12								
13								
14								

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : ME
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-091

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : April 2, 2015
COMPLETED : April 6, 2015

Project No. 17-123-902
SHEET 1 OF 1
DATUM Geodetic

N 4 826 718.1 E 591 438.8

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
		GROUND SURFACE		241.40				
		ASPHALT: (150mm)		241.25				
		SAND, gravelly, trace to some silt, brown, moist: (FILL)		0.15	1	GS		
1		compact			1	SS	21	
		CLAY, silty, some sand, trace gravel, stiff to hard, brown, moist: (TILL)		240.10 1.30				
2					2	SS	12	
3					3	SS	20	
					4	SS	25	
4					5	SS	36	Grain Size Analysis: Gr 0%/ Sa 17%/ Si 37%/ Cl 46%
5					6	SS	87/ 0.225	
		SAND, silty to gravelly, with cobbles and boulders, very dense, brown, moist: (TILL)		236.27 5.13				
	Hollow Stem Augers				7	SS	72	
6					8	SS	86/ 0.250	
		with zones of sand to sandy silt						
7					9	SS	98/ 0.275	Grain Size Analysis: Gr 0%/ Sa 82%/ Si & Cl 18%
					10	SS	50/ 0.125	
8								
					11	SS	50/ 0.075	
9								
					12	SS	50/ 0.125	
10					13	SS	50/ 0.075	
		SAND, gravelly, some silt, very dense, brown, moist		231.03 10.36				very slow augering from 10.3m to 12.2m (1.5 hours to advance 1.9m)
11					14	SS	100/ 0.100	
		SILT, sandy, some gravel, trace clay, trace cobble fragments, trace siltstone fragments, very dense, reddish brown, moist: (TILL)		230.12 11.28				
12								
	Tricone				15	SS	100/ 0.125	
13								
		END OF BOREHOLE AT 13.28m. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.04m slotted screen.		228.11 13.28	16	SS	100/ 0.025	no sample recovery, sampler bouncing
14								

WATER LEVEL READINGS:

DATE	DEPTH(m)	ELEV.(m)
Sep. 15/15	1.20	240.20

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH: Cu, KPa (nat V - ✚ Q - ✖ rem V - ● Cpen ▲): 40 80 120 160

WATER CONTENT, PERCENT: wp w wl; 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION: Concrete; Filter Sand; Cement/ Bentonite Grout; Filter Sand; Slotted Screen

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER September 15, 2015

LOGGED : ME
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-092

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : March 30, 2015
COMPLETED : April 1, 2015

Project No. 17-123-902
SHEET 1 OF 1
DATUM Geodetic

N 4 826 763.6 E 591 393.5

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS / DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT (wp, w, wl) 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		242.12							
		ASPHALT: (150mm)		240.97							
		SAND, gravelly, trace silt, trace asphalt, brown, moist: (FILL)		0.15	1	GS					
1		trace clayey silt pockets, compact			1	SS	25				
		CLAY, silty, trace sand, stiff, reddish brown, moist: (POSSIBLE FILL)		240.67 1.45	2	SS	11				
2		**SILT**, some sand, trace clay, compact, dense, brown, moist		239.91 2.21	3	SS	21				
3		**SILT**, some clay, trace sand, dense, brown, moist		239.17 2.95	4	SS	32	Grain Size Analysis: Gr 0%/ Sa 9%/ Si 73%/ Cl 18%			
	Hollow Stem Augers/Tricone/NQ Coring	**SAND**, silty to gravelly, with numerous cobbles and boulders, very dense, brown: (TILL)		238.39 3.73	5	SS	50/ 0.050				
4					6	SS	50/ 0.100				
5					7	SS	50/ 0.050	cored through cobbles and boulders from 5.5m to 7.5m			
6					8	SS	100/ 0.100				
7					9	SS	100/ 0.150				
8					10	SS	50/ 0.150				
		SILT, clayey, trace sand, with some shale fragments, hard, red, moist: (TILL)		233.28 8.84	11	SS	100/ 0.100				
9					12	SS	100/ 0.100				
10		**SAND**, silty to gravelly, with numerous cobbles and boulders, very dense, brown: (TILL)		231.76 10.36	13	SS	50/ 0.100				
11											
12				229.88	14	SS	100/ 0.050				
		END OF BOREHOLE AT 12.24m. BOREHOLE BACKFILLED WITH CEMENT/GROUT MIXED WITH BENTONITE HOLEPLUG TO 0.91m, SAND TO 0.15m, THEN ASPHALT TO SURFACE.		12.24							
13											
14											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : ME
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-093

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : March 27, 2015
COMPLETED : March 27, 2015
N 4 826 894.8 E 591 261.7

Project No. 17-123-902
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
		GROUND SURFACE		244.93				
		ASPHALT: (150mm)		244.78 0.00				
		SAND, gravelly, granular, brown, moist: (FILL)		0.15	1	GS		
1		compact			1	SS	16	
		SILT, clayey, trace gravel, trace sand, topsoil staining, very stiff to stiff, brown to black, moist		243.71 1.22				
2	Solid Stem Augers				2	SS	10	
					3	SS	14	
3		**SAND**, silty, some gravel to gravelly, trace clay, occasional rock fragments, hard, brown, moist: (TILL)		242.11 2.82	4	SS	60	Grain Size Analysis: Gr 30%/ Sa 43%/ Si & Cl 27%
4					2	GS		very slow augering from 3.0m to 5.2m
		SAND, gravelly, trace to some silt, occasional cobbles, very dense, brown, moist		240.36 4.57	5	SS	81	
5					3	GS		
		END OF BOREHOLE AT 5.26m UPON AUGER REFUSAL. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG MIXED WITH CUTTINGS TO 0.91m, SAND TO 0.15m, THEN ASPHALT TO SURFACE.		239.67 5.26	6	SS	100/ 0.075	
6								
7								
8								
9								
10								
11								
12								
13								
14								

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : ME
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-093A

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : August 17, 2015
COMPLETED : August 18, 2015
N 4 826 894.5 E 591 260.2

Project No. 17-123-902
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS / DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT wp w wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		244.93							
	Hollow Stem Augers	No sampling		0.00							
				240.36							
5		**SAND**, gravelly, trace to some silt, trace clay, occasional cobbles, very dense brown, moist		4.57	1	SS	50/ 0.100	very slow augering from 4.5m to 6.4m, augers grinding	○		
		some gravel			2	SS	50/ 0.025		○		
6					3	SS	100/ 0.100		○		
				238.53							
	Tricone	**GRAVEL**, some sand to sandy, trace silt, trace clay, occasional cobbles and boulders, very dense, brown, moist		6.40							
7					4	SS	118/ 0.200	Grain Size Analysis: Gr 75%/ Sa 19%/ Si & Cl 6%	○		
				237.23	5	SS	100/ 0.075		○		
		END OF BOREHOLE AT 7.70m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.91m, SAND TO 0.30m, THEN CONCRETE TO SURFACE.		7.70							

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : ME
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-094

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : March 26, 2015
COMPLETED : March 26, 2015

Project No. 17-123-902
SHEET 1 OF 1
DATUM Geodetic

N 4 827 024.2 E 591 128.2

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
		GROUND SURFACE		246.49				
	Solid Stem Augers	**SAND**, gravelly, with clayey silt pockets, brown, moist: (FILL)		0.00	1	GS		
				245.80				
1		**SILT**, clayey, trace sand, trace gravel, stiff, brown, moist		0.69	1	SS	12	
2					2	SS	10	
				244.28				
		SILT, clayey, sandy, trace gravel, very stiff, to hard, reddish brown, moist: (TILL)		2.21	3	SS	29	
3					4	SS	37	Grain Size Analysis: Gr 2%/ Sa 40%/ Si 42%/ Cl 16%
4				241.92				
		SAND and **GRAVEL**, trace to some silt, occasional cobbles, very dense, brown, moist		4.57	5	SS	50/ 0.125	very slow augering
5				241.26	6	SS	100/ 0.050	
		END OF BOREHOLE AT 5.23m UPON AUGER REFUSAL. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG WITH CUTTINGS TO SURFACE.		5.23				
6								
7								
8								
9								
10								
11								
12								
13								
14								

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : ME
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-094A

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : August 18, 2015
COMPLETED : August 18, 2015

Project No. 17-123-902
SHEET 1 OF 1
DATUM Geodetic

N 4 827 023.7 E 591 128.5

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✚ Q - ✖ rem V - ● Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT (wp w wl) 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		246.49							
	Hollow Stem Augers	No sampling		0.00							
		SAND and **GRAVEL**, trace to some clay, trace silt, occasional cobbles, very dense, brown, moist		241.92 4.57	1	SS	100/ 0.150		○		
					2	SS	60/ 0.075	Grain Size Analysis: Gr 41%/ Sa 44%/ Si & Cl 15%	○		
		some gravel			3	SS	100/ 0.125		○		
					4	SS	100/ 0.050		○ ○		
		END OF BOREHOLE AT 7.72m. BOREHOLE BACKFILLED WITH CUTTINGS MIXED WITH HOLEPLUG TO 0.91m, THEN SAND AND CUTTINGS TO SURFACE.		238.77 7.72	5	SS	100/ 0.100		○		

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : ME
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-095

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : March 26, 2015
COMPLETED : March 26, 2015

Project No. 17-123-902
SHEET 1 OF 1
DATUM Geodetic

N 4 827 167.3 E 590 982.6

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
		GROUND SURFACE		245.89				
		ASPHALT: (150mm)		245.74 0.15				
		SAND, some gravel, trace asphalt, brown, moist: (FILL)			1	GS		
				245.20 0.69				
1		**SILT**, clayey, trace gravel, trace asphalt, very stiff, brown to black, moist: (FILL)			1	SS	29	
		some asphalt fragments			2	SS	28	
2				243.68 2.21				
	Solid Stem Augers	**CLAY**, silty, sandy, trace gravel, stiff, brown, moist: (TILL)			3	SS	9	Grain Size Analysis: Gr 0%/ Sa 29%/ Si 47%/ Cl 24%
3					4	SS	8	
4		becoming reddish brown, hard		241.01 4.88	5	SS	35	
5		**SILT**, sandy, trace clay, trace gravel, very dense, reddish brown, moist: (TILL)						very slow augering from 5.3m to the bottom of the borehole
6		limestone fragments		239.72 6.17	6	SS	100/ 0.075	
		END OF BOREHOLE AT 6.17m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG MIXED WITH CUTTINGS TO 0.15m, THEN ASPHALT PATCH TO SURFACE.						
7								
8								
9								
10								
11								
12								
13								
14								

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : ME
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-096

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : March 26, 2015
COMPLETED : March 26, 2015

Project No. 17-123-902
SHEET 1 OF 1
DATUM Geodetic

N 4 827 301.3 E 590 848.4

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS
		GROUND SURFACE		243.87				
		ASPHALT: (150mm)		243.72 0.00				
		SAND, some gravel, brown, moist: (FILL)		0.15	1	GS		
				243.18				
1		**SILT**, clayey, trace gravel, trace asphalt, very stiff to stiff, grey to black, moist: (FILL)		0.69	1	SS	19	
2					2	SS	12	
				241.66				
		CLAY, silty, sandy, trace gravel, very stiff, brown, moist: (TILL)		2.21	3	SS	19	
3	Solid Stem Augers				4	SS	17	Grain Size Analysis: Gr 7%/ Sa 35%/ Si 37%/ Cl 21%
4								
5		becoming hard, reddish brown			5	SS	47	
6		occasional rock fragments			6	SS	48	very slow augering from 6.0m to the bottom of the borehole
7								
				236.12	7	SS	75/ 0.125	
8		END OF BOREHOLE AT 7.75m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG MIXED WITH CUTTINGS TO 0.15m, THEN ASPHALT PATCH TO SURFACE.		7.75				
9								
10								
11								
12								
13								
14								

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : ME
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-097

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : March 26, 2015
COMPLETED : March 26, 2015

Project No. 17-123-902
SHEET 1 OF 1
DATUM Geodetic

N 4 827 487.9 E 590 660.8

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS
		GROUND SURFACE		243.55				
		ASPHALT: (150mm)		243.40 0.00				
		SAND, gravelly, granular, brown, moist: (FILL)		0.15	1	GS		
				242.86 0.69				
1		**SAND**, silty, gravelly, with some asphalt fragments, dense to loose, blackish brown, moist: (FILL)			1	SS	33	
		some clayey silt pockets			2	SS	8	
2				241.34				
		SILT, clayey, some sand, trace gravel, hard, brown, moist: (TILL)		2.21	3	SS	28	
3					4	SS	36	
4	Solid Stem Augers			239.28				
		SAND, silty, some gravel to gravelly, trace clay, very dense, brown, moist: (TILL)		4.27	5	SS	50/ 0.100	Grain Size Analysis: Gr 26%/Sa 49%/ Si & Cl 25%
5								very slow augering from 4.5m to 6.0m
6		trace rock fragments			6	SS	50/ 0.125	
7								
				235.55	7	SS	97/ 0.225	
8		END OF BOREHOLE AT 8.00m. Piezometer installation consists of 25mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.		8.00				
9		WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) Sep. 15/15 2.76 240.79						
10								
11								
12								
13								
14								

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
September 15, 2015

LOGGED : ME
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-098

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : August 4, 2015
COMPLETED : August 4, 2015

Project No. 17-123-902
SHEET 1 OF 2
DATUM Geodetic

N 4 825 482.5 E 593 845.7

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✚ Q - ✖ rem V - ● Cpen ▲ 40 80 120 160) / WATER CONTENT, PERCENT (wp w wl 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		205.72							
		ASPHALT: (150mm)		205.57							
		SAND, some silt, some gravel, brown, moist: (FILL)		0.15	1	GS					
1		very dense			1	SS	67				
		becoming loose			2	SS	8				
2		**SILT**, clayey, trace gravel, trace rootlets, firm, dark brown, moist		203.74 1.98						55	
					3	SS	7				
3		trace sand			4	SS	6	Grain Size Analysis: Gr 0%/ Sa 31%/ Si 43%/ Cl 26%			
4				201.30							
		SAND, silty to **SAND** and **SILT**, trace to some clay, trace to some gravel, very dense, brown, moist: (TILL)		4.42	5	SS	52	Grain Size Analysis: Gr 13%/ Sa 53%/ Si 24%/ Cl 10%			
5	Hollow Stem Augers										
6					6	SS	89/ 0.275				
7											
					7	SS	50/ 0.075				
8					8	SS	50/ 0.100				
9					9	SS	100/ 0.275	Grain Size Analysis: Gr 2%/ Sa 37%/ Si 55%/ Cl 6%			
10					10	SS	50/ 0.100				
		becoming reddish brown									
				194.90	11	SS	80/ 0.100				FI
11		**SHALE**, moderately weathered to fresh, thinly bedded, medium strong, reddish brown with strong, grey limestone interbeds: (Queenston Formation) limestone seams at 11.13 to 11.25, 11.53 to 11.58, and 11.91 to 11.94m clay seam at 11.13 to 11.33m vertical fracture at 11.89 to 11.94m		10.82	1	RUN		TCR=78% SCR=67% RQD=51% UCS =34MPa (Shale) UCS =87MPa (Limestone)			7 2 2
12		limestone seams at 12.09 to 12.12, 12.23 to 12.24, 12.40 to 12.42, 12.57 to 12.65, 12.67 to 12.75, 12.95 to 12.98, 13.11 to 13.13, and 13.39 to 13.41m clay seam at 12.80 to 12.93m									3 3
13	NQ Coring	subhorizontal fracture at 13.01 to 13.03m subvertical fracture at 13.23 to 13.28m strong			2	RUN		TCR=100% SCR=100% RQD=82% UCS =44MPa (Shale) UCS =76MPa (Limestone)			3 1 2 2
14		subvertical fracture at 13.97 to 14.02m			3	RUN		TCR=95% SCR=95% RQD=48% UCS =39MPa (Shale)			1 2
		clay seams at 14.65 to 14.71, and 14.83 to 14.86m		190.68							7 4

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : ME/AHF
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-098

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : August 4, 2015
COMPLETED : August 4, 2015

Project No. 17-123-902
SHEET 2 OF 2
N 4 825 482.5 E 593 845.7
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT wp w wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		END OF BOREHOLE AT 15.04m. BOREHOLE BACKFILLED WITH CEMENT GROUT TO 0.61m, SAND TO 0.15m, THEN ASPHALT TO SURFACE.		15.04						2	
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											
26											
27											
28											
29											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : ME/AHF
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-099

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : August 6, 2015
COMPLETED : August 10, 2015
N 4 825 511.2 E 593 769.7

Project No. 17-123-902
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
		GROUND SURFACE		205.46				
	Hollow Stem Augers	**SAND**, some gravel, trace to some silt, brown, moist: (FILL)		0.00	1	GS		
1		**CLAY**, silty, trace gravel, trace peat, firm, dark brown, moist: (FILL)		204.39 1.07	1	SS	8	
		brown			2	SS	6	
2		with peat			3	SS	3	
3		**SAND**, some gravel, trace to some silt, loose, brown, moist: (FILL)		202.18 3.28	4	SS	9	
4		**CLAY**, silty, sandy, trace gravel, occasional cobbles, very hard, brown, moist: (TILL)		201.19 4.27	5	SS	69/ 0.275	Grain Size Analysis: Gr 10%/ Sa 38%/ Si 37%/ Cl 15%
5		**SAND** and **SILT**, trace clay, trace gravel, very dense, grey, moist: (TILL)		199.67 5.79	6	SS	56	
6					7	SS	80	
7					8	SS	74	Grain Size Analysis: Gr 4%/ Sa 36%/ Si 51%/ Cl 9%
8					9	SS	78	
9		some gravel			10	SS	50/ 0.150	
10		**SHALE**, highly weathered, thinly bedded, medium strong, reddish brown with medium strong to very strong, grey limestone interbeds: (Queenston Formation) becoming slightly weathered to fresh limestone interbeds (50mm) at 10.7m, (25mm) at 11.6m, (60mm) at 11.9m, and (50mm) at 12.1m		195.55 9.91	11	SS	100/ 0.100	
	NQ Coring				1	RUN		TCR=42% SCR=25% RQD=0% UCS =101MPa (Limestone)
11					2	RUN		TCR=95% SCR=77% RQD=67% UCS =30MPa (Shale) UCS =47MPa (Limestone)
12		limestone interbeds (50mm) at 12.2m and 12.6m, and (25mm) at 12.9m						
13					3	RUN		TCR=100% SCR=93% RQD=85% UCS =33MPa (Shale)
				191.74				
14		END OF BOREHOLE AT 13.72m. BOREHOLE BACKFILLED WITH CEMENT/BENTONITE GROUT TO 0.61m, THEN CUTTINGS MIXED WITH SAND TO SURFACE.		13.72				

SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160
WATER CONTENT, PERCENT wp w wl 10 20 30 40
DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
FI	
>30	
10	
4	
6	
6	
3	
4	
4	
3	
0	
0	

GROUNDWATER ELEVATIONS
▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : ME
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-100

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : August 5, 2015
COMPLETED : August 6, 2015

Project No. 17-123-902
SHEET 1 OF 1
DATUM Geodetic

N 4 825 531.4 E 593 695.5

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) 40 80 120 160 / WATER CONTENT, PERCENT wp w wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		205.17				DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100			
	Hollow Stem Augers	**SAND**, some gravel, trace to some silt, brown, moist: (FILL)		0.00	1	GS					
1		trace asphalt fragments, compact			1	SS	13				
		SAND and **SILT**, trace clay, loose, brown, moist: (FILL)		203.72 1.45	2	SS	6				
2		**CLAY**, silty, sandy, trace gravel, hard, reddish brown, moist: (TILL)		203.04 2.13	3	SS	31				
3		occasional cobbles			4	SS	37	Grain Size Analysis: Gr 3%/ Sa 34%/ Si 44%/ Cl 19%			
4											
5					5	SS	40				
6		trace limestone fragments, stiff, brown			6	SS	13	Grain Size Analysis: Gr 11%/ Sa 38%/ Si 36%/ Cl 15%			
		SAND and **SILT**, trace clay, trace to some gravel, occasional cobbles and boulders, compact to very dense, brown, moist: (TILL)		198.39 6.78				very slow augering from 6.7m to 10.0m			
7					7	SS	21				
8					8	SS	55				
9					9	SS	52	Grain Size Analysis: Gr 12%/ Sa 35%/ Si 43%/ Cl 10%			
					10	SS	67				
10		**SILT**, clayey, trace gravel, trace shale fragments, hard, red, moist: (TILL)		195.34 195.23 9.83	11	SS	100/ 0.100				
	—	**SHALE**, highly weathered, thinly bedded, weak, reddish brown with medium strong, grey limestone interbeds: (Queenston Formation)		10.06	12 1	SS RUN	100/ 0.078	TCR=67% SCR=50% RQD=0%			FI >25
11		becoming slightly weathered to fresh limestone interbeds (40mm) at 10.8m, (75mm) at 11.0m, and (50mm) at 11.6m			2	RUN		TCR=87% SCR=55% RQD=33% UCS =17MPa (Shale)			>28 >16 >30
12	NQ Coring										9 7 >12
		limestone interbeds (40mm) at 12.4m, (60mm) at 12.6m,(40mm) at 13.1m, and 13.4m, and (60mm) at 13.6m			3	RUN		TCR=100% SCR=87% RQD=80% UCS =20MPa (Shale) UCS =56MPa (Limestone)			9 9 6
13				191.45							2
14		END OF BOREHOLE AT 13.72m. BOREHOLE BACKFILLED WITH CEMENT/BENTONITE GROUT TO 0.61m, THEN SAND TO SURFACE.		13.72							

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : ME
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-101

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : August 11, 2015
COMPLETED : August 11, 2015
N 4 825 546.8 E 593 585.6

Project No. 17-123-902
SHEET 1 OF 1
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
		GROUND SURFACE		205.89				
	Hollow Stem Augers	**SAND**, some gravel, trace to some silt, brown, moist: (FILL)		0.00	1	GS		
1		compact		204.82	1	SS	18	
		CLAY, silty, sandy, trace gravel, very stiff, brown, moist: (TILL)		1.07				
2					2	SS	23	
		becoming hard			3	SS	48	
3		reddish brown			4	SS	81/ 0.250	
4								
		occasional cobbles			5	SS	50/ 0.125	
5								
6		grey			6	SS	84/ 0.275	
				199.11				
		SAND and **SILT**, trace gravel, trace to some clay, very dense, grey, moist: (TILL)		6.78	7	SS	82	Grain Size Analysis: Gr 10%/ Sa 40%/ Si 38%/ Cl 12%
7								
					8	SS	50/ 0.125	
8		occasional cobbles						
					9	SS	68	
9								
				196.59				
		CLAY, silty, sandy, trace gravel, trace shale fragments, hard, red, moist: (TILL)		9.30	10	SS	50/ 0.125	
10					11	SS	125/ 0.150	Grain Size Analysis: Gr 2%/ Sa 20%/ Si 62%/ Cl 16%
				195.22				
		SHALE, highly weathered, thinly bedded, medium strong, reddish brown with strong, grey limestone interbeds: (Queenston Formation)		10.67	12	SS	157/ 0.225	
11		becoming fresh			1	RUN		TCR=0% SCR=0% RQD=0%
					2	RUN		TCR=100% SCR=83% RQD=75% UCS =45MPa (Shale)
12	NQ Coring	limestone interbeds (75mm) at 12.1m, 12.3m, and 12.6m						
		siltstone interbed at 12.7m						
13		limestone interbeds (40mm) at 12.7m and 13.1m, (75mm) at 13.9m, and (50mm) at 14.1m			3	RUN		TCR=87% SCR=80% RQD=75% UCS =52MPa (Shale)
14				191.72				
		END OF BOREHOLE AT 14.17m. BOREHOLE BACKFILLED WITH CEMENT GROUT TO 0.61m, THEN CUTTINGS MIXED WITH BENTONITE HOLEPLUG TO SURFACE.		14.17				

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH: Cu, KPa (nat V - ✚ Q - ✖ rem V - ● Cpen ▲): 40 80 120 160

WATER CONTENT, PERCENT (wp w wl): 10 20 30 40

ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
FI	
>16	
2	
4	
8	
8	
2	
>13	
>22	
2	
0	
0	

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

LOGGED : ME
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-102

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : August 12, 2015
COMPLETED : August 13, 2015
N 4 825 546.4 E 593 494.7

Project No. 17-123-902
SHEET 1 OF 2
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS (DYNAMIC CONE PENETRATION RESISTANCE PLOT)	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) / WATER CONTENT, PERCENT (wp, w, wl)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		205.40							
0	Hollow Stem Augers	**SAND**, some gravel, trace to some silt, brown, moist: (FILL)		0.00	1	GS					Concrete
1		compact		204.33	1	SS	22				
		SILT, clayey, some sand, trace gravel, very stiff, brown, moist: (TILL)		1.07	2	SS	29				
2		occasional cobble, hard			3	SS	34				
3		**SAND** and **SILT**, trace clay, trace gravel, occasional cobbles, very dense, brown, moist: (TILL)		202.40 3.00	4	SS	50/ 0.125				
4											Cement/ Bentonite Grout
5					5	SS	113/ 0.225				
6		**CLAY**, silty, sandy, trace gravel, hard, brown, moist: (TILL)		199.91 5.49	6	SS	44	Grain Size Analysis: Gr 5%/ Sa 38%/ Si 42%/ Cl 15%			
7					7	SS	49	Grain Size Analysis: Gr 9%/ Sa 31%/ Si 46%/ Cl 14%			
8					8	SS	61				Bentonite
9					9	SS	33	Grain Size Analysis: Gr 4%/ Sa 43%/ Si 39%/ Cl 14%			Filter Sand
					10	SS	92				
10		**SAND** and **SILT**, trace clay, some gravel, very dense, reddish brown, moist: (TILL)		195.57 9.83	11	SS	53	Grain Size Analysis: Gr 15%/ Sa 41%/ Si 37%/ Cl 7%			Slotted Screen
11	NQ Coring	**SHALE**, highly weathered, thinly bedded, weak, reddish brown with strong, grey limestone interbeds: (Queenston Formation) limestone interbeds at 11.05, 11.18, 11.35, 11.71, 11.89, 12.27, and 12.47m		194.78 10.62	12 1	SS RUN	100/ 0.100	TCR=30% SCR=20% RQD=0%		FI >30 4	
12					2	RUN		TCR=97% SCR=63% RQD=58% UCS =9MPa (Shale)		6 5 >40	
13		limestone interbeds at 12.50, 13.59, 13.66, and 13.97m			3	RUN		TCR=100% SCR=100% RQD=100% UCS =11MPa (Shale)		>24 0 0 0	Cuttings
14		END OF BOREHOLE AT 14.02m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.		191.38 14.02						8 0	

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION ▼ WATER LEVEL IN WELL/PIEZOMETER

September 15, 2015

LOGGED : ME
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-102

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : August 12, 2015
COMPLETED : August 13, 2015

Project No. 17-123-902
SHEET 2 OF 2
N 4 825 546.4 E 593 494.7
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) (40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) Sep. 15/15 0.73 204.67									
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											
26											
27											
28											
29											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
September 15, 2015

LOGGED : ME
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-103

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : August 13, 2015
COMPLETED : August 16, 2015

Project No. 17-123-902
SHEET 1 OF 2
DATUM Geodetic

N 4 825 520.4 E 593 087.2

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	COMMENTS
		GROUND SURFACE		203.04				
	Hollow Stem Augers	**SAND**, trace to some silt, trace gravel, brown, moist: (FILL)		0.00	1	GS		
1		some gravel, compact			1	SS	28	
		SILT, clayey, trace gravel, very stiff, brown, moist trace roots		201.82 1.22	2	SS	15	
2		**CLAY**, silty, sandy, trace gravel, hard, brown, moist: (TILL)		200.83 2.21	3	SS	34	
3					4	SS	38	
4								
5					5	SS	48	
6		occasional sand seams and cobbles			6	SS	54	Grain Size Analysis: Gr 6%/ Sa 30%/ Si 47%/ Cl 17%
		SILT, sandy, with clay seams, trace gravel, occasional cobbles, very dense, brown, moist: (TILL)		196.26 6.78	7	SS	64	
7		**SILT**, sandy, trace clay, trace gravel, compact, brown, moist		195.65 7.39	8	SS	16	Grain Size Analysis: Gr 0%/ Sa 22%/ Si 73%/ Cl 5%
8		becoming wet			9	SS	27	
9		**SAND**, some silt, trace gravel, dense to very dense, brown, saturated		193.97 9.07	10	SS	40	
10								
11					11	SS	71	Grain Size Analysis: Gr 0%/ Sa 90%/ Si & Cl 10%
12					12	SS	37	
13								
		SILT, some sand, trace clay, loose, brown, wet		189.63 13.41	13	SS	7	Grain Size Analysis: Gr 0%/ Sa 14%/ Si 82%/ Cl 4%
14		**SAND**, gravelly, trace silt, very dense,		188.26 14.78				

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH: Cu, KPa
nat V - ✚ Q - ✖
rem V - ● Cpen ▲
40 80 120 160

WATER CONTENT, PERCENT
wp w wl
10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION
Cement/ Bentonite Grout
Bentonite
Filter Sand

GROUNDWATER ELEVATIONS
▽ WATER LEVEL UPON COMPLETION
▼ WATER LEVEL IN WELL/PIEZOMETER
September 15, 2015

LOGGED : ME
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15

RECORD OF BOREHOLE 14-103

PROJECT : Zone 4 Feedermains
LOCATION : Milton/Halton Hills, ON
STARTED : August 13, 2015
COMPLETED : August 16, 2015
N 4 825 520.4 E 593 087.2

Project No. 17-123-902
SHEET 2 OF 2
DATUM Geodetic

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS: DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100)	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, Cpen ▲) (40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
16		grey, wet		187.50				Grain Size Analysis: Gr 28%/Sa 69%/ Si & Cl 3%			Slotted Screen
		GRAVEL, sandy, some silt, trace clay, very dense, reddish grey, moist		15.54	14	SS	72				
		SAND, some silt, trace gravel, with clay seams, very dense, brown, wet		186.89 16.15							
17				186.02	15	SS	83/ 0.250				
		END OF BOREHOLE AT 17.02m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.		17.02							
18		WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) Sep. 15/15 0.65 202.39									
19											
20											
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23											
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26											
27											
28											
29											

GROUNDWATER ELEVATIONS

▽ WATER LEVEL UPON COMPLETION

▼ WATER LEVEL IN WELL/PIEZOMETER
September 15, 2015

LOGGED : ME
CHECKED : MTB

THURBER

THURBER2S 3902.GPJ 11/9/15