Appendix J

Geotechnical Report

THURBER ENGINEERING LTD.

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GEOTECHNICAL INVESTIGATION
MAVIS ROAD CLASS EA STUDY
COURTNEY PARK DRIVE TO RAY LAWSON BOULEVARD
CITY OF MISSISSAUGA

Report Submitted

To:

WSP | MMM Group Limited

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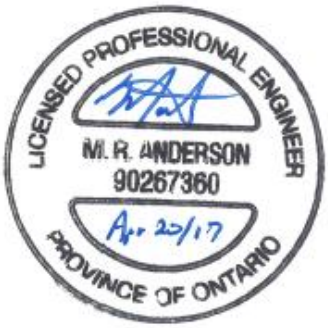
Review Principal



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60 YEARS

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1 INTRODUCTION

This report presents the results of a preliminary geotechnical investigation carried out by Thurber Engineering Ltd. (Thurber) for the improvement of Mavis Road between Courtney Park Drive and Ray Lawson Boulevard, located in the City of Mississauga and the City of Brampton. The work was undertaken by Thurber for WSP|MMM Group Limited (MMM) as part of a Class Environmental Assessment (EA) Study for the City of Mississauga.

The purpose of this investigation was to obtain pavement structure and subgrade information along the roadway corridor and based on the findings, to provide preliminary geotechnical recommendations regarding pavement rehabilitation/widening and municipal service installation. Foundation comments are also provided regarding potential widening of the Highway 407 underpass structure contained within the project limits.

The geotechnical investigation was carried out in general accordance with Thurber's proposal letter No. 115-3154 dated September 1, 2015. Additional scope to extend the study area north of Highway 407 (the north city limit of Mississauga) was outlined in an email message dated January 29, 2016.

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

2 PROJECT AND SITE DESCRIPTION

2.1 Background

Mavis Road is a major north-south arterial corridor in the City of Mississauga and the City of Brampton. The section of roadway within the study corridor extends from Courtney Park Drive in Mississauga to Ray Lawson Boulevard in Brampton, a total distance of approximately 3.7 km. Highway 407 crosses under Mavis Road approximately 800 m south of the north study limit, and forms the boundary between the Cities of Mississauga and Brampton.

At present, Mavis Road south of Highway 407 generally consists of a four lane urban cross section with a raised grass median and turn lanes at intersections. The section between Highway 407 and Ray Lawson Boulevard has recently been upgraded to a 5 to 6 lane urban section with turn lanes. The current posted speed limit is 70 km/h.

The City of Mississauga and the Region of Peel are considering corridor improvements with potential widening to address future traffic demands. The improvements may require widening of the existing underpass structure carrying Mavis Road over Highway 407.

2.2 Physiography

The study area is located within a physiographic region known as the Peel Plain, a level to undulating tract of clay soils forming a veneer over the silty clay to clayey silt till (Halton Till) of the surrounding South Slope region. Bedrock is expected to be at depths of over 30 m and comprise both reddish brown shale of the Queenston Formation and grey shale, limestone and dolostone of the Georgian Bay Formation.

Grades on Mavis Road generally vary from approximate elevation 181 at the crossing of Fletcher's Creek approximately 400 m north of Courtney Park Drive, to elevation 209 over Highway 407.

3 INVESTIGATION METHODOLOGY

A pavement investigation was carried out in May 2016 and comprised a pavement condition survey, pavement coring, borehole drilling, and laboratory testing on recovered samples of granular base/subbase materials and subgrade soils.

Initially, a visual pavement surface condition survey was completed in accordance with the Ministry Manual for Condition Rating of Flexible Pavement (SP-024) to assess the condition of the existing pavement surface, and to identify the type and severity of the specific pavement distresses. The completed pavement condition evaluation forms are provided in Appendix A, while typical photographs of existing conditions are provided in Appendix B.

A total of 35 boreholes were drilled through the existing pavement along Mavis Road at intervals of approximately 200 m in both directions, staggered by lane and direction, and repositioned as necessary to avoid utilities and minimize traffic disruption. Nine of the boreholes were terminated at 3.7 m depth, and the remainder were ended at depths of 1.5 to 2.1 m. The borehole locations are shown on Drawings 11203-1 to 3, Appendix C. Programmed Boreholes 16-29 to 16-32, located within Hwy 407/ETR jurisdiction and a hydro/pipeline utility corridor, were not completed as the level of effort and potential for delay to obtain the required permits/ authorizations was not considered to be justified by the needs of preliminary design.

Project stationing was established with Station 10+000 at Courtney Park Drive, with increasing stationing towards the north. Prior to the start of the drilling investigation, utility clearances were

obtained through the Ontario-One-Call service. Road occupancy permits were obtained from the City of Mississauga and Peel Region prior to the commencement of drilling. Traffic control was provided by Direct Traffic Management.

The boreholes were advanced using a truck-mounted CME-45 drill rig supplied and operated by Malone's Soil Samples Co. Ltd. Solid stem augers were employed to advance the boreholes, and soil samples were obtained in conjunction with the Standard Penetration Test (SPT) or from the augers. Asphalt cores were extracted from the pavement at eight selected borehole locations prior to drilling.

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. The asphalt cores were labelled and returned to Thurber's Oakville office for visual logging and photographing.

Groundwater conditions in the open boreholes were observed during drilling. All boreholes were backfilled with auger cuttings and/or bentonite holeplug upon completion in general accordance with MOE Regulation 903.

Results of the field drilling, sampling and testing are presented on the borehole logs in Appendix D. Boreholes logs for the shallow boreholes (1.5 to 2.1 m depth) are presented in tabular format, and logs for the deeper boreholes are provided on separate Record of Borehole sheets. Asphalt core logs and photographs are provided in Appendix E.

Geotechnical laboratory testing consisted of natural moisture content determinations, visual classification and description of all soil samples. Grain size distribution and particle size analyses were carried out on selected samples of the pavement granular materials and subgrade soils. Atterberg Limits tests were completed on several samples exhibiting plasticity. Results of the geotechnical laboratory testing are summarized on the borehole logs and presented on the figures in Appendix F.

Selected soil samples were submitted to a qualified laboratory for analytical environmental testing. The laboratory Certificates of Analysis are provided in Appendix G.

4 EXISTING PAVEMENT AND SUBGRADE CONDITIONS

4.1 Pavement Condition Survey

The results of the visual survey of existing pavement conditions are summarized on the evaluation forms provided in Appendix A. Typical photographs of the pavement are provided in Appendix B.

In general, the existing pavement surface on Mavis Road between Courtney Park Drive and Highway 407 is presently in fair condition, with a comfortable to relatively uncomfortable ride and slight bumps. Predominant distresses included slight to severe longitudinal construction joint cracking throughout, intermittent slight to moderate longitudinal wheel track cracking, frequent slight to moderate transverse cracking, and localized areas of slight severity alligator cracking with slight to moderate ravelling and manual patching. Some crack sealing has been carried out in the past with limited effectiveness.

The section of Mavis Road between the Highway 407 E-N/S ramp terminus and Ray Lawson Boulevard appears to have been relatively recently reconstructed, and is in excellent condition with no visible distresses.

4.2 Existing Pavement Structure

4.2.1 Asphalt

The asphalt thickness on Mavis Road south of Highway 407 varied from 150 to 200 mm, with an average thickness of about 170 mm. North of Highway 407, the asphalt thickness ranged from 190 to 250 mm (average 220 mm), with one thickness of 330 mm recorded immediately north of the Highway 407 E-N/S off ramp.

Photographs of the recovered asphalt cores are provided in Appendix E. Examination of the cores indicates a 45 to 60 mm thick surface course over 100 to 145 mm of binder course typically placed in two lifts. Delamination of the surface course from the binder course was observed in one core sample.

4.2.2 Granular Base/Subbase

The pavement granular material varied from sandy gravel to gravelly sand with trace to some silt. The total thickness of the granular material in the northbound lanes ranged from 520 to 1290 mm, averaging about 760 mm, with several boreholes terminated in granular material at 1.5 m depth. In the southbound lanes, the granular thickness varied from 970 to 1360 mm, averaging about 1050 mm. Where delineation of separate base and subbase layers was

possible (primarily in the southbound lanes), the base thickness varied from 120 to 400 mm, typically about 170 mm.

Grain size analyses were completed on 13 samples of the granular base/subbase material. The results are shown on Figures 1 to 3 in Appendix F. The results indicate that the granular materials generally reflect OPSS Granular A or Granular B Type II gradation specifications, although slightly finer in most cases. It is noted that the percentage passing the 75 µm sieve size ranged from 8 to 20%, exceeding the maximum permitted value of 8% for Granular A. This finding is common for samples collected from existing roadways, and could result from construction activities (i.e. compaction efforts) and/or drilling operations. To confirm the suitability for reuse of existing granular base/subbase materials, laboratory testing of bulk samples will be required during construction. Moisture contents in the retrieved samples ranged from 2 to 5%.

4.3 Subgrade Soils

The subgrade soil encountered beneath the pavement structure generally comprised fill or glacial till deposits consisting of silty sandy clay with trace gravel. Where encountered, the boreholes were terminated in the till materials at depths of 1.5 to 3.7 m in all except one borehole.

SPT N-values recorded in the till varied from 7 to 35 blows/0.3 m, indicating a firm to hard consistency. Moisture contents ranged from 9 to 21%.

The results of gradation analyses conducted on selected samples of the till are shown on Figures 4 to 6 in Appendix F. Atterberg Limits test results (Figures 7 and 8) indicate that the till is of low to intermediate plasticity, with a group symbol of CL to CI. The laboratory testing indicates that these soils in general have a low susceptibility to frost heave, with a low to moderate potential for soil erodibility.

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

Silty sand was encountered below the silty sandy clay till locally in Borehole 16-22 at 3.1 m depth. The silty sand was compact with an SPT N-value of 20 blows/ 0.3 m. A moisture content of 9% was recorded.

4.4 Groundwater

Groundwater was not observed in the boreholes during or upon completion of drilling.

5 PAVEMENT EVALUATION AND DESIGN

The pavement design analysis is based on the subsurface soil and groundwater conditions encountered during the investigation, and traffic data provided by others.

5.1 Traffic Analysis

Traffic information used for this investigation was provided by MMM in an e-mail dated December 15, 2016. The provided traffic information included Average Annual Daily Traffic (AADT) for 2015 and forecast AADT for 2041, along with estimated truck percentages for each section. A summary of the two-way 2015 AADT and forecast 2041 AADT are provided in Table 5.1.

Table 5.1 - Mavis Road Traffic Information

Segment	2015 AADT	2041 AADT	% Trucks
Highway 401 WB Off Ramp to Courtney Park Drive West	52,350	68,200	3.5
Courtney Park Drive West to Western Skies Way	46,450	59,800	4.0
Western Skies Way to Novo Star Drive	43,700	57,050	4.1
Novo Star Drive to Derry Road West	40,450	53,850	5.0
Derry Road West to Kaiser Drive	38,250	51,450	4.3
Kaiser Drive to Twain Avenue	39,950	53,100	3.1
Twain Avenue to Highway 407 EB Off Ramp	39,750	52,950	2.8
Highway 407 EB Off Ramp to Highway 407 WB Off Ramp	41,450	55,050	1.3
Highway 407 WB Off Ramp to Ray Lawson Boulevard	42,150	55,950	1.3

A compound annual growth rate of 1.1 percent was computed from the traffic projections. For the design analysis, it has been assumed that the roadway will be widened to six through lanes in 2018.

The traffic data was used to determine the pavement damage caused by the anticipated traffic volumes. Using 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*. An average truck factor of 1.6 was assigned for a principal arterial roadway. The 2018 AADT and 20-year design ESALs calculated for each segment of Mavis Road between Courtney Park Drive and Ray Lawson Boulevard are as follows.

Table 5.2 - Mavis Road ESALs

Segment	2018 AADT (Estimated)	20 Year Design ESALs (million)
Highway 401 WB Off Ramp to Courtney Park Drive West	54,100	7.4
Courtney Park Drive West to Western Skies Way	48,000	7.5
Western Skies Way to Novo Star Drive	45,150	7.2
Novo Star Drive to Derry Road West	41,800	8.1
Derry Road West to Kaiser Drive	39,550	6.6
Kaiser Drive to Twain Avenue	41,300	5.0
Twain Avenue to Highway 407 EB Off Ramp	41,100	4.5
Highway 407 EB Off Ramp to Highway 407 WB Off Ramp	42,850	2.2
Highway 407 WB Off Ramp to Ray Lawson Boulevard	43,550	2.2

5.2 New Pavement Design

The pavement design analysis was carried out using the methodology outlined in the 1993 AASHTO "*Guide for the Design of Pavement Structures*", as modified by the Ministry's "*Adaptation and Verification of AASHTO Pavement Design Guide for Ontario Conditions*", and the MTO "*Pavement Design and Rehabilitation Manual*". The AASHTO procedure 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 following design inputs were used in the AASHTO design analysis.

- Design period = 20 years
- Initial serviceability, (Pi) = 4.5
- Terminal serviceability (Pt) = 2.5
- Reliability level (R) = 90 percent
- Overall standard of deviation (So) = 0.44
- Mean soil resilient modulus (MR) = 30 MPa

Based on the design input parameters and the calculated design ESALs, the required design structural number (SN_{Des}) varies from about 116 within the Highway 407 interchange to 139 in the section immediately south of Derry Road. The corridor may be subdivided into three

separate segments to address these structural requirements, and the minimum pavement structures for the respective segments are as follows:

	Hwy 401 WB Off Ramp to Kaiser Drive	Kaiser Drive to Hwy 407 EB Off Ramp	Hwy 407 EB Off Ramp to Ray Lawson Blvd.
20 Year ESALs	6.6 to 8.1	4.5 to 5.0	2.2
Required SN	135 to 139	128 to 130	116
Hot Mix Asphalt (mm)	170	160	140
Granular Base (mm)	150	150	150
Granular Subbase (mm)	500	450	400

Note that the above pavement structures address only the structural requirements of new pavement. The thickness of the pavement components may need to be increased to achieve similar performance between new and existing pavements, and to maintain lateral drainage of granular materials from the existing pavements to new subdrains positioned at the new edge of pavement in widening areas. In this regards, the total depth of the existing pavement structure is typically about 900 mm in the northbound lanes and 1200 mm in the southbound lanes.

5.3 Pavement Rehabilitation Design

The existing pavement on Mavis Road was evaluated to determine the structural and functional capacity to support the anticipated future traffic volumes. The structural capacity of the pavement relates to the existing pavement component thickness and any adverse effects on load-carrying capability due to existing pavement distress and aging. A road's functional capacity is a measure of how well the pavement serves the user, and is a reflection of the pavement condition at a particular time during the service life of the pavement.

The rehabilitation design for the existing pavement was determined using the AASHTO 1993 overlay design methodology to assess the structural capacity of the existing pavement, and determine the overlay thickness required to meet the structural design requirements. Structural layer and drainage coefficients used to determine the existing pavement strength include:

Pavement Layer	Structural Coefficient	Drainage Coefficient
New Hot Mix Asphalt	0.42	1.0
Existing Asphalt Layer	0.28	1.0
Existing Granular Base	0.12	1.0
Existing Granular Subbase	0.09	0.9

The results of the structural design analysis indicate that the existing pavement structure in the northbound lanes will require a strengthening (SN) of about 26 mm from the south limit to Kaiser Drive, 17 mm between Kaiser Drive and the eastbound Highway 407 off ramp, and less than 5 mm from the Highway 407 eastbound off ramp to the north limit. No structural strengthening would be required in the southbound lanes where the existing granular depths are greater.

The visual pavement condition survey identified a number of distresses that impact the functional capacity of the existing pavement surface, including cracking, raveling and distortions. To remove any aged and deteriorated asphalt on the pavement surface, it is recommended that the asphalt surface be milled to a depth of 50 mm prior to placement of new hot mix for resurfacing.

Rehabilitation of the existing pavement structure to carry future traffic loads for a 20 year design period would therefore entail milling the existing asphalt to a depth of 50 mm, followed by placement of 100 mm of new hot mix asphalt on the northbound lanes south of Kaiser Drive, 75 mm of new asphalt between Kaiser Drive and the Highway 407 eastbound off ramp, and 50 mm of new asphalt in all remaining sections.

The required overlay would result in a grade raise of 25 to 50 mm along the northbound lanes with no corresponding grade raise in the southbound lanes, which is not expected to be practical. Therefore, similar treatment will be required in both northbound and southbound lanes (mill plus overlay) resulting in a grade raise of 50 mm in both directions. If a grade raise cannot be accommodated, the existing asphalt will need to be removed full depth and replaced with 170 mm of new asphalt.

Localized areas of structural distress (alligator/ fatigue cracking) as well as severe transverse and longitudinal cracking along construction joints were observed during the visual condition survey. An additional 50 mm depth of asphalt milling and replacement is recommended in these areas to strengthen highly distressed areas and to delay reflection of transverse or deteriorated construction joint cracks up into the new asphalt overlay surface.

North of the westbound Highway 407 off ramp, the pavement on Mavis Road was considered to be in excellent condition at the time of the pavement evaluation, with no visible distresses. In consideration of the excellent functional condition of the existing pavement, rehabilitation treatments for the improvement of the overall rideability are not required at the present time.

6 PRELIMINARY RECOMMENDATIONS

This section provides preliminary geotechnical recommendations for widening and rehabilitation of the pavement structure within the project limits, installation of underground municipal services, widening of the Highway 401 underpass structure, and disposal of surplus materials.

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.

6.1 Pavement Design and Construction

6.1.1 Pavement Design for Widening

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

	Northbound Widening	Southbound Widening
HL1	50 mm	50 mm
HDBC (2 lifts)	120 mm	120 mm
Granular A Base	150 mm	150 mm
Granular B Type I Subbase	600 mm	900 mm

Note that the thickness of the Granular B subbase has been increased to match the total depth of existing pavement, in order to maintain lateral drainage of the existing granular materials. The total depth of the existing pavement is typically about 900 mm in the northbound lanes and 1200 mm in the southbound lanes.

6.1.2 Rehabilitation of Existing Pavement

The recommended pavement rehabilitation strategy for the existing pavement on Mavis Road is as follows:

	South Limit to Hwy 407 EB Off Ramp	Hwy 407 EB Off Ramp to WB Off Ramp
Partial Depth Milling	50 mm	50 mm
HL1	50 mm	50 mm
HDBC	50 mm	-

Localized areas of structural distress (alligator/ fatigue cracking) as well as severe transverse and longitudinal cracking along construction joints were observed during the visual condition survey. An additional 50 mm depth of asphalt milling and replacement is recommended to strengthen highly distressed areas and to delay reflection of deteriorated construction joint cracks up into the new asphalt overlay surface.

The locations and extent of repair areas will need to be determined by visual examination of the exposed surface following surface milling during construction. For preliminary costing purposes, it may be assumed that approximately 5% of the existing pavement will require full-depth asphalt repair. Non-destructive (FWD) testing of the existing pavement structure should be carried out during detailed design to confirm the structural capacity of the existing pavement structure and assist identification of areas requiring strengthening.

6.1.3 Pavement Materials

All Hot Mix Asphalt (HMA) material should meet the requirements of OPSS 310, and Peel Region Specifications. All asphalt lifts should be placed and compacted to levels between 92 and 96.5 percent of the Marshall Maximum Relative Density (MRD). The recommended asphalt cement grade for all mixes should be PG 64-28, and shall conform to OPSS.MUNI.1101. Aggregates for the asphalt mixes should be in accordance with OPSS.MUNI.1003.

The existing asphalt removed from the project limits can be recycled into the new granular material, or used as Reclaimed Asphalt Pavement (RAP) in new Hot Mix Asphalt (HMA). It is important that appropriate blending ratios are adhered to as specified in the applicable OPSS.

All new granular subbase material should consist of OPSS Granular B Type I, while the granular base material should consist of OPSS Granular A. Reclaimed Concrete Material (RCM) shall not be permitted as Granular A on this project. All new granular material should meet the requirements of OPSS.MUNI.1010, and be compacted to 100 percent of the Standard Proctor Maximum Dry Density (SPMDD) within 2 percent of Optimum Moisture Content (OMC). All granular material should be compacted in accordance with the requirements of OPSS 501, and should be carried the entire width of the roadway platform to maintain appropriate drainage.

6.1.4 Transition Treatments

Smooth transitions are required in all areas where the new pavement meets the existing asphalt surface. All longitudinal and transverse joints should meet the requirements of OPSS 310. All longitudinal joints should be staggered between the asphalt lifts. The staggering of the longitudinal joints should be accomplished by offsetting the paving edge in the upper asphalt course by a minimum of 150 mm.

At the paving limits, the transverse tie-in should be trimmed to a depth of the surface course, full width, to provide a straight clean vertical surface so that the new asphalt material can be placed flush with the top of the existing pavement surface. At all transverse tie-ins to existing pavements, the top lift of asphalt should extend a minimum of 5 m in length beyond the transverse joint in the upper binder lift.

6.1.5 Pavement Drainage

The widened pavement structure should be constructed to maintain positive cross drainage at the top of subgrade, as well as at the pavement surface. The top of subgrade should be sloped at a minimum 3 percent grade, while the pavement surface should be constructed with a minimum 2 percent crossfall.

New curb and gutters should be constructed in accordance with OPSD 600.040, and Peel Region standards. Subdrains should be included and conform to Regional standards.

6.1.6 Subgrade Preparation

In all areas of pavement widening, the surficial vegetation and topsoil should be removed, until firm bottom is encountered. The underlying subgrade soils should be graded as required to accommodate the new pavement platform. 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 should be subexcavated and replaced with approved material within 2 percent of Optimum Moisture Content (OMC), and compacted to at least 98 percent of Standard Proctor Maximum Dry Density (SPMDD).

6.2 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 sandy 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.

Where space restrictions preclude excavation of inclined slopes, installation may be carried out using a trench box or temporary shoring. If the trench depth exceeds 6 m, the support system must be designed specifically for this project by an experienced Professional Engineer.

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 Peel 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.

6.3 Widening of Highway 407 Underpass Structure

A geotechnical investigation was carried out in 1999 for a previous widening of the Mavis Road/ Highway 407 underpass structure. Six boreholes were drilled at the level of Highway 407, one at both ends of each foundation unit. The Record of Borehole sheets and Borehole Location Plan from the investigation are reproduced in Appendix H. The subsurface stratigraphy encountered in the boreholes generally consisted of a surficial 0.3 to 0.6 m thick layer of crusher run limestone or silty sand fill, locally a 50 mm topsoil layer, overlying very dense native sandy silt to the borehole termination depths of 6.1 to 6.4 m.

Review of the General Arrangement drawing for the previous bridge widening (included in Appendix H) indicates that the existing structure is supported on spread footings. The founding elevations are near Elev. 201 at the abutments and Elev. 198 at the pier. The design bearing resistances noted on the drawing are as follows:

At Abutments:	At Pier:
SLS = 400 kPa	SLS = 500 kPa
ULS = 900 kPa	ULS = 900 kPa

The ground surface at the borehole locations ranged from Elev. 199.4 to 201.2 at the time of the investigation, and the surface of the native sandy silt deposit was at Elev. 199.1 to 200.8. These levels are generally below the design founding level of Elev. 201 indicated for the abutments. A construction note on the GA drawing indicates that “additional excavation is to be backfilled to the underside of footing with mass concrete or compacted Granular ‘A’ as directed by the geotechnical engineer.”

Based on the above information, the existing abutment footings are assumed to be founded near Elev. 201 on either mass concrete or compacted Granular ‘A’ material overlying very dense native sandy silt encountered below all existing fill and topsoil. The existing pier is considered to be founded directly on the very dense native soil at approximate Elev. 198. For preliminary design purposes, use of a similar foundation system is recommended for the widened portion of the bridge, comprising extension of the existing spread footings at the same founding level and designed using the same resistance values (factored resistance at ULS = 900 kPa; resistance at SLS = 400 kPa for 25 mm settlement) as the existing foundation units.

The horizontal resistance against sliding can be computed using an ultimate friction factor of 0.4 between cast-in-place concrete and the undisturbed sandy silt, or 0.55 between the concrete and Granular ‘A’.

For frost protection purposes, a minimum earth cover of 1.2 m or its thermal equivalent should be provided for all footing bases.

6.4 Results of Environmental Testing

In general, visual and olfactory examination of the soil samples recovered from the field investigation program revealed no unusual staining or odours indicative of hydrocarbon impact or other contamination.

To provide a preliminary evaluation of the environmental quality of the soils potentially requiring disposal during construction, six samples recovered from the boreholes were submitted to AGAT Laboratories Limited for analysis of selected parameters outlined in Ontario Regulation 153/04 (as amended by O.Reg. 511/09) and O.Reg. 558/00. The sample locations and material types are summarized in Table 6.1.

Table 6.1 – Samples Selected for Environmental Testing

Borehole	Depth (m)	Material	Test Parameters
16-04	1.5 – 2.1	Sandy Silty Clay	O.Reg.153 Metals & Inorganics Petroleum Hydrocarbons F1-F4
16-09	0.2 – 0.9	Sandy Gravel Fill	O.Reg.153 Metals & Inorganics
16-20	0.5 – 1.2	Sandy Gravel Fill	O.Reg.153 Metals & Inorganics O.Reg.558 Metals & Inorganics
16-33	1.2 – 1.5	Silty Clay	O.Reg.558 Metals & Inorganics Petroleum Hydrocarbons F1-F4
16-35	0.2 – 0.4	Gravel and Sand Fill	O.Reg.153 Metals & Inorganics Petroleum Hydrocarbons F1-F4

The results of the analyses are provided on the Certificates of Analysis in Appendix G.

The analytical results were compared to the soil standards indicated in Table 2 (Full Depth Generic Site Condition Standards in a Potable Groundwater Condition) of O.Reg. 153. These soil standards are shown on the laboratory certificates. The concentrations of all parameters measured in the samples meet the criteria established in Table 2 of the Regulation, with the exception of electrical conductivity (EC) and sodium adsorption ratio (SAR). The EC values of 0.8 to 1.6 mS/cm measured in four samples exceed the Table 2 standard of 0.7 mS/cm, and the SAR values of 16.3 and 9.0 measured in two samples exceed the Table 2 standard of 5.0. The elevated EC and SAR values likely result from salt applied to the roadways.

Two samples were tested for Toxicity Characteristic Leaching Procedure (TCLP) analysis of inorganic parameters in accordance with O.Reg. 558/00. The results of the analyses are presented on the Certificate of Analysis in Appendix G. The concentrations of all parameters measured in the TCLP analyses were below the leachate quality criteria specified in Schedule 4 of O.Reg 558/00.

Based on the available subsurface information and the analytical results of selected samples, excess soil from the project may generally be classified as a “non-subject waste” in accordance with O.Reg. 558/00 and disposed of at a suitable receiving site or reused on-site as general fill. Additional analytical testing will be required during detailed design to further assess the requirements for re-use or disposal of excavated materials when further details of the project are established.

Where excavation of existing pavement structures is required, asphalt should be removed separately from granular materials and recycled at an approved recycling facility or disposed of

appropriately off-site. Asphalt should not be mixed with excess excavated soil; fill receivers may not accept excess excavated soils if it contains asphalt. Excavated granular material may be reused on site for general fill purposes subject to geotechnical approval.

6.5 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 existing pavement thicknesses, subgrade conditions and preliminary pavement design recommendations;
- deflection testing (FWD) of the existing roadway if sections of the existing pavement are to be rehabilitated;
- additional boreholes at the proposed Highway 407 underpass structure and any retaining walls or fill embankments to confirm geotechnical recommendations for foundation and embankment design;
- further assessment of dewatering requirements and the need for a PTTW; and
- chemical testing to evaluate excess material disposal.

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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.

APPENDIX A

PAVEMENT CONDITION EVALUATION FORMS

Mavis Road

THURBER ENGINEERING LTD.

FLEXIBLE PAVEMENT CONDITION EVALUATION FORM

Section From: Courtney Park Drive **To:** Highway 407

LHRS ____ km (BEGINS / OFFSET) **Section** 2.4 km (LENGTH)

Survey Date 2016 03 (YEAR / MONTH) **PCR** 65 **RCR** 6.0

Contract No. ____ **WP No.** ____

Traffic Direction B — B: BOTH DIRECTIONS; N: NORTH BOUND; S: SOUTH BOUND; E: EAST BOUND; W: WEST BOUND

District ____

Facility A — A: ALL LANES; C: COLLECTOR; E: EXPRESS; O: OTHERS (Additional Lanes)

Highway ____

Class A — F: FREEWAY; A: ARTERIAL; C: COLLECTOR; L: LOCAL; S: SECONDARY

Ride Condition Rating (at 80 km/h)

- 10 **EXCELLENT** Smooth and pleasant
- 8 **GOOD** Comfortable
- 6 **FAIR** Uncomfortable
- 4 **POOR** Very rough and bumpy
- 2 **VERY POOR** Dangerous at 80 km/h
- 0

Pavement	Distress Type		Weighting	Severity of Distress: Very Slight	Slight	Moderate	Severe	Very Severe	Density of Distress (Extent of Occurrence, %): Few	Intermittent	Frequent	Extensive	Throughout
			(wi)	0.5	1	2	3	4	<10	10-20	20-50	50-80	80-100
Surface Defects	Ravelling & C. Agg. Loss	1	3.0			x					x		
	Flushing	2	1.5										
Surface Deformations	Rippling and Shoving	3	1.0										
	Wheel Track Rutting	4	3.0										
	Distortion	5	3.0		x					x			
Cracking — Longitudinal Wheel Track	Single and Multiple	6	1.5		x						x		
	Alligator	7	3.0		x					x			
Cracking — Centre Line	Single and Multiple	8	0.5			x					x		
	Alligator	9	2.0		x						x		
Cracking — Pavement Edge	Single and Multiple	10	0.5										
	Alligator	11	1.5										
Cracking — Transverse	Half, Full and Multiple	12	1.0		x						x		
	Alligator	13	3.0		x						x		
Long Meander and Midlane		14	1.0		x				x				
Random		15	0.5										
IRI from Ride Comfort Rating (RCR):			2.2										
Back-calculated PCI Value:			66									**DMI**	7.60

Shoulders		Distress	Severity of Distress: Right Mod	Right Severe	Left Mod	Left Severe	Density of Distress (Extent of Occurrence, %): Right 10-30	Right >30	Left 10-30	Left >30
Paved Full		Cracking								
Paved Partial		Pavement Edge/Curb Separation								
		Distortion								
Surface Treated		Breakup/Separation								
		Edge Break								
Primed		Breakup								
Gravel										

Maintenance Treatment		Extent of Occurrence, %: <10 (1)	10-20 (2)	20-50 (3)	50-80 (4)	>80 (5)
Pavement	Manual Patching					
	Machine Patching					
	Spray Patching					
	Rout and Seal Cracks					
	Chip Seal					
Shoulders	Manual Patching					
	Machine Patching					
	Rout and Seal Cracks					
	Chip Seal					

Distress comments (Items not covered above)

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

Evaluated by R. Islam

Mavis Road

THURBER ENGINEERING LTD.

FLEXIBLE PAVEMENT CONDITION EVALUATION FORM

Section From: Highway 407 **To:** Ray Lawson Blvd

LHRS ____ km (BEGINS / OFFSET) **Section** 1 km (LENGTH)

Survey Date 2016 03 (YEAR / MONTH) **PCR** 100 **RCR** 10.0

Contract No. ____ **WP No.** ____

Traffic Direction B — B: BOTH DIRECTIONS; N: NORTH BOUND; S: SOUTH BOUND; E: EAST BOUND; W: WEST BOUND

District ____

Facility A — A: ALL LANES; C: COLLECTOR; E: EXPRESS; O: OTHERS (Additional Lanes)

Highway ____

Class A — F: FREEWAY; A: ARTERIAL; C: COLLECTOR; L: LOCAL; S: SECONDARY

Ride Condition Rating (at 80 km/h)

- 10 **EXCELLENT** Smooth and pleasant
- 8 **GOOD** Comfortable
- 6 **FAIR** Uncomfortable
- 4 **POOR** Very rough and bumpy
- 2 **VERY POOR** Dangerous at 80 km/h
- 0

Pavement	Distress Type		Weighting	Severity of Distress: Very Slight	Slight	Moderate	Severe	Very Severe	Density of Distress (Extent of Occurrence, %): Few	Intermittent	Frequent	Extensive	Throughout
			(wi)	0.5	1	2	3	4	<10	10-20	20-50	50-80	80-100
Surface Defects	Ravelling & C. Agg. Loss	1	3.0										
	Flushing	2	1.5										
Surface Deformations	Rippling and Shoving	3	1.0										
	Wheel Track Rutting	4	3.0										
	Distortion	5	3.0										
Cracking — Longitudinal Wheel Track	Single and Multiple	6	1.5										
	Alligator	7	3.0										
Cracking — Centre Line	Single and Multiple	8	0.5										
	Alligator	9	2.0										
Cracking — Pavement Edge	Single and Multiple	10	0.5										
	Alligator	11	1.5										
Cracking — Transverse	Half, Full and Multiple	12	1.0										
	Alligator	13	3.0										
Cracking — Long Meander and Midlane		14	1.0										
Cracking — Random		15	0.5										
IRI from Ride Comfort Rating (RCR):			0.6										
Back-calculated PCI Value:			99										

DMI 10.00

Shoulders: Dominant Type		Distress	Severity of Distress: Right Mod	Right Severe	Left Mod	Left Severe	Density of Distress (Extent of Occurrence, %): Right 10-30	Right >30	Left 10-30	Left >30
Paved Full		Cracking								
Paved Full / Paved Partial		Pavement Edge/Curb Separation								
Paved Partial		Distortion								
Surface Treated		Breakup/Separation								
Surface Treated		Edge Break								
Primed		Breakup								
Gravel										

Maintenance Treatment		Extent of Occurrence, % <10 (1)	10-20 (2)	20-50 (3)	50-80 (4)	>80 (5)
Pavement	Manual Patching					
	Machine Patching					
	Spray Patching					
	Rout and Seal Cracks					
	Chip Seal					
Shoulders	Manual Patching					
	Machine Patching					
	Rout and Seal Cracks					
	Chip Seal					

Distress comments (Items not covered above)

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

Evaluated by R. Islam

THURBER

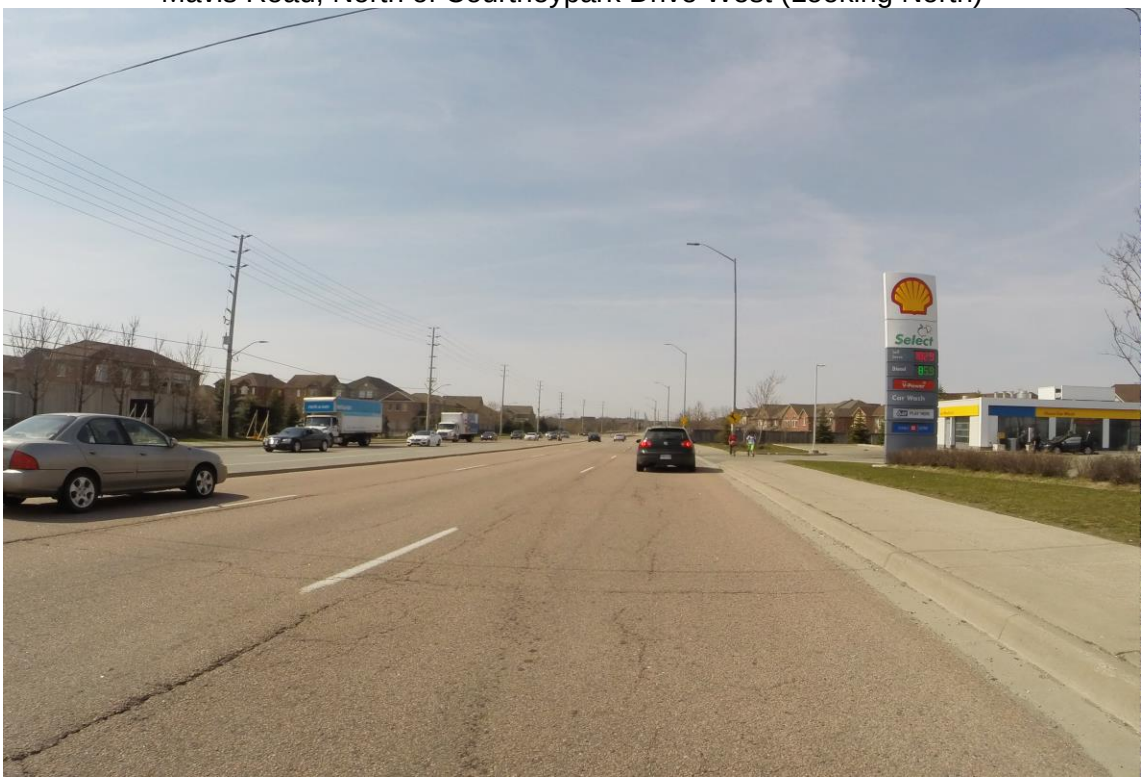
60 YEARS

APPENDIX B

PHOTOGRAPHS OF EXISTING PAVEMENT SURFACE

Mavis Road Class EA Study
Courtneypark Drive West to Ray Lawson Boulevard
Photographs of Typical Conditions

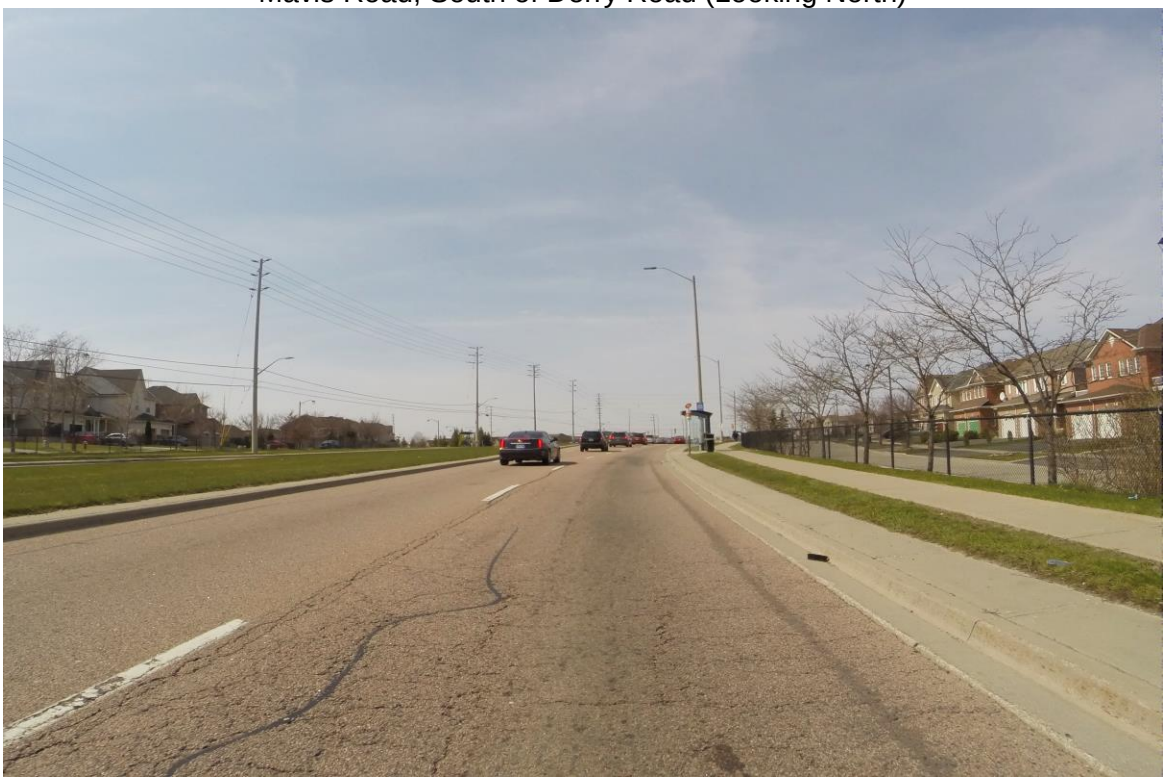
Photograph # 1
Mavis Road, North of Courtneypark Drive West (Looking North)



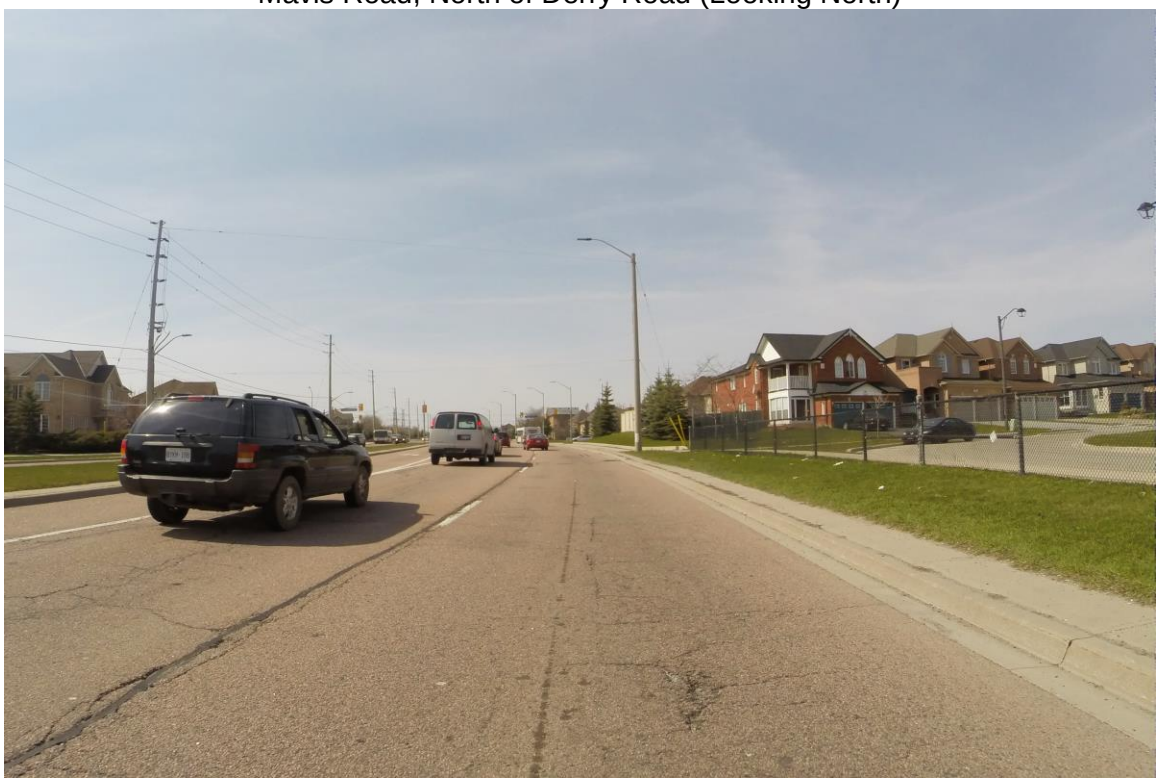
Photograph # 2
Mavis Road, South of Western Skies Way (Looking North)

Mavis Road Class EA Study
Courtneypark Drive West to Ray Lawson Boulevard
Photographs of Typical Conditions

Photograph # 3
Mavis Road, South of Derry Road (Looking North)



Photograph # 4
Mavis Road, North of Derry Road (Looking North)



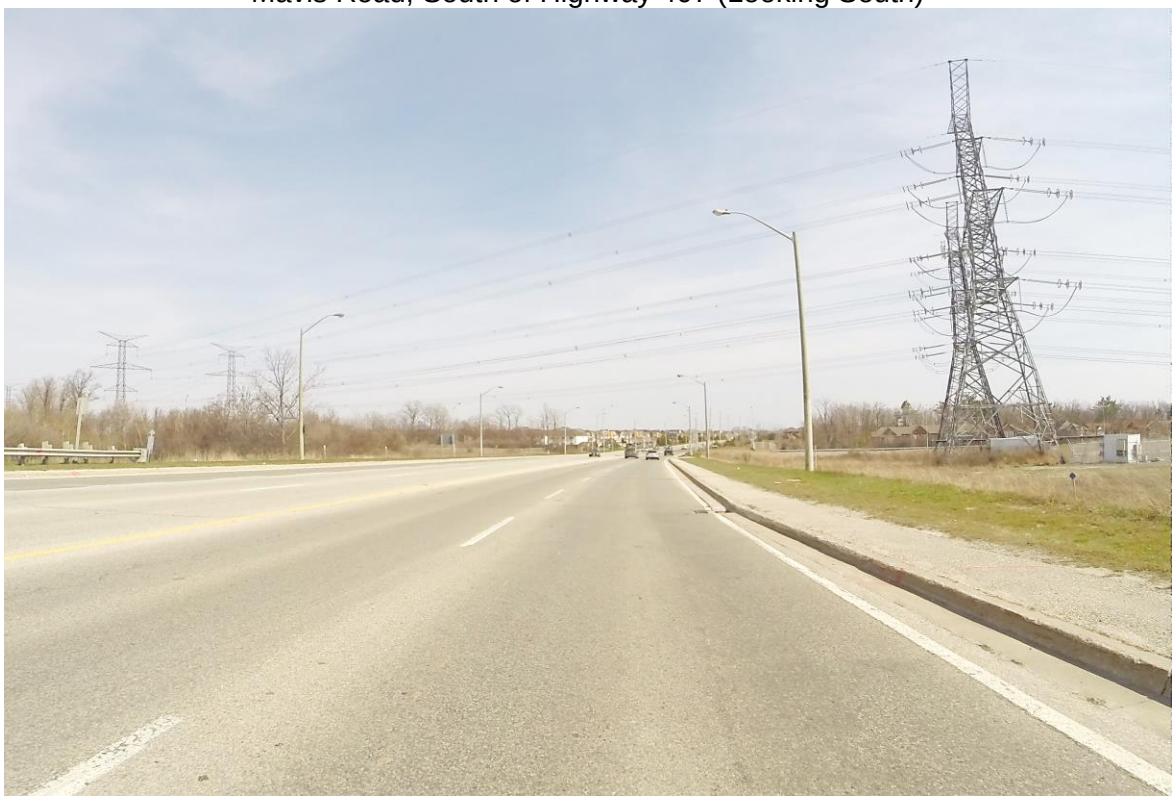
Mavis Road Class EA Study
Courtneypark Drive West to Ray Lawson Boulevard
Photographs of Typical Conditions

Photograph # 5
Mavis Road, North of Kaiser Drive (Looking North)

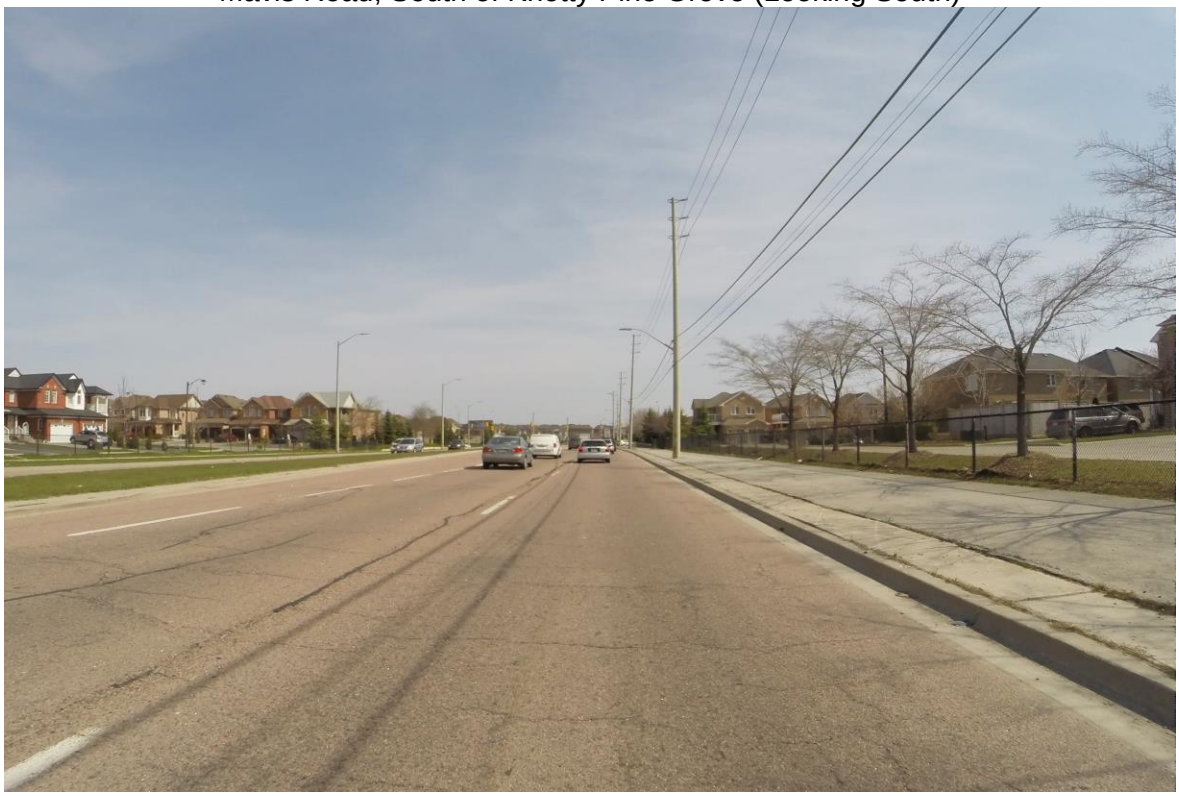
Photograph # 6
Mavis Road at Approach to Highway 407 (Looking North)

Mavis Road Class EA Study
Courtneypark Drive West to Ray Lawson Boulevard
Photographs of Typical Conditions

Photograph # 7
Mavis Road, South of Highway 407 (Looking South)

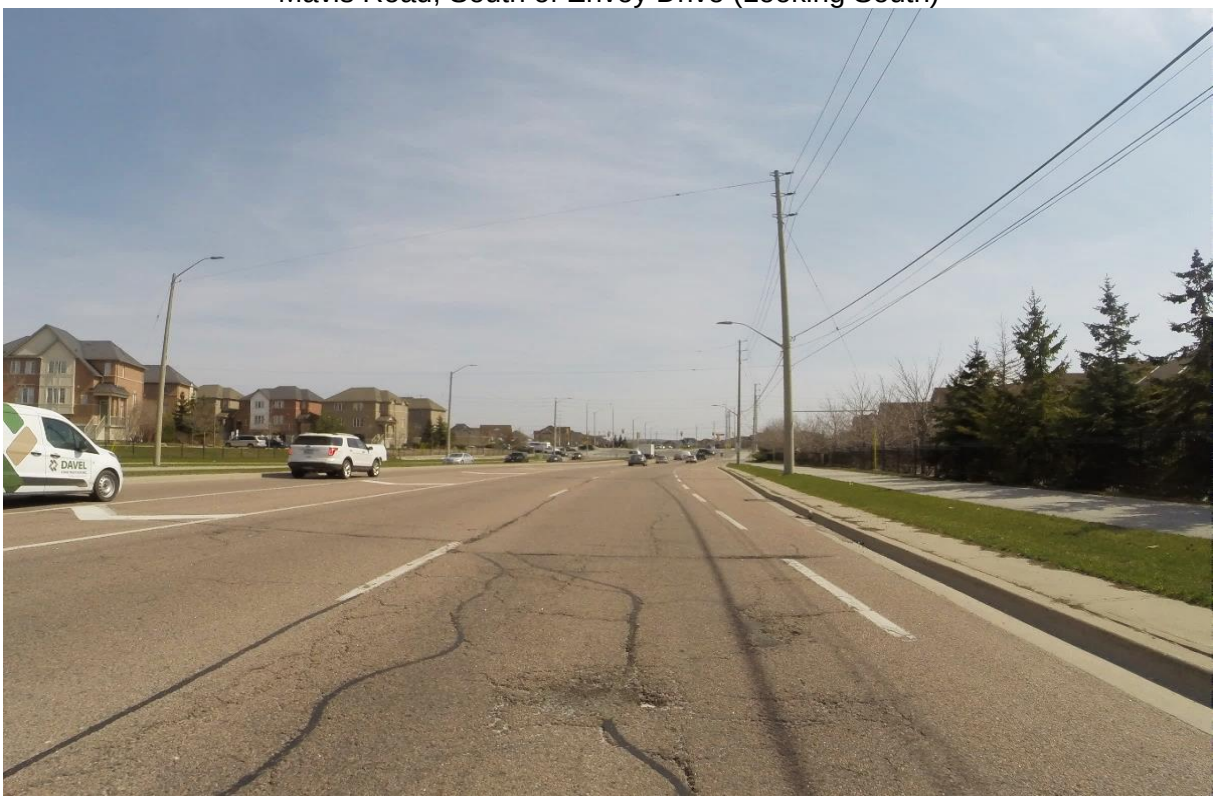


Photograph # 8
Mavis Road, South of Knotty Pine Grove (Looking South)



Mavis Road Class EA Study
Courtneypark Drive West to Ray Lawson Boulevard
Photographs of Typical Conditions

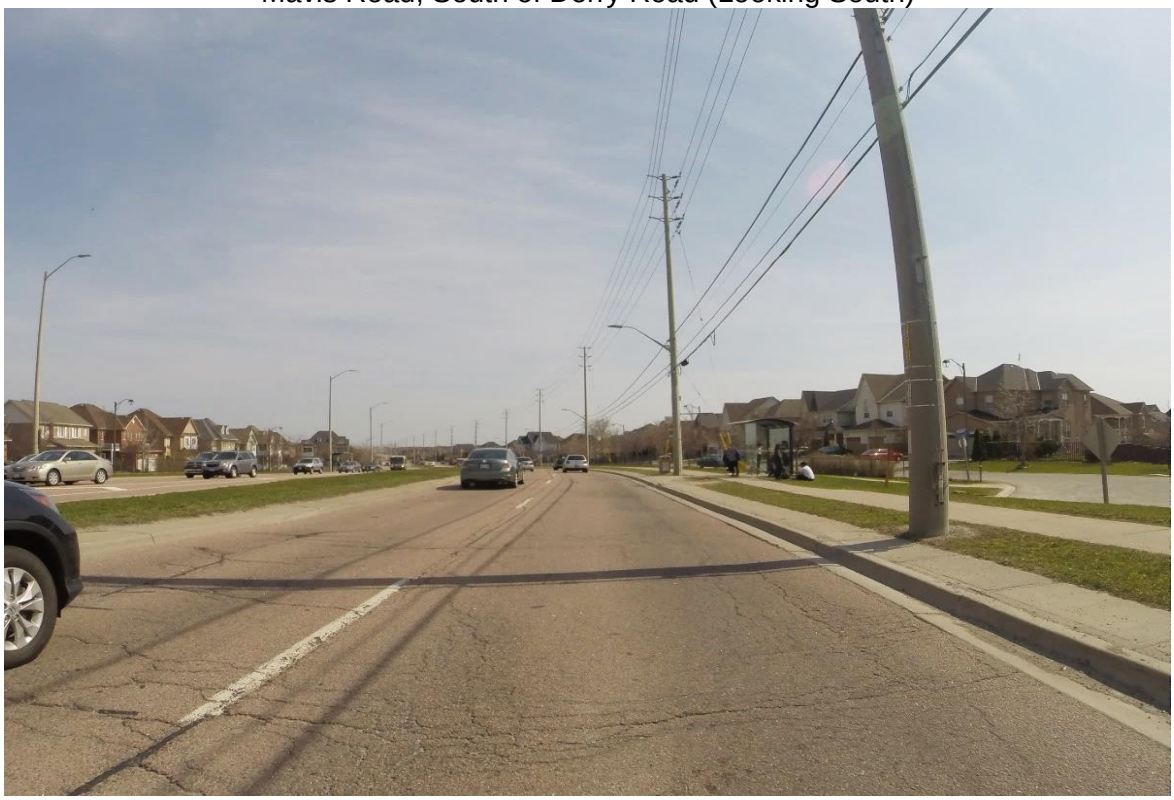
Photograph # 9
Mavis Road, South of Envoy Drive (Looking South)



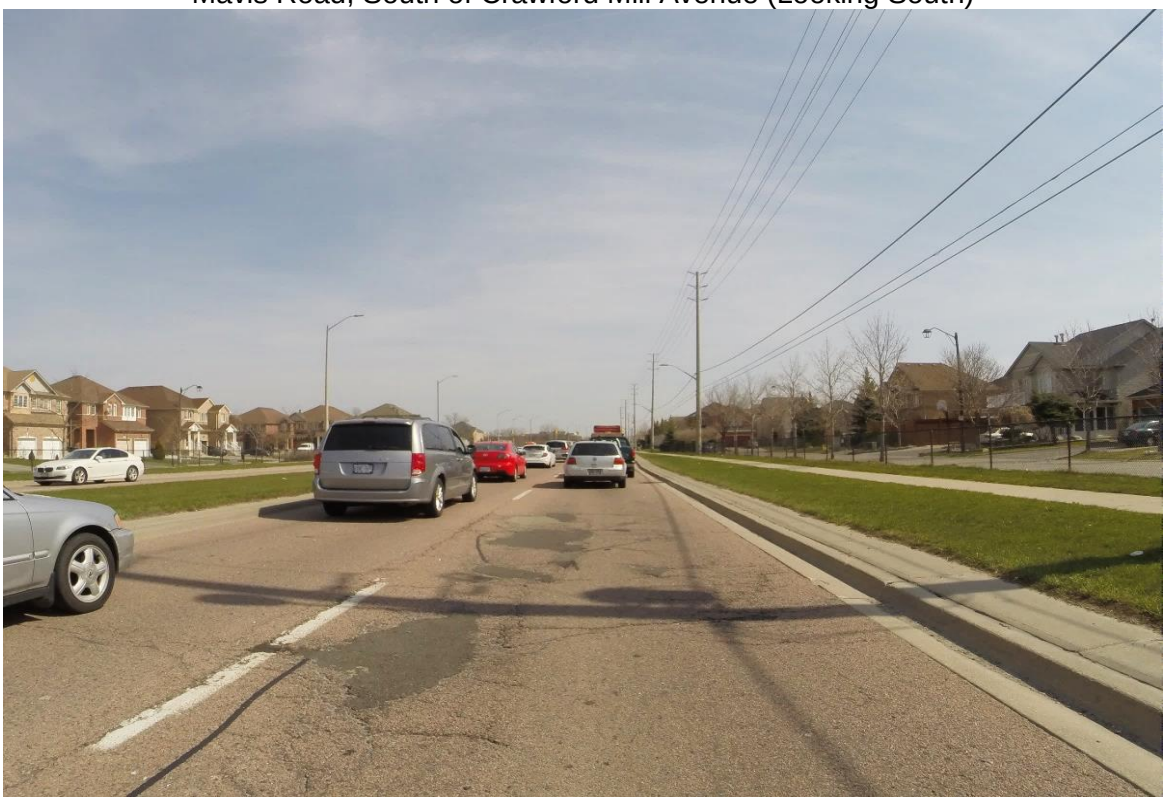
Photograph # 10
Mavis Road, approaching Derry Road (Looking South)

Mavis Road Class EA Study
Courtneypark Drive West to Ray Lawson Boulevard
Photographs of Typical Conditions

Photograph # 11
Mavis Road, South of Derry Road (Looking South)

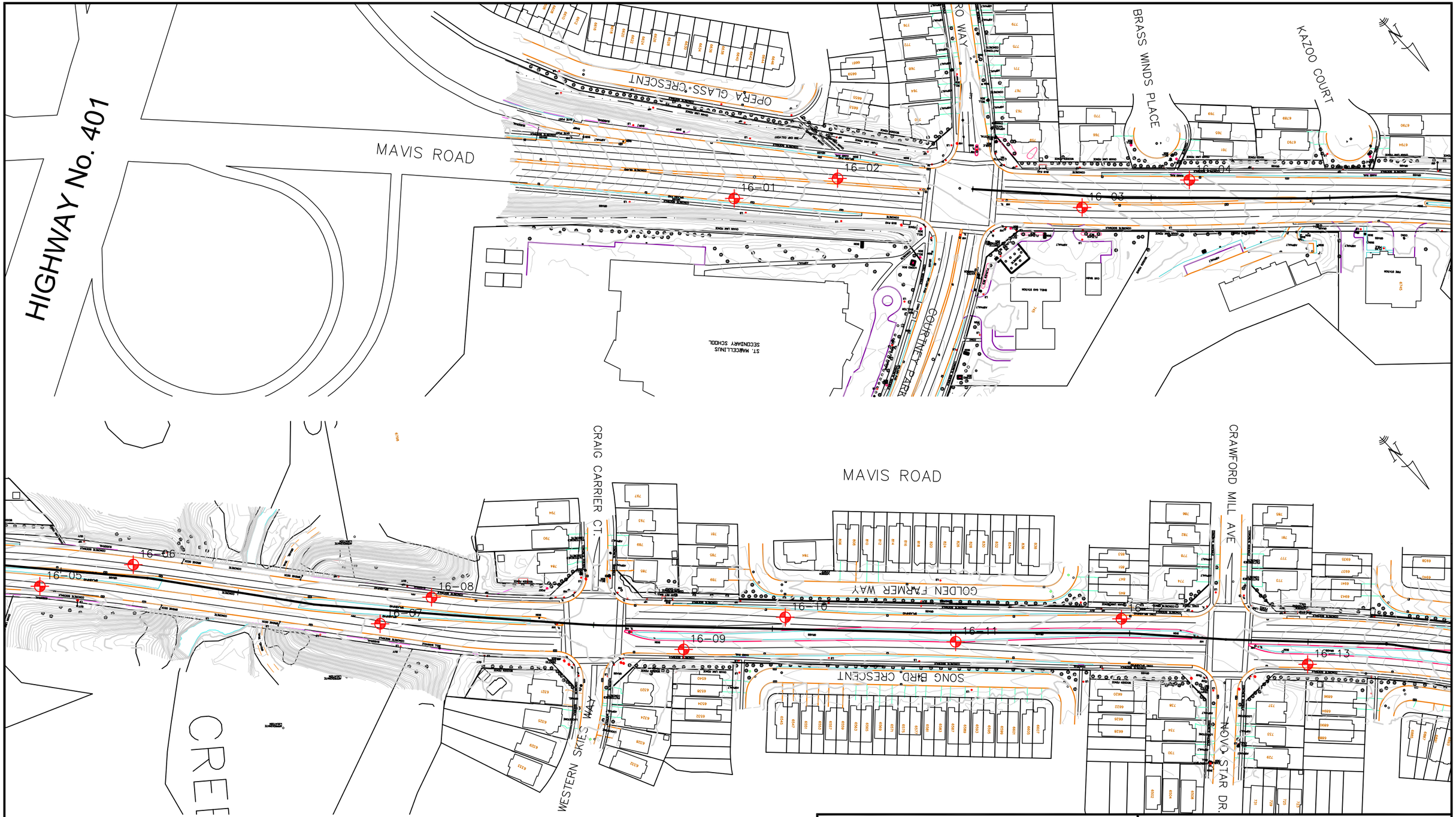


Photograph # 12
Mavis Road, South of Crawford Mill Avenue (Looking South)



APPENDIX C

BOREHOLE LOCATION PLAN



MAVIS ROAD
HIGHWAY 401 TO HIGHWAY 407
CLASS ENVIRONMENTAL ASSESSMENT

BOREHOLE LOCATIONS PLAN

11203

THURBER ENGINEERING LTD.

ENGINEER:	DRAWN:	APPROVED:
MRA	MFA	-
DATE:	SCALE:	DRAWING No.
JANUARY 2017	1:2000	11203-1

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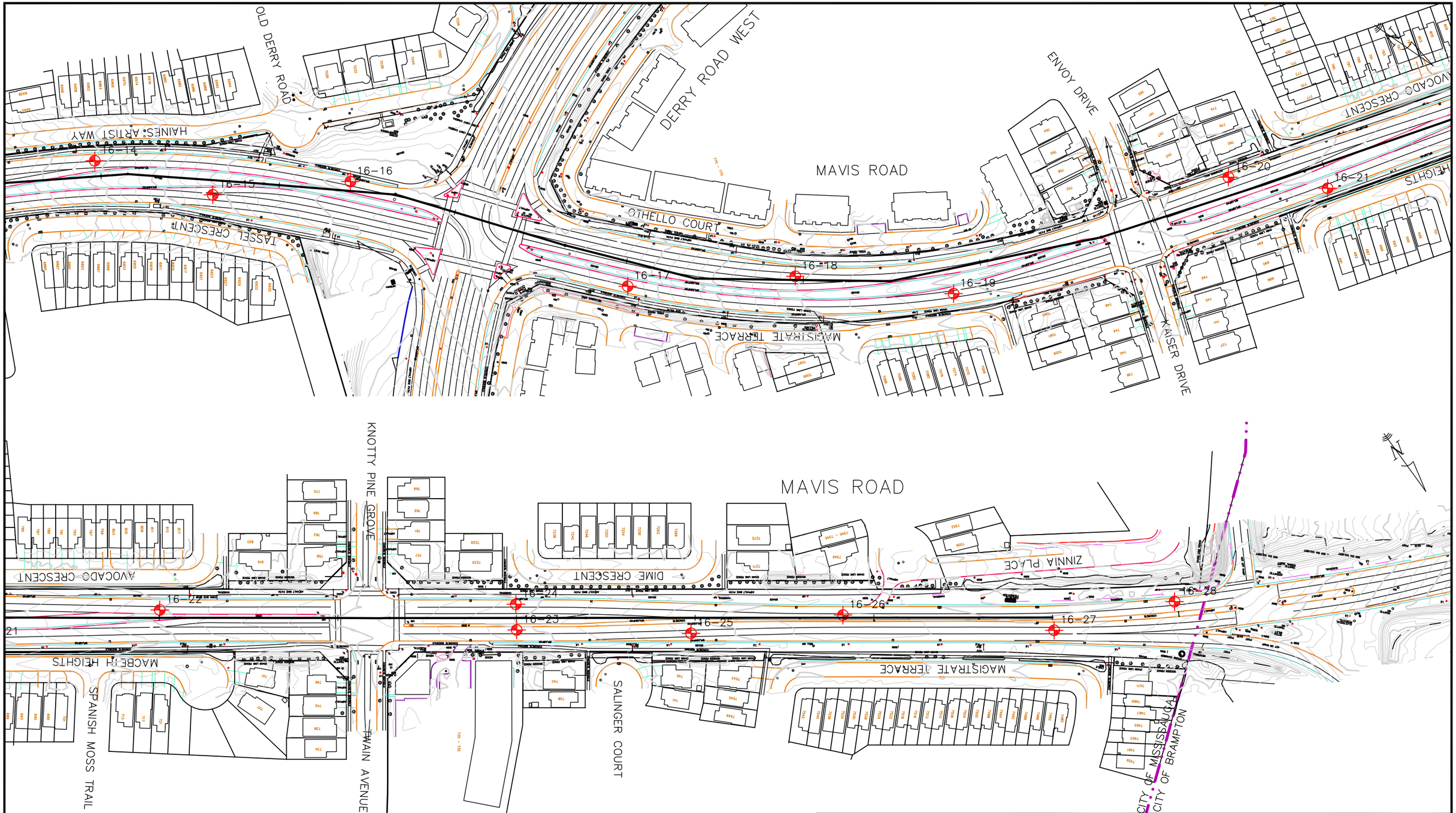

LEGEND

APPROXIMATE BOREHOLE LOCATION

40 0 40 80m

SCALE 1:2000

MAVIS ROAD
HIGHWAY 401 TO HIGHWAY 407
CLASS ENVIRONMENTAL ASSESSMENT

BOREHOLE LOCATIONS PLAN

11203

THURBER ENGINEERING LTD.

ENGINEER:	DRAWN:	APPROVED:
MRA	MFA	-
DATE:	SCALE:	DRAWING No.
JANUARY 2017	1:2000	11203-2

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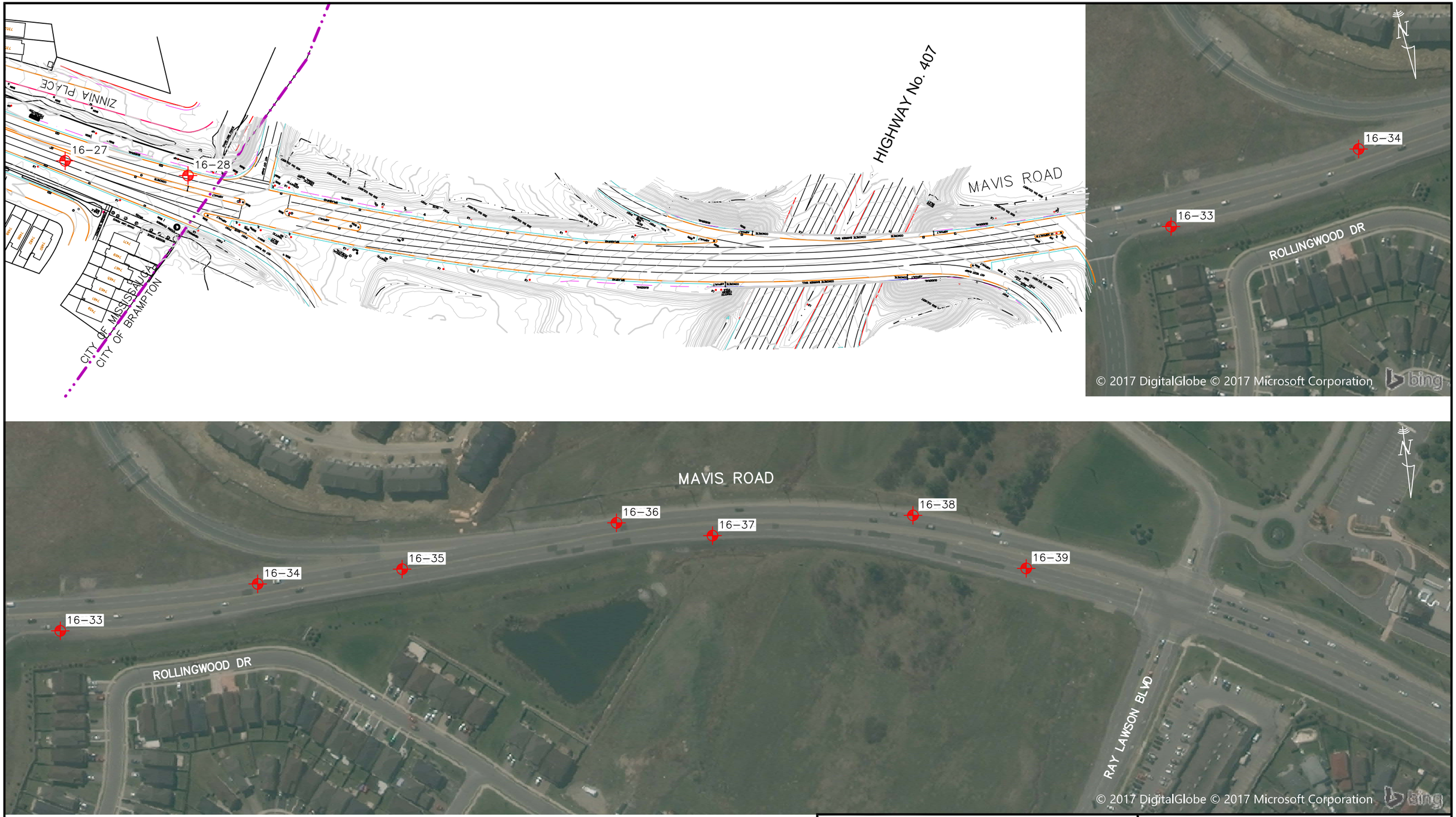

LEGEND

APPROXIMATE BOREHOLE LOCATION

40 0 40 80m

SCALE 1:2000

MAVIS ROAD
HIGHWAY 401 TO RAY LAWSON BOULEVARD
CLASS ENVIRONMENTAL ASSESSMENT

BOREHOLE LOCATIONS PLAN

11203

THURBER ENGINEERING LTD.

ENGINEER:	DRAWN:	APPROVED:
MRA	MFA	-
DATE:	SCALE:	DRAWING No.
FEBRUARY 2017	1:2000	11203-3

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PLOTDATE: Feb 1, 2017 - 12:19 PM

APPENDIX D

BOREHOLE LOGS

Accep	acceptable
Agg	aggregate
Amor	amorphous
Asph	asphalt
BH	borehole
Bl	blue
Bld (y)	boulder (y)
Blds	boulders
Blk	black
Br	brown
BR	bedrock
BU	break up
CF	channel face
Cl (y)	clay (ey)
Co	coarse
Cob	cobbles
Comp	compact
Conc	concrete
Contam	contaminated
Cord	corduroy
Cr	crushed
D	dense
Decomp	decomposed
Dk	dark
D_R	relative density
E	earth
F	fine
FB	frost boil
FH	frost heave
Fib	fibrous
Fr Wat	free water
Gr (y)	gravel (ly)
Gran	granular
Grn	green
Gry	grey
H	heavy
Hi	highly
HM	hot mix
HP	high plasticity
Ip	plasticity index
L	loose
Liq	liquid
Lo	loam
Lt	light
Matl	material
Max	maximum
MDD	maximum dry density
Med	medium
Mod	moderate
Mott	mottled
MP	medium plasticity
Mrl	marl
Mul	mulch
MWD	maximum wet density
NFP	no further progress
NFP (blds)	no further progress (boulders)
Num	numerous
Ob	overburden
Occ	occasional
Ora	orange
Org	organic
Org M	organic matter
Pavt	pavement
Pedo	pedological
Pen Mac	penetration macadam
Poss	possible
PST	prime and surface treated
Psty	polystyrene
Quant	quantity
Reinf	reinforced
RF	rock fill
RSS	remoulded shear strength
Sa (y)	sand (y)
Sat	saturated
SH	shale
Sh Rk	shot rock
Si (y)	silt (y)
Sl (y)	slight (ly)
SP	slight plasticity
SSM	select subgrade material
St	sensitivity
Stn (y)	stone (y)
Stks	streaks
Surf	surface
Temp	temperature
TH	test hole
TP	test pit
Tps	topsoil
Tr	trace
Unreinf	unreinforced
USS	undisturbed shear strength
Varv	varved
VF	very fine
w	field moisture content
W	with
W_L	liquid limit
Wd (y)	wood (y)
Weath	weathered
Wopt	optimum moisture content
Wp	plastic limit
WT	water table
Yel	yellow

SUSCEPTIBILITY TO FROST HEAVING

HSFH – High
MSFH – Medium
LSFH – Low

ONTARIO PROVINCIAL STANDARD DRAWING

ABBREVIATIONS

GEOTECHNICAL

Nov 2006 | Rev 1

OPSD 100.060

THURBER

MAVIS ROAD CLASS EA
COURTNEY PARK DRIVE TO RAY LAWSON BOULEVARD

PAVEMENT BOREHOLE LOGS

May 2016

Mavis Road

16-01 Station 09+850 NB Lane 2

0	-	165	Asph	
165	-	360	Br Cr Sa(y) Gr Tr Si	Moist
360	-	1.5	Gry Gr(y) Sa Some Si	Moist

16-03 Station 10+070 NB Lane 1

0	-	150	Asph	
150	-	1.2	Br Cr Sa(y) Gr Tr Si	Moist
1.2	-	1.5	Gry Gr(y) Sa Some Si	Moist

16-04 Station 10+120 SB Lane 2

0	-	155	Asph	
155	-	1.2	Gry Cr Gr W Sa Some Si	Moist
1.2	-	2.1	Br Si(y) Sa(y) Cl Tr Gr	Moist
			Nvalue=25 blows / 300mm	

16-06 Station 10+300 SB Lane 1

0	-	200	Asph	
200	-	1.2	Gry Cr Gr(y) Sa Some Si	Dry
			w @ 0.8m = 4%	
			Percent Passing 4.75 mm = 62%	
			75 µm = 19%	
			Not Acceptable as Granular B Type I	
1.2	-	1.5	Br Si(y) Sa(y) Cl Tr Gr	Moist
			w @ 1.3m = 12%	
			Percent Passing 4.75 mm = 96%	
			75 µm = 58%	
			5 µm = 30%	
			Frost Susceptibility = LSFH	
			Soil Erodibility =0.13	

16-07 Station 10+480 NB Lane 1

0	-	180	Asph	
180	-	900	Br Cr Sa(y) Gr Tr Si	Moist
900	-	1.5	Br Si(y) Sa(y) Cl Tr Gr	Moist

16-08 Station 10+500 SB Lane 2

0	-	165	Asph	
165	-	1.2	Gry Cr Gr(y) Sa Some Si	Moist
1.2	-	1.5	Gry Si(y) Sa(y) Cl Tr Gr	Moist

16-09 Station 10+650 NB Lane 2

0	-	150	Asph	
150	-	900	Gry Cr Sa(y) Gr Tr Si	Dry
			w @ 0.6m = 2%	
900	-	2.1	Br Si(y) Sa(y) Cl Tr Gr	Moist
			Nvalue=17 blows / 300mm	
			w @ 1.2m = 13%	
			w @ 1.8m = 14%	

16-11 Station 10+800 NB Lane 1

0	-	160	Asph	
160	-	1.1	Br Cr Gr W Sa Tr Si	Moist
1.1	-	1.5	Br Si(y) Sa(y) Cl	Moist

16-12 Station 10+900 SB Lane 2

0	-	180	Asph	
180	-	1.2	Gry Cr Gr(y) Sa Some Si	Moist
1.2	-	1.5	Gry Si(y) Sa(y) Cl Tr Gr	Moist

16-13 Station 11+000 NB Lane 2

0	-	180	Asph	
180	-	900	Br Cr Gr W Sa Tr Si	Moist
900	-	1.5	Br Si(y) Sa(y) Cl Tr Gr	Moist

16-14 Station 11+100 SB Lane 1

0	-	180	Asph	
180	-	300	Gry Cr Gr(y) Sa Some Si	Moist
300	-	1.2	Gry Gr(y) Sa Some Si	Moist
1.2	-	1.5	Gry Si(y) Sa(y) Cl Tr Gr	Moist

16-16 Station 11+250 SB Lane 2

0	-	165	Asph	
165	-	500	Gry Cr Gr W Sa Some Si	
500	-	1.2	Br Gr(y) Sa Some Si	
1.2	-	1.5	Br Si(y) Sa(y) Cl	Moist

16-17 Station 11+410 NB Lane 2

0	-	165	Asph	
165	-	900	Gry Cr Gr W Sa Some Si	Moist
900	-	1.5	Br Si(y) Sa(y) Cl	Moist

16-18 Station 11+500 SB Lane 1

0	-	180	Asph	
180	-	380	Gry Cr Gr W Sa Some Si	Moist
380	-	1.2	Br Gr(y) Sa Some Si	Moist
1.2	-	1.5	Br Si(y) Sa(y) Cl	Moist

16-20 Station 11+750 SB Lane 2

0	-	190	Asph	
190	-	330	Br Cr Sa(y) Gr Some Si	Moist
330	-	1.2	Br Sa(y) Gr Tr Si	Moist
1.2	-	1.5	Br Si(y) Sa(y) Cl	Moist

16-21 Station 11+815 NB Lane 2

0	-	150	Asph	
150	-	760	Br Cr Sa(y) Gr Some Si	Moist
760	-	1.5	Br Si(y) Sa(y) Cl Tr Gr	Moist

16-23 Station 12+100 NB Lane 1

0	-	150	Asph	
150	-	900	Br Cr Sa(y) Gr Some Si	Moist
900	-	2.1	Br Si(y) Sa(y) Cl Tr Gr	Moist
			Nvalue=35 blows / 300mm	

THURBER

MAVIS ROAD CLASS EA
COURTNEY PARK DRIVE TO RAY LAWSON BOULEVARD

PAVEMENT BOREHOLE LOGS

May 2016

16-24 Station 12+100 SB Lane 2

0	- 180	Asph		
180	- 360	Br Cr Gr and Sa Some Si		Moist
360	- 1.2	Br Gr(y) Sa Some Si		Moist
1.2	- 1.5	Br Si(y) Cl W Sa Tr Gr		Moist

16-25 Station 12+200 NB Lane 2

0	- 165	Asph		
165	- 1.2	Br Cr Sa(y) Gr Some Si		Moist
1.2	- 1.5	Br Si(y) Sa(y) Cl Tr Gr		Moist

16-26 Station 12+280 SB Lane 1

0	- 200	Asph		
200	- 600	Br Cr Gr and Sa Some Si		Moist
600	- 1.2	Br Gr(y) Sa Some Si		Moist
1.2	- 1.5	Br Si(y) Sa(y) Cl		Moist

16-28 Station 12+480 SB Lane 2

0	- 200	Asph		
200	- 380	Br Cr Gr and Sa Some Si		Dry
			w @ 0.2m = 2%	
380	- 1.2	Br Sa(y) Gr Tr Si		Dry
			w @ 0.8m = 3%	
1.2	- 2.1	Br Si(y) Cl W Sa Tr Gr		Moist
		Nvalue=8 blows / 300mm		
			w @ 1.3m = 17%	
			w @ 1.8 m = 14%	
			Percent Passing 4.75 mm = 93%	
			75 µm = 71%	
			5 µm = 40%	
			Frost Susceptibility = LSFH	
			Soil Erodibility = 0.22	
			W_L =30%	
			W_P = 15%	
			P_I = 15%	
			Unified Soil Classification =CL	

16-33 Station 13+050 NB Lane 2

0	- 330	Asph		
330	- 900	Br Cr Sa(y) Gr Some Si		Dry
			w @ 0.6m = 3%	
900	- 2.1	Gry Si(y) Cl W Sa Tr Gr		Moist
		Nvalue=11 blows / 300mm		
			w @ 1.2m = 15%	

16-35 Station 13+200 NB Lane 1

0	- 230	Asph		
230	- 360	Br Cr Gr and Sa Some Si		Moist
360	- 750	Gry Sa(y) Gr Tr Si		Moist
750	- 1.5	Gry Si(y) Cl W Sa Tr Gr		Moist

16-36 Station 13+330 SB Lane 2

0	- 230	Asph		
230	- 430	Br Cr Gr and Sa Some Si		Moist
430	- 1.2	Br Sa(y) Gr Tr Si		Moist
1.2	- 1.5	Br Si(y) Cl W Sa Tr Gr		Moist

16-37 Station 13+400 NB Lane 2

0	- 190	Asph		
190	- 1.5	Br Cr Sa(y) Gr Some Si		

16-38 Station 13+500 SB Lane 1

0	- 250	Asph		
250	- 430	Gry Cr Gr and Sa Some Si		Dry
			w @ 0.3m = 2%	
			Percent Passing 4.75 mm = 59%	
			75 µm = 12%	
			Acceptable as Granular B Type I	
430	- 1.5	Br Sa(y) Gr Tr Si		Moist
			w @ 1.0m = 5%	
			Percent Passing 4.75 mm = 49%	
			75 µm = 9%	
			Acceptable as Granular B Type I	
1.5	- 2.1	Br Si(y) Sa(y) Cl Tr Gr		Moist
		Nvalue=28 blows / 300mm		
			w @ 1.8m = 13%	
			Percent Passing 4.75 mm = 98%	
			75 µm = 61%	
			5 µm = 33%	
			Frost Susceptibility = LSFH	
			Soil Erodibility = 0.23	
			W_L =29%	
			W_P = 18%	
			P_I = 11%	
			Unified Soil Classification =CL	

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

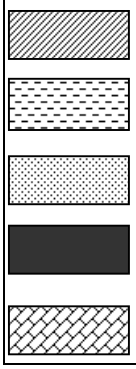
ROCK WEATHERING CLASSIFICATION

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 16-02

PROJECT : Mavis Road Class EA
LOCATION : Mississauga, ON
STARTED : May 16, 2016
COMPLETED : May 16, 2016

Project No. 11203
SHEET 1 OF 1
DATUM Geodetic

N 4 830 848.1 E 603 963.9

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS
		GROUND SURFACE						
		ASPHALT: (150mm)		0.00				
		SAND and **GRAVEL**, crushed, some silt, grey: (FILL)		0.15				Grain Size Analysis: Gr 52%/ Sa 36%/ Si & Cl 12%
		SAND and **GRAVEL**, some silt, brownish grey: (FILL)		0.38				Grain Size Analysis: Gr 37%/ Sa 46%/ Si & Cl 17%
1		**SILT**, sandy, clayey, some gravel, stiff, grey: (TILL)		1.22				
					1	SS	13	Grain Size Analysis: Gr 14%/ Sa 34%/ Si 38%/ Cl 14%
2		**CLAY**,silty, sandy, trace gravel, stiff, brown: (TILL)		2.13				
					2	SS	14	Grain Size Analysis: Gr 4%/ Sa 27%/ Si 42%/ Cl 27%
3		END OF BOREHOLE AT 3.66m.		3.66				
4								
5								
6								
7								
8								
9								

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

LOGGED : OA/RI
CHECKED : RI

THURBER

THURBER2S TEL-11203.GPJ 1/31/17

RECORD OF BOREHOLE 16-05

PROJECT : Mavis Road Class EA
LOCATION : Mississauga, ON
STARTED : May 16, 2016
COMPLETED : May 16, 2016

Project No. 11203
SHEET 1 OF 1
DATUM Geodetic

N 4 831 114.7 E 603 715.5

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS
		GROUND SURFACE						
		ASPHALT: (150mm)		0.00				
		GRAVEL, sandy, crushed, some silt, grey: (FILL)		0.15				Grain Size Analysis: Gr 59%/ Sa 31%/ Si & Cl 10%
1	Auger	**CLAY**, silty, sandy, trace gravel, very stiff, brown: (TILL)		0.91				
2					1	SS	24	Grain Size Analysis: Gr 6%/ Sa 36%/ Si 39%/ Cl 19%
3					2	SS	26	
		END OF BOREHOLE AT 3.66m.		3.66				
4								
5								
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 : OA/RI
CHECKED : RI

THURBER

THURBER2S TEL-11203.GPJ 1/31/17

RECORD OF BOREHOLE 16-06

PROJECT : Mavis Road Class EA
LOCATION : Mississauga, ON
STARTED :
COMPLETED :

Project No. 11203
SHEET 1 OF 1
N 4 831 141.7 E 603 669.1
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
		GROUND SURFACE									
1								Grain Size Analysis: Gr 36%/ Sa 46%/ Si & Cl 18%			
								Grain Size Analysis: Gr 5%/ Sa 38%/ Si 38%/ Cl 19%			
2											
3											
4											
5											
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

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

LOGGED :
CHECKED :

THURBER

THURBER2S TEL-11203.GPJ 1/31/17

RECORD OF BOREHOLE 16-10

PROJECT : Mavis Road Class EA
LOCATION : Mississauga, ON
STARTED : May 16, 2016
COMPLETED : May 16, 2016

Project No. 11203
SHEET 1 OF 1
N 4 831 413.0 E 603 423.3
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									
		ASPHALT: (165mm)		0.00							
		SAND and **GRAVEL**, crushed, some silt, grey: (FILL)		0.16							
1									○		
		CLAY, silty, sandy, trace gravel, very stiff to hard, brown: (TILL)		1.52	1	SS	24		○		
2											
3					2	SS	35		○		
		END OF BOREHOLE AT 3.66m.		3.66							
4											
5											
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

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

LOGGED : OA/RI
CHECKED : RI

THURBER

THURBER2S TEL-11203.GPJ 1/31/17

RECORD OF BOREHOLE 16-15

PROJECT : Mavis Road Class EA
LOCATION : Mississauga, ON
STARTED : May 16, 2016
COMPLETED : May 16, 2016

Project No. 11203
SHEET 1 OF 1
DATUM Geodetic

N 4 831 755.3 E 603 126.1

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS
		GROUND SURFACE						
		ASPHALT: (175mm)		0.00				
		GRAVEL, sandy, crushed, trace silt, brown: (FILL)		0.18				Grain Size Analysis: Gr 64%/ Sa 27%/ Si & Cl 9%
1		**CLAY**, silty, sandy, trace gravel, firm to very stiff, brown: (TILL)		0.91				
2					1	SS	7	Grain Size Analysis: Gr 3%/ Sa 28%/ Si 43%/ Cl 26%
3					2	SS	27	
		END OF BOREHOLE AT 3.66m.		3.66				
4								
5								
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 : OA/RI
CHECKED : RI

THURBER

THURBER2S TEL-11203.GPJ 1/31/17

RECORD OF BOREHOLE 16-19

PROJECT : Mavis Road Class EA
LOCATION : Mississauga, ON
STARTED : May 16, 2016
COMPLETED : May 16, 2016

Project No. 11203
SHEET 1 OF 1
DATUM Geodetic

N 4 832 127.6 E 602 935.4

DEPTH SCALE (metres)	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	COMMENTS	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						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)		
		ASPHALT: (160mm)		0.00							
		SAND, gravelly, crushed, some silt, brown: (FILL)		0.16				Grain Size Analysis: Gr 28%/ Sa 52%/ Si & Cl 20%			
1		**SILT**, clayey, sandy, trace gravel, brown: (TILL)		0.91							
		CLAY, silty, sandy, very stiff to stiff, brown: (TILL)		1.52	1	SS	19	Grain Size Analysis: Gr 0%/ Sa 37%/ Si 47%/ Cl 16%			
2											
3					2	SS	11				
		END OF BOREHOLE AT 3.66m.		3.66							
4											
5											
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

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

LOGGED : OA/RI
CHECKED : RI

THURBER

THURBER2S TEL-11203.GPJ 1/31/17

RECORD OF BOREHOLE 16-22

PROJECT : Mavis Road Class EA
LOCATION : Mississauga, ON
STARTED : May 16, 2016
COMPLETED : May 16, 2016

Project No. 11203
SHEET 1 OF 1
DATUM Geodetic

N 4 832 311.7 E 602 674.3

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									
		ASPHALT: (150mm)		0.00				Grain Size Analysis: Gr 46%/ Sa 40%/ Si & Cl 14%			
		SAND and **GRAVEL**, crushed, some silt, brown: (FILL)		0.15							
		GRAVEL, sandy, some silt, brown: (FILL)		0.28				Grain Size Analysis: Gr 57%/ Sa 31%/ Si & Cl 12%			
1		**CLAY**, silty, some sand, trace gravel, stiff, brown: (TILL)		1.22							
2					1	SS	9	Grain Size Analysis: Gr 0%/ Sa 19%/ Si 51%/ Cl 30%			
3		**SAND**, silty, trace gravel, compact, brown		3.05	2	SS	20				
		END OF BOREHOLE AT 3.66m.		3.66							
4											
5											
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

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

LOGGED : OA/RI
CHECKED : RI

THURBER

THURBER2S TEL-11203.GPJ 1/31/17

RECORD OF BOREHOLE 16-27

PROJECT : Mavis Road Class EA
LOCATION : Mississauga, ON
STARTED : May 16, 2016
COMPLETED : May 16, 2016

Project No. 11203
SHEET 1 OF 1
DATUM Geodetic

N 4 832 614.4 E 602 275.4

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 - ✚, 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									
		ASPHALT: (150mm)		0.00							
		SAND and **GRAVEL**, crushed, some silt, brown: (FILL)		0.15				Grain Size Analysis: Gr 51%/Sa 36%/ Si & Cl 13%	○		
1		**CLAY**, silty, sandy, trace gravel, firm to very stiff, brown: (TILL)		1.22	1	GS		Grain Size Analysis: Gr 0%/ Sa 34%/ Si 38%/ Cl 28%	○		
2					1	SS	7	Grain Size Analysis: Gr 0%/ Sa 24%/ Si 45%/ Cl 31%	○ — ⊖ —		
3					2	SS	26	Grain Size Analysis: Gr 0%/ Sa 30%/ Si 43%/ Cl 27%	○		
		END OF BOREHOLE AT 3.66m.		3.66							
4											
5											
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

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

LOGGED : OA/RI
CHECKED : RI

THURBER

THURBER2S TEL-11203.GPJ 1/31/17

RECORD OF BOREHOLE 16-28

PROJECT : Mavis Road Class EA
LOCATION : Mississauga, ON
STARTED :
COMPLETED :

Project No. 11203
SHEET 1 OF 1
N 4 832 640.9 E 602 211.4
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
		GROUND SURFACE									
1											
2								Grain Size Analysis: Gr 3%/ Sa 26%/ Si 44%/ Cl 27%			
3											
4											
5											
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

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

LOGGED :
CHECKED :

THURBER

THURBER2S TEL-11203.GPJ 1/31/17

RECORD OF BOREHOLE 16-34

PROJECT : Mavis Road Class EA
LOCATION : Mississauga, ON
STARTED : May 16, 2016
COMPLETED : May 16, 2016

Project No. 11203
SHEET 1 OF 1
DATUM Geodetic

N 4 832 803.5 E 601 576.5

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									
		ASPHALT: (195mm)		0.00							
		SAND and **GRAVEL**, crushed, some silt, brown: (FILL)		0.20				Grain Size Analysis: Gr 51%/ Sa 39%/ Si & Cl 10%	○		
		SAND and **GRAVEL**, trace silt, brown: (FILL)		0.35				Grain Size Analysis: Gr 56%/ Sa 36%/ Si & Cl 8%	○		
1											
		CLAY, silty, some sand, trace gravel, stiff to very stiff, brown/grey: (TILL)		1.52	1	SS	11	Grain Size Analysis: Gr 2%/ Sa 23%/ Si 43%/ Cl 32%	○ wp–w–wl		
2											
3					2	SS	20		○		
		END OF BOREHOLE AT 3.66m.		3.66							
4											
5											
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

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

LOGGED : OA/RI
CHECKED : RI

THURBER

THURBER2S TEL-11203.GPJ 1/31/17

RECORD OF BOREHOLE 16-38

PROJECT : Mavis Road Class EA
LOCATION : Mississauga, ON
STARTED :
COMPLETED :

Project No. 11203
SHEET 1 OF 1
N 4 832 807.5 E 601 207.8
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 (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									
								Grain Size Analysis: Gr 41%/ Sa 49%/ Si & Cl 10%			
1								Grain Size Analysis: Gr 52%/ Sa 40%/ Si & Cl 8%			
2								Grain Size Analysis: Gr 4%/ Sa 35%/ Si 42%/ Cl 19%	wp – w – wl		
3											
4											
5											
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

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

LOGGED :
CHECKED :

THURBER

THURBER2S TEL-11203.GPJ 1/31/17

RECORD OF BOREHOLE 16-39

PROJECT : Mavis Road Class EA
LOCATION : Mississauga, ON
STARTED : May 16, 2016
COMPLETED : May 16, 2016

Project No. 11203
SHEET 1 OF 1
DATUM Geodetic

N 4 832 844.3 E 601 148.2

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									
		ASPHALT: (225mm)		0.00							
		SAND, gravelly, crushed, some silt, grey: (FILL)		0.23				Grain Size Analysis: Gr 34%/Sa 56%/ Si & Cl 10%	○		
		SAND and **GRAVEL**, some silt, occasional cobbles, grey: (FILL)		0.38					○		
1											
		CLAY, silty, sandy, trace gravel, very stiff, grey: (TILL)		1.52	1	SS	27	Grain Size Analysis: Gr 3%/ Sa 31%/ Si 43%/ Cl 23%	○ ⊢		
2											
3					2	SS	30		○		
		END OF BOREHOLE AT 3.66m.		3.66							
4											
5											
6											
7											
8											
9											

GROUNDWATER ELEVATIONS

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

LOGGED : OA/RI
CHECKED : RI

THURBER

THURBER2S TEL-11203.GPJ 1/31/17

THURBER

60 YEARS

APPENDIX E

LOGS AND PHOTOGRAPHS OF ASPHALT CORES

Mavis Road Class EA Study
Courtneypark Drive West to Ray Lawson Boulevard
Pavement Core Photographs

Pavement Core BH 16-04

Southbound
Lane 2

Station 10+120

Layer	Thickness (mm)
Surface	50
Binder	50
Binder	55
Total	**155**

Pavement Core BH 16-05

Northbound
Lane 2

Station 10+290

Layer	Thickness (mm)
Surface	45
Binder	55
Binder	50
Total	**150**

Pavement Core BH 16-10

Southbound
Lane 1

Station 10+700

Layer	Thickness (mm)
Surface	45
Binder	50
Binder	70
Total	**165**

THURBER

Mavis Road Class EA Study
Courtneypark Drive West to Ray Lawson Boulevard
Pavement Core Photographs

Pavement Core BH 16-11

Northbound
Lane 1

Station 10+800

Layer	Thickness (mm)
Surface	60
Binder	45
Binder	55
Total	**160**

Pavement Core BH 16-21

Northbound
Lane 2

Station 11+815

Layer	Thickness (mm)
Surface	50
Binder	50
Binder	50
Total	**150**

Pavement Core BH 16-22

Southbound
Lane 1

Station 11+900

Layer	Thickness (mm)
Surface	50
Binder	100
Total	**150**

Note: Delamination at 50 mm depth

Mavis Road Class EA Study
Courtneypark Drive West to Ray Lawson Boulevard
Pavement Core Photographs

Pavement Core BH 16-34

Southbound
Lane 1

Station 13+100

Layer	Thickness (mm)
Surface	50
Binder	60
Binder	85
Total	**195**

Pavement Core BH 16-37

Northbound
Lane 2

Station 13+400

Layer	Thickness (mm)
Surface	60
Binder	70
Binder	60
Total	**190**

APPENDIX F

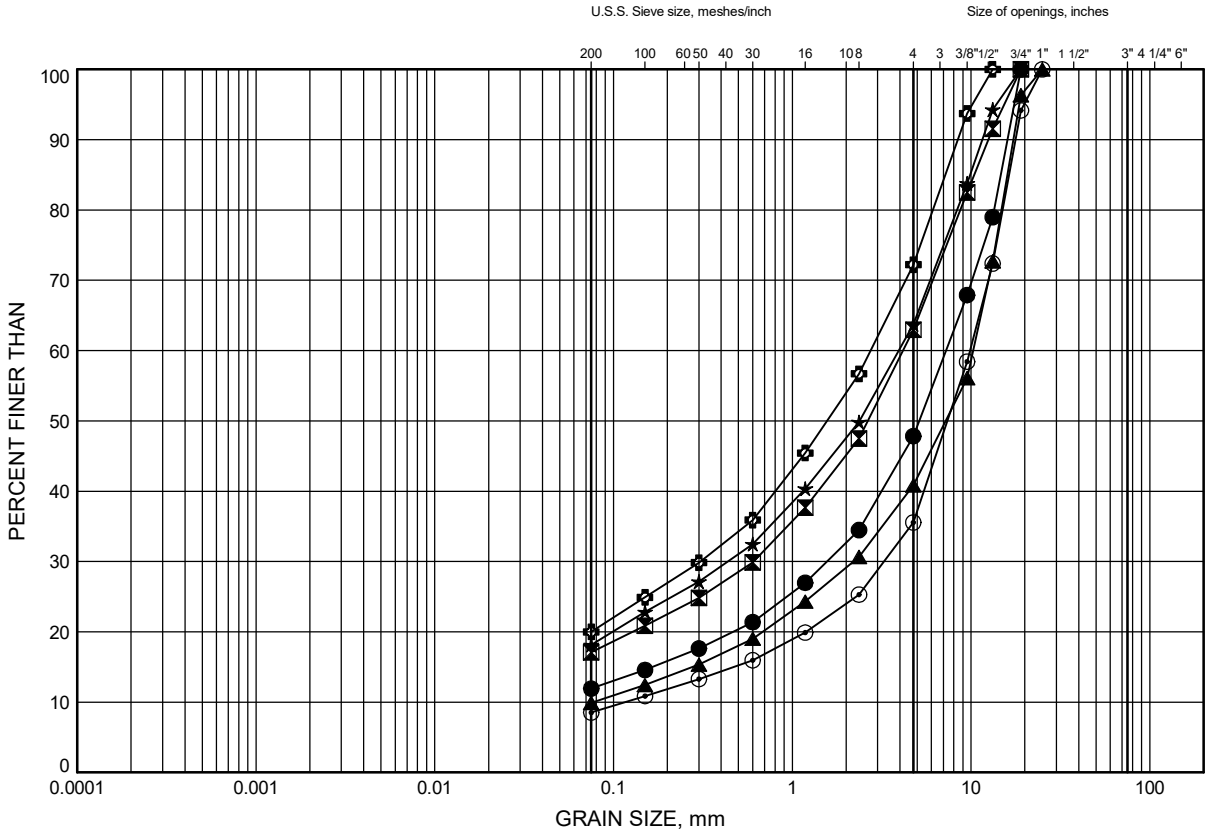
GEOTECHNICAL LABORATORY TEST RESULTS

Mavis Road Class EA

GRAIN SIZE DISTRIBUTION

FIGURE 1

Granular Material



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	16-02	0.32	
⊠	16-02	0.83	
▲	16-05	0.53	
★	16-06	0.71	
⊙	16-15	0.55	
✿	16-19	0.38	

Date January 2017

Project 11203

THURBER

Prep'd MFA

Chkd. MRA

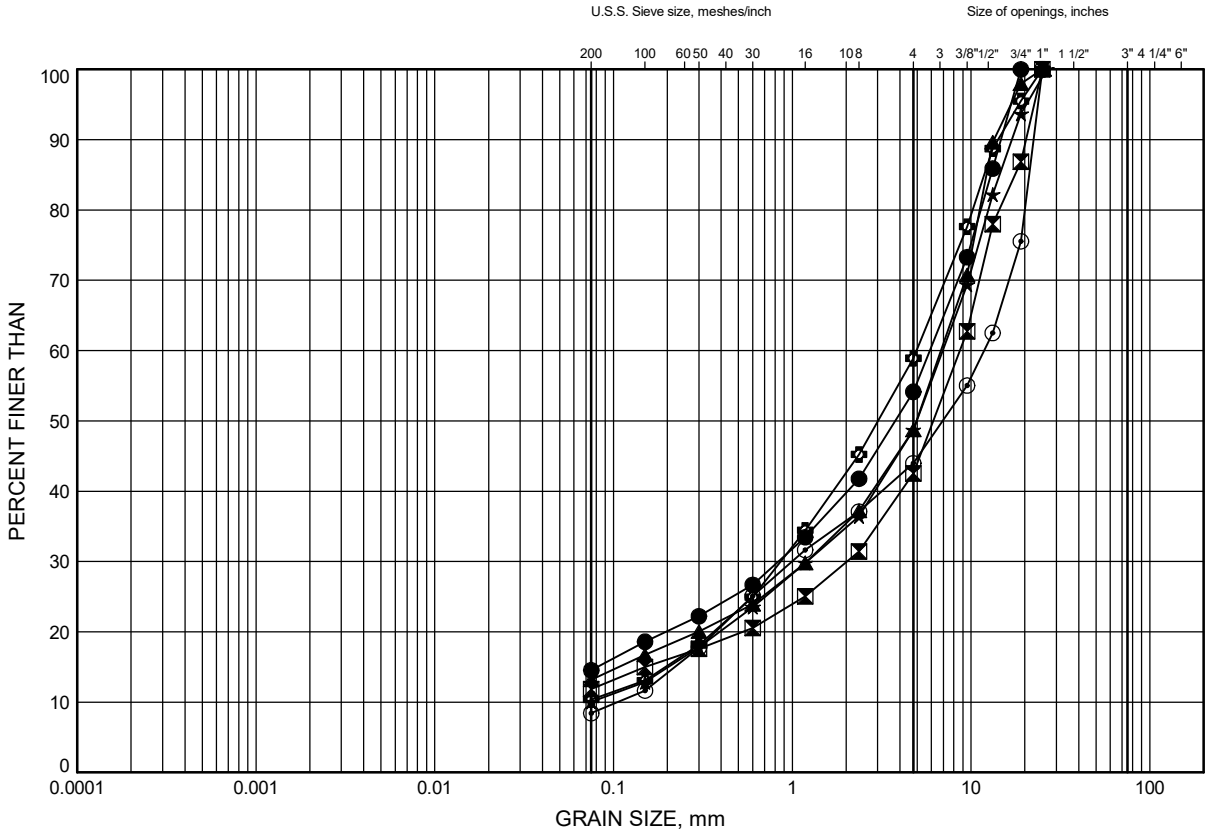
GRAIN SIZE DISTRIBUTION - THURBER TEL-11203.GPJ 1/31/17

Mavis Road Class EA

GRAIN SIZE DISTRIBUTION

FIGURE 2

Granular Material



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	16-22	0.22	
⊠	16-22	0.75	
▲	16-27	0.69	
★	16-34	0.29	
⊙	16-34	0.97	
✿	16-38	0.37	

Date January 2017

Project 11203

THURBER

Prep'd MFA

Chkd. MRA

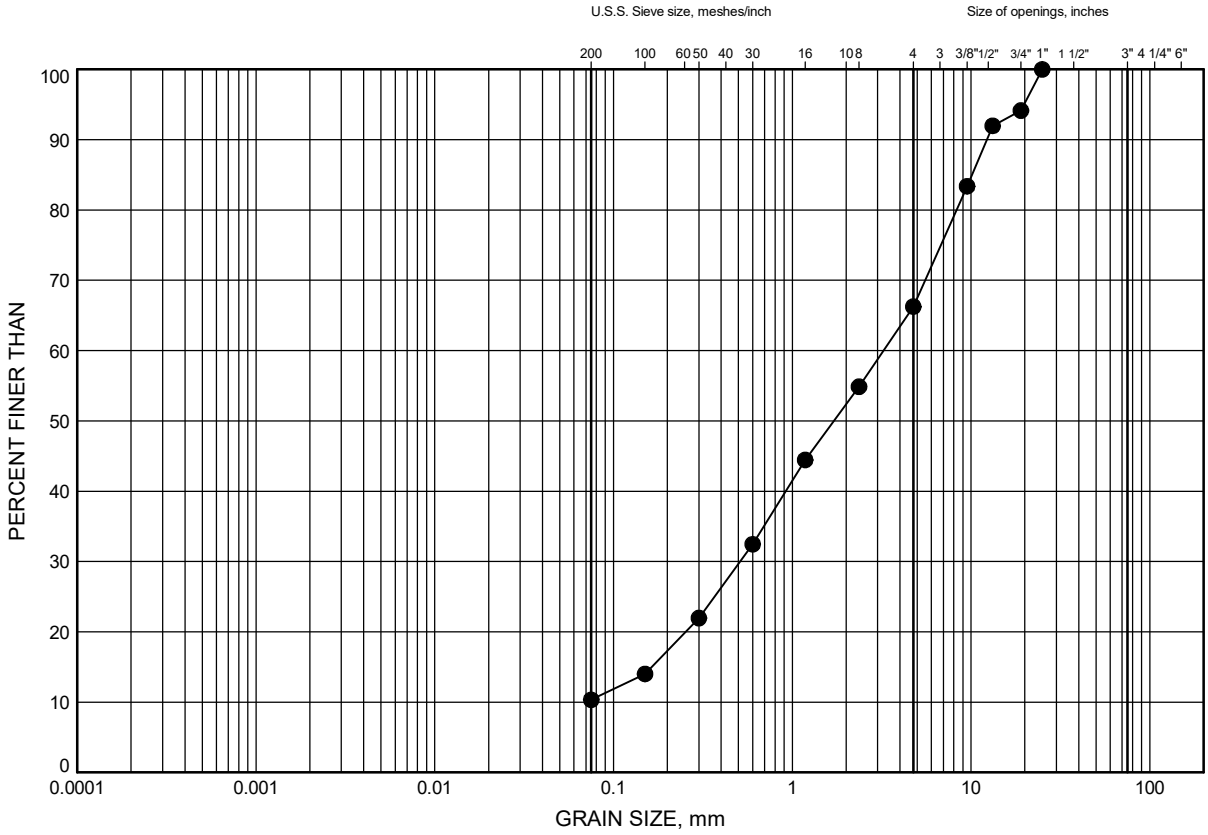
GRAIN SIZE DISTRIBUTION - THURBER TEL-11203.GPJ 1/31/17

Mavis Road Class EA

GRAIN SIZE DISTRIBUTION

FIGURE 3

Granular Material



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	16-39	0.33	

Date January 2017

Project 11203

THURBER

Prep'd MFA

Chkd. MRA

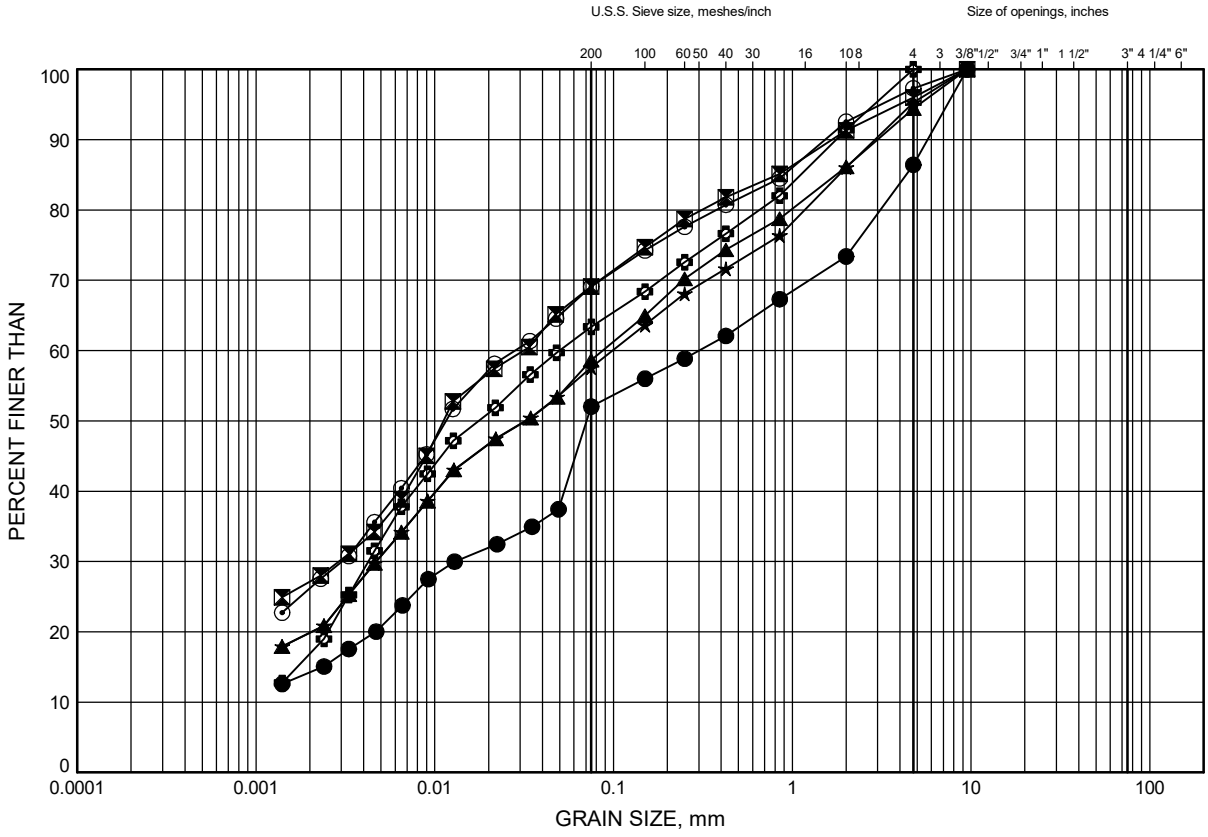
GRAIN SIZE DISTRIBUTION - THURBER TEL-11203.GPJ 1/31/17

Mavis Road Class EA

GRAIN SIZE DISTRIBUTION

FIGURE 4

Silty Sandy Clay Till



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	16-02	1.83	
⊠	16-02	3.35	
▲	16-05	1.83	
★	16-06	1.37	
⊙	16-15	1.83	
✿	16-19	1.83	

Date January 2017

Project 11203

THURBER

Prep'd MFA

Chkd. MRA

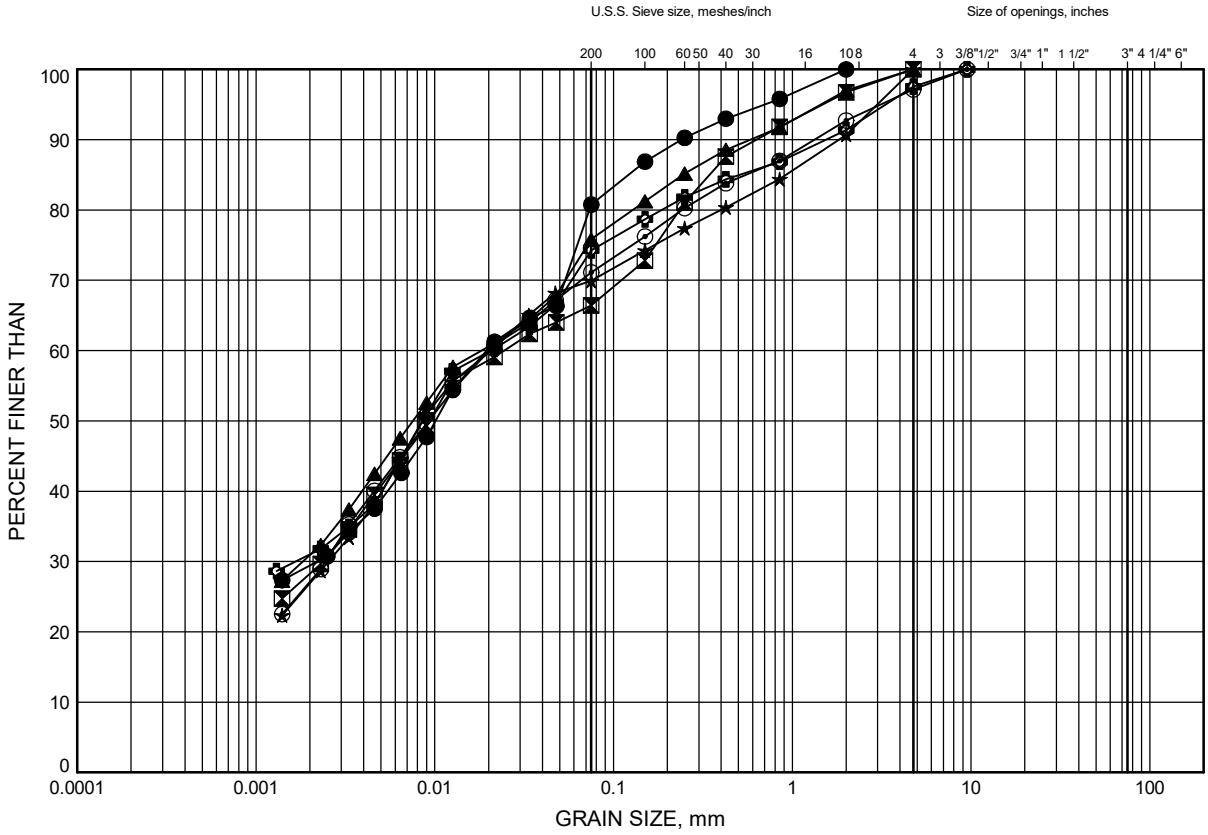
GRAIN SIZE DISTRIBUTION - THURBER TEL-11203.GPJ 1/31/17

Mavis Road Class EA

GRAIN SIZE DISTRIBUTION

FIGURE 5

Silty Sandy Clay Till



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	16-22	1.83	
⊠	16-27	1.37	
▲	16-27	1.83	
★	16-27	3.35	
⊙	16-28	1.83	
✿	16-34	1.83	

Date January 2017

Project 11203

THURBER

Prep'd MFA

Chkd. MRA

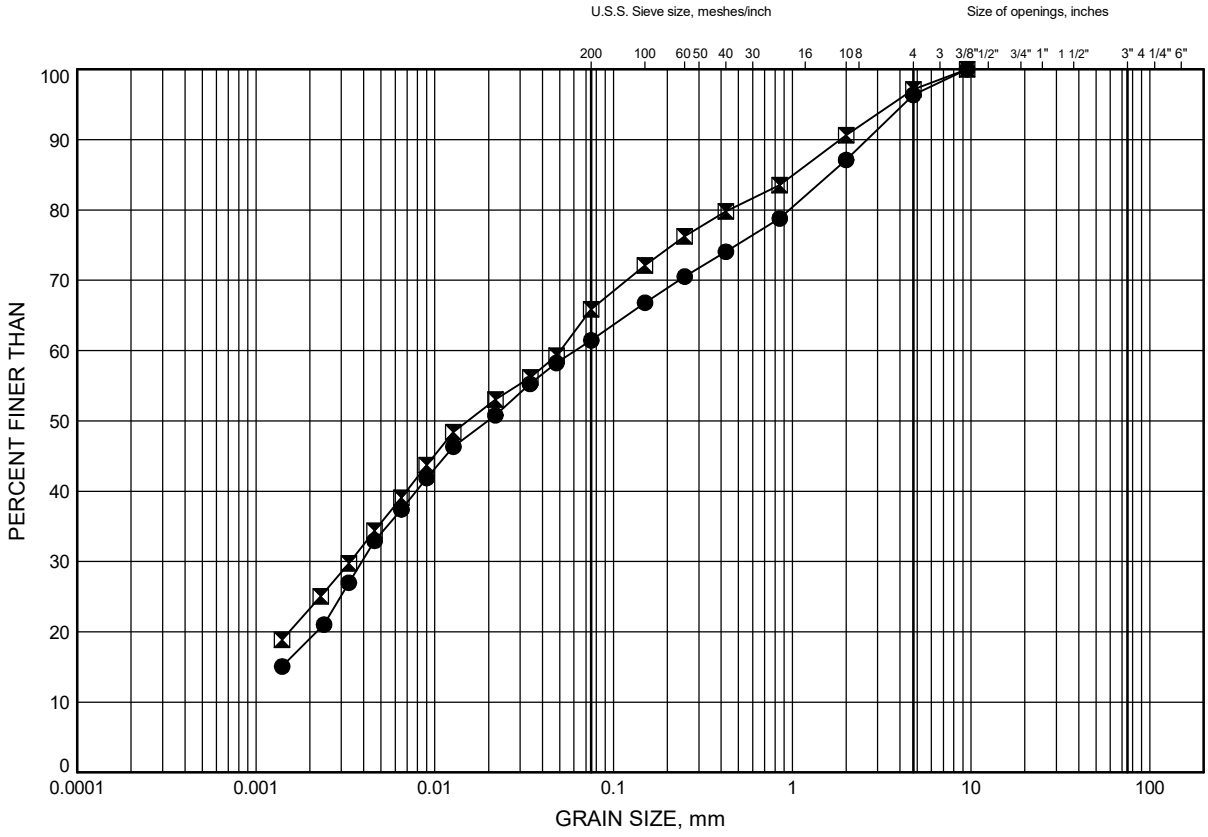
GRAIN SIZE DISTRIBUTION - THURBER TEL-11203.GPJ 1/31/17

Mavis Road Class EA

GRAIN SIZE DISTRIBUTION

FIGURE 6

Silty Sandy Clay Till



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	16-38	1.83	
⊠	16-39	1.83	

Date January 2017

Project 11203

THURBER

Prep'd MFA

Chkd. MRA

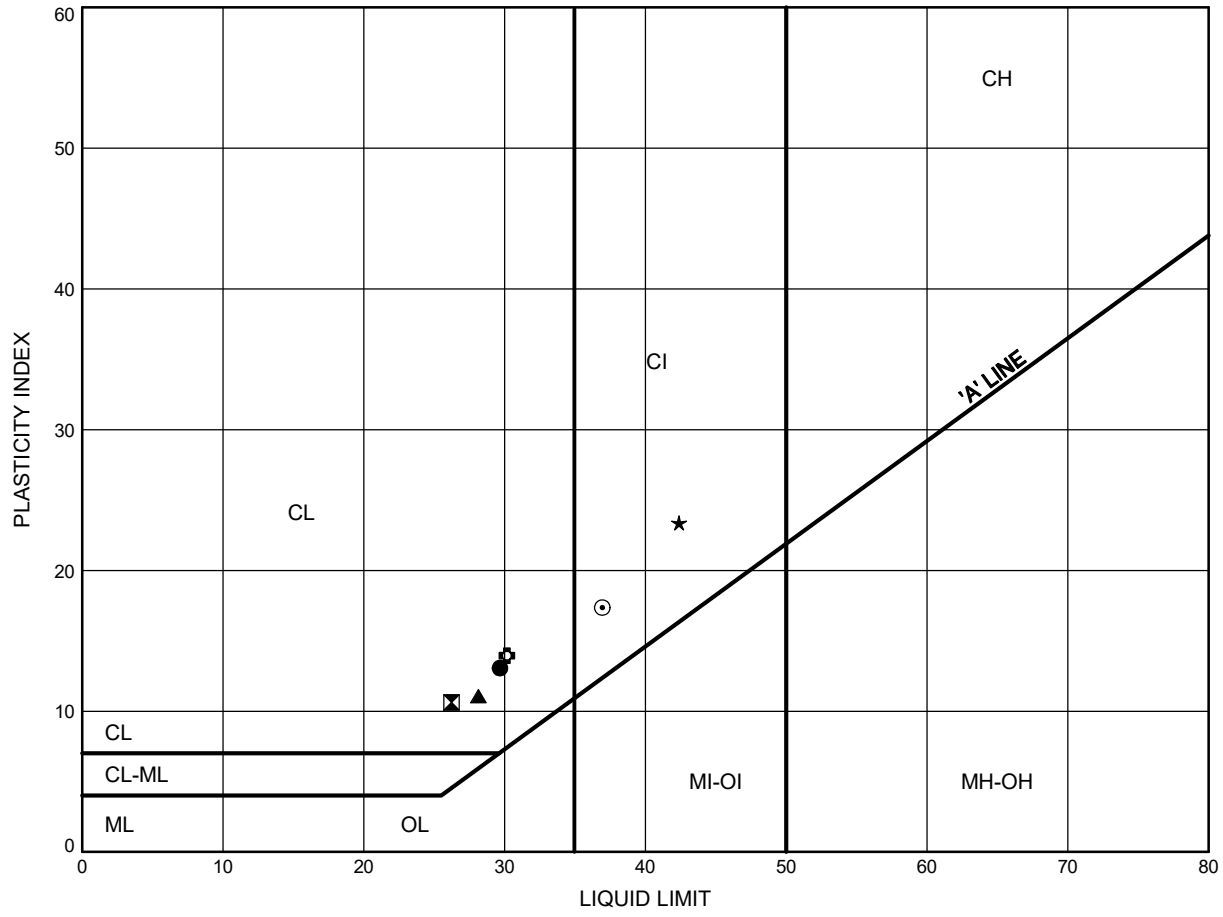
GRAIN SIZE DISTRIBUTION - THURBER TEL-11203.GPJ 1/31/17

Mavis Road Class EA

ATTERBERG LIMITS TEST RESULTS

FIGURE 7

Silty Sandy Clay Till



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	16-02	3.35	
⊠	16-05	1.83	
▲	16-19	1.83	
★	16-22	1.83	
⊙	16-27	1.83	
✿	16-28	1.83	

Date January 2017

Project 11203

THURBER

Prep'd MFA

Chkd. MRA

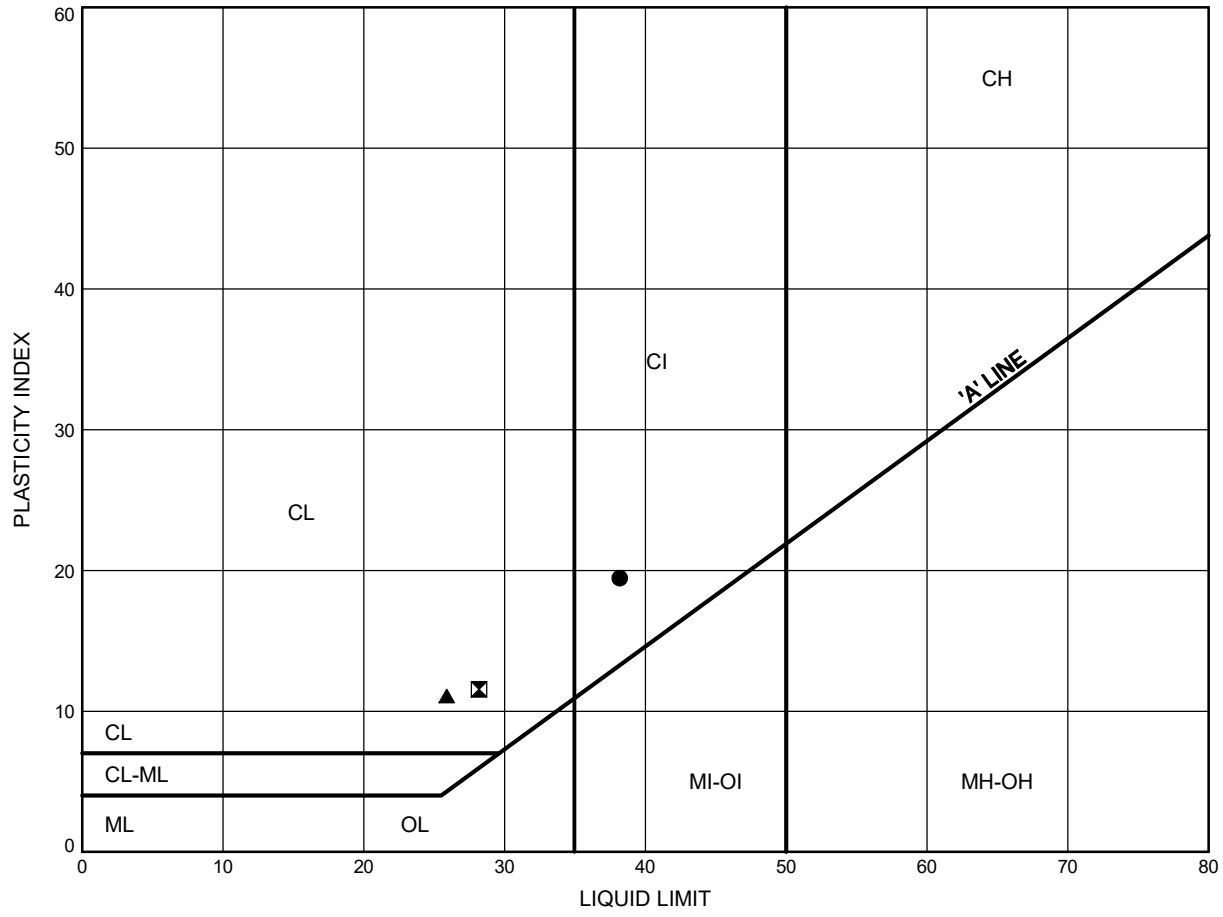
THURBALT TEL-11203.GPJ 1/31/17

Mavis Road Class EA

ATTERBERG LIMITS TEST RESULTS

FIGURE 8

Silty Sandy Clay Till



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	16-34	1.83	
⊠	16-38	1.83	
▲	16-39	1.83	

Date January 2017

Project 11203

THURBER

Prep'd MFA

Chkd. MRA

THURBALT TEL-11203.GPJ 1/31/17

APPENDIX G

ENVIRONMENTAL LABORATORY TEST RESULTS

AGAT Laboratories

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

Certificate of Analysis

AGAT WORK ORDER: 16T098258

PROJECT: 11203-Mavis Road

CLIENT NAME: THURBER ENGINEERING LTD

ATTENTION TO: Riyad Islam

SAMPLING SITE:

SAMPLED BY:Omar

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

DATE RECEIVED: 2016-05-20

DATE REPORTED: 2016-05-31

				BH 16-09	BH 16-20	BH 16-35	BH 16-04
SAMPLE DESCRIPTION:				(0'-6"-3'-0")	(0'-20"-4'-0")	(0'-9"-0'-14")	(5'-0"-7'-0")
SAMPLE TYPE:				Soil	Soil	Soil	Soil
DATE SAMPLED:				5/16/2016	5/16/2016	5/16/2016	5/16/2016
Parameter	Unit	G / S	RDL	7583710	7583721	7583722	7583724
Antimony	µg/g	7.5	0.8	<0.8	<0.8	<0.8	<0.8
Arsenic	µg/g	18	1	5	4	4	5
Barium	µg/g	390	2	5	7	57	80
Beryllium	µg/g	5	0.5	<0.5	<0.5	<0.5	0.7
Boron	µg/g	120	5	8	8	7	10
Boron (Hot Water Soluble)	µg/g	1.5	0.10	0.20	0.23	0.35	0.13
Cadmium	µg/g	1.2	0.5	<0.5	<0.5	<0.5	<0.5
Chromium	µg/g	160	2	<2	3	10	21
Cobalt	µg/g	22	0.5	1.3	1.4	4.8	12.7
Copper	µg/g	180	1	3	4	25	37
Lead	µg/g	120	1	6	6	11	38
Molybdenum	µg/g	6.9	0.5	<0.5	<0.5	0.6	<0.5
Nickel	µg/g	130	1	<1	<1	6	24
Selenium	µg/g	2.4	0.4	<0.4	<0.4	<0.4	<0.4
Silver	µg/g	25	0.2	<0.2	<0.2	<0.2	<0.2
Thallium	µg/g	1	0.4	<0.4	<0.4	<0.4	<0.4
Uranium	µg/g	23	0.5	<0.5	<0.5	<0.5	0.6
Vanadium	µg/g	86	1	3	3	17	27
Zinc	µg/g	340	5	42	44	44	59
Chromium VI	µg/g	10	0.2	<0.2	<0.2	<0.2	<0.2
Cyanide	µg/g	0.051	0.040	<0.040	<0.040	<0.040	<0.040
Mercury	µg/g	1.8	0.10	<0.10	<0.10	<0.10	<0.10
Electrical Conductivity	mS/cm	0.7	0.005	1.60	1.12	0.824	1.24
Sodium Adsorption Ratio	NA	5	NA	2.47	2.81	16.3	8.97
pH, 2:1 CaCl2 Extraction	pH Units		NA	8.38	8.37	8.43	7.78

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to ON T2 S RPI MFT

7583710-7583724 EC & SAR were determined on the DI water extract obtained from the 2:1 leaching procedure (2 parts DI water:1 part soil). pH was determined on the 0.01M CaCl2 extract prepared at 2:1 ratio.

Certified By: Amanjot Bhela

AGAT Laboratories

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

Certificate of Analysis

AGAT WORK ORDER: 16T098258

PROJECT: 11203-Mavis Road

CLIENT NAME: THURBER ENGINEERING LTD

ATTENTION TO: Riyad Islam

SAMPLING SITE:

SAMPLED BY:Omar

O. Reg. 558 Metals and Inorganics

DATE RECEIVED: 2016-05-20

DATE REPORTED: 2016-05-31

Parameter	Unit	G / S	RDL	BH 16-20 (0'-20"-4'-0") Soil 5/16/2016 7583721	BH 16-33 (4'-0"-5'-0") Soil 5/16/2016 7583723
Arsenic Leachate	mg/L		0.010	<0.010	<0.010
Barium Leachate	mg/L		0.100	0.173	0.743
Boron Leachate	mg/L		0.050	0.071	0.065
Cadmium Leachate	mg/L		0.010	<0.010	<0.010
Chromium Leachate	mg/L		0.010	<0.010	<0.010
Lead Leachate	mg/L		0.010	0.019	0.020
Mercury Leachate	mg/L		0.01	<0.01	<0.01
Selenium Leachate	mg/L		0.010	<0.010	<0.010
Silver Leachate	mg/L		0.010	<0.010	<0.010
Uranium Leachate	mg/L		0.050	<0.050	<0.050
Fluoride Leachate	mg/L		0.05	0.43	0.17
Cyanide Leachate	mg/L		0.05	<0.05	<0.05
(Nitrate + Nitrite) as N Leachate	mg/L		0.70	<0.70	<0.70

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to ON T2 S RPI MFT

Certified By: Amanjot Bhela

AGAT Laboratories

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

Certificate of Analysis

AGAT WORK ORDER: 16T098258

PROJECT: 11203-Mavis Road

CLIENT NAME: THURBER ENGINEERING LTD

ATTENTION TO: Riyad Islam

SAMPLING SITE:

SAMPLED BY:Omar

PHCs F1 - F4 (Soil)

DATE RECEIVED: 2016-05-20

DATE REPORTED: 2016-05-31

				BH 16-35	BH 16-33	BH 16-04
SAMPLE DESCRIPTION:				(0'-9"-0'-14")	(4'-0"-5'-0")	(5'-0"-7'-0")
SAMPLE TYPE:				Soil	Soil	Soil
DATE SAMPLED:				5/16/2016	5/16/2016	5/16/2016
Parameter	Unit	G / S	RDL	7583722	7583723	7583724
Benzene	µg/g	0.17	0.02	<0.02	<0.02	<0.02
Toluene	µg/g	6	0.08	<0.08	<0.08	<0.08
Ethylbenzene	µg/g	1.6	0.05	<0.05	<0.05	<0.05
Xylene Mixture	µg/g	25	0.05	<0.05	<0.05	<0.05
F1 (C6 to C10)	µg/g	65	5	<5	<5	<5
F1 (C6 to C10) minus BTEX	µg/g	65	5	<5	<5	<5
F2 (C10 to C16)	µg/g	150	10	<10	<10	<10
F3 (C16 to C34)	µg/g	1300	50	870	<50	<50
F4 (C34 to C50)	µg/g	5600	50	950	<50	<50
Gravimetric Heavy Hydrocarbons	µg/g	5600	50	NA	NA	NA
Moisture Content	%		0.1	3.4	6.9	9.8
Surrogate	Unit	Acceptable Limits				
Terphenyl	%	60-140		76	86	97

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to ON T2 S RPI MFT

7583722-7583724 Results are based on sample dry weight.
The C6-C10 fraction is calculated using Toluene response factor.
The C10 - C16, C16 - C34, and C34 - C50 fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons are not included in the Total C16-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
The chromatogram has returned to baseline by the retention time of nC50.
Total C6 - C50 results are corrected for BTEX contributions.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
Extraction and holding times were met for this sample.
Fractions 1-4 are quantified with the contribution of PAHs. Under Ontario Regulation 153, results are considered valid without determining the PAH contribution if not requested by the client.
Quality Control Data is available upon request.
The soil sample was prepared in the lab using the Methanol extraction technique. The sample was not field preserved with methanol and an Encore was not provided for analysis.

Certified By:

AGAT Laboratories

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

Guideline Violation

AGAT WORK ORDER: 16T098258

PROJECT: 11203-Mavis Road

CLIENT NAME: THURBER ENGINEERING LTD

ATTENTION TO: Riyad Islam

SAMPLEID	SAMPLE TITLE	GUIDELINE	ANALYSIS PACKAGE	PARAMETER	GUIDEVALUE	RESULT
7583710	BH 16-09 (0'-6"-3'-0")	ON T2 S RPI MFT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	0.7	1.60
7583721	BH 16-20 (0'-20"-4'-0")	ON T2 S RPI MFT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	0.7	1.12
7583722	BH 16-35 (0'-9"-0'-14")	ON T2 S RPI MFT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	0.7	0.824
7583722	BH 16-35 (0'-9"-0'-14")	ON T2 S RPI MFT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	5	16.3
7583724	BH 16-04 (5'-0"-7'-0")	ON T2 S RPI MFT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Electrical Conductivity	0.7	1.24
7583724	BH 16-04 (5'-0"-7'-0")	ON T2 S RPI MFT	O. Reg. 153(511) - Metals & Inorganics (Soil)	Sodium Adsorption Ratio	5	8.97

APPENDIX H

GEOTECHNICAL DATA FROM PREVIOUS INVESTIGATION AT HIGHWAY 407 STRUCTURE

RECORD OF BOREHOLE M-12

PROJECT : Hwy 407 & Mavis Road Interchange
LOCATION : N 4 833 257.0 E 285 627.0
STARTED : 1999 November 1
COMPLETED : 1999 November 1

PROJECT No. 19-3132-4

THURBER

SHEET 1 OF 1
DATUM

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✕, U - ▲) 40 80 120 160 / WATER CONTENT, PERCENT wp w wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		199.40							
		CRUSHER RUN LIMESTONE (FILL)		0.00							19mm PIEZOMETER
				199.09	1	SS	41		○		
		SILT, sandy, trace gravel, trace clay, very dense, brown, damp: (ML-NONPLASTIC)		0.30							
1					2	SS	50/125		○		
					3	SS	50/100		○		
2											CUTTINGS
					4	SS	96/225		○		
3					5	SS	50/100		○		
											195.74
4											BENTONITE
											195.13
					6	SS	50/100		○		FILTER SAND 194.82
5											
											SLOTTED SCREEN
6	210mm HOLLOW STEM AUGERS			193.30	7	SS	50/150		○		193.30
		END OF BOREHOLE AT 6.1m. BOREHOLE OPEN TO 6.1m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.		6.10							
7		WATER LEVEL READINGS: DATE DEPTH (m) 08/11/99 Dry to 6.0									
8											
9											

GROUNDWATER ELEVATIONS

SHALLOW/SINGLE INSTALLATION
WATER LEVEL (date)

DEEP/DUAL INSTALLATION
WATER LEVEL (date)

LOGGED : GA
CHECKED : AEG

THURBER

THURBER2 1324 99/11/10

RECORD OF BOREHOLE M-13

PROJECT : Hwy 407 & Mavis Road Interchange
LOCATION : N 4 833 288.0 E 285 657.1
STARTED : 1999 November 1
COMPLETED : 1999 November 1

PROJECT No. 19-3132-4

THURBER

SHEET 1 OF 1
DATUM

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✕, U - ▲; 40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl; 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		200.60							
		CRUSHER RUN LIMESTONE (FILL)		0.00	1	SS	20		○		
				200.00							
		SILT, sandy, trace gravel, trace clay, very dense, brown, damp: (ML-NONPLASTIC)		0.61	2	SS	50/125		○		
1					3	SS	50/075		○		
2	210mm HOLLOW STEM AUGERS				4	SS	89		○		
3					5	SS	50/150		○		
4											
					6	SS	50/150		○		
5											
6					7	SS	50/125		○		
				194.39							
		END OF BOREHOLE AT 6.2m BOREHOLE OPEN TO 6.2m. BOREHOLE DRY ON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS.		6.22							
7											
8											
9											

GROUNDWATER ELEVATIONS

▽ SHALLOW/SINGLE INSTALLATION
WATER LEVEL (date)

▼ DEEP/DUAL INSTALLATION
WATER LEVEL (date)

LOGGED : GA
CHECKED : AEG

THURBER

THURBER2 1324 99/11/10

RECORD OF BOREHOLE M-14

PROJECT : Hwy 407 & Mavis Road Interchange
LOCATION : N 4 833 250.0 E 285 660.1
STARTED : 1999 November 1
COMPLETED : 1999 November 1

PROJECT No. 19-3132-4

THURBER

SHEET 1 OF 1
DATUM

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✕, U - ▲) 40 80 120 160 / WATER CONTENT, PERCENT wp w wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		199.58							
		CRUSHER RUN LIMESTONE (FILL)		0.00							
				199.28	1	SS	54		○		
		SILT, sandy, trace gravel, trace clay, very dense, brown, damp: (ML-NONPLASTIC)		0.30							
1					2	SS	50/.100		○		
					3	SS	50/.125		○		
2											
					4	SS	81/.225		○		
3											
					5	SS	50/.075		○		
4											
					6		50/.050		○		
5											
6					7	SS	50/.075		○		
		END OF BOREHOLE AT 6.32m. BOREHOLE OPEN TO 6.32m. BOREHOLE DRY ON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS.		193.28 6.31							
7											
8											
9											

210mm HOLLOW STEM AUGERS

GROUNDWATER ELEVATIONS

SHALLOW/SINGLE INSTALLATION
WATER LEVEL (date)

DEEP/DUAL INSTALLATION
WATER LEVEL (date)

LOGGED : GA
CHECKED : AEG

THURBER

RECORD OF BOREHOLE M-15

PROJECT : Hwy 407 & Mavis Road Interchange
LOCATION : N 4 833 279.0 E 285 688.0
STARTED : 1999 November 1
COMPLETED : 1999 November 1

PROJECT No. 19-3132-4

THURBER

SHEET 1 OF 1
DATUM

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✕, U - ▲; 40 80 120 160) / WATER CONTENT, PERCENT (wp, w, wl; 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		200.87							
		TOPSOIL (50mm)		200.81 0.06							
	210mm HOLLOW STEM AUGERS	**SILT**, sandy, trace gravel, trace clay, compact to very dense, brown, damp: (ML-NONPLASTIC)			1	SS	14				19mm PIEZOMETER
					2	SS	89/.225				
					3	SS	50/.100				
					4	SS	50/.075				CUTTINGS
					5	SS	50/.100				
											196.93
											BENTONITE
				196.30 4.57							196.32
		SILT, clayey, sandy, trace gravel, hard, brown: (CL-ML)			6	SS	54				FILTER SAND 196.02
				195.08 5.79							SLOTTED SCREEN
		SILT, sandy, trace gravel, trace clay, very dense, brown, damp: (ML-NONPLASTIC)			7	SS	50/.125				
				194.50 6.37							194.49
		END OF BOREHOLE AT 6.38m. BOREHOLE OPEN TO 6.38m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.									
		WATER LEVEL READINGS: DATE / DEPTH (m) 08/11/99 Dry to 6.1									

GROUNDWATER ELEVATIONS

▽ SHALLOW/SINGLE INSTALLATION
WATER LEVEL (date)

▼ DEEP/DUAL INSTALLATION
WATER LEVEL (date)

LOGGED : GA
CHECKED : AEG

THURBER

RECORD OF BOREHOLE M-16

PROJECT : Hwy 407 & Mavis Road Interchange
LOCATION : N 4 833 240.0 E 285 698.9
STARTED : 1999 November 1
COMPLETED : 1999 November 1

PROJECT No. 19-3132-4

THURBER

SHEET 1 OF 1
DATUM

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✕, U - ▲) 40 80 120 160 / WATER CONTENT, PERCENT wp w wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		201.22							
		CRUSHER RUN LIMESTONE (FILL)		0.00	1	SS	24		○		
				200.76							
		SILT, sandy, trace gravel, trace clay, very dense, brown, damp; (ML-NONPLASTIC)		0.46							
1					2	SS	89/250		○		
					3	SS	50/100		○		
2					4	SS	50/125		○		
3	210mm HOLLOW STEM AUGERS				5	SS	50/075		○		
4											
					6	SS	50/100		○		
5											
6				195.09	7	SS			○		
		END OF BOREHOLE AT 6.15m. BOREHOLE OPEN TO 6.15m. BOREHOLE DRY ON COMPLETION. BOREHOLE BACKFILLED WITH DRILL CUTTINGS.		6.13							
7											
8											
9											

GROUNDWATER ELEVATIONS

▽ SHALLOW/SINGLE INSTALLATION
WATER LEVEL (date)

▼ DEEP/DUAL INSTALLATION
WATER LEVEL (date)

LOGGED : GA
CHECKED : AEG

THURBER

RECORD OF BOREHOLE M-17

PROJECT : Hwy 407 & Mavis Road Interchange
LOCATION : N 4 833 273.0 E 285 723.9
STARTED : 1999 November 1
COMPLETED : 1999 November 1

PROJECT No. 19-3132-4

THURBER

SHEET 1 OF 1
DATUM

DEPTH SCALE (metres)	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	COMMENTS	SHEAR STRENGTH: Cu, KPa (nat V - ✚, rem V - ●, Q - ✖, U - ▲) 40 80 120 160 / WATER CONTENT, PERCENT wp w wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		201.07							
		SAND, silty, trace clay, trace rootlets, trace organics, compact, brown: (FILL)		0.00	1	SS	15				19mm PIEZOMETER
				200.62							
		SILT, sandy, trace gravel, trace clay, very dense, brown, damp: (ML-NONPLASTIC)		0.46	2	SS	70				
1					3	SS	84/225				
2					4	SS	50/125				CUTTINGS
3	210mm HOLLOW STEM AUGERS				5	SS	80/225				
4											197.24 BENTONITE 196.63
					6	SS	50/125				FILTER SAND 196.33
5											SLOTTED SCREEN
6					7	SS	50/125				194.80
				194.80							
		END OF BOREHOLE AT 6.27m. BOREHOLE OPEN TO 6.27m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.		6.28							
7											
		WATER LEVEL READINGS: DATE DEPTH (m) 08/11/99 Dry to 6.2									
8											
9											

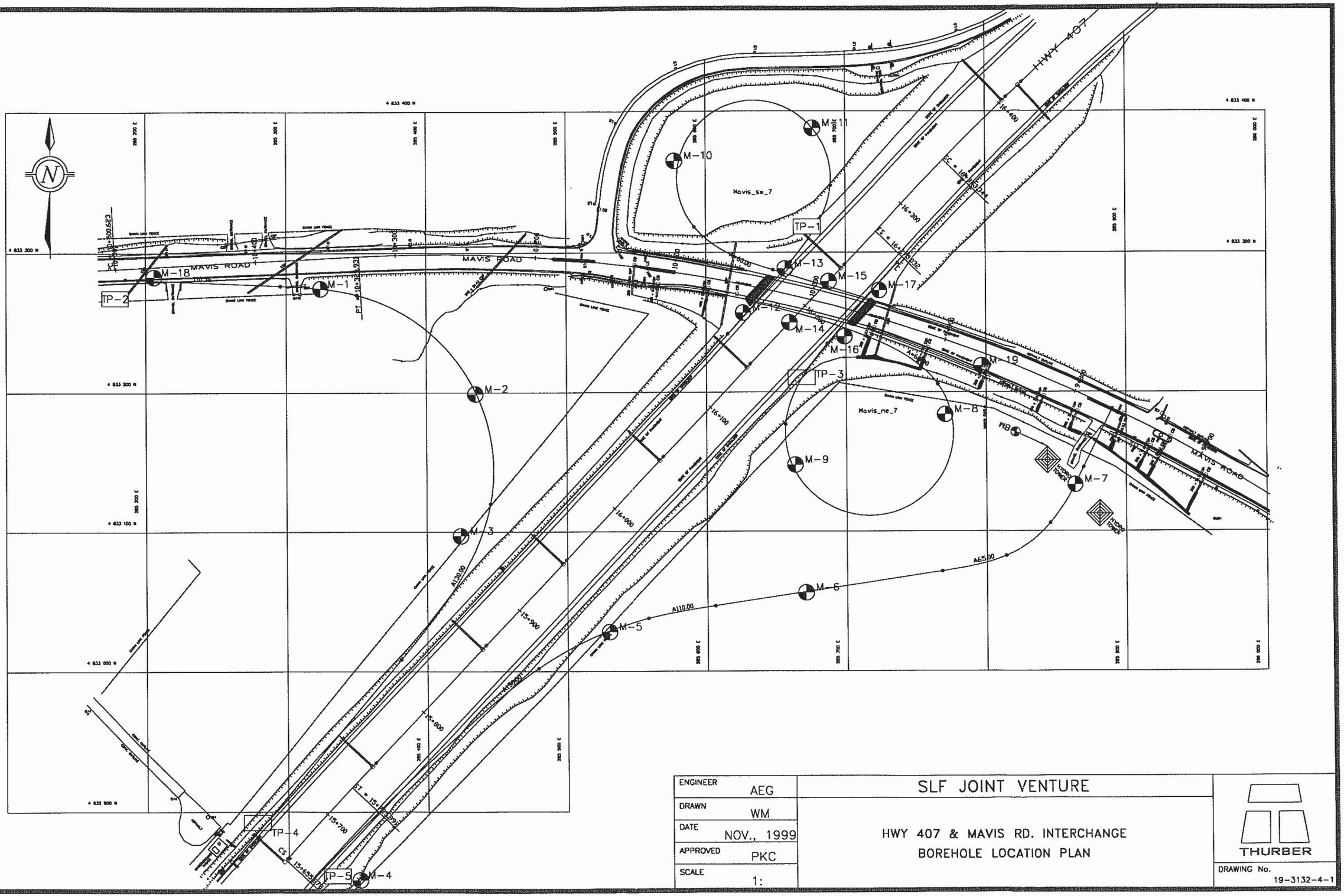
GROUNDWATER ELEVATIONS

▽ SHALLOW/SINGLE INSTALLATION
WATER LEVEL (date)

▼ DEEP/DUAL INSTALLATION
WATER LEVEL (date)

LOGGED : GA
CHECKED : AEG

THURBER



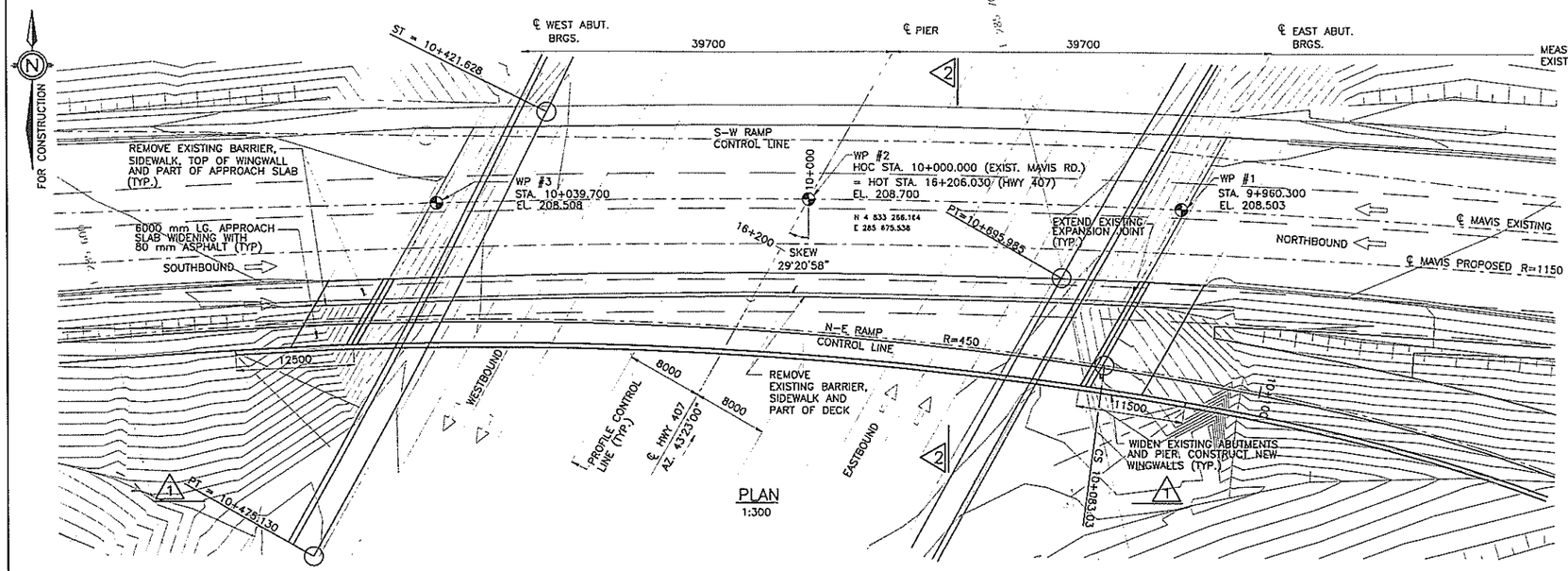
ENGINEER	AEG
DRAWN	WM
DATE	NOV., 1999
APPROVED	PKC
SCALE	1:

SLF JOINT VENTURE

HWY 407 & MAVIS RD. INTERCHANGE
BOREHOLE LOCATION PLAN

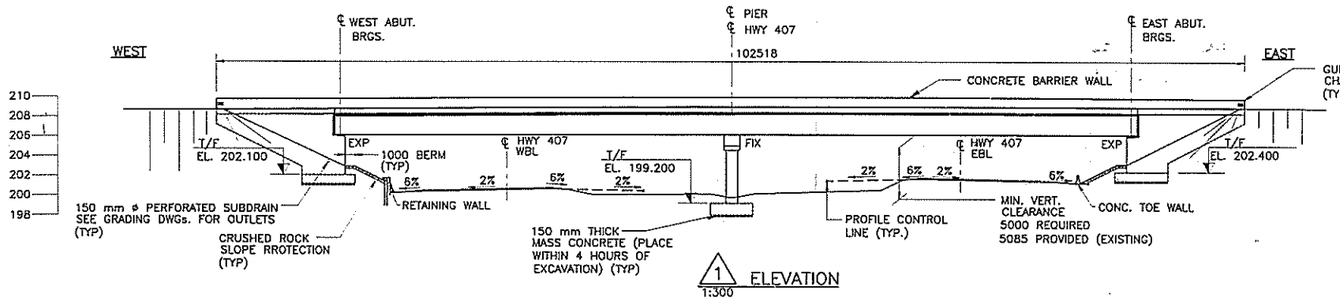
THURBER

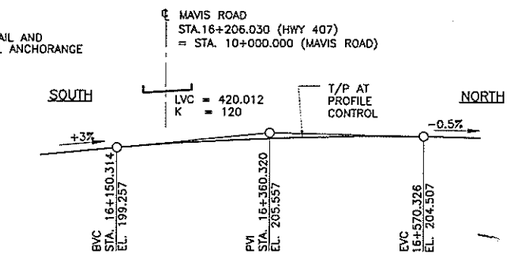
DRAWING No. 19-3132-4-1



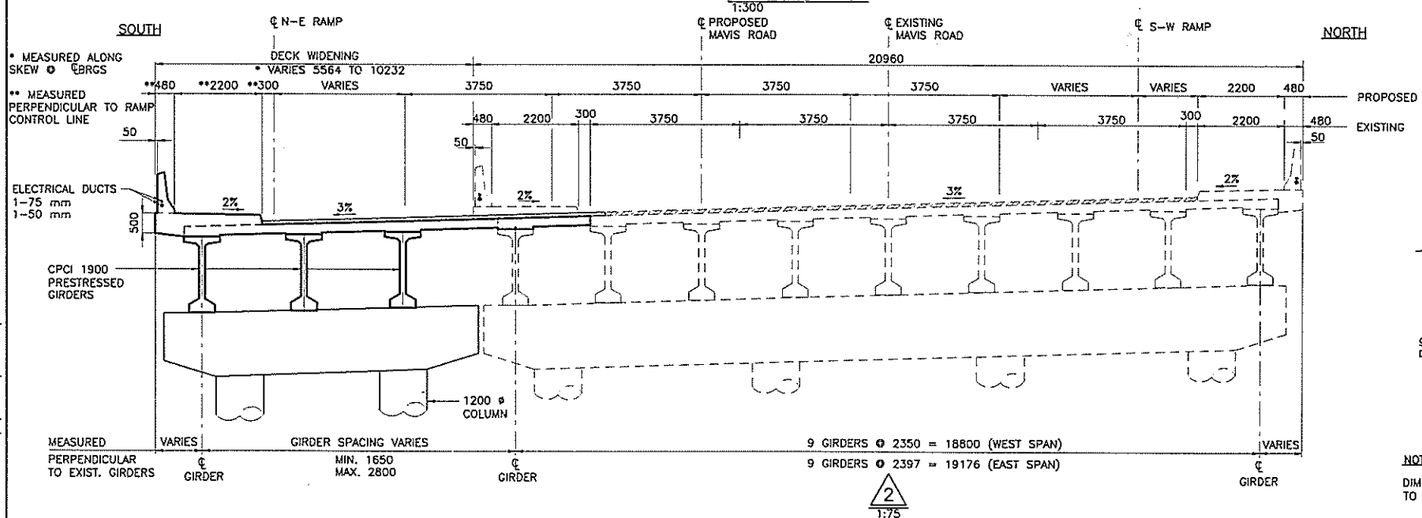
NOTES:

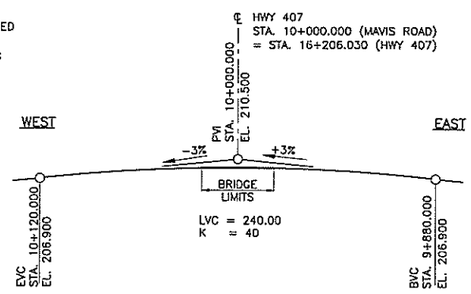
- * T/P DENOTES TOP OF PAVEMENT
- * T/FTG DENOTES TOP OF FOOTING
- * WP DENOTES WORKING POINT





PROFILE OF HWY 407
N.T.S.





PROFILE OF MAVIS ROAD
N.T.S.

NOTES:

DIMENSIONS SHOWN MEASURED NORMAL TO ℄ MAVIS RD. EXCEPT AS NOTED

GENERAL NOTES

CLASS OF CONCRETE

PRESTRESSED CONCRETE GIRDERS.....50 MPa
MASS CONCRETE.....20 MPa
REMAINDER(UNLESS NOTED OTHERWISE).....30 MPa

CLEAR COVER TO REINFORCING STEEL

FOOTINGS..... 100±25mm
DECK:
TOP..... 70±20mm
BOTTOM..... 40±0mm
REMAINDER (UNLESS NOTED OTHERWISE)...70±20mm

REINFORCING STEEL

REINFORCING STEEL SHALL BE GRADE 400 UNLESS OTHERWISE SPECIFIED. BAR MARKS WITH PREFIX 'C' DENOTE COATED BARS.

CONSTRUCTION NOTES

MASS CONCRETE SHALL NOT BE PLACED FOR FOOTINGS UNTIL THE DEPTH AND CHARACTER OF THE FOUNDATION HAVE BEEN INSPECTED AND APPROVED BY THE GEO-TECHNICAL ENGINEER. IF REQUIRED, THE CONTRACTOR SHALL PERFORM ADDITIONAL EXCAVATION UNDER THE DIRECTION OF THE GEOTECHNICAL ENGINEER. ADDITIONAL EXCAVATION IS TO BE BACKFILLED TO THE UNDERSIDE OF FOOTING WITH MASS CONCRETE OR COMPACTED GRANULAR 'A' AS DIRECTED BY THE GEOTECHNICAL ENGINEER.

THE CONTRACTOR SHALL ESTABLISH THE BEARING SEAT ELEVATIONS BY DEDUCTING THE ACTUAL BEARING THICKNESSES FROM THE TOP OF BEARING ELEVATIONS. IF ACTUAL BEARING THICKNESSES ARE DIFFERENT FROM THOSE GIVEN WITH THE BEARING DESIGN DATA, THE CONTRACTOR SHALL ADJUST THE REINFORCING STEEL TO SUIT.

BALLAST WALLS SHALL NOT BE CAST UNTIL GIRDERS ARE ERECTED.

UNLESS SHOWN OTHERWISE SAWCUTS SHALL BE 25 mm DEEP OR TO FIRST LAYER OF REINFORCING STEEL, WHICHEVER IS LESS.

THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND ELEVATIONS OF EXISTING WORK AND SHALL REPORT ANY DISCREPANCIES TO THE ENGINEER BEFORE PROCEEDING WITH FABRICATION OF JOINT ASSEMBLIES AND PRESTRESSED GIRDERS.

FOUNDATION NOTES

DESIGN BEARING CAPACITY:
AT ABUTMENTS
SLS = 400 KPa
ULS = 900 KPa
AT PIER
SLS = 500 KPa
ULS = 900 KPa

LIST OF DRAWINGS:

APPLICABLE STANDARD DRAWINGS

OPSD-4010.00 GUIDERAIL AND CHANNEL ANCHORAGE

DWG. NO.	REFERENCES	NO.	DATE	REVISIONS	BY	CHK	LEAD DES.	PROJ MGR.	DESIGN ENG.

D.B.MOORE — LICENCE TO PRACTISE IN ONTARIO
B.R.BRIDGES — REGISTERED PROFESSIONAL ENGINEER — LICENCE IN ONTARIO

CONSULTANT	DESIGNED	D.MOORE		JUNE.2000
	DRAWN	D.GOLEBIOWSKI		JUNE.2000
	CHECKED	B.BRIDGES		JUNE.2000
	APPROVED LEAD ENG.	B.BRIDGES		JUNE.2000
	APPROVED PROJ. MANAGER	J.JARCARO		JUNE.2000
SLF	REVIEWED			
SCALE AS SHOWN	NAME (PRINT)		INIT.	DATE

407 ETR Express Toll Route / La route express à péage
SLF Joint Venture
CONSULTANT
Giffels Giffels Associates Limited Consulting Engineers and Architects

TITLE
MAVIS ROAD OVER HWY 407
STRUCTURE WIDENING
GENERAL ARRANGEMENT

PROJECT NO.	SUBDIVISION	DISC.	DOC.	DRAWING NUMBER	REVISION NUMBER
331030	2CS1	42	DD	0001	1

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ALLAV
JUNE1, 2000