FOUNDATION INVESTIGATION REPORT
HIGH MAST LIGHTING POLES
HWY 401 WIDENING, HWY 410 TO CREDIT RIVER
MISSISSAUGA, ONTARIO
G.W.P. 2107-05-00

Geocres Number: 30M12-275

Report to

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation for the detailed design of high mast lighting (HML) poles at the Highway 401 and Hurontario Street interchange, which is part of the Highway 401 widening from Highway 410 to Credit River in Mississauga, Ontario.

The purpose of the investigation was to explore the subsurface conditions in the general vicinities of the proposed HML poles and, based on the data obtained, to provide a borehole location plan, records of boreholes, laboratory test results and a written description of the subsurface conditions.

Thurber carried out the investigation as a sub-consultant to MMM Group Limited (MMM) under the Ministry of Transportation Ontario (MTO) Agreement Number 2005-A-000347.

In the preparation of this report and in addition to the boreholes drilled for the HML poles, general reference has been made to information on subsurface conditions contained in other foundation reports. The titles of these reports are listed as follows:

- Thurber Engineering Ltd. report titled "Draft Foundation Investigation and Design Report, Highway 401 Widening, Highway 410 to Credit River, Hwy 401 WB Express to Hurontario Street N/S Ramp, Mississauga, Ontario, G.W.P. 2149-01-00 & 2150-01-00, Site 24-756, 19-1423-11, prepared for MMM Group Limited, dated September 14, 2007 (Reference 1).
- Thurber Engineering Ltd. report titled "Draft Foundation Investigation and Design Report, Hurontario Street Underpass, Highway 401 Widening, Highway 410 to Credit River, Mississauga, Ontario, G.W.P. 2149-01-00 & 2150-01-00, Site 24-132,

19-1423-11, prepared for MMM Group Limited, dated September 13, 2007 (Reference 2).

- Thurber Engineering Ltd. report titled "Draft Foundation Investigation and Design Report, Hurontario Street South to Highway 401 East Ramp, Highway 401 Widening, Highway 410 to Credit River, Mississauga, Ontario, G.W.P. 2107-05-00, WP 2107-05-02, Site 24-757, 19-1423-11, prepared for MMM Group Limited, dated December 18, 2007 (Reference 3).
- Thurber Engineering Ltd. report titled "Draft Foundation Investigation and Design Report, Hurontario North Access Road / N-W Ramp Structure and Retaining Walls, Highway 401 Widening, Highway 410 to Credit River, Mississauga, Ontario, G.W.P. 2107-05-00, WP 2107-05-04, Site 24-759, 19-1423-11, prepared for MMM Group Limited, dated January 22, 2007 (Reference 4).
- Thurber Engineering Ltd. report titled "Draft Foundation Investigation and Design Report, Hurontario Street South Access Road Structure and Retaining Walls, Highway 401 Widening, Highway 410 to Credit River, Mississauga, Ontario, G.W.P. 2107-05-00, WP 2107-05-03, Site 24-758, 19-1423-11, prepared for MMM Group Limited, dated February 8, 2007 (Reference 5).
- Thurber Engineering Ltd. report titled "Draft Foundation Investigation and Design Report, Patrol Yard, Highway 401 Widening, Highway 410 to Credit River, Mississauga, Ontario, G.W.P. 2107-05-00, 19-1423-11, prepared for MMM Group Limited, dated March 11, 2007 (Reference 6).
- Thurber Engineering Ltd. report titled "Draft Foundation Investigation and Design Report, Culverts, Highway 401 Widening, Highway 410 to Credit River, Mississauga, Ontario, G.W.P. 2107-05-00, prepared for MMM Group Limited, dated March, 2007 (Reference 7).

Records of boreholes from these reports relevant to the HML poles are attached in Appendix C for reference.

2 SITE DESCRIPTION

A total of ten HML poles are proposed at the Highway 401 and Hurontario Street interchange in Mississauga, Ontario. Five HML poles are proposed along the Highway 401 median on the east side of Hurontario Street. Three additional HML poles will be placed along the proposed Hwy 401 WB Express to Hurontario Street N/S Ramp, located approximately 400 m east of Highway 401 and Hurontario Street interchange. Three other HML poles will be placed within the patrol yard. Reference 6 provides recommendations for foundation design for the three HML poles within the Patrol Yard.

The lands at the northwest quadrant of Highway 401 and Hurontario Street are generally vacant and undeveloped. Vegetation is moderate consisting mainly of tall grass and shrubs. To the east of Hurontario Street and south of Highway 401, lands have been developed for commercial and industrial uses. The topography is typically flat.

The general site area is located within the physiographic region known as the Peel Plain, characterized by a level to undulating cohesive glacial till typically less than 1 m to 7 m thick which is underlain by reddish brown shale of the Queenston Formation with grey limestone and siltstone interbeds.

3 SITE INVESTIGATION AND FIELD TESTING

Site investigation and field testing for the proposed High Mast Lighting (HML) poles consisted of drilling and sampling a total of 5 boreholes at selected locations in the vicinities of the poles. This report focuses on the boreholes drilled and sampled for the HML poles as well as other boreholes relevant to the HML poles in References 1 to 7. A summary of the borehole designations for the HML poles that are not referenced elsewhere is provided in Table 3.1.

Table 3.1 – Borehole Designations

Borehole	Location	Drilling Date (2007)	Borehole Termination Depth (m)	Stratum at Termination Depth
HML-01	Northwest quadrant of Highway 401 and Hurontario Street interchange	October 3	5.7	Shale bedrock
HML-02	Southwest quadrant of Highway 401 and Hurontario Street interchange	October 22	6.1	Shale bedrock
HML-03	Northeast quadrant of Highway 401 and Hurontario Street interchange	October 5	10.4	Shale bedrock
HML-04	Southeast quadrant of Highway 401 and Hurontario Street interchange	September 17 and 24	11.0	Shale bedrock
HML-05	Highway 401 WB Collectors, approximate Station 19+672	September 28 and October 1	11.3	Shale bedrock

The approximate borehole locations are shown on the Borehole Location Drawings in Appendix D. The coordinates and elevations of the boreholes are given on these drawings and on the individual Record of Borehole Sheets in Appendix A.

The detailed subsurface soil and groundwater conditions encountered in the boreholes included in References 1 to 7 drilled in the interchange area and which are relevant to the HML locations, are presented on the Records of Boreholes in Appendix C.

Prior to commencement of drilling, utility clearances were obtained for all borehole locations.

Solid stem augers were used to advance the boreholes in the overburden and into the shale. Samples were obtained at selected intervals using a 50 mm diameter split spoon sampler in conjunction with Standard Penetration Testing (SPT). NQ rock coring equipment was used to recover core samples of the bedrock in the boreholes.

A member of Thurber's engineering staff supervised the drilling and sampling operations on a full time basis. The supervisor logged the boreholes, visually examined the recovered samples, and transported them to Thurber's laboratory for further examination and testing.

All rock cores were logged, and the Total Core Recovery (TCR), Rock Quality Designation (RQD) and the Fracture Indices (FI) were determined.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. Five standpipe piezometers consisting of 19 mm PVC pipes with screens were installed in the boreholes to permit monitoring of groundwater levels. Details of the piezometer installations and other borehole completion details are as shown in Table 3.2.

Table 3.2 – Borehole Completion Details

Borehole	Piezometer Tip Depth/ Elevation (m)	Completion Details
HML-01	5.7/185.5	Sand from 5.7 m to 3.7 m, bentonite grout to surface.
HML-02	6.1/184.1	Sand from 6.1 m to 4.0 m, bentonite grout to surface.
HML-03	10.4/182.1	Sand from 10.4 m to 8.5 m, bentonite grout to surface.
HML-04	11.0/181.1	Sand from 11.0 m to 9.1 m, bentonite grout to surface.
HML-05	11.1/186.3	Sand from 11.1 m to 9.2 m, bentonite grout to surface.

4 LABORATORY TESTING

All recovered soil and rock samples were subjected to Visual Identification (VI) and geological logging. Moisture content determinations were carried out on all soil samples. At least 25% of the recovered soil samples were also subjected to grain size distribution analyses (sieve and hydrometer) and Atterberg Limits testing where appropriate. The results of this testing program are presented on the Record of Borehole sheets in Appendix A and on the figures contained in Appendix B.

Core samples of the shale bedrock were carefully protected to prevent drying during transport to the laboratory. Point load tests were carried out on selected samples of intact shale, limestone and siltstone upon arrival at the laboratory to assist evaluation of the compressive strength of the bedrock. The results of point load tests on the selected rock core samples are shown on the Record of Borehole sheets and in Table 1, immediately following the text.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

This section presents a generalized summary of the subsurface conditions encountered at the borehole locations drilled specifically for the HML poles (Boreholes HML-01 to HML-05). Reference is made to the Records of Borehole sheets in Appendix A. Records of relevant Borehole Sheets from other recent investigations in the vicinity are included in Appendix C. Details of the encountered soil and rock stratigraphy are presented in these appendices. An overall description of the stratigraphy encountered in Boreholes HML-01 to HML-05 is given in the following paragraphs. However, the factual data presented in the Record of Borehole Sheets governs any interpretation of the site conditions.

In general terms, the soil stratigraphy encountered at this site consists of topsoil overlying fill which is underlain by native silty clay/clayey silt till deposits. Weathered shale bedrock was contacted below the till deposits. More detailed descriptions of the individual stratum are presented below.

5.1 Topsoil

Topsoil was identified at ground surface in the boreholes, except in Borehole HML-02. The topsoil thickness generally ranged from 25 mm to 100 mm. The topsoil thickness may vary between and beyond the borehole locations and the data is not intended for the purpose of estimating quantities.

5.2 Fill

Fill was encountered below the topsoil in Boreholes HML-01, HML-04 and HML-05. In Boreholes HML-04 and HML-05, the fill consists of brown silty clay containing trace to some sand, trace of gravel and occasional rootlets. In Borehole HML-01, the fill consists of reddish brown shale with trace of gravel. Thickness of the fill ranged from 0.6 m to 0.7 m.

Based on recorded SPT N-values ranging between 20 and 26 blows for 0.3 m of penetration, the silty clay fill is described as very stiff. An SPT N-value of 50 blows per 0.15 m penetration was observed within the shale fill, indicating a hard consistency.

The natural moisture contents of the fill samples obtained were approximately 17% in the clay fill and 3% in the shale fill.

The depth to the base of the fill ranged from 0.6 m to 0.8 m (Elevations 190.6 m to 196.6).

5.3 Silty Clay Till and Clayey Silt Till

Deposits of native brown/reddish brown to grey silty clay till and clayey silt till with sand to some sand, trace of gravel, occasional rootlets and red shale fragments were contacted below the fill and topsoil in all the boreholes. Thickness of the till deposits ranged from 0.9 m to 6.5 m.

Based on SPT N-values ranging from 16 blows for 0.3 m of penetration to greater than 50 blows for 0.1 m of penetration, the silty clay till and clayey silt till are described as very stiff to hard.

The natural moisture contents of the samples recovered from the silty clay till and clayey silt till layers ranged from 8 to 21%.

Grain size distribution curves for the samples tested are presented on the Record of Borehole sheets and on Figures B1 and B2 of Appendix B. Atterberg Limit test results are presented on Figures B3 and B4 of Appendix B.

The results of laboratory gradation and Atterberg Limits tests are summarized as follows:

Soil Particles	(%)
Gravel	0 to 2
Sand	16 to 54
Silt	33 to 61
Clay	12 to 27

Index Property	(%)
Liquid Limit	20 to 32
Plastic Limit	12 to 17
Plasticity Index	8 to 15

The above results show that the silty clay till and clayey silt till are of low plasticity with a group symbol of CL.

The depth to the base of the till deposits ranged from 1.0 m to 6.7 m (Elevations 185.4 m to 193.7 m).

Although not encountered in the boreholes, glacial tills inherently contain cobbles and boulders and the lower part of the till may contain pieces and slabs of bedrock which may account for some high blow counts and resistance to augering.

5.4 Bedrock

The soils described above were found to be underlain by shale bedrock of the Queenston Formation. The shale encountered in the boreholes is described as fine-grained, thinly bedded and contains numerous hard interbedded siltstone and limestone layers. The shale bedrock is typically highly weathered within the upper zone with the degree of weathering decreasing with depth. SPT N-values obtained in the upper part of the shale bedrock ranged from 80 blows per 0.3 m of penetration to greater than 100 blows per less than 0.3 m penetration. Moisture contents of disturbed shale samples ranged from 2 to 7%. Elevations of the top of bedrock are shown in Table 5.1.

Table 5.1 – Elevation of Top of Weathered Bedrock

Borehole	Depth to Weathered Bedrock (m)	Top of Weathered Bedrock Elevation (m)
HML-01*	1.5	189.6
HML-02*	1.0	189.2
HML-03*	6.6	186.0
HML-04*	6.7	185.4
HML-05*	3.7	193.7

* Proved by coring below augered depth

The depth and elevation of shale bedrock in the other boreholes reported in References 1 to 7 which are relevant to the HML poles are presented in Table 5.2.

Table 5.2 – Elevation of Top of Weathered Bedrock

Borehole	Depth to Weathered Bedrock (m)	Top of Weathered Bedrock Elevation (m)
BW01	11.8*	189.9
BW02-07	10.8**	191.1
BW05	1.2	193.9
BW07	1.6*	191.6
BW10	4.0*	190.6
BW11	4.0*	188.6
BW12	4.1	190.0
H2	13.7	186.1
H6	11.7*	187.9
H7	-	-
H8	8.8	189.2
NAR08	5.5*	188.2
NAR15	4.3	190.1
RW1-1	1.5	188.3
RW1-2	0.6	190.1
RW2-1	0.8	189.5
RW2-2	1.2	189.8
RW3-1	1.5	189.4
RW3-2	3.1	190.1
C3-1	0.6	185.6
C3-2	0.6	184.4
C4-1	-	-
C4-2	-	-
C4-3	5.2	186.6
C4-4	5.5	185.2
HAR-15	7.3*	189.3
HAR-16	6.7	189.4
HAR18	5.8	189.2
RSE-17	4.0	187.3

*Proved by coring below augered depth
** Auger refusal

Bedrock cores were collected using NQ sized coring equipment. Total Core Recovery (TCR) in the bedrock ranged from 91% to 100% in most core runs, except in Borehole HML-05 Run 1 where the TCR was 23%.

The RQD values recorded for five of the core runs ranged from 57% to 100% indicating fair to excellent rock quality. Fracture Index (FI) of the rock, expressed as fractures per 0.3 m of core, ranged from 0 to greater than 10.

The results of Point Load tests conducted on rock layers/interbeds of intact core samples were as follows:

Rock Type	Inferred Unconfined Compressive Strength (UCS) (MPa)
Shale or shale/siltstone	3 to 27
Siltstone	40 to 85
Limestone	60 to 167

It must be noted, however, that point load tests were possible only on less weathered shale or higher strength limestone and siltstone interbed samples as the more typically weathered shale cores tended to be too weak for point load testing. Broken zones were observed within the cores at various depths.

The shale bedrock typically contains layers of siltstone and limestone that can be significantly harder than the shale itself. The distribution, thickness and strength of these layers vary from location to location, and these layers typically exhibit less pronounced weathering than the shale. The logs indicated that these hard interbeds range approximately from 20 to 300 mm in thickness. Sampling and interpretation from small diameter boreholes may underestimate the frequency, thickness and strength of the strong layers and therefore geological expertise and past experience must be applied in any decision making process regarding the bedrock.

5.5 Water Levels

Water level was observed in the boreholes during and upon completion of drilling. Standpipe piezometers were installed in the five boreholes to monitor water levels after completion of drilling. The water levels measured in the piezometers are summarized in Table 5.3.

Table 5.3 – Measured Groundwater Levels

HML	Borehole	Date (2007)	Water Level (m)		Comment
			Depth	Elevation	
1	HML-1	October 5	2.0	189.2	In piezometer
		October 18	1.5	189.7	
		November 1	1.5	189.7	
		November 15	1.3	189.9	
2	HML-2	November 1	3.7	186.5	In piezometer
		November 15	3.9	186.3	
3	HML-3	October 18	1.3	191.2	In piezometer
		November 1	1.2	191.3	
		November 15	1.3	191.2	
4	HML-4	October 18	1.4	190.8	In piezometer
		November 1	1.0	191.2	
		November 15	1.1	191.0	
5	HML-5	October 5	3.0	194.4	In piezometer
		October 18	3.0	194.4	
		November 1	3.1	194.3	
		November 15	3.0	194.4	

The above table, indicates that the groundwater levels range from Elevations 186.3 m to 194.4 m.

The above values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall. Further, perched water may be encountered at higher levels in pockets or zones of more permeable sands and silts interbeds within the heterogeneous tills, or within the fill.

6 MISCELLANEOUS

Borehole locations and ground surface elevations were supplied to Thurber by MMM Group Limited. The drilling and sampling equipment was supplied and operated by DBW Drilling of Ajax Ontario. The field work was supervised on a full time basis by Mr. George Azzopardi of Thurber Engineering Ltd.

Laboratory testing was carried out at Thurber's Laboratory in Oakville, Ontario.

Supervision of the field program, interpretation of the field data and preparation of the investigation report was conducted by Mr. Sydney Pang, P. Eng. and Ms. R. Palomeque Reyna, P.Eng.

Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects, reviewed the report.

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TABLE 1 -Point Load Results

Highway 401 Widening – High Mast Lighting Poles

HML-1	DEPTH			Is (MPa)	Is50 (MPa)	UCS (Mpa)	Rock Type
	FT.	IN.	(m)				
RUN #1	9	5	2.87	0.000	0.000	3.00	shale, siltstone
	10	6	3.20	0.000	0.000	3.00	shale
	11	10	3.61	0.428	0.463	11.12	shale, siltstone
	13	10	4.22	0.000	0.000	3.00	shale, siltstone
	9	9	2.97	1.812	1.651	39.62	siltstone
RUN #2	14	4	4.37	0.000	0.000	3.00	shale, siltstone
	15	1	4.60	1.984	2.572	61.72	limestone
	16	5	5.00	0.234	0.279	6.71	shale, siltstone
	17	4	5.28	0.000	0.000	3.00	shale, siltstone
	18	6	5.64	1.332	1.604	38.49	limestone

UC Test Average			
RUN #1:			
	AVERAGE	MAX	MIN
Shale	3.0	3.0	3.0
Siltstone	39.6	39.6	39.6
Shale/Siltstone	5.7	11.1	3.0
Limestone			
RUN #2:			
Shale			
Siltstone			
Shale/Siltstone	4.2	6.7	3.0
Limestone	50.1	61.7	38.5
SUMMARY	AVERAGE	MAX	MIN
Shale	3.0	3.0	3.0
Siltstone	39.6	39.6	39.6
Shale/Siltstone	5.0	11.1	3.0
Limestone	50.1	61.7	38.5

HML-2	DEPTH			Is (MPa)	Is50 (MPa)	UCS (Mpa)	Rock Type
	FT.	IN.	(m)				
RUN #1	12	1	3.68	4.613	3.725	89.40	limestone
	13	2	4.01	0.677	0.672	16.14	limestone
	14	9	4.50	0.000	0.000	3.00	shale, siltstone
RUN #2	14	4	4.37	0.000	0.000	3.00	shale, siltstone
	15	1	4.60	1.984	2.572	61.72	limestone
	16	5	5.00	0.234	0.279	6.71	shale, siltstone
	17	4	5.28	0.000	0.000	3.00	shale, siltstone
	18	6	5.64	1.332	1.604	38.49	limestone

UC Test Average			
RUN #1:			
	AVERAGE	MAX	MIN
Shale			
Siltstone			
Shale/Siltstone	3.0	3.0	3.0
Limestone	52.8	89.4	16.1
RUN #2:			
Shale			
Siltstone			
Shale/Siltstone	4.2	6.7	3.0
Limestone	50.1	61.7	38.5
SUMMARY	AVERAGE	MAX	MIN
Shale			
Siltstone			
Shale/Siltstone	3.9	6.7	3.0
Limestone	51.4	89.4	16.1

TABLE 1 -Point Load Results

Highway 401 Widening – High Mast Lighting Poles

HML-3	DEPTH			Is (MPa)	Is50 (MPa)	UCS (Mpa)	Rock Type
	FT.	IN.	(m)				
RUN #1	24	10	7.57	7.890	6.968	167.23	limestone
	25	5	7.75	0.000	0.000	3.00	shale
	26	6	8.08	0.000	0.000	3.00	shale
	27	8	8.43	0.563	0.531	12.75	shale, siltstone
	28	10	8.79	2.200	2.200	52.80	siltstone
RUN #2	29	9	9.07	3.140	3.294	79.05	limestone
	30	5	9.27	0.000	0.000	3.00	shale
	31	4	9.55	0.444	0.472	11.32	shale, siltstone
	32	11	10.03	0.477	0.565	13.56	shale, siltstone
	33	5	10.19	2.778	3.043	73.03	limestone
	33	7	10.24	0.778	1.157	27.76	limestone

UC Test Average			
RUN #1:			
	AVERAGE	MAX	MIN
Shale	3.0	3.0	3.0
Siltstone	52.8	52.8	52.8
Shale/Siltstone	12.8	12.8	12.8
Limestone	167.2	167.2	167.2
RUN #2:			
Shale	3.0	3.0	3.0
Siltstone			
Shale/Siltstone	12.4	13.6	11.3
Limestone	59.9	79.1	27.8
SUMMARY	AVERAGE	MAX	MIN
Shale	3.0	3.0	3.0
Siltstone	52.8	52.8	52.8
Shale/Siltstone	12.5	13.6	11.3
Limestone	86.8	167.2	27.8

HML-4	DEPTH			Is (MPa)	Is50 (MPa)	UCS (Mpa)	Rock Type
	FT.	IN.	(m)				
RUN #1	27	10	8.48	0.331	0.333	7.98	shale, siltstone
	29	2	8.89	0.770	0.949	22.77	shale, siltstone
	31	0	9.45	0.000	0.000	3.00	shale
RUN #2	32	4	9.86	1.093	1.131	27.14	shale, siltstone
	33	3	10.13	0.393	0.363	8.70	shale
	34	1	10.39	1.063	1.115	26.77	shale
	34	9	10.59	3.109	3.531	84.75	siltstone
	35	10	10.92	2.571	2.931	70.35	siltstone

UC Test Average			
RUN #1:			
	AVERAGE	MAX	MIN
Shale	3.0	3.0	3.0
Siltstone			
Shale/Siltstone	15.4	22.8	22.8
Limestone			
RUN #2:			
Shale	17.7	26.8	8.7
Siltstone	77.5	84.7	70.3
Shale/Siltstone	27.1	27.1	27.1
Limestone			
SUMMARY	AVERAGE	MAX	MIN
Shale	12.8	26.8	3.0
Siltstone	77.5	84.7	70.3
Shale/Siltstone	19.3	27.1	8.0
Limestone			

TABLE 1 -Point Load Results

Highway 401 Widening – High Mast Lighting Poles

HML-5	DEPTH			Is (MPa)	Is50 (MPa)	UCS (Mpa)	Rock Type
	FT.	IN.	(m)				
RUN #1	27	10	8.48	0.000	0.000	3.00	shale
	28	9	8.76	0.000	0.000	3.00	shale, siltstone
	29	11	9.12	0.643	0.733	17.59	shale, siltstone
	30	9	9.37	2.522	3.079	73.90	limestone
RUN #2	32	11	10.03	0.696	0.763	18.31	shale, siltstone
	34	0	10.36	0.000	0.000	3.00	shale, siltstone
	34	11	10.64	0.000	0.000	3.00	shale
	35	10	10.92	0.658	0.741	17.79	shale, siltstone
	36	10	11.23	0.590	0.544	13.05	shale, siltstone
	33	2	10.11	3.125	2.795	67.08	limestone

UC Test Average			
RUN #1:			
	AVERAGE	MAX	MIN
Shale			
Siltstone			
Shale/Siltstone	10.3	17.6	3.0
Limestone	73.9	73.9	73.9
RUN #2:			
Shale	3.0	3.0	3.0
Siltstone			
Shale/Siltstone	13.0	18.3	3.0
Limestone	67.1	67.1	67.1
SUMMARY	AVERAGE	MAX	MIN
Shale	3.0	3.0	3.0
Siltstone			
Shale/Siltstone	12.1	18.3	3.0
Limestone	70.5	73.9	67.1

Appendix A

Record of Borehole Sheets

(HML investigation)

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.

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			

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RECORD OF BOREHOLE No HML-01 1 OF 1 METRIC

G.W.P. 2107-05-00 LOCATION NW Quadrant of HWY 401 & Hurontario St. Int., N 4 832 243.630 E 289 771.988 ORIGINATED BY GA

HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY ES

DATUM Geodetic DATE 2007-03-10 - 2007-03-10 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
191.2											
0.0	**TOPSOIL:** (25mm)		1	SS	50/.150		191		o		
190.6	**SHALE**, trace gravel, hard, reddish brown, moist (FILL)										
0.6	Clayey **SILT** with sand, trace gravel Very Stiff Brown (TILL)		2	SS	28		190		o		1 35 47 17
189.6			3	SS	50/.050				o		
1.5	**SHALE**, highly to moderately weathered, thinly bedded, reddish brown, with green-grey siltstone and grey limestone interbeds		4	SS	0/.000		189				
	Coring started at 2.7m Horizontal joint at 2.84, 2.92, 3.02, 3.33, 3.38, 3.94, 4.17, and 4.11m Green-grey siltstone interbeds at 2.74 to 2.79m, 2.90, 3.05, 3.30, 3.40, 3.45, 3.66, 4.14 and 4.19m Highly broken zones at 3.96 to 4.14 and 2.79 to 2.87m		1	RUN			188			FI >20 1 1 1	RUN 1# TCR=100%, SCR=70%, RQD=57%, UCS=6MPa (Shale/Siltstone) UCS = 39 MPa (Siltstone)
	Moderately to sightly weathered Green-grey siltstone interbeds at 4.39, 4.45 to 4.47, 4.52 to 4.57, 5.18 and 5.38m Limestone interbeds at 4.62 to 4.70, 4.93 to 4.95, 5.23 to 5.28 and 5.64 to 5.69m Horizontal joints at 5.23, 5.28, 5.38 and 5.44m		2	RUN			187			>10 0 0 0	RUN 2# TCR=100%, SCR=92%, RQD=94%, UCS=4MPa (Shale/Siltstone) UCS = 50 MPa (Limestone)
185.5							186			4 0	
5.7	END OF BOREHOLE AT 5.69m. BOREHOLE OPEN UPON COMPLETION. Piezometer installation consists of 19mm diameter schedule 40 PVC pipe. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) Oct 05/07 2.0 189.2 Oct 18/07 1.5 189.7 Nov 01/07 1.5 189.7 Nov 15/07 1.3 189.9										

$+^3$, $\times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 3/17/08

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Ontario

RECORD OF BOREHOLE No HML-02 1 OF 1 METRIC

G.W.P. 2107-05-00 LOCATION SW Quadrant of HWY 401 & Hurontario St. Int., N 4 832 097.475 E 289 804.136 ORIGINATED BY VS

HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY ES

DATUM Geodetic DATE 2007-10-22 - 2007-10-22 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
190.2											
0.0	Silty **CLAY**, some sand, trace gravel Very Stiff Brown (TILL)		1	SS	25		190		○		2 19 52 27
189.2			2	SS	26				○		
1.0	**SHALE**, highly weathered, thinly to very thinly bedded, reddish brown, with green-grey siltstone and grey limestone interbeds		3	SS	80		189		○		
			4	SS	82		188		○		
	Slightly weathered to fresh Coring started at 3.1m Siltstone interbeds at 3.12 to 3.15, 3.40 to 3.45, 3.91 to 3.94 and 4.47 to 4.52m Highly broken zones at 3.05 to 3.40m Limestone interbeds at 3.61, 3.68 and 3.96 to 4.04m		1	RUN			187			FI >5 4 0 0	RUN 1# TCR=91%, SCR=83%, RQD=83% UCS = 3 MPa (Shale/Siltstone) UCS = 53 MPa (Limestone)
	Fresh, thinly bedded Siltstone interbeds at 5.33 to 5.41, 5.44, 5.46, 5.54, 5.64 to 5.66 and 5.89 to 5.92m Limestone interbeds at 4.75, 4.80, 5.21, 5.72 to 5.79, 5.84 and 5.94 to 6.25m		2	RUN			186 185			0 0 0 0 0 2	RUN 2# TCR=100%, SCR=100%, RQD=100% UCS = 4 MPa (Shale/Siltstone) UCS = 50 MPa (Limestone)
184.1											
6.1	END OF BOREHOLE AT 6.1m. Piezometer installation consists of 19mm diameter schedule 40 PVC pipe. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Nov 01/07 3.7 186.5 Nov 15/07 3.9 186.3										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$15 \oplus^{20}_{10} 5$ (%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 3/6/08

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Ontario

RECORD OF BOREHOLE No HML-03 1 OF 2 METRIC

G.W.P. 2107-05-00 LOCATION NE Quadrant of HWY 401 & Hurontario St. Int., N 4 832 357.348 E 290 008.800 ORIGINATED BY GA
HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY ES
DATUM Geodetic DATE 2007-10-05 - 2007-10-05 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
192.5											
0.0	**TOPSOIL:** (100mm)										
0.1	Silty **CLAY**, some sand, occasional rootlets Very stiff Brown to mottled brown-grey (TILL)		1	SS	20		192	○			
			2	SS	16	▼		○			
			3	SS	17		191	○			
			4	SS	26		190	○			0 16 61 23
	Hard Occasional iron oxidized stains		5	SS	50/.150		189	○			
188.0							188				
4.6	Clayey **SILT** with sand, trace gravel Hard Brown to grey (TILL)		6	SS	69/.150			○			1 31 68 (SI+CL)
186.4							187				
6.1	Silty **CLAY**, trace to some sand, trace gravel Hard		7	SS	152			○			
186.0							186				
6.6	Grey to reddish brown (TILL)										
	SHALE, highly weathered, thinly bedded, reddish brown, with limestone and green-grey siltstone interbeds, occasional clay seams Coring started at 7.3m Highly broken zones at 7.31 to 7.59 and 7.67 to 7.72m Limestone interbeds at 7.47 and 7.59 to 7.62m Green-grey siltstone interbeds at 7.39, 7.57, 7.70 to 7.77, 8.03, 8.46 to 8.51, 8.56, 8.61, 8.69 to 8.71 and 8.79 to 8.84m Horizontal joints at 8.26, 8.28 and 8.33m Clay seams at 7.72 and 8.38m Limestone interbeds at 9.07 to 9.12, 10.21 to 10.26 and 10.31 to 10.36m Green-grey siltstone interbeds at 8.86 to 8.89, 9.02, 9.04, 9.19, 9.22, 9.40, 9.47, 9.53 to 9.58, 9.75, 9.80, 9.86, 9.91 to 9.96, 10.01 to 10.06 and		1	RUN			185		FI >10 5 0 0 0	RUN 1# TCR=100%, SCR=70%, RQD=66%, UCS=3MPa Average (Shale) UCS = 12 MPa (Shale/Siltstone) UCS = 52 MPa (Siltstone) UCS = 167 MPa (Limestone)
			2	RUN			184		0 0 0 0 0	RUN 2# TCR=100%, SCR=100%, RQD=100%, UCS=3MPa Average (Shale) UCS = 12 MPa (Shale/Siltstone)
							183				

Continued Next Page

+³, ×³: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 3/6/08

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Ontario

RECORD OF BOREHOLE No HML-03 2 OF 2 METRIC

G.W.P. 2107-05-00 LOCATION NE Quadrant of HWY 401 & Hurontario St. Int., N 4 832 357.348 E 290 008.800 ORIGINATED BY GA

HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY ES

DATUM Geodetic DATE 2007-10-05 - 2007-10-05 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	WATER CONTENT (%) 20 40 60	kN/m^3	GR SA SI CL
	Continued From Previous Page										
	10.19m										UCS = 60 MPa
182.2	Horizontal joints at 9.45 and 9.70 to 9.73m									0	(Limestone)
10.4	END OF BOREHOLE AT 10.36m. BOREHOLE OPEN UPON COMPLETION. Piezometer installation consists of 19mm diameter schedule PVC pipe. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) Oct 18/07 1.3 191.2 Nov 01/07 1.2 191.3 Nov 15/07 1.3 191.2						182				

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE
10

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Ontario

RECORD OF BOREHOLE No HML-04 1 OF 2 METRIC

G.W.P. 2107-05-00 LOCATION SE Quadrant of HWY 401 & Hurontario St. Int., N 4 832 240.061 E 290 085.531 ORIGINATED BY GA
HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY MFA
DATUM Geodetic DATE 2007-09-17 - 2007-09-24 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
192.1											
0.0 / 0.1	**TOPSOIL:** (75mm)										
	Silty **CLAY**, trace to some sand, trace gravel, occasional rootlets		1	SS	26		192		○		
191.5	Very Stiff										
0.7	Brown										
	(FILL)										
	Silty **CLAY**, trace to some sand, trace gravel		2	SS	32	▼	191		○		
	Hard										
	Brown										
	(TILL)		3	SS	64				⊖		0 34 45 21
	Occasional iron oxidized stains						190				
			4	SS	89				○		
			5	SS	101		189		⊖		2 36 42 20
	Brown to Reddish Brown		6	SS	113		188		○		
186.4							187				
5.8	Clayey **SILT** with sand, some shale fragments										
	Hard										
	Reddish Brown		7	SS	105		186		○		
	(TILL)										
185.4											
6.7	**SHALE**, highly weathered, thinly bedded, reddish brown, with green-grey siltstone interbeds, occasional limestone interbeds, and occasional clay seams						185				
			8	SS	50/.000						
							184			FI	
	Coring started at 8.23m									0	RUN 1#
	Slightly weathered to fresh										TCR=100%, SCR=100%,
	Clay seam at 8.72, 9.09, and 9.14m									2	RQD=91%
	Green-grey siltstone interbeds at 8.46 to 8.51, 8.56 to 8.61, 8.71, 8.81 to 8.84, 8.80 to 8.92, 9.02 to 9.04, 9.09 to 9.24, 9.24 to 9.30, and 9.30 to 9.45m		1	RUN						2	Average UCS = 3 MPa (Shale)
							183			0	UCS = 15 MPa (Siltstone)
	Limestone interbeds at 9.91 to 9.93 and 10.01 to 10.08m									9	RUN 2#
										1	TCR=100%, SCR=100%

Continued Next Page

+ ^{3} × ^{3} Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 3/6/08

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HML-04 2 OF 2 METRIC

G.W.P. 2107-05-00 LOCATION SE Quadrant of HWY 401 & Hurontario St. Int., N 4 832 240.061 E 290 085.531 ORIGINATED BY GA

HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY MFA

DATUM Geodetic DATE 2007-09-17 - 2007-09-24 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	'N' VALUES						GR SA SI CL
	Continued From Previous Page										
181.2	Siltstone interbeds at 9.60, 9.75, 10.34, 10.57, and 10.97m Clay seam at 10.20m		2	RUN			182			0 0	RQD=98% Average UCS = 18 MPa (Shale) UCS = 27 MPa (Shale/Siltstone) UCS = 77 MPa (Siltstone)
11.0	END OF BOREHOLE AT 11.0m. BOREHOLE OPEN AND DRY TO 11.0m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) Oct 18/07 1.4 190.8 Nov 01/07 1.0 191.2 Nov 15/07 1.1 191.0										

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+ ³ . × ³ : Numbers refer to Sensitivity

15 (20/10) 5 (%) STRAIN AT FAILURE

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No HML-05 1 OF 2 METRIC

G.W.P. 2107-05-00 LOCATION Highway 401 WB Collector, N 4 832 548.750 E 290 380.492 ORIGINATED BY GA

HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY ES

DATUM Geodetic DATE 2007-09-28 - 2007-10-01 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
197.4											
0.0	**TOPSOIL:** (100mm)										
0.1	Silty **CLAY**, some sand, some gravel, occasional rootlets Very stiff Brown		1	SS	20		197		o		
196.6	(FILL)										
0.8	Clayey **SILT** with sand, trace gravel Hard Brown to reddish brown (TILL)		2	SS	56		196		o		
			3	SS	47				e		2 38 44 16
			4	SS	50/ .150		195		o		
	Iron oxidized stains		5	SS	50/ .100		194		o		1 54 33 12
193.7	Boulder (350mm)										
3.7	Coring started at 3.7m **SHALE**, highly to slightly weathered, thinly bedded, reddish brown, with grey limestone and green-grey siltstone interbeds		1	RUN			193				RUN 1# TCR=23%, SCR=23%, RQD=23% Average UCS = 10 MPa (Shale/Siltstone) UCS = 73 MPa (Limestone)
	Augering to 8.1m depth without coring/sampling						192				
							191				
							190				
							189			FI	RUN 2#
	Siltstone interbeds at 8.79, 8.84, 9.04, 9.14, 9.17, 9.27 to 9.30 and 9.68 to 9.73m Limestone interbeds at 8.99 and 9.37 to 9.45m Highly broken zones at 8.64 to 8.76m		2	RUN						2 >5 1 1	TCR=100%, SCR=83%, RQD=67% Average UCS = 3 MPa (Shale) UCS = 12 MPa (Shale/Siltstone) UCS = 70 MPa (Limestone)
							188			0	
	Slightly weathered to fresh									0	RUN 3# TCR=100%

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 3/6/08

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HML-05 2 OF 2 METRIC

G.W.P. 2107-05-00 LOCATION Highway 401 WB Collector, N 4 832 548.750 E 290 380.492 ORIGINATED BY GA

HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY ES

DATUM Geodetic DATE 2007-09-28 - 2007-10-01 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Siltstone interbeds at 9.78, 9.88, 10.01, 10.16, 10.41, 10.44, 10.92, 10.97 and 11.15 to 11.23m Limestone interbeds at 9.80 to 9.83, 10.11 and 10.31m		3	RUN			187			0 0 0 0	SCR=100%, RQD=100%
186.1 11.3	END OF BOREHOLE AT 11.28m. Piezometer installation consists of 19mm diameter schedule PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Oct 05/07 3.0 194.4 Oct 18/07 3.0 194.4 Nov 01/07 3.1 194.3 Nov 15/07 3.0 194.4										

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 3/6/08

Appendix B

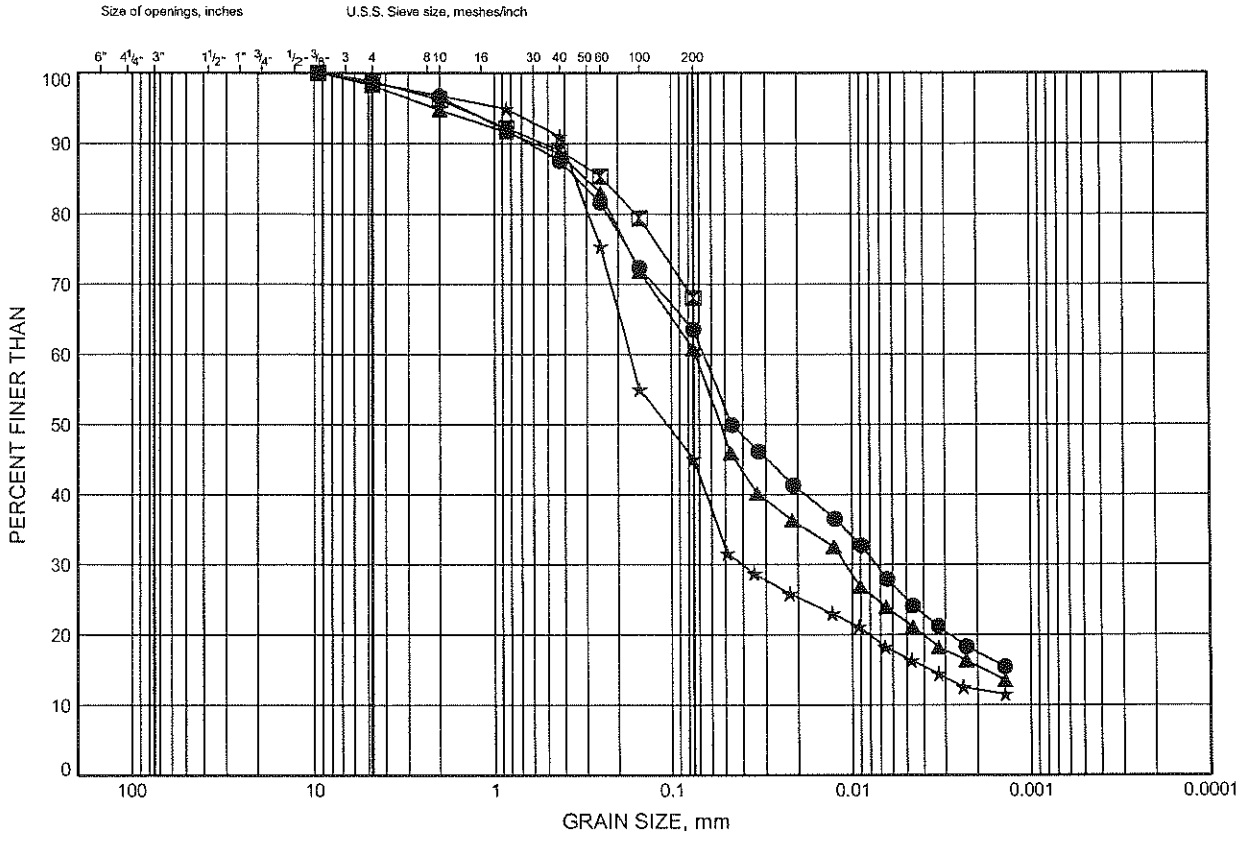
Laboratory Test Results

Hwy 401/410 to Credit River

GRAIN SIZE DISTRIBUTION

FIGURE B1

Clayey Silt with Sand



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	HML-01	1.07	190.10
⊠	HML-03	4.72	187.80
▲	HML-05	1.83	195.55
★	HML-05	3.35	194.03

Date January 2008

Project 2107-05-00

THURBER

Prep'd MFA

Chkd. RPR

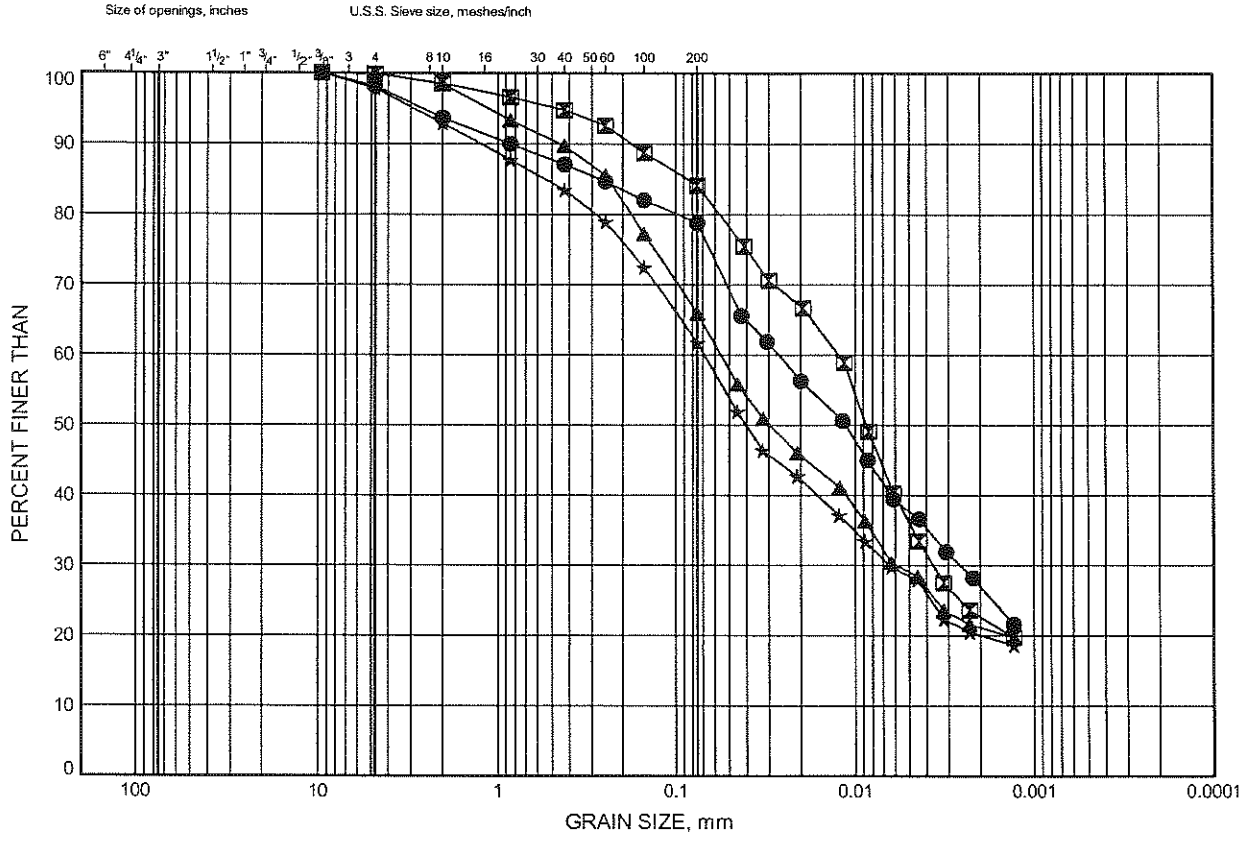
THURBGSD 2311.GPJ 1/28/08

Hwy 401/410 to Credit River

GRAIN SIZE DISTRIBUTION

FIGURE B2

Silty Clay Till



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

SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	HML-02	0.30	189.94
⊠	HML-03	2.59	189.94
▲	HML-04	1.83	190.32
★	HML-04	3.35	188.80

Date January 2008

Project 2107-05-00

THURBER

Prep'd MFA

Chkd. RPR

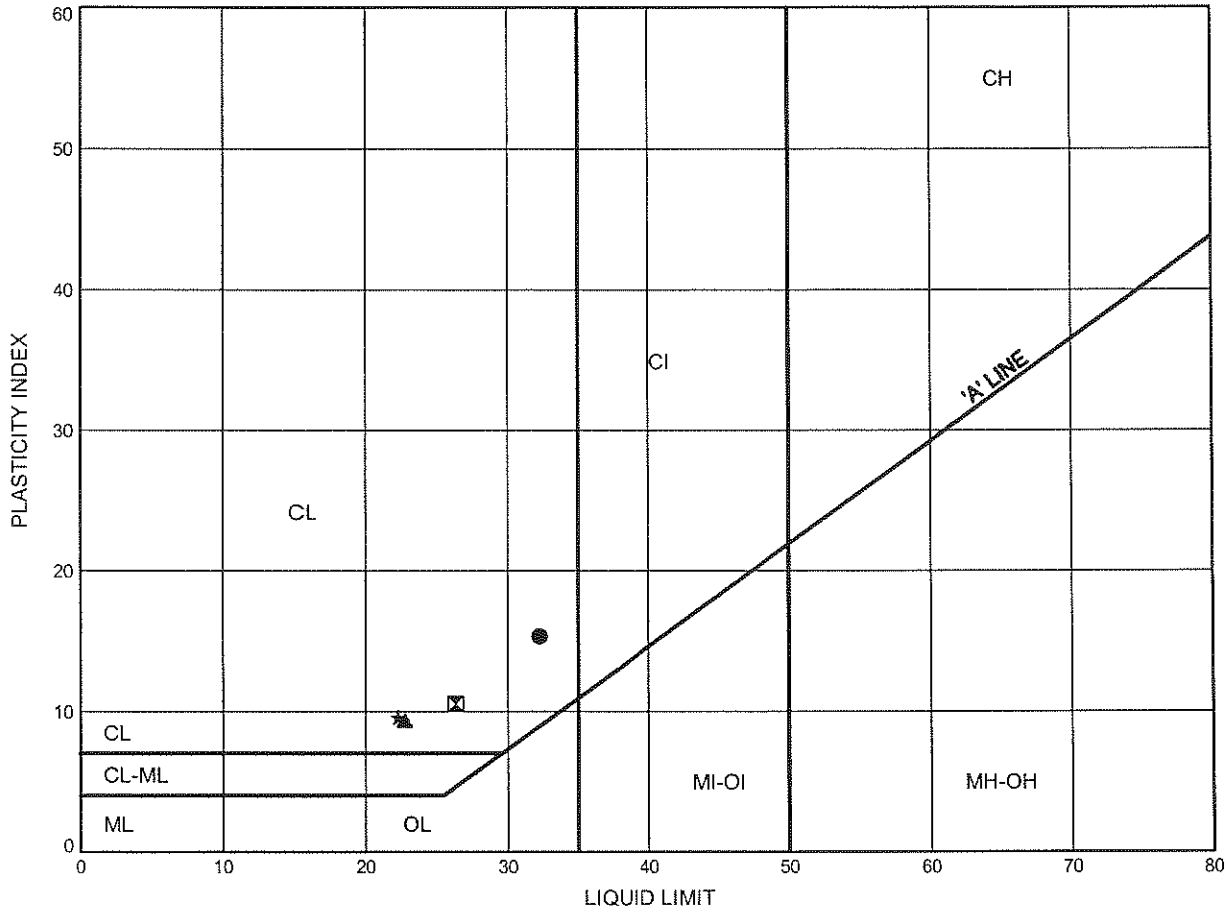
THURBGSD 2311.GPJ 1/28/08

Hwy 401/410 to Credit River

ATTERBERG LIMITS TEST RESULTS

FIGURE B3

Silty Clay Till



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	HML-02	0.30	189.94
⊠	HML-03	2.59	189.94
▲	HML-04	1.83	190.32
★	HML-04	3.35	188.80

Date January 2008

Project 2107-05-00

THURBER

Prep'd MFA

Chkd. RPR

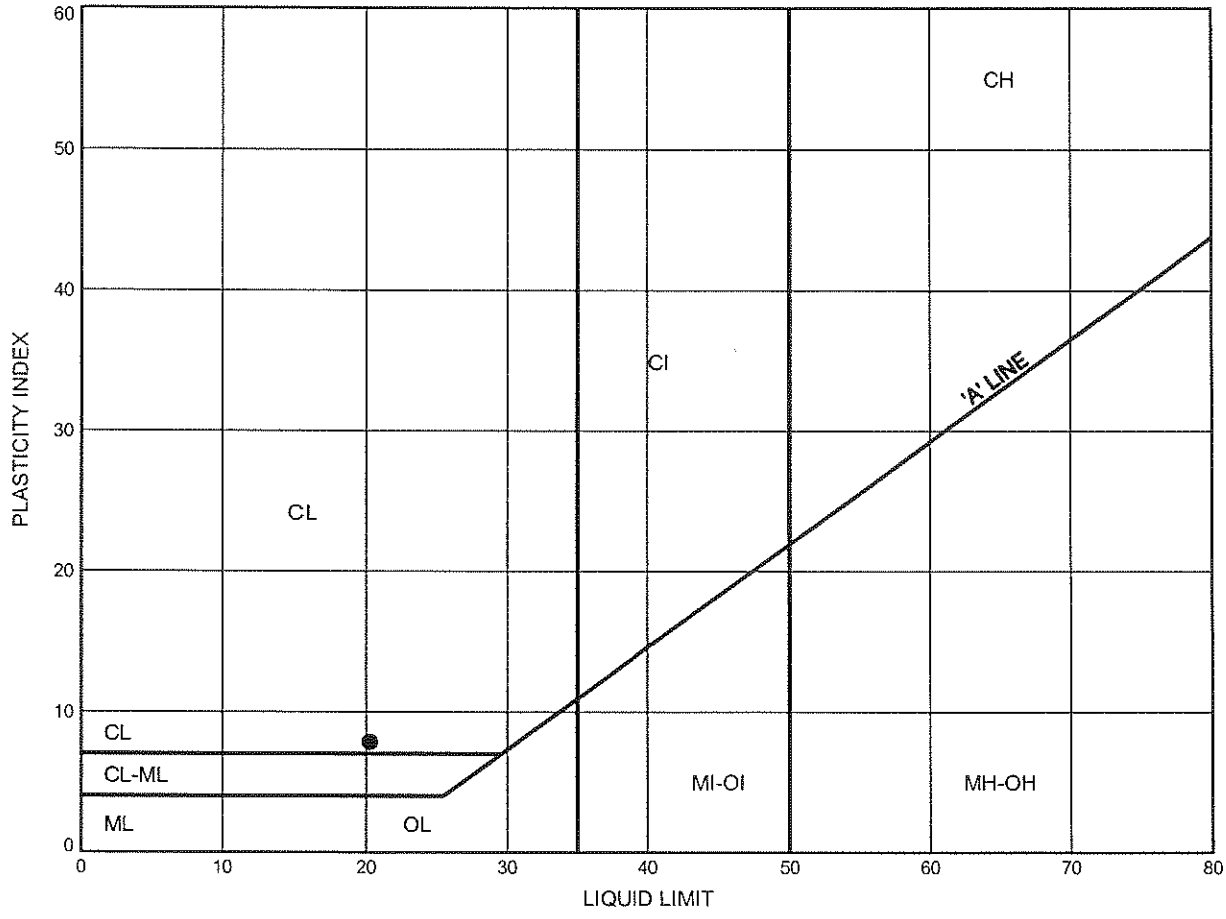
THURBALT 2311.GPJ 1/28/08

Hwy 401/410 to Credit River

ATTERBERG LIMITS TEST RESULTS

FIGURE B4

Clayey Silt with Sand



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	HML-05	1.83	195.55

Date January 2008

Project 2107-05-00

THURBER

Prep'd MFA

Chkd. RPR

THURBALT 2311.GPJ 1/28/08

Appendix C

Record of Borehole Sheets

(Adjacent Structure Investigations)

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No BW01 1 OF 2 METRIC

G.W.P. 2149-01-00 & 2150-01-00 LOCATION Hwy 401 WBL Core - Hurontario Street N/S Ramp N 4 832 599.1 E 290 453.4 ORIGINATED BY SLL
HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY MFA
DATUM Geodetic DATE 2006-10-26 - 2006-10-27 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
201.7											
0.0	TOPSOIL: (50 mm)										
	CLAY, with limestone fragments Stiff to Very Stiff Brown / Grey (WEATHERED SHALE FILL)		1	SS	19		201		○		
			2	SS	22		200		○		
			3	SS	12		199		○		
	Hard		4	SS	50/ .075		198		○		
			5	SS	12		197		○ ○		
194.2							196				
7.4	Sandy SILT, trace gravel and clay Very Dense Brown Moist (FILL)		6	SS	55		195				
192.8							194		○		
8.9	reddish brown SHALE, with grey limestone layers (FILL)		7	SS	50/ .125		193		○		
191.9	Coring started at 9.52m										
9.8	SAND, some gravel, trace silt,						192				

Continued Next Page

+ ³ . × ³ : Numbers refer to Sensitivity

20 / 15 ○ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 2/21/08

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No BW01 2 OF 2 METRIC

G.W.P. 2149-01-00 & 2150-01-00 LOCATION Hwy 401 WBL Core - Hurontario Street N/S Ramp N 4 832 599.1 E 290 453.4 ORIGINATED BY SLL
HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY MFA
DATUM Geodetic DATE 2006-10-26 - 2006-10-27 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	SAND, some gravel, trace silt, occasional cobbles Very Dense Grey Moist to Wet (TILL)		8	SS	50/.100		191		○		41 46 13 (SI+CL)
189.9											
11.8	Highly weathered, thinly bedded, very weak, reddish brown, SHALE, with grey limestone layers		9	SS	74		190		○		
			1	RUN			189			FI 8 9 5 4	RUN 1# TCR=77%, SCR=63%, RQD=37%, UCS=53MPa
			2	RUN			188			6 4 >10 2	RUN 2# TCR=100%, SCR=97%, RQD=23%, UCS=3MPa
			3	RUN			187				RUN 3# TCR=100%, SCR=94%, RQD=54%, UCS=3MPa
184.7							186				
17.0	END OF BOREHOLE AT 17.00 m. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.						185				

+ ³, × ³: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 2/21/08

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No BW02 1 OF 1 METRIC

G.W.P. 2149-01-00 & 2150-01-00 LOCATION Hwy 401 WBL Core - Hurontario Street N/S Ramp N 4 832 614.5 E 290 489.9 ORIGINATED BY SLL
HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MFA
DATUM Geodetic DATE 2007-01-10 - 2007-02-10 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (O UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
201.9											
0.0	Silty CLAY, with shale and limestone fragments Stiff Brown / Grey (WEATHERED SHALE FILL)						202				
			1	SS	11		201		o		
			2	SS	14		200		o		
	Becoming Very Stiff		3	SS	21				o		
			4	SS	52		199		o		
	Becoming Hard						198				
			5	SS	62/ .225		197		o		
196.0											
5.9	END OF BOREHOLE AT 5.94 m. BOREHOLE GROUTED WITH BENTONITE TO SURFACE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 2/21/08

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No BW02-07 1 OF 2 METRIC

G.W.P. 2149-01-00 & 2150-01-00 LOCATION Basketweave Hurontario ORIGINATED BY GA
HWY 401 BOREHOLE TYPE Hollow Stem Auger COMPILED BY ES
DATUM Geodetic DATE 2006-10-23 - 2006-10-25 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
201.9							202				
0.0	**SAND, GRAVEL and SILTY CLAY,** with shale and limestone fragments Brown / Grey (FILL)						201				
	* Refer to Borehole BW02 for details of fill layer.						200				
							199				
							198				
							197				
							196				
194.9			1	SS	63		195				
7.0	CLAY, silty, some sand, trace gravel Hard Mottled brown-grey (TILL)						194		d		1 27 50 22
192.8			2	SS	83		193		o		
9.1	SILT, trace to some sand Dense Grey Damp (TILL)		3	SS	49		192				

Continued Next Page

+ ³, × ³: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 2/21/08

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No BW02-07 2 OF 2 METRIC

G.W.P. 2149-01-00 & 2150-01-00 LOCATION Basketweave Hurontario ORIGINATED BY GA
HWY 401 BOREHOLE TYPE Hollow Stem Auger COMPILED BY ES
DATUM Geodetic DATE 2006-10-23 - 2006-10-25 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, X LAB VANE; 20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	SILT, trace to some sand Very Dense Grey Moist to wet (TILL)										
191.1			4	SS	100/						
10.8	Lots of Grinding at 10.8m				.150				o		
	END OF BOREHOLE AT 10.82m. AUGER REFUSAL ON POSSIBLE BEDROCK. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.						191				

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 2/21/08

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No BW05 1 OF 1 METRIC

G.W.P. 2149-01-00 & 2150-01-00 LOCATION Hwy 401 WBL Core - Hurontario Street N/S Ramp N 4 832 660.8 E 290 579.7 ORIGINATED BY SLL
HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MFA
DATUM Geodetic DATE 2006-10-23 - 2006-10-23 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: O UNCONFINED + FIELD VANE, ● QUICK TRIAXIAL × LAB VANE, 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
195.1											
0.0	TOPSOIL: (150 mm)										
0.2	Silty CLAY, occasional sand layer		1	SS	4		195				
194.5	Firm										
	Brown										
0.6	Sandy SILT, trace clay, trace rootlets										
	Compact		2	SS	22						
	Brown						194				
193.9	Moist										
1.2	Highly weathered, thinly bedded, very weak, reddish brown, SHALE, with grey limestone layers		3	SS	48						
			4	SS	50/.075		193				
			5	SS	62		192				
191.5											
3.7	END OF BOREHOLE AT 3.66 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.										

WATER LEVEL READINGS:

DATE	DEPTH(m)	ELEV.(m)
10/27/06	0.5	194.7
11/13/06	0.7	194.4
12/12/06	0.2	194.9
29/01/07	0.3	194.8

$+^3$ $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 2/21/08

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No BW07 1 OF 1 METRIC

G.W.P. 2149-01-00 & 2150-01-00 LOCATION Hwy 401 WBL Core - Hurontario Street N/S Ramp N 4 832 678.6 E 290 637.1 ORIGINATED BY SLL

HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 2006-10-24 - 2006-10-25 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
193.2											
0.0	TOPSOIL: (150 mm)										
0.2	Silty CLAY, mixed with topsoil, trace roots		1	SS	4		193				
192.6	Firm										
0.6	Brown										
	(FILL)										
	Silty CLAY, some sand, trace gravel		2	SS	16						
	Very Stiff						192				
	Brown										
191.6											
1.6	Highly weathered, thinly bedded, very weak, reddish brown, SHALE, with grey limestone layers		3	SS	46						
	Limestone interbed at 2.08m to 2.13m										
	Coring started at 2.1m		1	RUN			191				RUN 1# TCR=20%, SCR=15%, RQD=0%, UCS=3MPa
	Limestone interbed at 3.61m to 3.71m		2	RUN			190				RUN 2# TCR=80%, SCR=53%, RQD=0%, UCS=51MPa
	Limestone interbeds at 5.20m to 5.30m, 6.28m to 6.30m, 6.35m to 6.37m		3	RUN			189				RUN 3# TCR=100%, SCR=90%, RQD=7%, UCS=29MPa
186.6							188				
6.7	END OF BOREHOLE AT 6.65 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.						187				

WATER LEVEL READINGS:

DATE	DEPTH(m)	ELEV.(m)
10/27/06	0.5	192.7
11/13/06	0.6	192.6
12/17/06	0.5	192.7
29/01/07	0.5	192.7

+ ^{3}, × ^{3} : Numbers refer to Sensitivity

20 15 5 10 (%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 2/21/08

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No BW10 1 OF 1 METRIC

G.W.P. 2149-01-00 & 2150-01-00 | LOCATION Hwy 401 WBL Core - Hurontario Street N/S Ramp N 4 832 685.2 E 290 706.5 | ORIGINATED BY BJ
HWY 401 | BOREHOLE TYPE Solid Stem Augers/NQ Coring | COMPILED BY WM
DATUM Geodetic | DATE 2006-12-12 - 2006-12-12 | CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
194.5											
0.0 / 0.1	TOPSOIL: (50 mm)										
	Sandy SILT, gravelly, trace to some clay Compact to Loose Grey to Brown Moist (FILL)		1	SS	24		194				
			2	SS	7						
193.0							193				
1.5	Silty CLAY, some sand, trace gravel, some black staining Very Stiff Brown (FILL)		3	SS	26						
192.2							192				0 6 47 47
2.3	Silty CLAY, trace sand, occasional oxide staining Stiff to Very Stiff Mottled grey-brown (CI)		4	SS	11						
			5	SS	26		191				
190.6											
4.0	Highly weathered, thinly bedded, very weak to weak, reddish brown, SHALE, occasional siltstone layers										
	Coring started at 4.67m		6	SS	50/.100		190			FI	RUN 1# TCR=100%, SCR=100%, RQD=37%, UCS=33MPa
			1	RUN						10 4 5 5 6	
							189				
			2	RUN			188			5 5 2 2	RUN 2# TCR=100%, SCR=100%, RQD=50%, UCS=3MPa
186.8							187			3	
7.7	END OF BOREHOLE AT 7.72 m. BOREHOLE GROUTED TO SURFACE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 2/21/08

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No BW11 1 OF 1 METRIC

G.W.P. 2149-01-00 & 2150-01-00 LOCATION Hwy 401 WBL Core - Hurontario Street N/S Ramp N 4 832 718.3 E 290 748.9 ORIGINATED BY BJ

HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY WM

DATUM Geodetic DATE 2006-11-12 - 2006-11-12 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
192.6											
0.0 / 0.1	**TOPSOIL**: (75 mm)										
	Silty **CLAY**, some sand, trace rootlets, occasional black staining Soft to Stiff (FILL)		1	SS	4						
191.1			2	SS	8		192				
1.5	Silty **CLAY**, some sand, trace gravel, trace rootlets Very Stiff Brown		3	SS	15		191				1 10 45 44
190.3											
2.3	Silty **CLAY**, some sand, trace gravel Hard Brown (TILL)		4	SS	34		190				
			5	SS	66/ 125						1 39 40 20
188.6							189				
4.0	Highly weathered, thinly bedded, very weak , reddish brown, **SHALE**		6	SS	50/ .075		188			FI	
	Coring started at 4.67m		1	RUN						5	RUN 1# TCR=100%, SCR=100%, RQD=45%
	Clay seam at 4.93m to 5.00m						187			5 4 4	
			2	RUN			186			2 6 3	RUN 2# TCR=92%, SCR=92%, RQD=40%
184.9							185			3 5 4	
7.7	END OF BOREHOLE AT 7.72 m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 29/01/07 1.0 191.6										

$+^3$ $\times^3$ Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 2/21/08

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No BW12 1 OF 1 METRIC

G.W.P. 2149-01-00 & 2150-01-00 LOCATION Hwy 401 WBL Core - Hurontario Street N/S Ramp N 4 832 704.3 E 290 755.2 ORIGINATED BY BJ

HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY WM

DATUM Geodetic DATE 2006-12-12 - 2006-12-12 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES 'N' VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
194.1											
0.0 / 0.0	TOPSOIL: (50 mm)										
	Silty CLAY, some sand, trace rootlets Firm Dark Brown		1	SS	5		194		○		
193.4	(FILL)										
0.8	Sandy SILT, trace gavel Compact Brown Moist		2	SS	20		193		○		
192.6	(FILL)										
1.5	Silty CLAY, trace sand, trace gravel, trace rootlets Firm Mottled brown-grey		3	SS	6				○		
191.9	(FILL)						192				
2.3	Silty CLAY, trace sand Stiff to Very Stiff Mottled brown-grey (CI)		4	SS	12				○		
			5	SS	18		191		⊢●⊣		0 2 46 52
190.0											
4.1	Highly weathered, thinly bedded, very weak, reddish brown, SHALE						190				
189.3			6	SS	50/.075				○		
4.8	END OF BOREHOLE AT 4.81 m. BOREHOLE BACKFILLED WITH HOLEPLUG.										

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 2/21/08

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No H2 1 OF 2 METRIC

G.W.P. 2149-01-00 & 2150-01-00 | LOCATION Proposed Hurontario St. Underpass N 4 832 276.4 E 289 882.0 | ORIGINATED BY GA/JHL
HWY 401 | BOREHOLE TYPE Solid Stem Augers | COMPILED BY JHL
DATUM Geodetic | DATE 2006-10-30 - 2006-11-03 | CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
199.8											
0.0	**ASPHALT:** (100 mm)		1	SS	50/ .075						
0.1	Gravelly **SAND**, some silt, occasional shale fragments Very Dense Brown Damp (FILL)		2	SS	85		199				
198.2											
1.5	Silty **CLAY**, some sand, trace gravel, some shale fragments Very Stiff to Hard Brown to Reddish Brown (FILL)		3	SS	50		198				5 31 46 18
			4	SS	23		197				
	some limestone fragments		5	SS	50/ .150		196				
			6	SS	22		195				
			7	SS	20	▼	194				11 37 35 17
	black staining						193				
			8	SS	35		192				
			9	SS	50/ .025		191				
190.3											
9.4	Silty **CLAY**, some sand, trace gravel, occasional siltstone and limestone fragments						190				

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 3/4/08

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No H2 2 OF 2 METRIC

G.W.P. 2149-01-00 & 2150-01-00 LOCATION Proposed Hurontario St. Underpass N 4 832 276.4 E 289 882.0 ORIGINATED BY GA/JHL

HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY JHL

DATUM Geodetic DATE 2006-10-30 - 2006-11-03 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: O UNCONFINED + FIELD VANE; ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	Silty **CLAY**, some sand, trace gravel, occasional siltstone and limestone fragments Hard Grey (TILL)		10	SS	50/.125		189		o		7 43 36 14
			11	SS	50/.125		188		o		
186.1							187				
13.7	**SHALE**, highly weathered, thinly bedded, reddish brown, grey limestone layers		12	SS	126		186		o		
184.5							185				
15.3	END OF BOREHOLE AT 15.32 m. BOREHOLE OPEN AND WATER LEVEL AT 13.1 m UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 13.11.06 6.0 193.8		13	SS	100/.075				o		

+^{3}, ×^{3}: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 3/4/08

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No H6 1 OF 2 METRIC

G.W.P. 2149-01-00 & 2150-01-00 LOCATION Proposed Hurontario St. Underpass N 4 832 190.6 E 289 977.1 ORIGINATED BY GA
HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY JHL
DATUM Geodetic DATE 2006-11-06 - 2006-11-07 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
199.7											
0.0	**ASPHALT:** (150 mm)										
0.2	**SAND AND GRAVEL** Dense Brown Moist (FILL)		1	SS	32		199		○		
198.9 0.8	Sandy **SILT**, trace gravel, occasional shale fragments Dense Brown (FILL)		2	SS	32				○		
198.1 1.5	Silty **CLAY**, some sand to sandy, trace gravel Stiff to Very Stiff Reddish Brown (FILL)		3	SS	12		198		○		
			4	SS	16		197		○⊢		1 28 47 24
			5	SS	13				○		
			6	SS	10		196		○		
			7	SS	15		195		○		
	occasional asphalt fragments Hard		8	SS	45		194		○		
191.1 8.5	Silty **CLAY**, some sand, trace gravel Hard Brown (TILL)		9	SS	57		193		○⊢		1 32 46 21
							192				
							191				
							190				

Continued Next Page

+ ³ . × ³ . Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 3/4/08

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No H6 2 OF 2 METRIC

G.W.P. 2149-01-00 & 2150-01-00 LOCATION Proposed Hurontario St. Underpass N 4 832 190.6 E 289 977.1 ORIGINATED BY GA
HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY JHL
DATUM Geodetic DATE 2006-11-06 - 2006-11-07 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa O UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Silty **CLAY**, some sand, trace gravel Hard Brown (TILL)		10	SS	144		189	o			
187.9							188				
11.7	**SHALE**, highly to moderately weathered, thinly bedded, reddish brown, grey limestone layers		11	SS	106		187	o			
			12	SS	100/.125		186	o		FI	
	Rubble zones from 14.10m to 14.14m, 14.53m to 14.56m Limestone interbeds at 14.51m to 14.56m, 14.68m to 14.71m, 14.75m to 14.80m, 14.99m to 15.04m		1	RUN			185			>5 2 4 0	RUN 1# TCR=100%, SCR=90%, RQD=52%, UCS=79MPa
	Limestone interbeds at 15.73m to 15.80m, 16.00m to 16.05m		2	RUN			184			>5 4 0 0	RUN 2# TCR=100%, SCR=92%, RQD=58%, UCS=29MPa
182.8							183			0	
16.8	END OF BOREHOLE AT 16.84 m. BOREHOLE OPEN TO BOTTOM UPON COMPLETION. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 14.11.06 7.1 192.6										

$+^3$, $\times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 3/4/08

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No H7 1 OF 1 METRIC

G.W.P. 2149-01-00 & 2150-01-00 LOCATION Proposed Hurontario St. Underpass N 4 832 287.0 E 289 859.4 ORIGINATED BY JHL
HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY JHL
DATUM Geodetic DATE 2006-10-31 - 2006-10-31 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa (O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE) 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
199.2											
0.0	**ASPHALT**: (100 mm)										
0.1	**SAND**, trace silt Very Dense Brown Moist		1	SS	56		199				
198.3	(FILL)										
0.9	Silty **CLAY**, some sand, trace gravel, occasional shale fragments Firm to Hard Brown (FILL)		2	SS	56		198				
			3	SS	18						
	occasional rock fragments Becoming Reddish Brown to Brown		4	SS	21		197				
			5	SS	8		196				2 38 40 20
193.1			6	SS	11		195				
6.1	Silty **CLAY**, some sand, trace gravel Stiff to Very Siff Grey (TILL)		7	SS	14		194				
							193				1 18 44 37
191.1			8	SS	28		192				
8.1	END OF BOREHOLE AT 8.08 m. BOREHOLE GROUTED WITH BENTONITE TO SURFACE. WATER NOT OBSERVED IN BOREHOLE UPON COMPLETION OF DRILLING.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 3/4/08

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No H8 1 OF 2 METRIC

G.W.P. 2149-01-00 & 2150-01-00 LOCATION Proposed Hurontario St. Underpass N 4 832 133.0 E 289 989.3 ORIGINATED BY GA
HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY JHL
DATUM Geodetic DATE 2006-11-09 - 2006-11-09 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa (O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE) 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
198.0							198				
0.0	**TOPSOIL:** (225 mm)										
0.2	Silty **CLAY**, some sand, some asphalt fragments, organics and rootlets Firm to Very Stiff Brown to Reddish Brown (FILL)		1	SS	8						
			2	SS	7		197				
			3	SS	15		196				
			4	SS	14						
			5	SS	10		195				
							194				
			6	SS	11		193				0 27 46 27
							192				
191.0			7	SS	20						
7.0	Silty **CLAY**, some sand, trace gravel Hard Brown (TILL)						191				
			8	SS	42		190				6 21 46 27
189.2											
8.8	**SHALE**, highly weathered, thinly bedded, reddish brown, grey limestone layers						189				
			9	SS	106						
188.6											
9.4	END OF BOREHOLE AT 9.45 m. BOREHOLE OPEN AND DRY TO BOTTOM UPON COMPLETION.										

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 3/4/08

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No H8 2 OF 2 METRIC

G.W.P. 2149-01-00 & 2150-01-00 LOCATION Proposed Hurontario St. Underpass N 4 832 133.0 E 289 989.3 ORIGINATED BY GA

HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY JHL

DATUM Geodetic DATE 2006-11-09 - 2006-11-09 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						GR SA SI CL
	Continued From Previous Page										
	Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.										
	WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 13.11.06 7.7 190.3 12.12.06 7.1 190.9 29.01.07 7.4 190.6										

$+^3$, $\times^3$ Numbers refer to Sensitivity

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

ONTMTAS 2311.GPJ 3/4/08

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No RW1-1 1 OF 1 METRIC

G.W.P. 2107-05-00 LOCATION Hurontario St. North - HWY 401 West Ramp, N 4 832 167.797 E 289 673.658 ORIGINATED BY GA

HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES

DATUM Geodetic DATE 2007-10-04 - 2007-10-04 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
189.8											
0.0 / 0.1	**TOPSOIL:** (75mm)										
	Silty **CLAY**, trace sand, trace shale fragments, occasional rootlets Hard Reddish brown (FILL)		1	SS	37				○		
189.0 / 0.8	Silty **CLAY**, some sand, trace gravel, occasional shale fragments Very stiff Brown to reddish brown (TILL)		2	SS	17		189		○ ⊢		1 26 53 20
188.3 / 1.5	**SHALE**, highly weathered, fine grained, thinly bedded, reddish brown		3	SS	50/ .150		188		○		
	Occasional green siltstones		4	SS	100/ .125		187		○		
186.7 / 3.0	END OF BOREHOLE AT 3.05m. AUGER REFUSAL ON PROBABLE LIMESTONE LAYER. BOREHOLE OPEN AND DRY TO BOTTOM UPON COMPLETION. Piezometer installation consists of 19mm diameter schedule PVC pipe. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) Oct 18/07 1.4 188.4 Nov 01/07 0.9 188.9 Nov 15/07 1.3 188.5										

$+^3$, $\times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 2/5/08

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No RW1-2 1 OF 1 METRIC

G.W.P. 2107-05-00 LOCATION Hurontario St. North - HWY 401 West Ramp, N 4 832 201.428 E 289 703.136 ORIGINATED BY GA

HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES

DATUM Geodetic DATE 2007-10-04 - 2007-10-04 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
190.7											
0.0 / 0.1	**TOPSOIL:** (50mm)										
	Silty **CLAY**, trace to some sand, trace gravel, occasional rootlets Hard Brown to reddish brown (TILL)		1	SS	34				○		
190.1 / 0.6											
	SHALE, highly weathered, fine grained, thinly bedded, reddish brown		2	SS	50/ .075		190		○		
			3	SS	100/ .150		189		○		
	Moderate to slightly weathered, 50mm thick limestone layer		4	SS	100/ .125		188		○		
			5	SS	100/ .075				○		
187.0											
3.7	END OF BOREHOLE AT 3.66m. AUGER REFUSAL ON PROBABLE LIMESTONE LAYER. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.										

+ ³, × ³: Numbers refer to Sensitivity

15 ⊕ 5 (20, 10) (%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 2/5/08

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No RW2-1 1 OF 1 METRIC

G.W.P. 2107-05-00 LOCATION Northwest Quadrant of HWY 401 & Hurontario St., N 4 832 206.495 E 289 756.121 ORIGINATED BY GA

HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES

DATUM Geodetic DATE 2007-10-03 - 2007-10-03 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
190.3											
0.0 / 0.1	**TOPSOIL:** (75mm)										
	Silty **CLAY**, some sand, trace gravel, occasional rootlets Very stiff Brown		1	SS	20		190		○		
189.5 / 0.8	(TILL)		2	SS	50/.150				○		
	SHALE, highly to moderately weathered, fine grained, thinly bedded, reddish brown		3	SS	100/.150		189		○		
	Occasional green siltstone interbeds		4	SS	100/.150		188		○		
			5	SS	50/.000		187				
186.6 / 3.7	END OF BOREHOLE AT 3.66m. AUGER REFUSAL ON PROBABLE LIMESTONE LAYER. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 2/5/08

Ministry of Transportation
Ontario

THUNDER

RECORD OF BOREHOLE No RW2-2 1 OF 1 METRIC

G.W.P. 2107-05-00 LOCATION Northwest Quadrant of HWY 401 & Hurontario St., N 4 832 232.272 E 289 800.127 ORIGINATED BY GA

HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES

DATUM Geodetic DATE 2007-10-03 - 2007-10-03 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: o UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	Silty **CLAY**, trace to some sand, trace gravel, occasional rootlets Hard Brown (FILL)		1	SS	50/.150		191		o		
190.4 0.6	Silty **CLAY**, some sand, trace gravel, occasional rootlets Hard Dark grey (TILL)		2	SS	50/.150		190		o		1 16 57 26
189.8 1.2	**SHALE**, highly weathered, fine grained, thinly bedded, reddish brown		3	SS	100/.125		189		o		
188.0			4	SS	100/.150				o		
3.0	END OF BOREHOLE AT 3.05m. AUGER REFUSAL ON PROBABLE LIMESTONE BEDROCK. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.										

+³, ×³: Numbers refer to Sensitivity

15 (20) 5 10 (%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 2/5/08

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No RW2-3 1 OF 1 METRIC

G.W.P. 2107-05-00 LOCATION Northwest Quadrant of HWY 401 & Hurontario St., N 4 832 256.327 E 289 842.836 ORIGINATED BY GA
HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES
DATUM Geodetic DATE 2007-03-10 - 2007-03-10 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE; 20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
194.9											
0.0 / 0.1	**TOPSOIL:** (75mm)										
	Silty **CLAY**, trace to some sand, trace gravel, occasional rootlets Hard to Very Stiff Brown to Mottled Grey and Brown (FILL)		1	SS	48				○		
			2	SS	23		194		○		
193.3											
1.5	**SHALE**, highly weathered, thinly bedded, reddish brown (FILL)		3	SS	8		193		○		
			4	SS	20	▼	192		○		
191.9											
3.0	Silty **CLAY**, some sand, trace gravel, occasional rootlets Hard Dark grey (TILL)		5	SS	71		192		⊖		1 22 55 22
191.2											
3.7	**SHALE**, highly weathered, fine grained, thinly bedded, reddish brown		6	SS	100/.125		191		○		
							190				
188.8							189				
6.1	END OF BOREHOLE AT 6.10m. AUGER REFUSAL ON PROBABLE LIMESTONE LAYER. BOREHOLE OPEN AND DRY UPON COMPLETION. Piezometer installation consists of 19mm diameter schedule PVC pipe. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) Oct 05/07 5.0 189.9 Oct 18/07 2.8 192.1 Nov 01/07 2.9 192.0 Nov 15/07 2.7 192.2										

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 2/12/08

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No RW3-1 1 OF 1 METRIC

G.W.P. 2107-05-00 LOCATION Hurontario St. South Access Road N 4 832 020.551 E 289 930.652 ORIGINATED BY GA

HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES

DATUM Geodetic DATE 2007-11-10 - 2007-11-10 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE; 20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
190.9											
0.0	**TOPSOIL:** (100mm)										
0.1	Silty **CLAY**, some sand, occasional rootlets Very Stiff to Hard Brown (FILL)		1	SS	16				○		0 16 54 30
			2	SS	50/.100		190		○		
189.4											
1.5	Highly to moderately weathered, thinly bedded, reddish brown **SHALE**		3	SS	42		189		○		
			4	SS	50/.150	▼	188		○		
			5	SS	109				○		
	Grinding at 3.66m to 4.27m						187				
			6	SS	100/.150				○		
185.4							186				
5.5	END OF BOREHOLE AT 5.49m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION. Piezometer installation consists of 19mm diameter schedule PVC pipe. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) Oct 18/07 Dry - Nov 15/07 2.7 188.2										

+ ^{3}, × ^{3} : Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 2/5/08

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No RW3-2 1 OF 1 METRIC

G.W.P. 2107-05-00 LOCATION Hurontario St. South Access Road N 4 832 040.894 E 289 977.204 ORIGINATED BY GA
HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES
DATUM Geodetic DATE 2007-11-10 - 2007-11-10 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
193.2											
0.0	**TOPSOIL:** (100mm)										
0.1	Silty **CLAY**, with sand, trace gravel, occasional rootlets Very Stiff Brown (FILL)		1	SS	27		193				
			2	SS	20		192				
	oxidized stains Brown to Grey		3	SS	15						1 31 44 24
			4	SS	19		191				
190.1			5	SS	50/ .075		190				
3.1	Highly weathered, thinly bedded, reddish brown **SHALE**		6	SS	100/ .150		189				
			7	SS	100/ .125		188				
			8	SS	100/ .100		187				
184.3							186				
8.9	END OF BOREHOLE AT 8.89m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.						185				

$+^3$, $\times^3$: Numbers refer to Sensitivity

$15 \oplus^{20}_{10} 5$ (%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 2/5/08

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No NAR08 1 OF 2 METRIC

G.W.P. 2107-05-00 | LOCATION Proposed North Access Road/N-W Ramp N 4 832 324.6 E 289 752.5 | ORIGINATED BY GA
HWY 401 | BOREHOLE TYPE Solid Stem Augers/NQ Coring | COMPILED BY MFA
DATUM Geodetic | DATE 2006-10-17 - 2006-10-17 | CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
193.7											
0.0	TOPSOIL: (100 mm)										
0.1	Silty CLAY, some sand, trace gravel, occasional rootlets Firm to Very Stiff Mottled Brown to Grey (FILL)		1	SS	6		193		○		
			2	SS	24				○		
192.1							192				
1.5	SAND and SILT, some clay, trace gravel Dense to Very Dense Brown Moist (TILL)		3	SS	43				○		
			4	SS	50/.150				○		4 36 47 13
190.9							191				
2.7	Sandy SILT, trace clay Very Dense Brown Moist		5	SS	50/.150				○		0 27 69 4
	becoming Grey						190				
188.9											
4.7	Silty CLAY, trace sand, trace gravel, occasional shale fragments Hard Reddish Brown (TILL)		6	SS	80		189		○		
188.2											
5.5	SHALE, highly to moderately weathered, fine grained, thinly bedded, reddish brown, with frequent rubble zones and limestone interbeds					▼	188				
			7	SS	50/.150				○	FI	
	Rubble zone from 6.43m to 6.74m Limestone interbeds at 6.76m to 6.79m, 7.52m to 7.55m		1	RUN			187			>10 >10 5 5 4	RUN 1# TCR=100%, SCR=75%, ROD=22%
	Moderately to slightly weathered Limestone interbeds at 7.77m to 7.89m, 8.28m to 8.33m, 8.72m to 8.77m, 8.92m to 9.07m, 9.14m to 9.17m, 9.24m to 9.30m		2	RUN			186			5 5 3 2	RUN 2# TCR=100%, SCR=97%, ROD=53%
184.4							185			1	
9.3	END OF BOREHOLE AT 9.30m. BOREHOLE OPEN TO BOTTOM UPON COMPLETION.										

Continued Next Page

+ ³ , × ³ Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 2/26/08

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No NAR08 2 OF 2 METRIC

G.W.P. 2107-05-00 LOCATION Proposed North Access Road/N-W Ramp N 4 832 324.6 E 289 752.5 ORIGINATED BY GA

HWY 401 BOREHOLE TYPE Solid Stem Augers/NQ Coring COMPILED BY MFA

DATUM Geodetic DATE 2006-10-17 - 2006-10-17 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE; 20 40 60 80 100	WATER CONTENT (%) 20 40 60		GR SA SI CL
	Continued From Previous Page										
	Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) 08.12.06 0.80 192.8 29.01.07 0.70 193.0 01.11.07 5.89 187.8										

$+^3$ $\times^3$ Numbers refer to Sensitivity

20 / 15 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 2/26/08

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No NAR15 1 OF 1 METRIC

G.W.P. 2107-05-00 LOCATION Proposed North Access Road/N-W Ramp N 4 832 342.5 E 289 748.0 ORIGINATED BY GA
HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES
DATUM Geodetic DATE 2007-10-02 - 2007-10-02 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
194.3											
0.0 / 0.1	TOPSOIL 0.08m										
193.9	SAND, some gravel, trace silt, trace clay, some gravel, occasional rootlets Very Dense Brown Moist (FILL)		1	SS	84		194		o		
0.5	Silty CLAY, trace to some sand, trace gravel Hard Mottled Brown/Reddish Brown (FILL)		2	SS	54				o		
192.8 / 1.5	Silty CLAY, with sand, trace gravel Hard Brown (TILL)		3	SS	58		193		⊣⊢		2 29 47 22
			4	SS	50/.150		192		o		
191.3 / 3.0	SAND and SILT, trace gravel, trace to some clay, occasional iron oxide staining Very Dense Brown (TILL) Grinding at 3.96m to 4.27m		5	SS	50/.150		191		o		4 48 39 9
190.1 / 4.3	SHALE, highly weathered, fine grained, thinly bedded Reddish Brown		6	SS	100/.125		190		o		
188.2							189				
6.2	END OF BOREHOLE AT 6.17m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.		7	SS	100/.075				o		

$+^3$, $\times^3$: Numbers refer to Sensitivity

(%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 2/26/08

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HAR-15 1 OF 2 METRIC

G.W.P. 2107-05-00 LOCATION Hurontario St. South Access Road N 4 832 097.821 E 290 058.189 ORIGINATED BY GA

HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES

DATUM Geodetic DATE 2007-10-17 - 2007-10-17 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa: o UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
196.6 / 0.0	**ASPHALT:** (125mm)										
0.1	**SAND** and **GRAVEL** Dense to Very Dense Brown (FILL)		1	SS	33		196	o	o		
			2	SS	50/.150				o		
195.3 / 1.4	Silty **CLAY**, some sand, trace gravel, occasional shale fragments Very Stiff Reddish Brown (FILL)		3	SS	20		195		o⊢		1 22 52 25
194.4 / 2.3	**SHALE**, highly weathered, thinly bedded Stiff to Hard Reddish Brown (FILL)		4	SS	30		194		o		
			5	SS	14		193		o		
192.1 / 4.6	Silty **CLAY**, with sand, trace gravel Hard Mottled Brown and Grey (TILL)		6	SS	33		192		o		
			7	SS	60		191		o⊢		1 25 51 23
189.3 / 7.3	**SHALE**, highly weathered to fresh, thinly bedded, reddish brown, with occasional green siltstone and grey limestone interbeds		8	SS	70/.150		190		o		
	Coring started at 8.5m.						189				
	Green siltstone interbeds at 8.66, 8.74, 8.94, 9.11, 9.22, 9.25 to 9.30, 9.58, 9.81, 9.85, 9.98 and 10.03m Limestone interbeds at 9.02, 9.09, 9.63, 9.81 and 10.03m Highly broken zones at 8.56 to 8.69,		1	RUN			188			Fl >5 >5 >5 4 0	RUN 1# TCR=100%, SCR=48%, RQD=48%, UCS=17.5MPa (Shale/Siltstone) UCS=63MPa (Siltstone)
							187				

Continued Next Page

+ ^{3}, × ^{3} Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 3/6/08

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No HAR-15 2 OF 2 METRIC

G.W.P. 2107-05-00 LOCATION Hurontario St. South Access Road N 4 832 097.821 E 290 058.189 ORIGINATED BY GA

HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES

DATUM Geodetic DATE 2007-10-17 - 2007-10-17 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	PLASTIC LIMIT w_P	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w_L	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE; 20 40 60 80 100	WATER CONTENT (%) 20 40 60				GR SA SI CL
	Continued From Previous Page												
	8.81 to 8.99 and 9.20 to 9.32m Weak to strong											0	RUN 2# TCR=100%, SCR=100%, RQD=100%, UCS=28MPa (Shale/Siltstone) UCS=105MPa (Siltstone) UCS=86MPa (Limestone)
												0	
	Green siltstone interbeds at 10.08 to 10.11, 10.90, 10.97, 11.15 to 11.20, 11.25 to 11.28, 11.30 to 11.41 and 11.56 to 11.58m		2	RUN			186					0	
	Grey limestone interbeds at 10.26, 10.49 to 10.52, 11.33 and 11.51 to 11.56m											0	
185.1 / 11.6	END OF BOREHOLE AT 11.58m. BOREHOLE OPEN AND WATER LEVEL AT 4.88m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE TO 0.9m, CONCRETE to 0.15m AND COLD PATCH TO SURFACE.												

+ ^{3}, × ^{3}: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE
10

ONTMT4S 2311.GPJ 3/6/08

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No HAR-16 1 OF 1 METRIC

G.W.P. 2107-05-00 LOCATION Hurontario St. South Access Road N 4 832 110.129 E 290 065.885 ORIGINATED BY GA
HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MFA
DATUM Geodetic DATE 2007-09-14 - 2007-09-14 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
196.1											
0.0	**TOPSOIL:** (100mm)										
0.1	**SAND**, some silt, trace clay, trace gravel Compact to Dense Brown (FILL)		1	SS	40		196				
			2	SS	16		195				
	Loose		3	SS	9						0 86 14 (SI+CL)
193.9							194				
2.2	Silty **CLAY**, trace to some sand, trace gravel Stiff Brown to Reddish Brown		4	SS	12						
193.2	(FILL)						193				
3.0	Silty **CLAY**, with sand, trace gravel, occasional iron oxidized stains Hard Mottled Brown and Grey (TILL)		5	SS	16						
			6	SS	49	▼	192				1 29 50 20
	Brown to Reddish Brown		7	SS	60/.150		191				
189.4							190				
6.7	**SHALE**, highly weathered, thinly bedded, reddish brown										
188.5							189				
7.6	END OF BOREHOLE AND AUGER REFUSAL AT 7.6m. BOREHOLE OPEN AND DRY TO 7.6m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) Sep 19/07 4.8 191.3 Sep 28/07 4.5 191.6 Oct 05/07 4.6 191.5 Oct 18/07 4.2 191.9 Nov 01/07 4.5 191.6 Nov 15/07 4.7 191.4		8	SS	50/.000						

$+^3$, $\times^3$: Numbers refer to Sensitivity

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE
10

ONTMT4S 2311.GPJ 3/6/08

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No HAR-18 1 OF 1 METRIC

G.W.P. 2107-05-00 LOCATION Hurontario St. South Access Road N 4 832 069.279 E 290 058.058 ORIGINATED BY GA

HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY ES

DATUM Geodetic DATE 2007-10-09 - 2007-10-09 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
195.0							195				
0.0	TOPSOIL: (100mm)										
0.1	SAND, trace clay, trace silt, trace gravel, occasional rootlets Compact Brown		1	SS	24				○		
194.2											
0.8	(FILL)										
	Silty CLAY, with sand, trace gravel Very Stiff Mottled Dark Grey-Brown (FILL)		2	SS	16		194		○		
			3	SS	18		193		○		
			4	SS	13				⊢●		9 33 43 15
	Brown to Mottled Brown-Reddish		5	SS	19		192		○		
							191				
	Hard		6	SS	50/.150				○		
189.2							190				
5.8	SHALE, highly weathered, thinly bedded, reddish brown, with occasional sand seams		7	SS	100/.150		189		○		
187.4							188				
7.6	END OF BOREHOLE AT 7.62m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.										

$+^3$, $\times^3$: Numbers refer to Sensitivity

20 / 15 ⊕ 5 / 10 (%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 3/6/08

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No RSE-17 1 OF 1 METRIC

G.W.P. 2107-05-00 LOCATION Hurontario St. South to HWY 401 East Ramp N 4 832 134.2 E 290 109.1 ORIGINATED BY GA

HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 2013-09-07 - 2013-09-07 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa: O UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
191.3											
0.0 / 0.1	**TOPSOIL:** (75mm)										
	Silty **CLAY**, trace to some sand, trace gravel, occasional rootlets Very Stiff to Hard Brown (FILL)		1	SS	17		191		o		
			2	SS	36				o		
189.9							190				
1.4	Silty **CLAY**, trace sand, occasional rootlets, organic odour Very Stiff Grey		3	SS	16				o		
189.1											
2.2	Silty **CLAY**, some sand, trace gravel Very Stiff to Hard Mottled Brown/Grey (TILL)		4	SS	21		189		o—o		0 25 47 28
			5	SS	68		188		o		
187.3											
4.0	**SHALE**, highly weathered, thinly bedded, reddish brown						187				
186.7											
4.6	END OF BOREHOLE AND AUGER REFUSAL AT 4.6m. BOREHOLE OPEN AND DRY TO 4.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.		6	SS	50/.000						

+ 3, × 3 : Numbers refer to Sensitivity

15 (20/10) 5 (%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 2/5/08

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No C4-3 1 OF 1 METRIC

G.W.P. 2107-05-00 LOCATION Highway 401 Station 19+200 N 4 832 243.563 E 290 019.052 ORIGINATED BY GA
HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MFA
DATUM Geodetic DATE 2007-09-13 - 2007-09-13 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	**TOPSOIL:** (100mm)										
0.1	Silty **CLAY**, trace to some sand, trace gravel, occasional rootlets Stiff to Very Stiff Brown to Greenish Grey (FILL)		1	SS	12				○		
			2	SS	20		191		○		
190.3											
1.4	Silty **CLAY** with sand, trace gravel Stiff to Hard Brown to Mottled Brown/Grey (TILL)		3	SS	13		190		○		
	occasional oxidized stains		4	SS	38				○⊣		2 33 50 15
	occasional shale fragments		5	SS	50/ .150		189		○		
187.2							188				
4.6	**SAND** and **SILT**, some clay, trace gravel, occasional shale fragments Very Dense Reddish Brown		6	SS	103		187		○		6 42 38 14
186.6	(TILL)										
5.2	**SHALE**, highly weathered, thinly bedded, reddish brown						186				
185.7											
6.1	END OF BOREHOLE AT 6.1m UPON AUGER REFUSAL. BOREHOLE OPEN AND DRY TO 6.1m. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.										

+³, ×³: Numbers refer to Sensitivity

20
15 ⊕ 5
10
(%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 3/6/08

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No C4-4 1 OF 1 METRIC

G.W.P. 2107-05-00 LOCATION Highway 401 Station 19+200 N 4 832 225.335 E 290 034.664 ORIGINATED BY GA
HWY 401 BOREHOLE TYPE Solid Stem Augers COMPILED BY MFA
DATUM Geodetic DATE 2007-11-13 - 2007-11-13 CHECKED BY RPR

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
190.7								
0.0	**TOPSOIL:** (125mm)							
0.1	Silty **CLAY**, trace to some sand, trace gravel, occasional rootlets Stiff Brown (FILL)		1	SS	13			
			2	SS	10			
189.2								
1.4	Silty **CLAY** with sand, occasional oxide stains Firm to Hard Mottled Brown-Grey to Brown (TILL)		3	SS	8			
			4	SS	49			
			5	SS	50/.150			2 34 46 18
186.1								
4.6	**SAND** and **SILT**, some clay, trace gravel Very Dense Grey Damp to Moist (TILL)		6	SS	50/.150			2 44 44 10
185.2								
5.5	**SHALE**, highly weathered, thinly bedded, reddish brown							
184.4			7	SS	100/.150			
6.2	END OF BOREHOLE AT 6.2m UPON AUGER REFUSAL. BOREHOLE OPEN TO 6.2m AND WATER LEVEL AT 1.5m UPON COMPLETION OF DRILLING. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH(m) ELEV.(m) Sep 14/07 0.9 189.8 Sep 19/07 0.8 189.9 Sep 28/07 1.0 189.7 Oct 05/07 0.8 189.9 Oct 18/07 0.8 189.9 Nov 01/07 0.8 189.9 Nov 15/07 0.7 190.0								

ELEVATION SCALE: 190, 189, 188, 187, 186, 185

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE; 20 40 60 80 100

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%): 20 40 60

+³ ×³ Numbers refer to Sensitivity

15 20 10 5 (%) STRAIN AT FAILURE

ONTMT4S 2311.GPJ 3/6/08

Appendix D

Borehole Location Drawings

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

HWY 401
SITE No
GWP No 2107-05-00

SHEET

HIGHWAY 401
HIGH MAST LIGHTING POLES
BOREHOLE LOCATION PLAN

MMM GROUP

THURBER ENGINEERING LTD.
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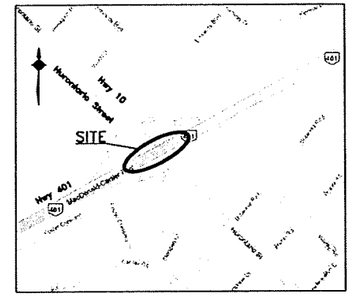

KEYPLAN

LEGEND

✦	Borehole (Present Investigation, 2007 and 2006)
✧	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
▼	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
HML-01	191.2	4 832 243.6	289 772.0
HML-02	190.2	4 832 097.5	289 804.1
HML-03	192.5	4 832 357.3	290 008.8
HML-04	192.1	4 832 240.1	290 085.5
HML-05	197.4	4 832 548.8	290 380.5

-NOTES-

1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 30M12-275

LICENSED PROFESSIONAL ENGINEER
R. Palomeque Reyna
100083209
Feb/5/09
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
Feb 5/09
PROVINCE OF ONTARIO

PLAN

20 0 25 50m

REVISIONS			
DATE	BY	DESCRIPTION	
DESIGN AEG	CHK PKC	CODE	LOAD — DATE FEB. 2009
DRAWN MFA	CHK PKC	SITE	STRUCT. — SCHEME. — DWG 1

PLOT SCALE 1:1
PR-D-707 88-08
MINISTRY OF TRANSPORTATION, ONTARIO

FILENAME: H:\Drafting\19\1423\11 Hwy 401\se2311-HML.dwg
PLOTDATE: Feb 06, 2009 - 8:48am

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

HWY 401
SITE No
GWP No 2107-05-00

HIGHWAY 401
HIGH MAST LIGHTING POLES
BOREHOLE LOCATION PLAN

SHEET

MMM GROUP

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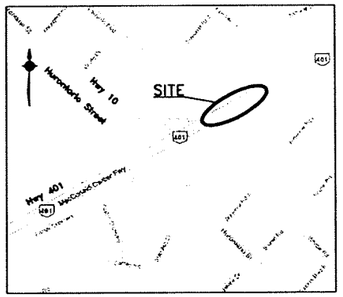
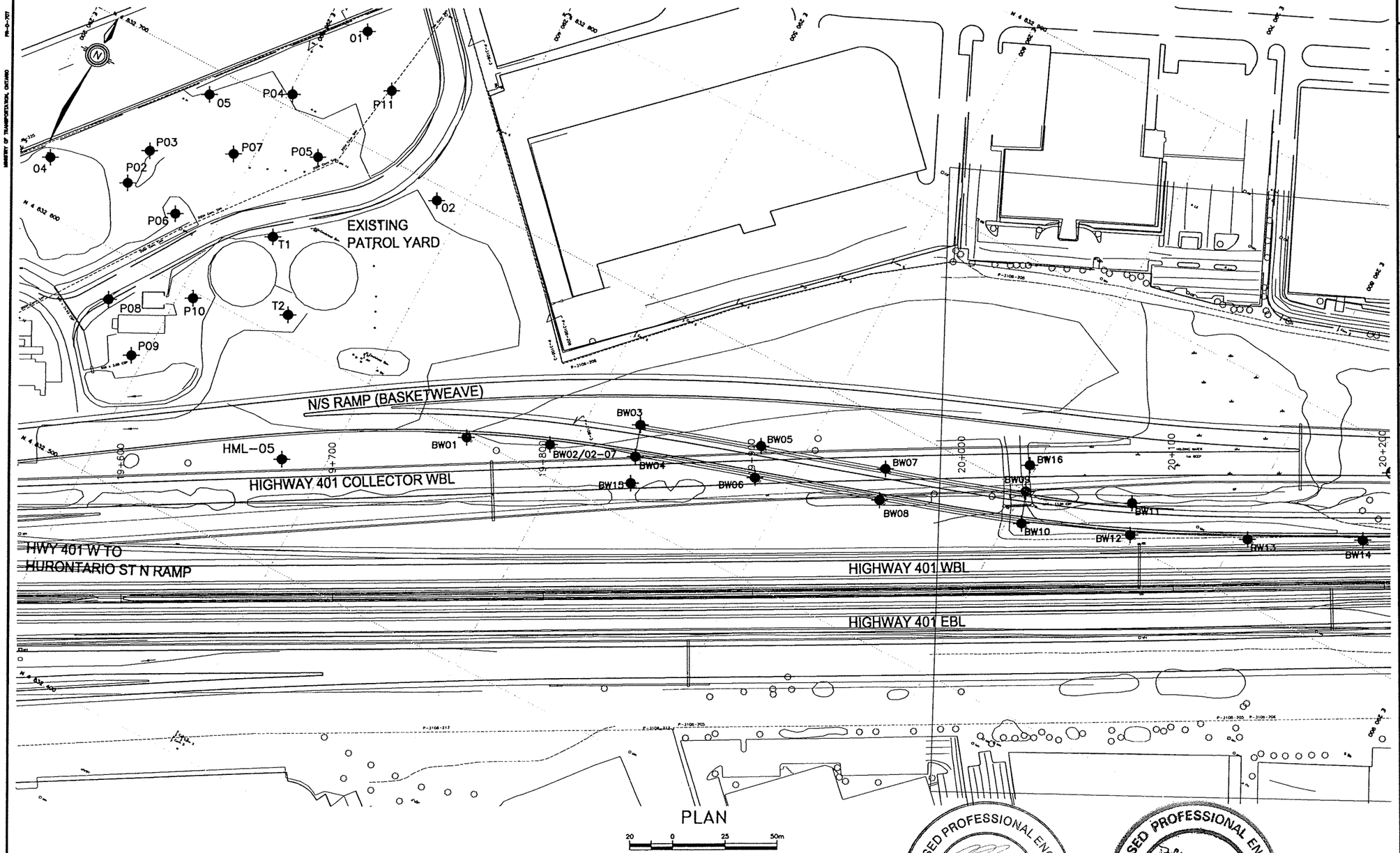


KEYPLAN



PLAN

20 0 25 50m

LEGEND

⊕	Borehole (Present Investigation, 2007 and 2006)
⊕	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
▼	Water Level
	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
HML-01	191.2	4 832 243.6	289 772.0
HML-02	190.2	4 832 097.5	289 804.1
HML-03	192.5	4 832 357.3	290 008.8
HML-04	192.1	4 832 240.1	290 085.5
HML-05	197.4	4 832 548.8	290 380.5

-NOTES-

1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 30M12-275

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Feb 5/09

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REVISIONS		
DATE	BY	DESCRIPTION

DESIGN	AEG	CHK	PKC	CODE		LOAD		DATE	FEB. 2009
DRAWN	MFA	CHK	PKC	SITE		STRUCT.	SCHEME.	DWG	2

FILENAME: H:\Drafting\10\1423\11 Hwy 401\sd2311-HML.dwg
PLOTDATE: Feb 05, 2009 - 8:49am

PLOT SCALE 1:1
PR-D-707 86-08
MINISTRY OF TRANSPORTATION, ONTARIO