

**FOUNDATION INVESTIGATION REPORT
OVERHEAD SIGN SUPPORTS
FROM DIXIE ROAD TO MCLAUGHLIN ROAD
HWY 401 WIDENING, HWY 410 TO CREDIT RIVER
MISSISSAUGA, ONTARIO
G.W.P. 2107-05-00**

Geocres Number: 30M12-277

Report to

MMM Group Limited

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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 overhead sign supports (OHS) along Highway 401 from Dixie Road to McLaughlin Road, which is part of the Highway 401 widening from Highway 410 to the Credit River in Mississauga, Ontario.

The purpose of the investigation was to explore the subsurface conditions in the general vicinity of the proposed OHS foundations 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.

2 SITE DESCRIPTION

The lands north of Highway 401 between McLaughlin Road and Hurontario Street are generally vacant and undeveloped. Vegetation is moderate consisting mainly of tall grass and shrubs. To the east of Hurontario Street to Dixie Road and throughout the length of the project limits south of Highway 401, the lands have been developed for commercial and industrial uses. The topography is generally level though slopes gently towards Lake Ontario to the south.

The general site area is located within the physiographic region known as the Peel Clay Plain. The Peel plain is of glacial origin. The overburden materials typical to this area were deposited by either glacial or pro-glacial sediments. The region is characterized by a level to undulating cohesive glacial till typically less than 1 m to 7 m in thickness.

Bedrock in the area is comprised of the reddish brown shale of the Queenston Formation, grey shales and limestones of the Georgian Bay Formation.

3 SITE INVESTIGATION AND FIELD TESTING

Site investigation and field testing for the proposed OHS foundations consisted of drilling and sampling a total of 11 boreholes at selected locations in the vicinities of the poles. This report compiles the boreholes drilled and sampled for the OHS foundations. A summary of the borehole designations for the OHS foundations is provided in Table 3.1.

Table 3.1 – Borehole Designations

Borehole	Location	Drilling Date (2009)	Borehole Termination Depth (m)	Stratum at Termination Depth
OHS-01	South side of Highway 401, east of McLaughlin Road; Near Sta. 18+075	March 12	9.4	Silty Clay Till
OHS-02	South side of Highway 401, west of the Hurontario Street E-S interchange Near Sta. 18+750	March 12	5.8	Shale Bedrock
OHS-03	Northwest quadrant of Highway 401 and Hurontario Street interchange; Near Sta. 18+900	March 6	5.8	Shale Bedrock
OHS-05	South side of Highway 401, approx. 800 m east of the Hurontario Street N-E interchange; Near Sta. 19+750	March 9	6.0	Shale Bedrock
OHS-06	North side of Highway 401, approx. 400 m west of the Kennedy Road; Near Sta. 20+175	March 11	5.7	Shale Bedrock
OHS-07	South side of Highway 401, approx. 375 m west of the Kennedy Road; Near Sta. 20+200	March 9	6.0	Shale Bedrock
OHS-08	South side of Highway 401, approx. 300 m west of Kennedy Road; Near Sta. 20+300	March 6	5.8	Shale Bedrock
OHS-09	North side of Highway 401, approx. 100 m west of Kennedy Road; Near Sta. 20+460	March 11	7.0	Shale Bedrock
OHS-10	North side of Highway 401, approx. 40 m east of Kennedy Road; Near Sta. 20+600	March 11	5.8	Shale Bedrock
OHS-11	South side of Highway 401, approx. 160 m east of Kennedy Road; Near Sta. 20+750	March 10	5.8	Shale Bedrock
OHS-12	Northwest quadrant of Highway 401 and Highway 410 S-E interchange Near Sta. 20+920	March 10	7.0	Shale Bedrock

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

Prior to commencement of drilling, utility clearances were obtained for each borehole location.

Solid stem augers were used to advance the boreholes in the overburden and into the shale. Samples of the overburden material were obtained at selected intervals using a 50 mm diameter split spoon sampler in conjunction with Standard Penetration Testing (SPT). HQ2 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 in air tight containers 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. Four standpipe piezometers consisting of 19 mm PVC pipes with screens were installed in the boreholes to permit longer 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 Installations			Completion Details
	Screen Tip (m)	Screen El. (m)	Sand Filter Stratum	
OHS-05	6.0	189.2	Shale Bedrock	Sand filter from 6.0 to 4.0 m, bentonite holeplug to surface.
OHS-06	5.7	186.9	Shale Bedrock	Sand filter from 5.7 to 3.7 m, bentonite holeplug to surface.
OHS-10	5.8	183.4	Shale Bedrock	Sand filter from 5.8 to 3.7 m, bentonite holeplug to surface.
OHS-12	7.0	179.4	Shale Bedrock	Sand filter from 7.0 to 5.1 m, bentonite holeplug 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 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 minimize 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 OHS foundations (Boreholes OHS-01 to OHS-12). Reference is made to the Records of Borehole sheets in Appendix A. An overall description of the stratigraphy encountered in Boreholes OHS-01 to OHS-12 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 or a heterogeneous fill which is underlain by native silty clay/clayey silt till deposits. Though not encountered in any of the current boreholes, previous investigations in the area have shown that the cohesive till deposits are occasionally interbedded with cohesionless formations of variable gradation. 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 the ground surface in all boreholes except Boreholes OHS-07 and OHS-08. Where encountered, the topsoil thickness was observed to range from 50 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 from ground surface in Boreholes OHS-07 and OHS-08 and below the topsoil in Boreholes OHS-01, OHS-09, OHS-10 and OHS-11. In Boreholes OHS-01 and OHS-11, the fill consists of brown silty clay containing trace to some sand and trace of gravel. In Borehole OHS-09 the fill consists of a reddish brown shale. The remaining boreholes (Boreholes OHS-07, OHS-08 and OHS-10) encountered a fill layer that was composed of a sand to a sand and gravel material. The thickness of the fill ranged from 0.8 to 1.5 m. The base of the fill layers were encountered between El. 186.3 to 194.1 m.

The SPT N-values recorded in the cohesive fill layers were observed to range from 9 to 18 blows for 0.3 m of penetration, corresponding with a stiff to very stiff consistency. The SPT N-values recorded in the shale fill ranged from 6 to 9 blows for 0.3 m of penetration, indicating a firm to stiff consistency. SPT N-values in the cohesionless fill were observed to range from 15 to 25 blows for 0.3 m of penetration indicating a compact relative density.

Grain size analyses conducted on samples of the fill are presented on Figure B1 in Appendix B. The results of grain size analyses carried out on two (2) samples are tabulated below.

Cohesionless Fill

Gravel %	37 to 40
Sand %	46 to 48
Silt and Clay %	12 to 17

The natural moisture contents of the various fill samples recovered ranged from approximately 13 to 18% in the clay fill, from approximately 16 to 19% in the shale fill and from approximately 6 to 8% in the cohesionless fill.

5.3 Silty Clay

A layer of silty clay with trace sand and occasional rootlets was encountered below the shale fill in Borehole OHS-09. The thickness of the silty clay was observed to be 0.8 m and was encountered at a depth of 1.5 m below the ground surface (El. 189.6 m). The base of the cohesive deposit was contacted at a depth of 2.3 m below the ground surface (El. 188.8 m).

The SPT N-value in the silty clay was observed as 7 blows for 0.3 m of penetration indicating a firm consistency.

Grain size analyses conducted on one (1) sample of the cohesive silty clay are presented on Figure B2 in Appendix B.

The result of the laboratory gradation test is summarized as follows:

Gravel %	0
Sand %	14
Silt %	46
Clay %	40

Natural moisture content was measured to be 23% in the sample recovered from the silty clay material.

5.4 Silty Clay Till

Deposits of native brown/reddish brown to grey silty clay till with trace to some sand and trace of gravel were contacted at depths ranging from 50 mm to 2.3 m below the ground surface (El. 186.0 to 195.2 m). The silty clay till was not encountered in Boreholes OHS-07, OHS-08 and OHS-10. The base of the glacial till was encountered at depths ranging from 0.9 to deeper than 9.4 m below the ground surface (El. 178.4 to 193.1 m). The thickness of the till deposit ranged from 0.8 to 7.9 m.

SPT N-values ranged widely from 6 to 51 blows for 0.3 m of penetration. One SPT test indicated an N-value greater than 50 blows for 0.15 m of penetration. Based on the observed N-values, the silty clay till is described as firm to hard, though were typically stiff to very stiff.

The natural moisture contents of the samples recovered from the silty clay till layers ranged widely from 5 to 22%.

Grain size distribution curves for ten (10) samples tested are presented on the Record of Borehole sheets and on Figures B3 to B4 of Appendix B. Atterberg Limit test results for five (5) samples are presented on Figure B5 of Appendix B.

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

Gravel %	0 to 4
Sand %	12 to 48
Silt %	38 to 56
Clay %	9 to 24
Liquid Limit %	23 to 48
Plastic Limit %	13 to 22

The above results show that the silty clay till IS of low to intermediate plasticity with a USCS group symbol of CL to CI.

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 the shale and limestone bedrocks which may account for some high blow counts and resistance to augering.

5.5 Bedrock

The soils described above were found to be underlain by shale bedrock of the Queenston and Georgian Bay Formations. The shale encountered in the boreholes is described as fine-grained, thinly bedded and contains numerous strong to very strong interbedded layers of siltstone and limestone. 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 highly weathered portion of the shale bedrock ranged from 14 to 74 blows for 0.3 m of penetration corresponding with a stiff to hard consistency. Three SPT N-values were measured to be greater than 50 blows for less than 0.05 m penetration.

In general the rock core samples in the vicinity of Hurontario Road are comprised of the Queenston Formation. The bedrock core samples recovered from the easternmost limit of the investigation near the Highway 410 interchange was composed of the Georgian Bay Formation.

Moisture contents of disturbed shale samples ranged from 4 to 19%.

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)
OHS-01	Not encountered	-
OHS-02	0.9	185.1
OHS-03	1.2	189.4
OHS-05	2.1	193.1
OHS-06	2.1	190.5
OHS-07	1.5	192.6
OHS-08	0.8	194.1
OHS-09	3.7	187.4
OHS-10	0.8	188.4
OHS-11	2.1	185.4
OHS-12	4.0	182.4

Bedrock cores were collected using HQ2 sized coring equipment. Total Core Recovery (TCR) in the bedrock ranged from 43% to 100% in most core runs. Values of TCR between less than 60 occurred but were relatively rare.

The RQD values recorded in all of the core runs ranged from 13 to 100% indicating very poor to excellent rock quality. Fracture Index (FI) of the rock, expressed as fractures for 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 are shown on Table 1 immediately following this report and are tabulated below as follows:

Table 5.2 – Inferred Unconfined Compressive Strength in Bedrock Cores

Rock Type	Inferred Unconfined Compressive Strength (UCS) (MPa)
Shale or shale/siltstone	2 to 60
Siltstone	3 to 62
Limestone	18 to 101

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 disintegrate during point load testing, which rendered the results of the test unreliable. Fractured zones were observed within the cores at various depths and are noted on the respective borehole log sheets.

In general, the strength of the shale bedrock increases with depth. 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 strong to very strong interbeds range approximately from 10 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.

5.6 Groundwater Levels

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

Table 5.3 – Measured Groundwater Levels

Borehole	Date (2009)	Water Level (m)		Comment
		Depth	Elevation	
OHS-01	March 12	2.8	185.0	Open Borehole
OHS-02	March 12	1.3	184.7	Open Borehole
OHS-03	March 6	0.7	189.9	Open Borehole
OHS-05	March 12	1.3	193.9	In Piezometer
	March 26	1.1	194.1	
	April 16	0.7	194.5	
OHS-06	March 26	2.7	189.8	In Piezometer
	April 16	2.7	189.8	
OHS-07	March 9	1.5	192.6	Open Borehole
OHS-08	March 6	0.9	194.0	Open Borehole
OHS-09	March 11	0.6	190.5	Open Borehole
OHS-10	March 12	1.9	187.3	In Piezometer
	March 26	2.9	186.3	
	April 16	2.9	186.3	
OHS-11	March 10	1.3	186.2	Open Borehole
OHS-12	March 12	2.9	183.5	In Piezometer
	March 26	3.2	183.2	
	April 16	3.2	183.2	

The above table indicates that the depth to the groundwater level ranges from 0.6 to 3.2 m below the ground surface (El. 183.2 to 194.1 m).

The above values are shorter 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 lenses 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 Walker Drilling Ltd. of Utopia 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, was conducted by Ms. R. Palomeque Reyna, P.Eng. Interpretation of the field data and preparation of the investigation report was conducted by Mr. David E. Elwood, P.Eng. Mr. Alastair E. Gorman, P.Eng. and Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects, reviewed the report.

THURBER ENGINEERING LTD.

David E. Elwood, P.Eng.

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Appendix A

Record of Borehole Sheets

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

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

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

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

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

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

NOTE: Hierarchy of Soil Strength Prediction

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

4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

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

5. LEGEND FOR RECORDS OF BOREHOLES

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

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

 Water Level
 Shear Strength Determination by Pocket Penetrometer

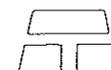
- (1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT Dynamic Cone Penetration Test – Continuous penetration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

EXPLANATION OF ROCK LOGGING TERMS

<u>ROCK WEATHERING CLASSIFICATION</u>		<u>SYMBOLS</u>			
Fresh (FR)	No visible signs of weathering.		CLAYSTONE		
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.		SILTSTONE		
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.		SANDSTONE		
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.		COAL		
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.		Bedrock (general)		
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.				
<u>DISCONTINUITY SPACING</u>		<u>STRENGTH CLASSIFICATION</u>			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength	Field Estimation of Hardness*	
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Medium bedded	0.2 to 0.6m	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Thinly bedded	60mm to 0.2m	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Very thinly bedded	20 to 60mm	Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Laminated	6 to 20mm	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Thinly Laminated	Less than 6mm	Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail
<u>TERMS</u>					
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.				
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.				
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.				
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen				
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.				



RECORD OF BOREHOLE No OHS-01

1 OF 2

METRIC

G.W.P. 2107-05-00 LOCATION N 4 831 676.8 E 288 985.0 ORIGINATED BY GA
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN
 DATUM Geodetic DATE 2009.03.12 - 2009.03.12 CHECKED BY RPR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			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	20	40					
187.8	Geodetic													
0.0	TOPSOIL (50mm)													
	Silty CLAY, trace to some sand, trace gravel Stiff Brown (FILL)		1	SS	9									
			2	SS	18									
186.3														
1.5	Silty CLAY, some sand, trace gravel, occasional oxidized staining Very Stiff Brown (TILL)		3	SS	29								2	41 42 15
			4	SS	25								3	48 40 9
	Grey		5	SS	20									
			6	SS	23								2	41 38 19
			7	SS	19									
			8	SS	32								1	39 41 19
			9	SS	50/									
178.4					0.150									
9.4	END OF BOREHOLE AT 9.4m. BOREHOLE OPEN AND WATER LEVEL AT 2.8m UPON COMPLETION													

ONTMTAS 2311HML.GPJ 6/4/09

Continued Next Page

+ 3 . x 3 . Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No OHS-01

2 OF 2

METRIC

G.W.P. 2107-05-00 LOCATION N 4 831 676.8 E 288 985.0 ORIGINATED BY GA
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN
 DATUM Geodetic DATE 2009.03.12 - 2009.03.12 CHECKED BY RPR

SOIL PROFILE		SAMPLES				GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _p	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT NUMBER	TYPE	"N" VALUES	20			40	60	80	100						
	Continued From Previous Page OF DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.																

ONTM14S 231:HML.GPJ 6/4/09

+³, X³: Numbers refer to Sensitivity 20 15 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No OHS-02

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 831 985.0 E 289 564.3 ORIGINATED BY GA
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN
 DATUM Geodetic DATE 2009.03.12 - 2009.03.12 CHECKED BY RPR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					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			T _N VALUES	SHEAR STRENGTH kPa									WATER CONTENT (%)				
						20	40	60	80	100	40	80	120	160	200	20	40	60		GR SA SI CL	
186.0	Geodetic																				
0.0	TOPSOIL (100mm)																				
0.1	Silty CLAY, some sand, trace gravel Stiff Brown (TILL)		1	SS	8																
185.1	SHALE, highly weathered Reddish Brown		2	SS	14																
0.9			3	SS	74																
	Coring started at 2.7m Slightly weathered, very weak to weak, occasional mechanical fractures Clay seam at 2.8m. Siltstone interbeds at 2.7, 2.9, 3.0, 3.3, 3.5, 3.6 and 4.0m. Limestone interbeds at 3.3m. Horizontal joints at 2.8, 3.0, 3.4, 3.9, 4.0 and 4.1m. Rubble zone at 3.8 and 3.9m.																				
	Slightly weathered, very weak, occasional mechanical fractures siltstone interbeds at 4.4, 4.5, 4.8, 5.3, 5.4, 5.5 and 5.7m.		1	RUN																	UCS = 101 MPa (Limestone) RUN 1# TCR=100%, SCR=95%, RQD=68%, UCS=6MPa (Siltstone)
			2	RUN																	RUN 2# TCR=100%, SCR=100%, RQD=100%, UCS=3MPa (Shale) UCS = 4 MPa (Shale)
180.2	END OF BOREHOLE AT 5.8m. BOREHOLE OPEN AND WATER LEVEL AT 1.3m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.																				
5.8																					

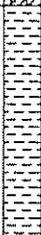
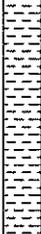
ONTMT4S 2311HML.GPJ 6/4/09

RECORD OF BOREHOLE No OHS-03

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 832 130.7 E 289 746.8 ORIGINATED BY GA
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN
 DATUM Geodetic DATE 2009.03.06 - 2009.03.06 CHECKED BY RPR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				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								WATER CONTENT (%)							
						20	40	60	80	100	40	80	120	160	200	20	40	60	GR	SA	SI	CL	
190.6	Geodetic																						
0.0	TOPSOIL (50mm)																						
0.0	Silty CLAY, some sand, trace gravel Stiff Reddish Brown (TILL)		1	SS	10																		
189.4			2	SS	23																		4 18 56 22
189.4	SHALE, highly weathered Reddish Brown																						
1.2	Coring started at 2.7m Highly to moderately weathered, very weak Rubble zone at 2.7 to 2.8m, 3.4m to 3.5m, 3.7m to 3.8m and 4.0m to 4.1m. Green siltstone interbeds at 2.7 and 3.3m. Horizontal joints at 2.7, 3.0, 3.1, 3.3, 3.5, 3.6 and 3.7m.		1	RUN																			RUN 1# TCR=100%, SCR=75%, RQD=46%, UCS=3MPa (Shale)
	Moderately to slightly weathered, very weak to weak Occasional mechanical fractures Siltstone interbeds at 4.4, 4.5, 4.7, 4.8, 5.0, 5.2, 5.4 and 5.7m. Limestone interbeds at 5.3 and 5.5m.		2	RUN																			RUN 2# TCR=100%, SCR=100%, RQD=100%, UCS=18MPa (Shale/Siltstone) UCS = 3 MPa (Siltstone) UCS = 3 MPa (Shale/Siltstone)
184.8	END OF BOREHOLE AT 5.8m. BOREHOLE OPEN AND WATER LEVEL AT 0.7m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.																						
5.8																							

ONTMT45 2311HML.GPJ 6/4/09

RECORD OF BOREHOLE No OHS-05

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 832 562.0 E 290 592.5 ORIGINATED BY GA
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN
 DATUM Geodetic DATE 2009.03.09 - 2009.03.09 CHECKED BY RPR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80			100
195.2	Geodetic													
0.0	TOPSOIL (50mm)													
	Silty CLAY, some sand, trace gravel Firm to Very Stiff Brown (TILL)		1	SS	6									
			2	SS	11									2 38 38 22
			3	SS	24									
193.1	2.1													
	SHALE, highly weathered Reddish Brown													
	Coring started at 3.0m. Highly to moderately weathered, very weak Occasional mechanical fractures		1	RUN										RUN 1# TCR=60%, SCR=23%, RQD=20%, UCS=3MPa (Shale/Siltstone)
	Medium to slightly weathered, very weak to weak Limestone interbeds at 4.7, 5.0, 5.1 and 5.2m. Siltstone interbeds at 4.5, 4.7, 4.8, 5.0, 5.1, 5.2 and 5.3m. Rubble zone at 5.0 to 5.2m.		2	RUN										RUN 2# TCR=100%, SCR=92%, RQD=92%, UCS=3MPa (Shale)
189.2	6.0													UCS = 3 MPa (Shale)
	END OF BOREHOLE AT 6.0m. BOREHOLE OPEN AND WATER LEVEL AT SURFACE. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.													
	WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2009.03.12 1.3 193.9 2009.03.26 1.1 194.1 2009.04.16 0.7 194.5													

ONTWT4S 2311HML.GPJ 4/20/09

RECORD OF BOREHOLE No OHS-06

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 832 762.8 E 290 815.9 ORIGINATED BY GA
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN
 DATUM Geodetic DATE 2009.03.11 - 2009.03.11 CHECKED BY RPR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				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							
192.6	Geodetic														
0.0 0.1	TOPSOIL (75mm)														
	Silty CLAY, some sand, trace gravel, occasional oxidized staining Firm to Very Stiff Brown (TILL)		1	SS	6										
			2	SS	7										2 31 43 24
			3	SS	23										
190.5															
2.1	SHALE, highly weathered Reddish Brown														
	Coring started at 2.7m Slightly weathered, very weak to weak, occasional mechanical fractures Horizontal joints at 2.8, 2.9, 3.0, 3.9, 4.0 and 4.1m. Siltstone interbeds at 2.7, 2.9 and 3.3m. Limestone inlerbeds at 2.7 and 2.8m.		1	RUN											RUN 1# TCR=100%, SCR=89%, RQD=78%, UCS=4MPa (Siltstone)
	Slightly weathered to medium weathered, weak Siltstone interbeds at 4.2, 4.3, 4.4, 4.5, 4.6 and 4.7m. Rubble zone at 4.2, 4.4, 4.5 and 4.6m.		2	RUN											RUN 2# TCR=43%, SCR=16%, RQD=13%, UCS=3MPa (Shale)
186.9															
5.7	END OF BOREHOLE AT 5.7m. BOREHOLE OPEN AND WATER LEVEL AT 0.3m 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) 2009.03.26 2.7 189.8 2009.04.16 2.7 189.8														

ONTMT4S 231THML.GPJ 4/20/09

+³, X³: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No OHS-07

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 832 725.4 E 290 852.1 ORIGINATED BY GA
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN
 DATUM Geodetic DATE 2009.03.09 - 2009.03.09 CHECKED BY RPR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				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								WATER CONTENT (%)							
						20	40	60	80	100	40	80	120	160	200	20	40	60	GR	SA	SI	CL	
194.1 0.0	Geodetic SAND and GRAVEL, trace silt Compact Brown Moist (FILL)		1	SS	25																		
			2	SS	19																		
192.6 1.5	SHALE, highly weathered, thinly bedded Reddish Brown Coring started at 3.0m. Highly to moderately weathered, very weak Rubble zone at 3.1 to 3.2m, 3.4 to 3.5m, 3.8 to 3.9m and 4.3 to 4.4m. Siltstone interbeds at 3.4, 3.8, 3.9, 4.0, 4.4 and 4.5m. Horizontal joints at 3.1, 3.6, 3.7 and 3.9m. Moderately to slightly weathered, very weak Siltstone interbeds at 4.5 to 4.6m, 4.8, 5.0, 5.2, 5.3, 5.4, 5.6, 5.7 and 5.9m. Highly mechanical fractured zone at 4.6 to 4.7m, 4.8 to 4.9m, 5.0 to 5.1m and 5.7 to 5.8m.		3	SS	35																		
			1	RUN																			
			2	RUN																			
188.1 6.0	END OF BOREHOLE AT 6.0m. BOREHOLE OPEN AND WATER LEVEL AT 1.5m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.																						

ONTMT4S 2311HML.GPJ 6/4/09

+³, x³: Numbers refer to Sensitivity 20 15 10 5 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No OHS-09

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 832 860.5 E 291 099.7 ORIGINATED BY GA
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN
 DATUM Geodetic DATE 2009.03.11 - 2009.03.11 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			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							
						20	40	60	80	100	40	60	80	100	
191.1	Geodetic														
0.0	TOPSOIL (75mm)														
0.1	SHALE, highly weathered Stiff to Firm Reddish Brown Moist (FILL)		1	SS	9										
			2	SS	6										
189.6															
1.5	Silty CLAY, trace sand, occasional rootlets Firm Brown		3	SS	7									0 14 46 40	
189.8															
2.3	Silty CLAY, some sand, trace gravel Very Stiff Brown (TILL)		4	SS	21										
			5	SS	48									2 31 46 22	
167.4															
3.7	SHALE, highly weathered Reddish Brown Coring started at 3.9m. Medium to slightly weathered, very weak to weak Occasional mechanical fractures Siltstone interbeds at 3.9, 4.1, 4.2, 4.4, 4.6, 4.8, 4.9, 5.2, 5.4 and 5.5m. Horizontal joints at 4.0 and 4.1m. Rubble zone at 4.0 and 4.1m. Limestone interbeds from 5.5 to 5.6m.		1	RUN										RUN 1# TCR=100%, SCR=95%, RQD=95%, UCS=29MPa (Siltstone)	
	Slightly weathered to fresh, weak to strong Siltstone interbeds at 5.4, 5.7, 6.0, 6.1, 6.2, 6.5 and 6.6m. Limestone interbeds at 6.7 and 6.8m.		2	RUN										RUN 2# TCR=100%, SCR=100%, RQD=100%, UCS=26MPa (Siltstone) UCS = 31 MPa (Siltstone) UCS = 3 MPa (Shale)	
184.1															
7.0	END OF BOREHOLE AT 7.0m. BOREHOLE OPEN AND WATER LEVEL AT 0.6m. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.														

ONTMT4S 2311HML.GPJ 6/4/09

RECORD OF BOREHOLE No OHS-10

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 832 953.0 E 291 210.0 ORIGINATED BY GA
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN
 DATUM Geodetic DATE 2009.03.11 - 2009.03.11 CHECKED BY RPR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				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	20	40	60	GR SA SI CL
189.2	Geodetic														
0.0	TOPSOIL (50mm)														
188.4	SAND, trace gravel Compact Brown Wet (FILL)		1	SS	15										
0.8			2	SS	50/										
	SHALE, highly weathered Reddish Brown Layer of siltstone				0.100										
			3	SS	50/	0.050									
	Coring started at 2.7m. Slightly weathered to fresh, weak to strong Occasional mechanical fractures Siltstone interbeds at 2.7, 2.8, 2.9, 3.0, 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.8 and 4.2m. Limestone interbeds at 3.2 and 3.3m. Horizontal joints at 2.7, 2.8 and 2.9m.														
			1	RUN											RUN 1# TCR=100%, SCR=100%, RQD=83%, UCS=103MPa (Siltstone) UCS = 87 MPa (Limestone) UCS = 85 MPa (Siltstone)
	Fresh, thinly bedded, weak to strong Limestone interbeds at 4.4, 5.0, 5.1 and 5.2m. Siltstone interbeds at 4.4, 4.7, 4.9, 5.4 and 5.7m. Rubble zone from 5.3 to 5.4m.														
			2	RUN											RUN 2# TCR=100%, SCR=100%, RQD=100%, UCS=20MPa (Limestone)
183.4	END OF BOREHOLE AT 5.8m. BOREHOLE OPEN AND WATER LEVEL AT 0.6m UPON COMPLETION OF DRILLING. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.														
5.8															
	WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2009.03.12 1.9 187.3 2009.03.26 2.9 186.3 2009.04.16 2.9 186.3														

ONTMT4S 2311HML.GPJ 4/20/09

+³ . X³ : Numbers refer to Sensitivity 20
15 10 5 0 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No OHS-11

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 832 950.7 E 291 376.7 ORIGINATED BY GA
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN
 DATUM Geodetic DATE 2009.03.10 - 2009.03.10 CHECKED BY RPR

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa								
						20	40	60	80	100	W _p	W	W _L	kN/m ³	GR SA S ₁ CL	
187.5 0.0	Geodetic TOPSOIL (50mm)		1	SS	10											
166.7 0.8	Silty CLAY, trace to some sand, trace gravel Stiff Brown (FILL)		2	SS	10										3	33 43 20
185.4	Silty CLAY, some sand, trace gravel, occasional rootlets Stiff to Very Stiff Brown (TILL)		3	SS	24											
185.4 2.1	SHALE, highly weathered Reddish Brown Coring started at 2.7m. Highly to slightly weathered, weak to very weak Rubble zone at 2.9 to 3.0m and 3.4 to 3.6m. Siltstone interbeds at 3.0, 3.2, 3.4, 3.5, 3.6 and 3.8m. Horizontal joints at 3.0, 3.1, 3.2, 3.4 and 3.6m. Slightly weathered to fresh, weak to strong, occasional mechanical fractures Limestone interbeds at 4.3, 4.5, 5.0, 5.3, 5.6 and 5.7m Siltstone interbeds at 4.5 to 4.7m.		1	RUN												RUN 1# TCR=100%, SCR=86%, RQD=66%, UCS=60MPa (Shale/Siltstone) UCS = 22 MPa (Shale)
181.7 5.8	END OF BOREHOLE AT 5.8m. BOREHOLE OPEN AND WATER LEVEL AT 1.3m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH HOLEPLUG TO SURFACE.		2	RUN												RUN 2# TCR=100%, SCR=100%, ROD=100%, UCS=35MPa (Limestone) UCS = 19 MPa (Limestone) UCS = 59 MPa (Limestone)

ONTMT4S 2311HML.GPJ 6/4/09

+ 3 . x 3 : Numbers refer to Sensitivity
 20
 15 5
 10 (%) STRAIN AT FAILURE

RECORD OF BOREHOLE No OHS-12

1 OF 1

METRIC

G.W.P. 2107-05-00 LOCATION N 4 833 070.2 E 291 489.8 ORIGINATED BY GA
 HWY 401 BOREHOLE TYPE Solid Stem Augers/HQ2 Coring Equipment COMPILED BY AN
 DATUM Geodetic DATE 2009.03.10 - 2009.03.10 CHECKED BY RPR

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT Y kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	GR
186.4	Geodetic																	
0.0	TOPSOIL (75mm)																	
0.1	Silty CLAY, trace to some sand, trace gravel Firm to Hard Brown (TILL)		1	SS	7													
			2	SS	10													
			3	SS	12													0 12 43 45
			4	SS	30													
			5	SS	51													
182.4	SHALE , slightly weathered to fresh Grey Coring started at 3.9m Horizontal joints at 4.1, 4.2 and 4.4m. Limestone interbeds at 4.0 to 4.1m and 4.7 to 4.8m. Rubble zone at 4.9 to 5.0m, 5.3 to 5.4m.		1	RUN														RUN 1# TCR=100%, SCR=95%, RQD=83%, UCS=58MPa (Limestone) UCS = 61 MPa (Limestone)
	Slightly weathered to fresh, weak to strong Limestone interbeds at 5.5, 5.6, 5.7, 5.9, 6.2, 6.3, 6.4, 6.5, 6.7, 6.8 and 6.9m. Horizontal joints at 6.8m.		2	RUN														RUN 2# TCR=100%, SCR=100%, RQD=100%, UCS=34MPa (Limestone) UCS = 38 MPa (Limestone) UCS = 65 MPa (Limestone) UCS = 17 MPa (Limestone)
179.4	END OF BOREHOLE AT 7.0m. BOREHOLE OPEN AND WATER LEVEL AT 0.9m UPON COMPLETION OF DRILLING. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen.																	
7.0	WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2009.03.12 2.9 183.5 2009.03.26 3.2 183.2 2009.04.16 3.2 183.2																	

ONTM4S 2311HML.GPJ 4/20/09

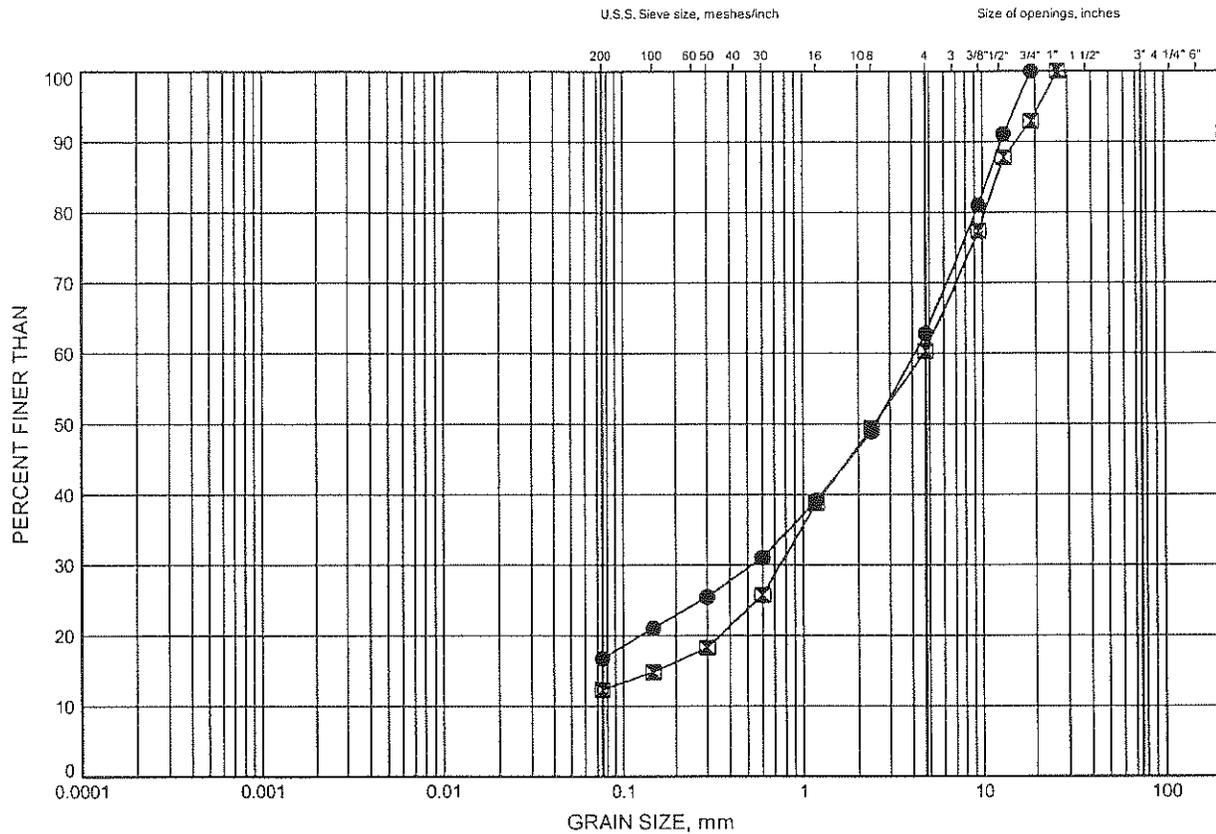
Appendix B

Laboratory Test Results

Hwy 401 Widening
GRAIN SIZE DISTRIBUTION

FIGURE B1

COHESIONLESS FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	OHS-07	1.07	193.03
◻	OHS-08	0.30	194.60

GRAIN SIZE DISTRIBUTION - THURBER 2311HML.GPJ B/A/09

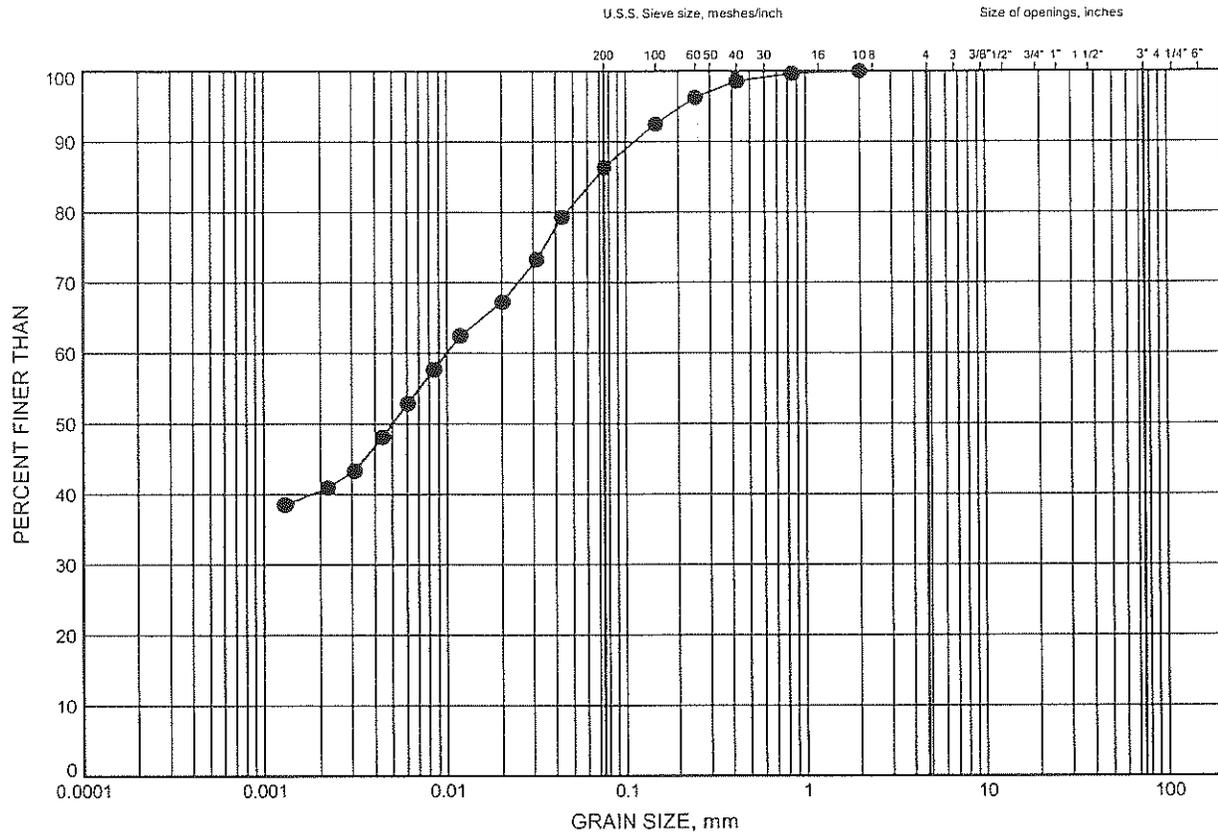
W.P.# .2107-05-00.....
Prepared By .MFA.....
Checked By .DEE.....



Hwy 401 Widening
GRAIN SIZE DISTRIBUTION

FIGURE B2

SILTY CLAY



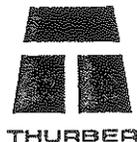
SILT and CLAY	FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED	SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	OHS-09	1.83	189.27

GRAIN SIZE DISTRIBUTION - THURBER 2311HML.GPJ 8/4/09

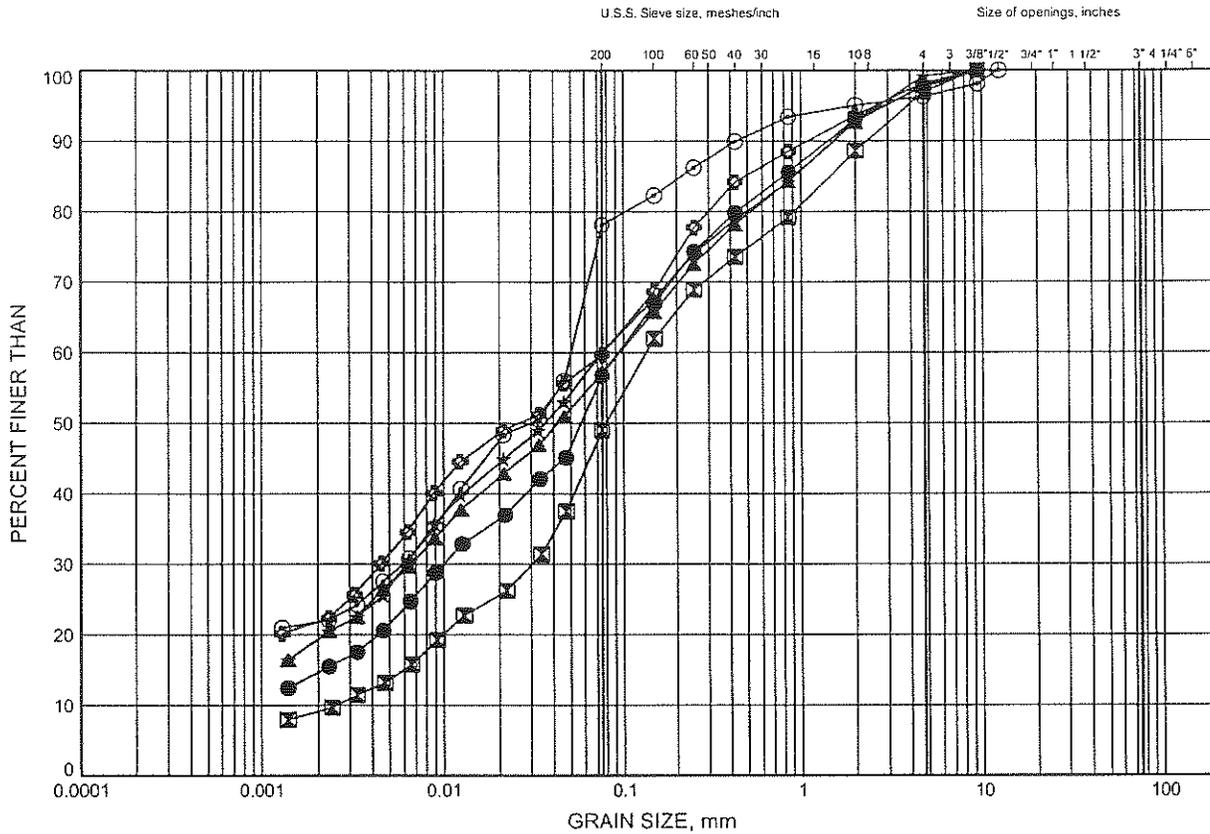
W.P.# 2107-05-00.....
Prepared By MFA.....
Checked By DEE.....



Hwy 401 Widening
GRAIN SIZE DISTRIBUTION

FIGURE B3

SILTY CLAY TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	OHS-01	1.83	185.97
⊠	OHS-01	2.59	185.21
▲	OHS-01	4.88	182.92
★	OHS-01	7.92	179.88
⊙	OHS-03	1.07	189.53
⊠	OHS-05	1.07	194.13

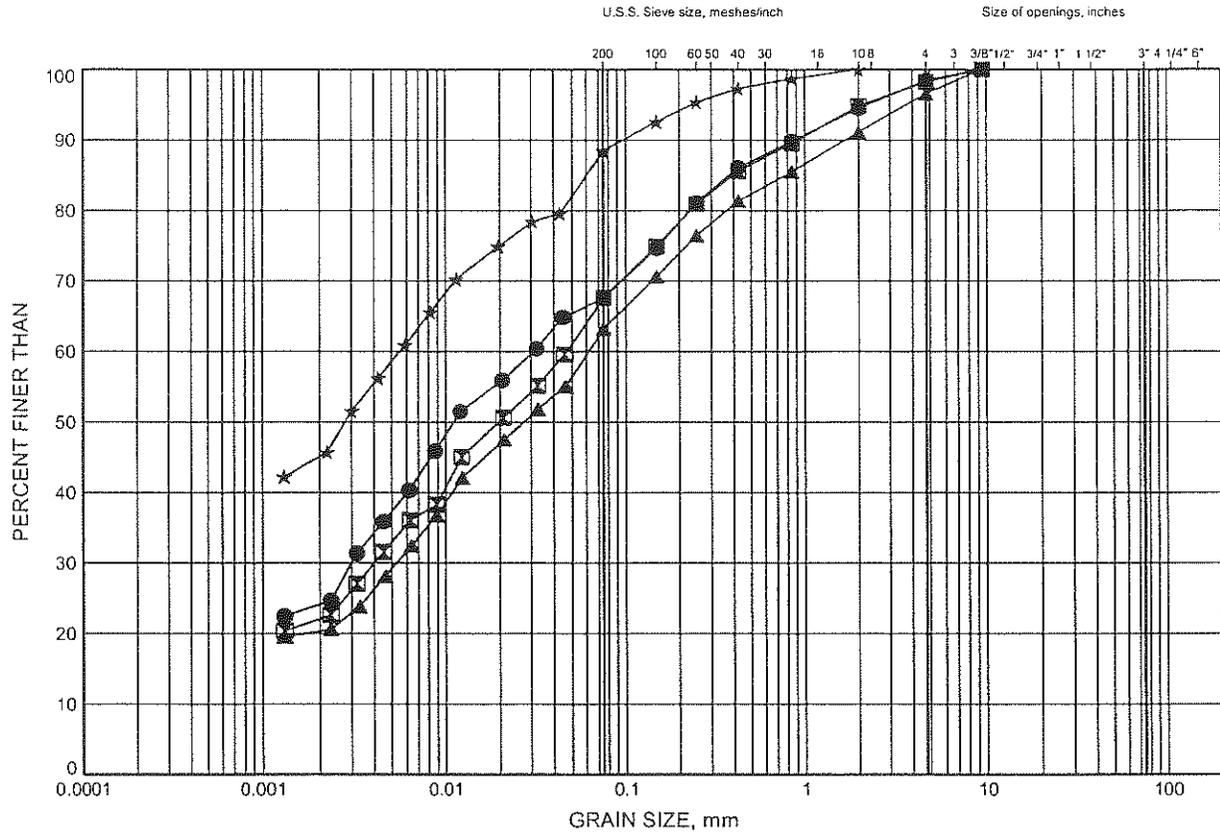


W.P.# 2107-05-00.....
Prepared By MFA.....
Checked By DEE.....

Hwy 401 Widening
GRAIN SIZE DISTRIBUTION

FIGURE B4

SILTY CLAY TILL



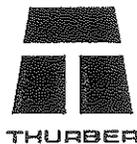
SILT and CLAY		FINE	MEDIUM	COARSE	FINE	COARSE	COBBLE SIZE
FINE GRAINED		SAND			GRAVEL		

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	OHS-06	1.07	191.53
■	OHS-09	3.35	187.75
▲	OHS-11	1.07	186.43
★	OHS-12	1.83	184.57

GRAIN SIZE DISTRIBUTION - THURBER 2311HML.GPJ 8/4/09

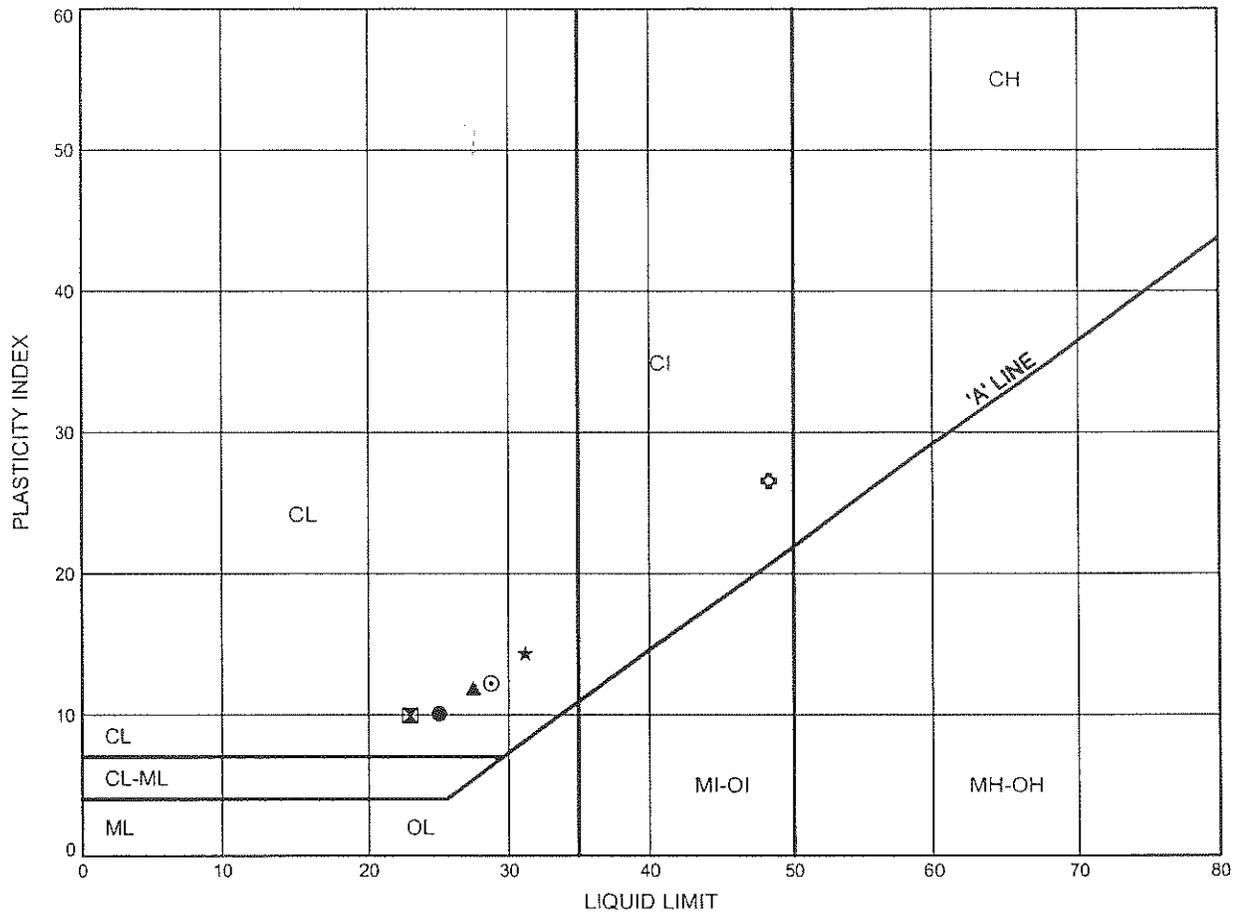
W.P.# .2107-05-00.....
Prepared By .MFA.....
Checked By .DEE.....



Hwy 401 Widening
ATTERBERG LIMITS TEST RESULTS

FIGURE B5

SILTY CLAY TILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	OHS-01	1.83	185.97
⊠	OHS-01	4.88	182.92
▲	OHS-05	1.07	194.13
★	OHS-06	1.07	191.53
⊙	OHS-09	3.35	187.75
⊕	OHS-12	1.83	184.57

THURBALT 2311HML.GPJ 8/4/09

Date April 2009
 Project 2107-05-00



Prep'd MFA
 Chkd. DEE

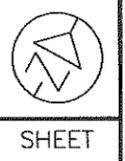
Appendix C

Borehole Location Drawings

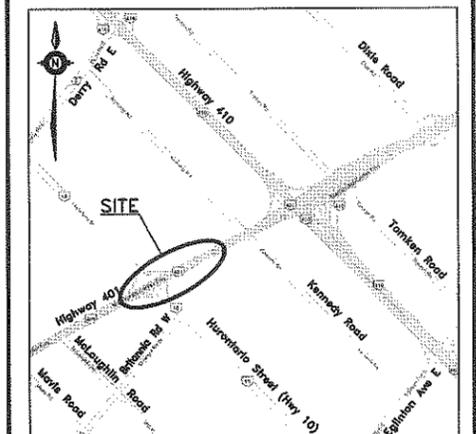


METRIC
 DIMENSIONS ARE IN METRES
 AND/OR MILLIMETRES
 UNLESS OTHERWISE SHOWN

CONT No
 GWP No
 HIGHWAY 401
 OVERHEAD SIGN SUPPORTS
 WEST OF KENNEDY ROAD
 BOREHOLE LOCATION PLAN



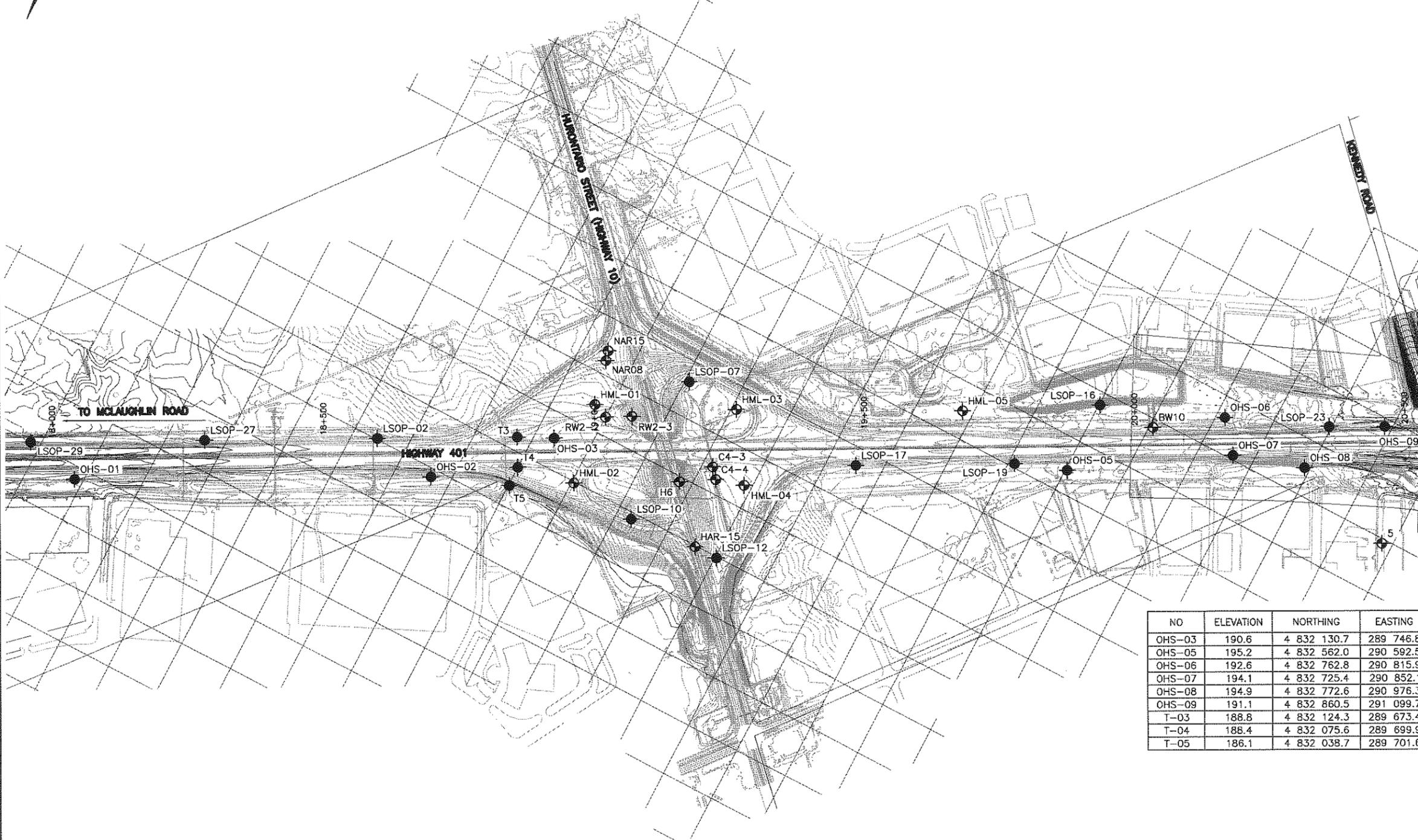
SHEET



KEYPLAN

LEGEND

- ◆ Borehole (Present Investigation)
- ◊ Borehole (Previous Investigation)
- 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



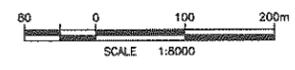
NO	ELEVATION	NORTHING	EASTING
OHS-03	190.6	4 832 130.7	289 746.8
OHS-05	195.2	4 832 562.0	290 592.5
OHS-06	192.6	4 832 762.8	290 815.9
OHS-07	194.1	4 832 725.4	290 852.1
OHS-08	194.9	4 832 772.6	290 976.3
OHS-09	191.1	4 832 860.5	291 099.7
T-03	188.8	4 832 124.3	289 673.4
T-04	188.4	4 832 075.6	289 699.9
T-05	186.1	4 832 038.7	289 701.6

NO	ELEVATION	NORTHING	EASTING
LSOP-02	187.7	4 832 002.1	289 444.2
LSOP-07	193.2	4 832 362.2	289 908.1
LSOP-10	194.8	4 832 087.8	289 929.3
LSOP-12	192.7	4 832 097.9	290 102.7
LSOP-16	194.6	4 832 676.7	290 601.9
LSOP-17	194.6	4 832 368.2	290 252.0
LSOP-19	195.4	4 832 507.4	290 511.1
LSOP-23	192.2	4 832 837.6	290 995.3
LSOP-27	187.8	4 831 851.6	289 163.9
LSOP-29	189.0	4 831 700.1	288 882.1
OHS-01	187.8	4 831 676.8	288 985.0
OHS-02	186.0	4 831 985.0	289 564.3

-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. 30M12-277



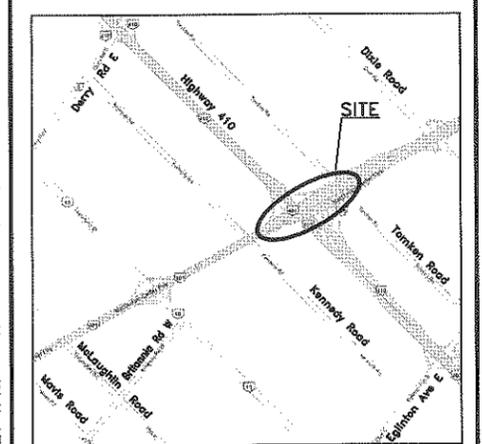
REVISIONS	DATE	BY	DESCRIPTION
DESIGN	RPR	CHK AEG	CODE
DRAWN	MFA	CHK PKS	SITE
			STRUCT
			DWG 1

METRIC
 DIMENSIONS ARE IN METRES
 AND/OR MILLIMETRES
 UNLESS OTHERWISE SHOWN

CONT No
 GWP No
 HIGHWAY 401
 OVERHEAD SIGN SUPPORTS
 EAST OF KENNEDY ROAD
 BOREHOLE LOCATION PLAN



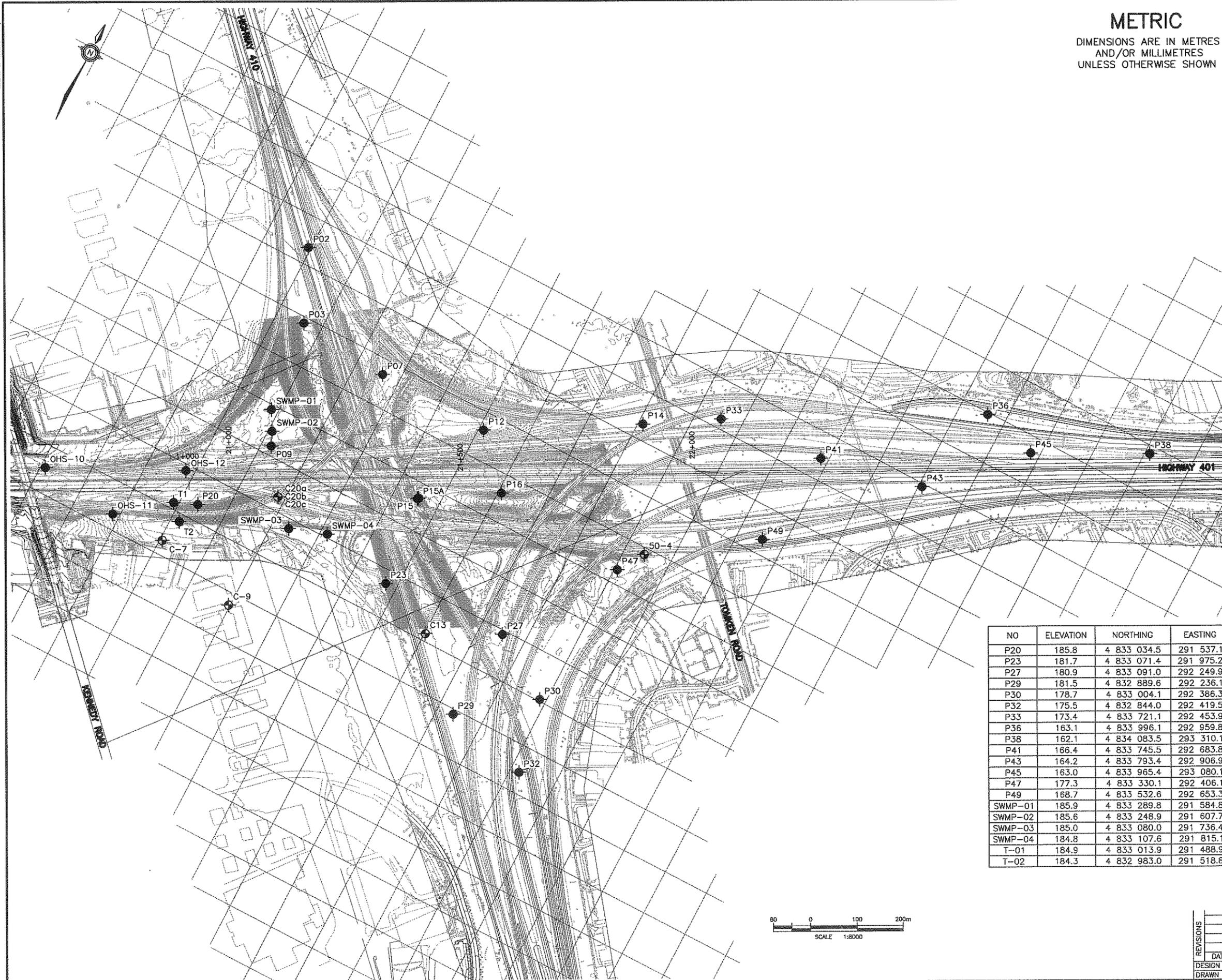
SHEET



KEYPLAN

LEGEND

- Borehole (Present Investigation)
- ⊙ Borehole (Previous Investigation)
- 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

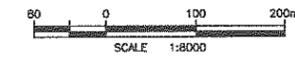


NO	ELEVATION	NORTHING	EASTING	NO	ELEVATION	NORTHING	EASTING
P20	185.8	4 833 034.5	291 537.1	OHS-10	189.2	4 832 953.0	291 210.0
P23	181.7	4 833 071.4	291 975.2	OHS-11	187.5	4 832 950.7	291 376.7
P27	180.9	4 833 091.0	292 249.9	OHS-12	186.4	4 833 070.2	291 489.8
P29	181.5	4 832 889.6	292 236.1	P02	176.3	4 833 635.5	291 494.6
P30	178.7	4 833 004.1	292 386.3	P03	180.8	4 833 487.1	291 561.2
P32	175.5	4 832 844.0	292 419.5	P07	178.1	4 833 467.0	291 761.0
P33	173.4	4 833 721.1	292 453.9	P09	184.9	4 833 220.0	291 620.9
P36	183.1	4 833 996.1	292 959.8	P12	180.6	4 833 462.2	292 010.4
P38	162.1	4 834 083.5	293 310.1	P14	172.6	4 833 633.3	292 310.0
P41	166.4	4 833 745.5	292 683.8	P15	176.9	4 833 265.8	291 952.1
P43	164.2	4 833 793.4	292 906.9	P15A	178.5	4 833 267.9	291 954.2
P45	163.0	4 833 965.4	293 080.1	P16	178.6	4 833 359.9	292 107.1
P47	177.3	4 833 330.1	292 406.1				
P49	168.7	4 833 532.6	292 653.3				
SWMP-01	185.9	4 833 289.8	291 584.8				
SWMP-02	185.6	4 833 248.9	291 607.7				
SWMP-03	185.0	4 833 080.0	291 736.4				
SWMP-04	184.8	4 833 107.6	291 815.1				
T-01	184.9	4 833 013.9	291 488.9				
T-02	184.3	4 832 983.0	291 518.8				

NOTES

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GEOCRES No. 30M12-277



REVISIONS		DATE	BY	DESCRIPTION
DESIGN	RPR	CHK	AEG	CODE
DRAWN	MFA	CHK	PKS	SITE
		LOAD		DATE APR. 2009
		STRUCT		DWG 2