FOUNDATION INVESTIGATION REPORT
CP OVERHEAD AT MANITOUWADGE (MILEAGE 1.90)
HIGHWAY 17
BOMBY TOWNSHIP, DISTRICT OF THUNDER BAY, ONTARIO
G.W.P. 510-00-00, STRUCTURE NO. 48E-28

Geocres Number: 42C-28

Report to

McCormick Rankin Corporation

Thurber Engineering Ltd.
2010 Winston Park Drive, Suite 103
Oakville, Ontario
L6H 5R7
Phone: (905) 829 8666
Fax: (905) 829 1166

February 13, 2013
File: 19-1351-197

H:\19\1351\197 NWR 32 Rehabs\Reports & Memos\CP Overhead Manitouwadge\CP Overhead Manitouwadge FINAL FIR rpr.doc

TABLE OF CONTENTS

Appendices

FOUNDATION INVESTIGATION REPORT
CP OVERHEAD AT MANITOUWADGE (MILEAGE 1.90)
HIGHWAY 17
BOMBY TOWNSHIP, DISTRICT OF THUNDER BAY, ONTARIO
G.W.P. 510-00-00, STRUCTURE NO. 48E-28

Geocres Number: 42C-28

PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a geotechnical investigation conducted at the location of a bridge carrying Highway 17 over the CP Manitouwadge track (Mileage 1.90) in the Township of Bomby, District of Thunder Bay, Ontario.

The purpose of the investigation was to explore the subsurface conditions at the bridge site and, based on the data obtained, to provide a borehole location plan, borehole logs, stratigraphic profile, laboratory test results and a written description of the subsurface conditions.

Thurber carried out the investigation as a sub-consultant to McCormick Rankin Corporation under the Ministry of Transportation Ontario (MTO) Agreement Number 6010-E-0011.

2 SITE DESCRIPTION

The bridge site is located approximately 475 m east of the intersection of Highway 17 and Highway 614 in the Township of Bomby, Ontario. This is approximately 40 km east of the Town of Marathon, Ontario.

The existing highway is a two-lane paved road and crosses the abandoned CP trackbed on approach embankments about 7.0 m to 8.5 m high. The CP rail track has been removed and the track bed ballast remains along the rail grade.

The existing structure was originally constructed in 1958 and consists of a single span concrete rigid frame bridge. The span of the existing structure is 7.5 m and its width is 13.4 m.

Lands surrounding the bridge site are generally flat and undeveloped forested land.

Photographs in Appendix C show the bridge and the abandoned trackbed and the general nature of the surrounding land.

The site lies within the Superior Province, Wawa Sub-Province, of the Canadian Shield, characterized by low, rounded hills of Pre-Cambrian bedrock mantled by varying thicknesses of overburden. According to bedrock geology maps produced by the Ontario Geological Survey, the bridge site is underlain by massive granodiorite to granite bedrocks. At the bridge site, granular fill exists over bedrock.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this project were carried out between May 3 and 5, 2011. A total of four sampled boreholes (numbered MN11-01 to MN11-04) were drilled at the site. Boreholes MN11-02 and MN11-03 were drilled at the west and east abutments, respectively and Boreholes MN11-01 and MN11-04 were drilled at the west and east approaches. The boreholes were advanced through the roadway to depths of 7.3 m to 11.6 m (elevations 319.4 to 324.1). In addition, Dynamic Cone Penetration Tests (DCPTs) were advanced near each borehole location, for a total of four DCPTs, to depths of 8.0 to 8.5 m (elevations 322.5 to 323.1).

Bedrock was proved in Boreholes MN11-02 and MN11-03 by NQ size diamond coring. Bedrock cores were 3.1 m long.

The approximate locations of the boreholes and DCPTs are shown on the Borehole Locations and Soil Strata Drawing included in Appendix D. The coordinates and elevations of the boreholes are presented on the drawing and on the individual Record of Borehole sheets included in Appendix A.

The coordinates and ground surface elevations at the boreholes were surveyed by MMM Group Limited survey personnel.

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

Hollow stem augers and NQ coring techniques were used to advance the boreholes. Samples were obtained at selected intervals using a 50 mm diameter split spoon sampler in conjunction with Standard Penetration Testing (SPT).

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

A member of Thurber's technical 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.

Groundwater conditions were observed throughout the drilling operations in the open boreholes. In Borehole MN11-03, a standpipe piezometer consisting of 19 mm diameter PVC pipe with slotted screen was installed and enclosed in filter sand to permit longer term groundwater level monitoring. The boreholes were backfilled with bentonite holeplug in general accordance with O.Reg. 903 upon completion. The borehole completion details are shown in Table 3.1.

Table 3.1 – Borehole Abandonment Details

Borehole	Piezometer Tip Depth/ Elevation (m)	Abandonment Details
MN11-01	None installed	Borehole backfilled with bentonite holeplug from 8.1 m to 0.3 m, concrete from 0.3 m to 0.1 m, then asphalt to surface.
MN11-02	None installed	Borehole backfilled with bentonite holeplug from 11.6 m to 0.3 m, concrete from 0.3 m to 0.1 m, then asphalt to surface.
MN11-03	11.3 / 320.0	Sand filter from 11.3 to 9.5 m, bentonite holeplug from 9.5 to 0.2 m, concrete from 0.2 m to 0.1 m, then asphalt to surface.
MN11-04	None installed	Borehole backfilled with bentonite holeplug from 8.3 m to 0.3 m, concrete from 0.3 m to 0.1 m, then asphalt to surface.

4 LABORATORY TESTING

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. Selected samples were also subjected to grain size distribution analyses. The results of this testing program are shown on the Record of Borehole sheets in Appendix A and on the figures included in Appendix B.

Point load tests were carried out on selected samples of intact bedrock upon arrival at the laboratory to assist in evaluation of the unconfined compressive strength of the bedrock. Results of point load tests on the rock core samples are presented in Appendix B and on the Record of Borehole sheets included in Appendix A. The Unconfined Compressive Strength (UCS) values were interpreted from the point load tests.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets included in Appendix A for details of the encountered soil stratigraphy. A stratigraphic profile is presented on the Borehole Locations and Soil Strata Drawing in Appendix D, for illustrative purposes. Overall descriptions of the stratigraphy are given in the following paragraphs. However, the factual data presented in the Record of Borehole sheets governs any interpretation of the site conditions. It must be recognized that soil conditions may vary between and beyond borehole locations.

The soil stratigraphy encountered at the borehole locations typically consists of asphalt overlying sand fill, which is underlain by bedrock.

More detailed descriptions of the individual strata are presented below.

5.1 Asphalt

Asphalt was encountered at surface in the four boreholes drilled at this site, which were drilled through the existing Highway 17 roadway. The thickness of the asphalt layer varied from 50 mm to 100 mm.

5.2 Sand Fill

The asphalt was underlain by fill consisting of brown sand containing trace to some gravel and trace to some silt and clay. The thickness of the sand fill ranged from 7.2 m to 8.4 m.

The lower boundary of the sand fill was encountered at depths of 7.3 m to 8.5 m (Elev. 324.1 to 322.5 m).

Within the upper 2.0 m of sand fill, the SPT N-values ranged from 16 to 62 blows per 0.3 m of penetration, indicating a compact to very dense relative density. Generally, below the upper 2.0 m and between elevations 329.5 and 323.8, the SPT N-values were 5 to 10 blows per 0.3 m of penetration indicating a loose to compact relative density. Below elevation 323.8, the SPT N-values increased, ranging from 14 to 62 blows per 0.3 m of penetration, indicating a compact to very dense relative density.

Moisture contents of the sand fill varied from 2 to 10%.

Selected samples of the sand fill underwent grain size analysis testing, the results of which are summarized below. These results are also presented on the Record of Borehole sheets included in Appendix A. The grain size distribution curves for these samples of the sand fill are shown on Figures B1 and B2 of Appendix B.

Soil Particle	Percentage (%)
Gravel	5 to 21
Sand	58 to 83
Silt & Clay	4 to 21

5.3 Bedrock

The sand fill described above are underlain by grey and dark grey granitic bedrock. Occasional mechanical breaks and horizontal joints were observed in the bedrock cores.

Bedrock was proved by coring at Boreholes MN11-02 and MN11-03, located at the west and east abutments, respectively. Boreholes MN11-01 and MN11-04 were terminated upon auger refusal on probable bedrock. Table 5.1 summarizes depths and elevations to the top of bedrock and auger refusal on probable bedrock in these boreholes.

Table 5.1 – Depths and Elevations of Top of Bedrock and Auger Refusal

Borehole	Top of Bedrock	
	Depth (m)	Elevation (m)
MN11-01	8.1	322.7
MN11-02	8.5[(1)]	322.5
MN11-03	8.2[(1)]	323.1
MN11-04	7.3	324.1

[(1)] Bedrock proved by coring.

Core recovery in the bedrock was 100% in all cores. The RQD values ranged from 97% to 100%, indicating excellent rock quality. The Fracture Index (FI) of the rock, expressed as fractures per 0.3 m of core, was generally less than 3.

The unconfined compressive strength (UCS) of the rock cores estimated from point load testing ranged from 79 MPa to 195 MPa, indicating a strong to very strong rock.

5.4 Water Levels

Boreholes MN11-01 and MN11-04 were dry upon completion of drilling. Water was added into the drill casing during rock coring operation in Boreholes MN11-02 and MN11-03 and therefore it was not possible to measure natural groundwater levels during or upon completion of drilling. A standpipe piezometer was installed in Borehole MN11-03 to monitor water levels after completion of drilling. The water level measured in the piezometer on May 4, 2011 was at 9.0 m depth (Elev. 322.3 m) and 9.1 m (elevation 322.2) on May 5, 2011. It must be noted that the piezometric readings in Borehole MN11-03 likely represent standing water originating from the rock coring operations and does not represent stabilized groundwater level.

The above observations are short-term and fluctuations of the actual groundwater level are to be expected subject to seasonal conditions.

6 MISCELLANEOUS

The borehole locations were established in the field by Thurber Engineering. The coordinates and ground surface elevations at the boreholes were subsequently surveyed by MMM Group Limited survey personnel.

Thurber obtained utility clearances for the borehole locations prior to drilling.

George Downing Estate Drilling Ltd. supplied a track-mounted CME 55 drill rig and conducted the drilling, sampling and in-situ testing operations for all of the boreholes and DCPTs.

The field program was supervised on a full time basis by Mr. George Azzopardi of Thurber Engineering Ltd. Overall supervision of the field program was provided by Mr. Alastair E. Gorman, P.Eng. and Ms. Lindsey Blaine, E.I.T.

Interpretation of the data and preparation of the report was carried out by Ms. Lindsey Blaine, E.I.T. and Ms. R. Palomeque Reyna, P.Eng. The report was reviewed by Dr. P.K. Chatterji, P.Eng. a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd.

Lindsey Blaine, E.I.T.
Project Manager

Rocío Palomeque Reyna, P.Eng., M.Eng.
Geotechnical Engineer

P.K. Chatterji, P.Eng., Ph.D.
Review Principal

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

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

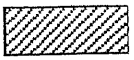
MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, 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			

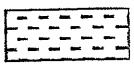
EXPLANATION OF ROCK LOGGING TERMS

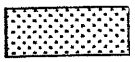
ROCK WEATHERING CLASSIFICATION

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

SYMBOLS


CLAYSTONE


SILTSTONE


SANDSTONE


COAL


Bedrock (general)

DISCONTINUITY SPACING

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

TERMS

Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a 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.

STRENGTH CLASSIFICATION

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

THURBER

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No MN11-01 1 OF 1 METRIC

510-00-00 LOCATION CP Manitouwadge N 5 396 891.6 E 389 260.3 ORIGINATED BY GA

HWY 17 BOREHOLE TYPE Hollow Stem Augers/Casing COMPILED BY AN

DATUM Geodetic DATE 2011.05.05 - 2011.05.05 CHECKED BY LRB

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
330.8											
0.0	**ASPHALT:** (100mm)										
0.1	**SAND**, trace to some gravel, trace to some silt, trace clay Very Dense to Compact Brown Damp (FILL)		1	SS	62		330				
			2	SS	28						
			3	SS	33		329				16 77 7 (SI+CL)
	Loose		4	SS	8		328				
			5	SS	8		327				
			6	SS	8		326				5 78 17 (SI+CL)
			7	SS	9		325				
			8	SS	62		324				
322.7							323				
8.1	END OF BOREHOLE AT 8.1m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED FROM 8.1m TO 0.3m WITH BENTONITE HOLEPLUG, FROM 0.3m TO 0.1m WITH CONCRETE, THEN ASPHALT TO SURFACE.										

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

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

ONTMT4S 1197.GPJ 2012TEMPLATE(MTO).GDT 2/5/13

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No MN11-02 1 OF 2 METRIC

510-00-00 | LOCATION CP Manitouwadge N 5 396 894.2 E 389 268.4 | ORIGINATED BY GA

HWY 17 | BOREHOLE TYPE Hollow Stem Augers/Casing | COMPILED BY AN

DATUM Geodetic | DATE 2011.05.04 - 2011.05.04 | CHECKED BY LRB

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
331.0											
0.0	**ASPHALT:** (75mm)						331				
0.1	**SAND**, some gravel, trace silt and clay Very Dense to Compact Brown Damp (FILL)		1	SS	60						
			2	SS	25		330				
	Loose to Compact		3	SS	6						13 83 4 (SI+CL)
			4	SS	10		329				
			5	SS	9		328				
			6	SS	5		327				
			7	SS	5		326				
			8	SS	36		325				12 83 5 (SI+CL)
	Dense						324				
322.5							323				
8.5	**BEDROCK**, granite, fresh, grey		1	RUN			322			FI 0 1 1 1 1	RUN #1 TCR=100% SCR=100% RQD=97% UCS=147MPa (average)
	Horizontal joints at 9.1m, 9.4m and 10.0m										

Continued Next Page

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

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

ONTMT4S 1197.GPJ 2012TEMPLATE(MTO).GDT 2/12/13

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No MN11-02 2 OF 2 METRIC

510-00-00 LOCATION CP Manitouwadge N 5 396 894.2 E 389 268.4 ORIGINATED BY GA

HWY 17 BOREHOLE TYPE Hollow Stem Augers/Casing COMPILED BY AN

DATUM Geodetic DATE 2011.05.04 - 2011.05.04 CHECKED BY LRB

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
	Continued From Previous Page										
	BEDROCK, granite, fresh, grey Sub-horizontal joints at 10.6m, 10.7m and 11.1m		2	RUN			321 320			0 1 3 0	RUN #2 TCR=100% SCR=100% RQD=82% UCS=128MPa (average)
319.4 11.6	END OF BOREHOLE AT 11.6m. BOREHOLE BACKFILLED FROM 11.6m TO 0.3m WITH BENTONITE HOLEPLUG, FROM 0.3m TO 0.1m WITH CONCRETE AND ASPHALT TO SURFACE.									0	

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

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

ONTMT4S 1197.GPJ 2012TEMPLATE(MTO).GDT 2/12/13

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No MN11-03 1 OF 2 METRIC

510-00-00 LOCATION CP Manitouwadge N 5 396 903.2 E 389 282.1 ORIGINATED BY GA

HWY 17 BOREHOLE TYPE Hollow Stem Augers/Casing COMPILED BY AN

DATUM Geodetic DATE 2011.05.03 - 2011.05.03 CHECKED BY LRB

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
331.3											
0.0	**ASPHALT:** (75mm)										
0.1	**SAND**, trace to some gravel, trace to some silt and clay Very Dense to Compact Brown Damp (FILL)		1	SS	55		331				
			2	SS	21						21 58 21 (SI+CL)
			3	SS	16		330				
	Loose		4	SS	8		329				
			5	SS	7		328				
			6	SS	6		327				
			7	SS	6		326				
			8	SS	14		325				10 81 9 (SI+CL)
	Compact						324				
323.1										FI	
8.2	**BEDROCK**, granite, fresh, grey		1	RUN			323			1	RUN #1 TCR=100% SCR=100% RQD=100% UCS=156MPa (average)
	Sub-vertical joint at 8.2m Horizontal joint at 8.9m									0	
							322			1	
										0	
										0	
										0	

ONTMT4S 1197.GPJ 2012TEMPLATE(MTO).GDT 2/12/13

Continued Next Page

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

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

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No MN11-03 2 OF 2 METRIC

510-00-00 LOCATION CP Manitouwadge N 5 396 903.2 E 389 282.1 ORIGINATED BY GA

HWY 17 BOREHOLE TYPE Hollow Stem Augers/Casing COMPILED BY AN

DATUM Geodetic DATE 2011.05.03 - 2011.05.03 CHECKED BY LRB

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
	Continued From Previous Page							20 40 60 80 100	20 40 60		
	BEDROCK, granite, fresh, dark grey		2	RUN			321			0	RUN #2 TCR=100% SCR=100% RQD=100% UCS=166MPa (average)
										0	
										0	
320.0										0	
11.3	END OF BOREHOLE AT 11.3m. BOREHOLE OPEN TO 11.3m AND WATER LEVEL AT 8.2m 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) May 04/11 9.0 322.3 May 05/11 9.1 322.2 * Theses are standing water levels originating from use of water for rock coring operation and do not represent stabilized ground water level.										

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

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

ONTMT4S 1197.GPJ 2012TEMPLATE(MTO).GDT 2/12/13

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No MN11-04 1 OF 1 METRIC

510-00-00 LOCATION CP Manitouwadge N 5 396 905.8 E 389 289.7 ORIGINATED BY GA

HWY 17 BOREHOLE TYPE Hollow Stem Augers/Casing COMPILED BY AN

DATUM Geodetic DATE 2011.05.04 - 2011.05.04 CHECKED BY LRB

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
331.4											
0.0 / 0.1	**ASPHALT:** (50mm)										
	SAND, some gravel, trace to some silt and clay Very Dense to Compact Brown Damp (FILL)		1	SS	55		331				
			2	SS	26						
			3	SS	27		330				14 76 10 (SI+CL)
	Loose		4	SS	8		329				
			5	SS	6		328				
			6	SS	6		327				
			7	SS	19		326				
	Compact						325				16 69 15 (SI+CL)
324.1							324				
7.3	END OF BOREHOLE AT 7.3m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE OPEN TO 7.3m AND DRY UPON COMPLETION. BOREHOLE BACKFILLED FROM 8.3m TO 0.3m WITH BENTONITE HOLEPLUG, FROM 0.3m TO 0.1m WITH CONCRETE AND ASPHALT PATCH TO SURFACE.										
323.1											
8.3	END OF DYNAMIC CONE PENETRATION TEST AT 8.3m.										

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

(%) STRAIN AT FAILURE

ONTMT4S 1197.GPJ 2012TEMPLATE(MTO).GDT 2/5/13

Appendix B

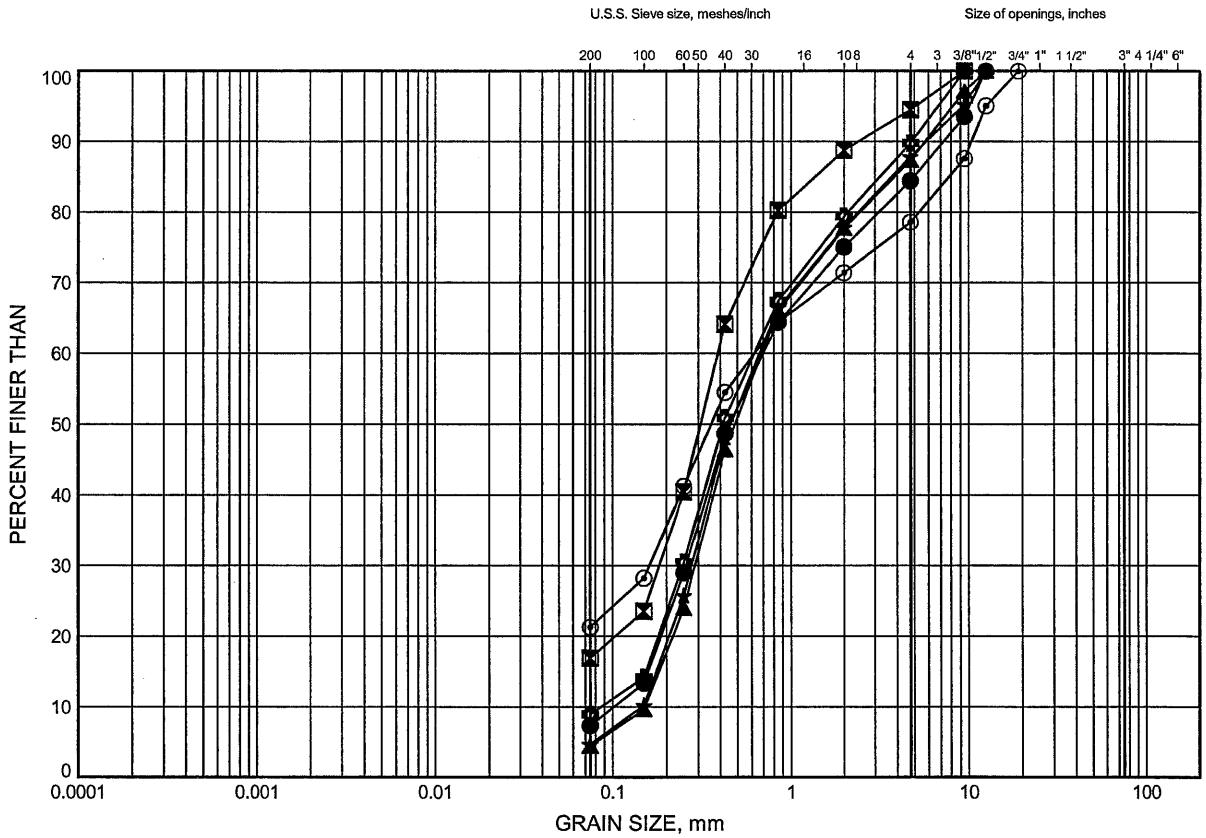
Laboratory Test Results

CP Manitouwadge

GRAIN SIZE DISTRIBUTION

FIGURE B1

SAND FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MN11-01	1.83	328.97
⊠	MN11-01	4.88	325.92
▲	MN11-02	1.83	329.18
★	MN11-02	6.40	324.61
⊙	MN11-03	1.07	330.22
✿	MN11-03	6.40	324.89

Date May 2012

W.P.# 510-00-00

THURBER

Prep'd MFA

Chkd. LRB

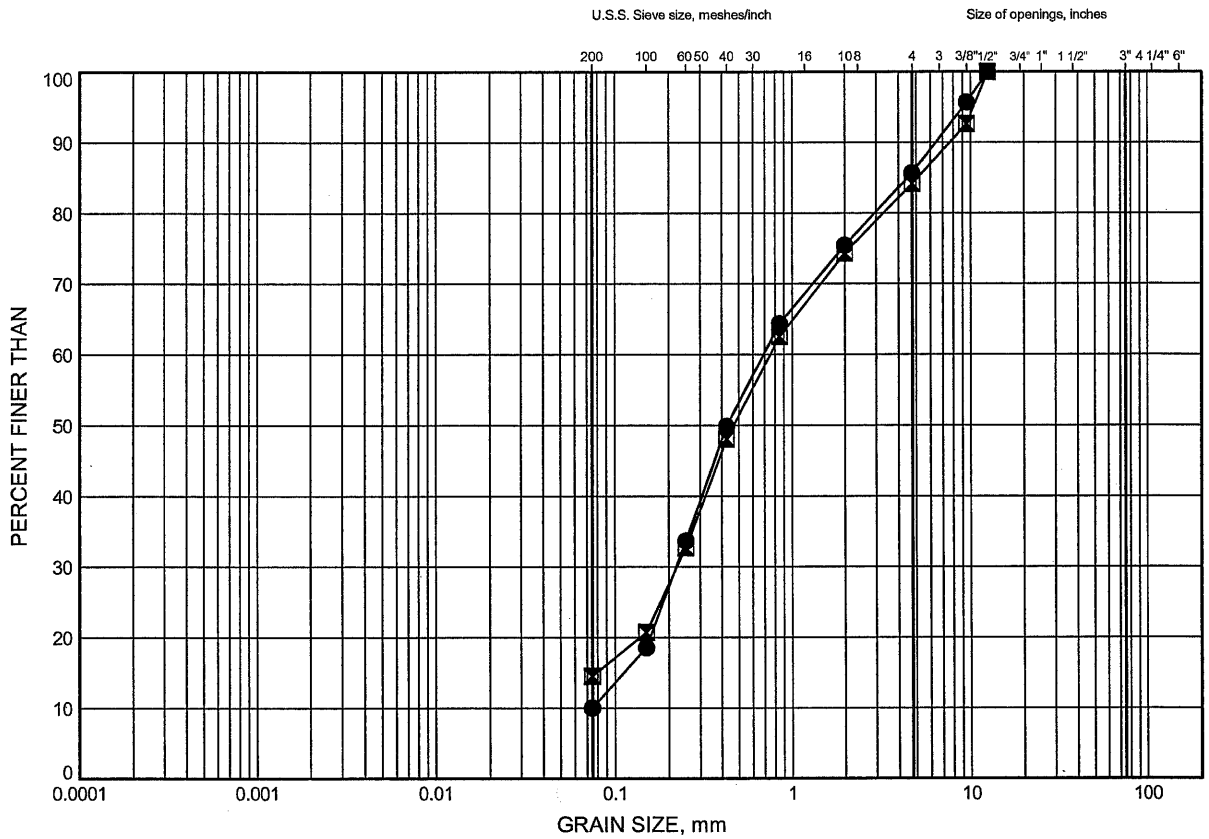
GRAIN SIZE DISTRIBUTION - THURBER 1197.GPJ 5/2/12

CP Manitouwadge

GRAIN SIZE DISTRIBUTION

FIGURE B2

SAND FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MN11-04	1.83	329.55
⊠	MN11-04	6.40	324.97

Date May 2012

W.P.# 510-00-00

THURBER

Prep'd MFA

Chkd. LRB

GRAIN SIZE DISTRIBUTION - THURBER 1197.GPJ 5/2/12

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

POINT LOAD TEST SHEET

Job No : 19-1351-197 **Client :** MRC

Date Drilled : 5/3/2011

Project Name : NWR 32 Rehabs - CPR Overhead Manitouwadge **Date Tested :** 5/10/2011

Core Size : NQ **BH No :** MN11-03 **Tester :** BT

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (kPa)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	8.4	D	16360.0	47.0	116.3	163.7	Granite	Very Strong
2	1	8.4	A	18260.0	47.0	41.3	167.7	Granite	Very Strong
3	1	8.9	D	14580.0	47.0	90.2	145.9	Granite	Very Strong
4	1	8.9	A	13840.0	47.1	42.8	123.4	Granite	Very Strong
5	1	9.2	D	19480.0	47.1	56.1	194.6	Granite	Very Strong
6	1	9.4	A	16440.0	47.1	48.0	134.2	Granite	Very Strong
7	1	9.7	D	16020.0	47.1	93.5	159.9	Granite	Very Strong
8									
9	2	9.8	D	15520.0	47.1	68.2	155.0	Granite	Very Strong
10	2	10.1	D	18660.0	47.1	88.2	186.5	Granite	Very Strong
11	2	10.0	A	16360.0	47.0	48.1	133.4	Granite	Very Strong
12	2	10.7	D	17060.0	47.1	77.9	170.3	Granite	Very Strong
13	2	11.3	D	17540.0	47.1	83.3	175.1	Granite	Very Strong
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									

* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1
Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

* Diametral Test should have 0.7 x D on either side of test point.

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

POINT LOAD TEST SHEET

Job No :	19-1351-197	**Client :**	MRC
		Date Drilled :	5/3/2011
Project Name :	NWR 32 Rehabs - CPR Overhead Manitouwadge	**Date Tested :**	5/10/2011
Core Size :	NQ **BH No :** MN11-03	**Tester :**	BT

Test No.	Run No.	Depth (m)	Axial or Diametral	Gauge (kPa)	Diameter (mm)	Length (mm)	UCS (MPa)	Rock Type	Notes
1	1	8.4	D	16360.0	47.0	116.3	163.7	Granite	Very Strong
2	1	8.4	A	18260.0	47.0	41.3	167.7	Granite	Very Strong
3	1	8.9	D	14580.0	47.0	90.2	145.9	Granite	Very Strong
4	1	8.9	A	13840.0	47.1	42.8	123.4	Granite	Very Strong
5	1	9.2	D	19480.0	47.1	56.1	194.6	Granite	Very Strong
6	1	9.4	A	16440.0	47.1	48.0	134.2	Granite	Very Strong
7	1	9.7	D	16020.0	47.1	93.5	159.9	Granite	Very Strong
8									
9	2	9.8	D	15520.0	47.1	68.2	155.0	Granite	Very Strong
10	2	10.1	D	18660.0	47.1	88.2	186.5	Granite	Very Strong
11	2	10.0	A	16360.0	47.0	48.1	133.4	Granite	Very Strong
12	2	10.7	D	17060.0	47.1	77.9	170.3	Granite	Very Strong
13	2	11.3	D	17540.0	47.1	83.3	175.1	Granite	Very Strong
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									

* It is ideal to perform axial test on core specimens with D/L ratio of 1.1 ± 0.1
Long pieces of core can be tested diametrically to produce suitable lengths for axial testing

* Diametral Test should have 0.7 x D on either side of test point.

Appendix C

Selected Photographs

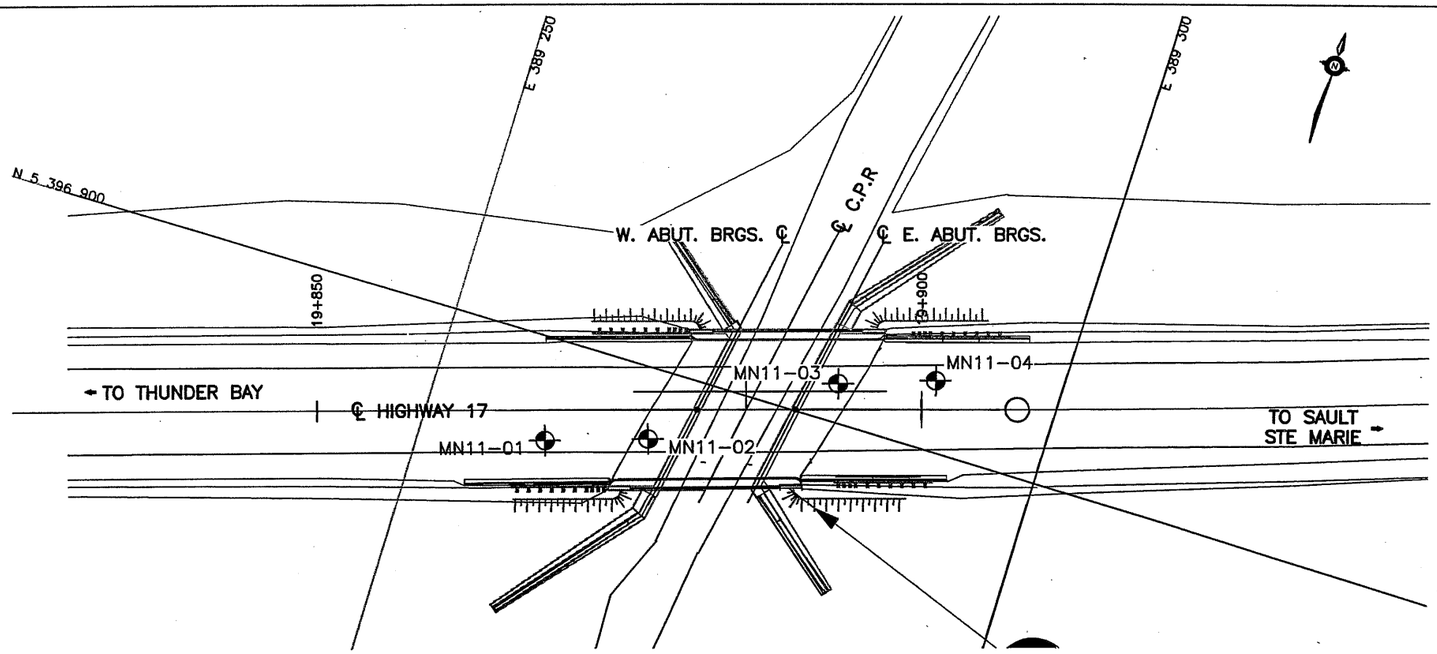
Photograph 1: Existing CP Overhead at Manitouwadge

Photograph 2: On Highway 17 looking east over the CP Overhead at Manitouwadge

Photograph 3: CP Overhead at Manitouwadge

Appendix D

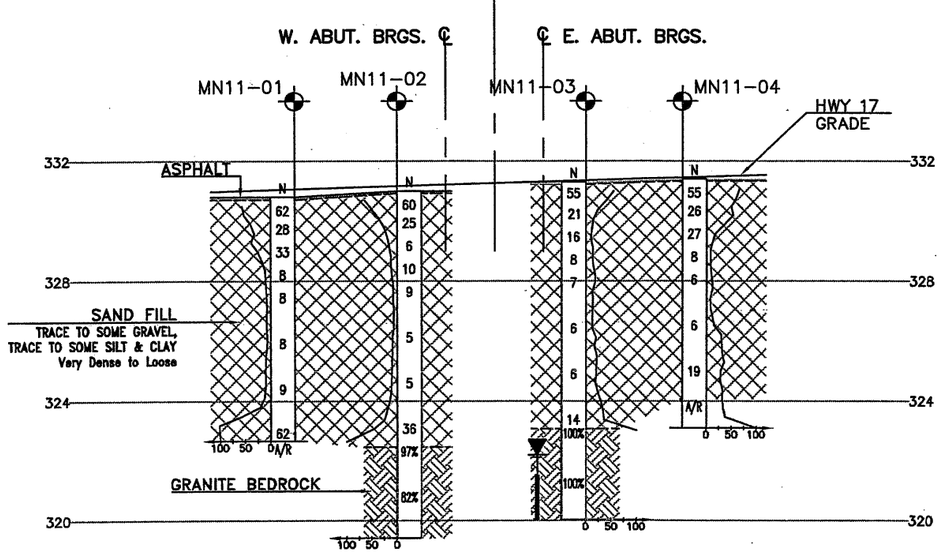
Drawing titled "Borehole Locations and Soil Strata"



PLAN

10 0 10 20m

SCALE 1:500



PROFILE ALONG ℄ HIGHWAY 17

10 0 10 20m H 1:500

4 0 4 8 V 1:200

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

CONT No

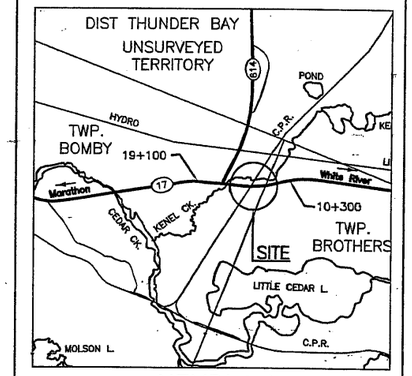
WP No 510-00-00

HIGHWAY 17
CP OVERHEAD
AT MANITOUWADGE
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

McCORMICK RANKIN
A member of MMM GROUP

THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

✱	Borehole
⊕	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
MN11-01	330.8	5 396 891.6	389 260.3
MN11-02	331.0	5 396 894.2	389 268.4
MN11-03	331.3	5 396 903.2	389 282.1
MN11-04	331.4	5 396 905.8	389 289.7

-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.
3) These are standing water levels originating from use of water for rock coring operation and do not represent stabilized ground water level.

GEOCRES No. 42C-28

LICENSED PROFESSIONAL ENGINEER
R. Palomeque Reyna
100083209
Feb 13/2013
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
Feb 13/2013
PROVINCE OF ONTARIO

REVISIONS			
DATE	BY	DESCRIPTION	
DESIGN LRB	CHK AEG	CODE	LOAD
DRAWN MFA	CHK PKC	SITE	STRUCT
		DATE FEB. 2013	DWG 1

LEGNAME: H:\Drafting\18\1351\197\ted1197-CPManitouwadge\Plan&Profile\Revise\(Feb05-2013).dwg
LOGDATE: 2/12/2013, 8:35 AM