FOUNDATION INVESTIGATION REPORT
DEER CREEK (FROOD) BRIDGE REPLACEMENT
HIGHWAY 539, TOWNSHIP OF CRERAR
W.P. 5236-05-01, SITE: 43-012

Geocres Number: 41I-265

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 conducted at the site of the bridge that carries Highway 539 over Deer Creek (Frood) in the Township of Crerar, Ontario. It is proposed that this bridge will be replaced on or close to the existing alignment.

The purpose of the investigation was to explore the subsurface conditions at the site and, based on the data obtained, to provide a borehole location plan, records of boreholes, stratigraphic profile and cross-sections, laboratory test results and a written description of the subsurface conditions. A model of the subsurface conditions was developed from the data obtained in the course of the investigation.

Thurber carried out the investigation as a sub-consultant to MMM Group, under the Ministry of Transportation Ontario (MTO) Agreement Number 5008-E-0013.

2 SITE DESCRIPTION

The site is located approximately 13.6 km north of the intersection of Highway 17 (Trans-Canada Highway) and Highway 539 in Warren, Ontario. At the site, Deer Creek flows towards the southwest on a relatively gentle gradient. The channel is approximately 9.5 m wide and the water level in the creek was recorded as Elevation 235.65 in February 2010. The banks of the creek are approximately 3.5 m high at the site. The creek banks are heavily vegetated with shrubs and small trees. Selected photographs of the site are included in Appendix D.

Geologically, the site lies within the Canadian Shield, which is characterized by Pre-Cambrian bedrock. Locally, however, Deer Creek flows across post-glacial deposits of silt and sand, and sand and gravel with cobbles and boulders. There is a single private residence/farm located northeast of the existing bridge. No other buildings or other developments are located within the immediate vicinity of the site.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field-testing for this project was carried out from May 17 to 19, 2010 and consisted of drilling six boreholes identified as DCR10-01 to DCR10-06. The approximate locations of the six (6) boreholes are shown on the attached Borehole Locations and Soil Strata Drawing in Appendix E. Two boreholes (DCR10-04 and DCR10-05) were drilled at the approximate location of the proposed east abutment and two boreholes (DCR10-02 and DCR10-03) were drilled at the approximate location of the proposed west abutment. One borehole (DCR10-01) was drilled along the west approach and one borehole (DRC10-06) was drilled along the east approach. The depths of the boreholes ranged from 8.2 m to 18.5 m. The Record of Borehole sheets are included in Appendix A.

Prior to commencing the site investigation, clearance was obtained from utility companies having buried plant in the area.

A combination of hollow-stem auger drilling and NQ-sized coring techniques was used to advance the boreholes. Samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT) in the overburden soils.

At least 3 m of bedrock was cored in Boreholes DCR10-02 to DCR10-05 at the proposed abutment locations. The rock cores were logged and the total core recovery (TCR), solid core recovery (SCR) and Rock Quality Designation (RQD) were determined for each core.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. At each abutment one standpipe piezometer consisting of 19 mm PVC pipe with a slotted screen was installed and enclosed in filter sand to permit groundwater level monitoring. The locations and completion details of the piezometers and boreholes are shown in Table 3.1.

A member of Thurber's technical staff supervised the drilling and sampling operations on a full time basis. The supervisor logged the boreholes and processed the recovered soil and rock samples for transport to Thurber's laboratory for further examination and testing.

Table 3.1 – Borehole Completion Details

Borehole Location	Borehole ID	Piezometer Tip Depth/ Elevation (m)	Completion Details
West Approach	DCR10-01	None Installed	Borehole backfilled with bentonite to 2.6 m, then drill cuttings to 0.1 m, then asphalt to ground surface.
West Abutment	DCR10-02	9.1 / 230.0	Piezometer with 1.5 m slotted screen installed with sand filter to 6.9 m, bentonite seal from 6.9 m to ground surface.
	DCR10-03	None Installed	Borehole backfilled with bentonite to 1.8 m, then drill cuttings to 0.1 m, then asphalt to ground surface.
East Abutment	DCR10-04	None Installed	Borehole backfilled with bentonite to 1.8 m, then drill cuttings to 0.1 m, then asphalt to ground surface.
	DCR10-05	15.2 / 224.0	Piezometer with 1.5 m slotted screen installed with sand filter to 13.0 m, bentonite seal from 13.0 m to 12.3 m, then drill cuttings to 11.8 m, then bentonite to 1.6 m, then cuttings to 0.1 m, the asphalt to ground surface.
East Approach	DCR10-06	None Installed	Borehole backfilled with bentonite to 2.0 m, then drill cuttings to ground surface.

4 LABORATORY TESTING

All of the recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination in the laboratory. Selected samples were also subjected to gradation analysis (hydrometer and sieve) and Atterberg Limits testing where appropriate, the results of which are summarized on the Record of Borehole sheets in Appendix A and on the figures contained in Appendix B.

Point load tests were carried out in the laboratory on selected samples of intact bedrock to assist in evaluation of the compressive strength of the bedrock. The results of the point load tests are tabulated in Table 1 in Appendix B and on the Record of Borehole sheets in Appendix A.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

A detailed description of the soil stratigraphy encountered at each borehole location is presented in Appendix A and on the "Borehole Locations and Soil Strata" drawings in Appendix E. An overall description of the stratigraphy 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, the site is underlain by sand fill overlying silty clay over cohesionless deposits of silt and sand with some gravel, cobbles and boulders, overlying granite bedrock.

5.1 Asphalt

Asphalt was encountered at the surface in all of the boreholes and the thickness ranged from 50 to 100 mm. Borehole DCR10-02 was drilled through the existing bridge deck and encountered 150 mm of concrete and 150 mm of wood underlying 100 mm of asphalt.

5.2 Sand Fill (Road Base Material)

Sand fill was encountered below the asphalt pavement in all of the boreholes, with the exception of Borehole DCR10-02, which was drilled through the existing bridge deck. The sand fill contained trace to some gravel and trace to some silt. The thickness of the sand fill ranged from 0.6 to 2.1 m and the elevation of the underside of the sand fill layer ranged from 236.9 to 239.2 m.

SPT N-values recorded in the sand fill ranged from 5 to 12 blows per 0.3 m of penetration, indicating a loose to compact relative density. Natural moisture contents of samples from the sand fill ranged from 3 to 13%.

A grain size distribution curve for a sample of the sand fill is shown on Figure B1 in Appendix B. The results of this test are summarized on the appropriate Record of Borehole sheet included in Appendix A and are presented below.

Soil Particles	Percentage
Gravel	4
Sand	83
Silt and Clay	13

5.3 Silty Clay

A layer of silty clay with trace gravel and sand seams was encountered below the sand fill in Boreholes DCR10-01 and DCR10-03 to DCR10-06 and at the ground surface under the bridge at the location of Borehole DCR10-02. The thickness of the silty clay layer ranged from 0.8 to 3.4 m with underside elevations of 234.8 to 236.2 m.

SPT N-values recorded in the silty clay layer ranged from 1 to 19 blows per 0.3 m of penetration, indicating a very soft to very stiff condition. Natural moisture contents of samples collected from the silty clay layer ranged from 13 to 44%.

Selected samples of the silty clay material were subjected to gradation analysis and Atterberg Limits testing where appropriate. The results are summarized below:

Soil Particles / Index Property	Percentage
Gravel	0
Sand	1 to 6
Silt	47 to 72
Clay	22 to 52
Liquid Limit	42 to 44
Plastic Limit	21 to 22

The grain size distribution curves for these samples are presented in Figure B2 of Appendix B and the results of the Atterberg Limits tests are plotted on Figure B6 of Appendix B. The Atterberg Limits tests indicate that the material is classified as a medium

plasticity clay (CI). The results are also summarized on the appropriate Record of Borehole sheet in Appendix A.

5.4 Silt

Silt containing trace to some clay and trace to some sand was encountered below the silty clay layer in Boreholes DCR10-04 to DCR10-06. The thickness of the silt layer ranged from 3.4 to 5.7 m with an underside elevation of 230.5 to 232.4 m.

SPT N-values recorded in the silt layer ranged from 2 to 8 blows per 0.3 m of penetration, indicating a very loose to loose relative density. Natural moisture contents of the silt samples ranged from 21 to 26%.

Selected samples of the silt were subjected to gradation analysis, the results of which are summarized below. The grain size distribution curves for these samples are presented in Figure B3 of Appendix B and the results are summarized on the appropriate Record of Borehole sheets in Appendix A.

Soil Particles	Percentage
Gravel	0
Sand	1 to 14
Silt	67 to 90
Clay	6 to 19

5.5 Sandy Silt to Silty Sand

A layer of sandy silt to silty sand with varying proportions of silt, sand, and clay was encountered underlying the silty clay and silt layers in all of the boreholes. Where the layer was fully penetrated, the thickness of the deposits ranged from 2.1 m to 4.5 m with underside elevations of 227.2 to 231.9 m.

SPT N-values recorded in the sandy silt to silty sand generally ranged from 0 to 9 blows per 0.3 m penetration, indicating a very loose to loose condition. Natural moisture contents of the sandy silt to silty sand samples ranged from 18 to 43%.

Selected samples of the sandy silt to silty sand were subjected to gradation analysis (hydrometer and sieve), the results of which are summarized below. The grain size distribution curves for these samples are presented in Figure B4 of Appendix B and the results are summarized on the appropriate Record of Borehole sheet in Appendix A.

Soil Particles	Percentage
Gravel	0 to 3
Sand	27 to 77
Silt and Clay	20
Silt	23 to 69
Clay	2 to 5

5.6 Sand to Sand and Gravel

A deposit of sand to sand and gravel was encountered in Boreholes DCR10-01 to DCR10-05 below the silty sand to sandy silt layer. The sand to sand and gravel layer also contains some cobbles and boulders. Where the deposit was fully penetrated, the thickness ranged from 2.0 to 4.6 m, with an underside elevations of 223.8 to 229.9 m.

SPT N-values recorded in the sand and gravel layer ranged from 11 blows per 0.3 m penetration to 100 blows for less than 0.3 m of penetration indicating a compact to very dense relative density. The N-values of 100 blows for less than 0.3 m penetration are indicative of the presence of cobbles and boulders. Rock coring methods were required in Boreholes DCR10-03 and DCR10-05 to penetrate this dense layer containing cobbles and boulders. The natural moisture contents of the sand and gravel samples ranged from 11 to 24%.

One sand and gravel sample was subjected to laboratory gradation analysis, the results of which are summarized below. The grain size distribution curve for this sample is presented in Figure B5 of Appendix B and the results are summarized on the appropriate Record of Borehole sheet in Appendix A.

Soil Particles	Percentage
Gravel	53
Sand	37
Silt and Clay	10

5.7 Bedrock

The overburden soils described above are underlain by granitic bedrock. The bedrock was generally light grey with occasional pink and white bands visible in most cores. Occasional mechanical breaks and sub-vertical fractures were observed in the rock cores.

Approximately 3.1 to 4.3 m of bedrock core was collected from Boreholes DCR10-02 to DCR10-05.

Bedrock was encountered at various depths and it was proved by coring at the abutment boreholes. Table 5.1 summarizes the depths and elevations to the top of bedrock in the boreholes.

Table 5.1 – Depths and Elevations of Top of Bedrock

Borehole	Location	Top of Bedrock	
		Depth (m)	Elevation (m)
DCR10-02	STA. 11+857.5 2.8 m LT	9.2	229.9
DCR10-03	STA. 11+856.0 3.0 m RT	10.8	228.3
DCR10-04	STA. 11+831.1 2.3 m RT	14.1	225.0
DCR10-05	STA. 11+834.0 3.2 m LT	15.4	223.8

Core recovery in the bedrock generally ranged from 96% to 100%. The RQD values generally ranged from 68% to 100%, indicating fair to excellent rock quality. A RQD value of 33%, indicating poor rock quality, was noted for Borehole DCR10-05 Run 4. The Fracture Index (FI) of the rock, expressed as fractures per 0.3 m of core, generally ranged from 0 to 10.

The estimated unconfined compressive strength of the rock cores generally ranges from 158 MPa to 271 MPa, indicating a very strong to extremely strong rock. These estimated rock strength values are interpreted from point load tests that were conducted on rock cores recovered from the boreholes. A summary of the Point Load Test Results is presented in Table 1 in Appendix B.

5.8 Groundwater Conditions

Two 19 mm diameter standpipe piezometers were installed in selected boreholes, one at each abutment. Water levels were measured after completion of drilling and are presented in Table 5.2.

Table 5.2 – Groundwater Levels and Elevations

Borehole	Location	Date	Groundwater	
			Depth (m)	Elevation (m)
DCR10-01	Open borehole	May 19, 2010	5.6	233.6
DCR10-02	Piezometer	May 20, 2010	2.4	236.7
DCR10-05	Piezometer	May 19, 2010 May 20, 2010	2.4 2.3	236.8 236.9
DCR10-06	Open borehole	Open borehole	4.0	235.9

The water table will fluctuate seasonally and will be strongly influenced by the level of the river.

6 MISCELLANEOUS

George Downing Estate Drilling Ltd. of Hawkesbury, Ontario supplied a truck mounted CME 75 drill rig and conducted the drilling, sampling and in-situ testing operations.

The drilling and sampling operations in the field were supervised on a full time basis by Mr. Stephane Loranger of Thurber, under the direction of Mr. Tony Harte, M.Sc..

The borehole locations were recorded in the field as Station and Offset and coordinates and elevations are based on AutoCad drawings provided by MMM Group Ltd.

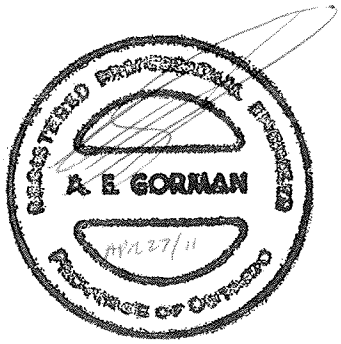
Ms. Lindsey Blaine, E.I.T. and Mr. Alastair E. Gorman, P.Eng prepared the Foundation Investigation Report.

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

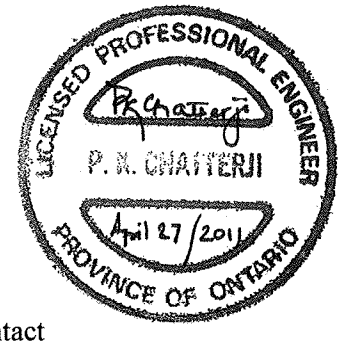
Thurber Engineering Ltd.

L. Blaine Apr. 27/11

Lindsey Blaine, E.I.T.
Engineer in Training



Alastair E. Gorman, P.Eng.,
Senior Foundations Engineer



Report Reviewed by:
P.K. Chatterji, P.Eng.,
Review Principal, Designated MTO Contact

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

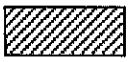
MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels,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

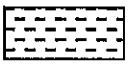
ROCK WEATHERING CLASSIFICATION

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

RECORD OF BOREHOLE No DCR10-01 1 OF 1 METRIC

W.P. 5236-05-01 LOCATION STA 11+815.4, 3.0m LT ORIGINATED BY SLL
HWY 539 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA
DATUM Geodetic DATE 2010.05.19 - 2010.05.19 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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
239.2											
0.0	**ASPHALT:** (100mm)										
0.1	**SAND**, trace to some gravel, trace to some silt Compact Brown Moist (FILL)		1	GS			239				
			1	SS	10						
237.8							238				
1.4	Silty **CLAY**, trace sand Firm to Very Stiff Brown (CI)		2	SS	19						
			3	SS	5		237				0 1 58 41
	Some sand seams		4	SS	7		236				
235.1											
4.1	Sandy **SILT**, trace clay Very Loose to Loose Grey Wet to Saturated		5	SS	3		235				
			6	SS	5		234				
231.9							233				0 31 64 5
7.3	**SAND**, some silt, some cobbles and boulders Dense Grey Wet		7	SS	45		232				
230.7							231				
8.5	END OF BOREHOLE AT 8.5m UPON AUGER REFUSAL ON PROBABLE BEDROCK. BOREHOLE OPEN TO 6.2m AND WATER LEVEL AT 5.6m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 2.6m, THEN CUTTINGS TO 0.1m, THEN ASPHALT TO SURFACE.										

+³, ×³: Numbers refer to Sensitivity

15 20 5 10 (%) STRAIN AT FAILURE

ONTMT4S 6158 (DC FROOD).GPJ 11/19/10

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No DCR10-02 1 OF 2 METRIC

W.P. 5236-05-01 LOCATION STA 11+834.0, 3.2m LT ORIGINATED BY SLL

HWY 539 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY MFA

DATUM Geodetic DATE 2010.05.19 - 2010.05.19 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) 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
239.1											
0.0 / 238.8	**ASPHALT:** (100mm)						239				
238.8 / 238.3	**CONCRETE:** (150mm)										
238.3 / 0.4	**WOOD:** (150mm)										
	Open space under bridge deck.						238				
237.3											
1.8	Silty **CLAY**, mixed with sand, trace roots and rootlets Very Soft to Soft Brown		1	SS	1		237				
			2	SS	3		236				
235.2											
3.9	Silty **SAND**, trace gravel Very Loose to Loose Grey Wet		3	SS	6		235				3 76 20 (SI+CL)
			4	SS	2		234				
	Timber at 5.2m.										
233.0											
6.1	Sandy **SILT**, trace clay Loose Grey Moist to Wet		5	SS	7		233				0 27 69 4
231.9											
7.2	**SAND**, some silt, trace cobbles Compact Grey Wet		6	SS	11		232				
							231				
229.9											
9.2	**GRANITE BEDROCK**, with micaceous seams, very strong to extremely strong		1	RUN			230			FI 0 0	RUN 1# TCR=100%, SCR=100%, RQD=100% UCS=257MPa

Continued Next Page

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

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

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No DCR10-02 2 OF 2 METRIC

W.P. 5236-05-01 LOCATION STA 11+834.0, 3.2m LT ORIGINATED BY SLL

HWY 539 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY MFA

DATUM Geodetic DATE 2010.05.19 - 2010.05.19 CHECKED BY LRB

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										
	Sub-vertical joints at 9.96 and 10.06m.						229			2	
	Sub-vertical joints at 10.42, 10.57, 10.62, 10.72, and 10.97m.		2	RUN						0 4 3	RUN 2# TCR=100%, SCR=95%, RQD=86% UCS=271MPa
							228			3	
	Vertical joint at 11.38 to 11.58m. Sub-vertical joints at 11.58, 11.66, 11.73, 11.91, and 12.04m.		3	RUN						3 7 4	RUN 3# TCR=100%, SCR=95%, RQD=78% UCS=172MPa
226.8							227			2	
12.3	END OF BOREHOLE AT 12.3m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2010.05.20 2.4 236.7										

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

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

ONTMT4S 6158 (DC FROOD).GPJ 11/19/10

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No DCR10-03 1 OF 2 METRIC

W.P. 5236-05-01 LOCATION STA 11+831.1, 2.3m RT ORIGINATED BY SLL

HWY 539 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY MFA

DATUM Geodetic DATE 2010.05.17 - 2010.05.17 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
239.1											
0.0	**ASPHALT:** (100mm)										
0.1	**SAND**, trace to some gravel, trace silt Loose Brown Moist (FILL)		1	GS			239		○		
			1	SS	9		238		○		
			2	SS	5				○		4 82 13 (SI+CL)
236.9							237				
2.2	Silty **CLAY**, trace gravel, with sand seams Soft Brown		3	SS	3				○		
236.1							236		○		
3.0	Silty **SAND**, trace gravel, trace clay, mixed with organics and wood fibers Very Loose to Loose Brown Moist to Wet		4	SS	0				○		
			5	SS	1		235		○		
			6	SS	2				○		
	Becoming grey, saturated						234				
			7	SS	5		233		○		1 74 23 2
231.6							232				
7.5	**SAND**, some gravel, some cobbles and boulders Very Dense Grey Moist		1	RUN			231				
			2	RUN			230				
			3	RUN							

Continued Next Page

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

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

ONTMT4S 6158 (DC FROOD).GPJ 11/19/10

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No DCR10-03 2 OF 2 METRIC

W.P. 5236-05-01 LOCATION STA 11+831.1, 2.3m RT ORIGINATED BY SLL

HWY 539 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY MFA

DATUM Geodetic DATE 2010.05.17 - 2010.05.17 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 / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page									
	SAND, some gravel, some cobbles and boulders Very Dense Grey Moist		4	RUN			229			
228.3			8	SS	100/					
10.8	**GRANITE BEDROCK**, fresh, strong to very strong				.050				Fl	RUN 5# TCR=96%, SCR=82%, RQD=68% UCS=240MPa
	Sub-vertical joint at 11.34 to 11.42m.		5	RUN			228		1 1 2 8	
	Rubble zone at 11.73 to 12.17m.									
	Sub-vertical joint at 12.17 to 12.24, and 13.49 to 13.64m.		6	RUN			227		3 1 4 0	RUN 6# TCR=100%, SCR=100%, RQD=79% UCS=227MPa
	Sub-vertical joint at 13.64 to 13.72, and 14.20 to 14.35m.		7	RUN			226		4 1 3 2	RUN 7# TCR=100%, SCR=100%, RQD=98% UCS=158MPa
224.0	Mechanical break at 15.14m.						225		1 0	
15.1	END OF BOREHOLE AT 15.1m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.8m, THEN CUTTINGS TO 0.1m, THEN ASPHALT TO SURFACE.									

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

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

ONTMT4S 6158 (DC FROOD).GPJ 11/19/10

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No DCR10-04 1 OF 2 METRIC

W.P. 5236-05-01 LOCATION STA 11+856.0, 3.0m RT ORIGINATED BY SLL

HWY 539 BOREHOLE TYPE Hollow Stem Augers/NW Casing/NQ Coring COMPILED BY MFA

DATUM Geodetic DATE 2010.05.18 - 2010.05.19 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
239.1											
0.0	**ASPHALT:** (88mm)										
0.1	**SAND**, some gravel, trace silt Loose Brown Moist (FILL)		1	GS							
			1	SS	6				○		
237.7											
1.4	Silty **CLAY**, trace sand, trace roots and rootlets Firm Brown		2	SS	5				○		
			3	SS	5				○		0 6 72 22
			4	SS	4				○		
234.8											
4.3	**SILT**, trace to some clay, trace rootlets Very Loose to Loose Grey Wet		5	SS	5				○		
	Some sand seams		6	SS	6				○		0 1 90 9
			7	SS	3				○		
230.5											
8.6	Sandy **SILT**, trace clay, some cobbles Loose Grey to Brown Moist to Wet		8	SS	9				○		0 27 68 5

Continued Next Page

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

(%) STRAIN AT FAILURE

ONTMT4S 6158 (DC FROOD).GPJ 11/19/10

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No DCR10-04 2 OF 2 METRIC

W.P. 5236-05-01 LOCATION STA 11+856.0, 3.0m RT ORIGINATED BY SLL
HWY 539 BOREHOLE TYPE Hollow Stem Augers/NW Casing/NQ Coring COMPILED BY MFA
DATUM Geodetic DATE 2010.05.18 - 2010.05.19 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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Sandy **SILT**, trace clay, some cobbles Loose to Very Dense Grey to Brown Moist to Wet						229				
			9	SS	8		228		o		
227.2											
11.9	**SAND**, some silt, some cobbles Very Dense Brown Wet		10	SS	100/ .175		227		o		
225.0							226				
14.1	**GRANITE BEDROCK**, very strong to extremely strong		1	RUN			225			Fl 5 5 0	RUN 1# TCR=100%, SCR=100%, RQD=74% UCS=264MPa
			2	RUN			224			0 0 2 0	RUN 2# TCR=100%, SCR=100%, RQD=94% UCS=218MPa
	Sub-vertical joint at 16.13 to 16.21m.						223				
	Sub-vertical joints at 16.54, 16.71, 16.79, and 17.12 to 17.21m.		3	RUN			222			1 4 1	RUN 3# TCR=100%, SCR=100%, RQD=85% UCS=209MPa
221.5										0	
17.6	END OF BOREHOLE AT 17.6m. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.8m, THEN SAND CUTTINGS TO 0.1m, THEN ASPHALT TO SURFACE.										

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

20
15 5
10
(%) STRAIN AT FAILURE

ONTMT4S 6158 (DC FROOD).GPJ 11/19/10

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No DCR10-05 1 OF 2 METRIC

W.P. 5236-05-01 LOCATION STA 11+857.5, 2.8m LT ORIGINATED BY SLL

HWY 539 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY MFA

DATUM Geodetic DATE 2010.05.18 - 2010.05.18 CHECKED BY LRB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
239.2									
0.0	**ASPHALT:** (100mm)								
0.1	**SAND**, some gravel, trace silt Compact Brown Moist (FILL)		1	GS			239		
			1	SS	12				
237.8							238		
1.4	Silty **CLAY**, some sand seams Firm to Very Stiff Brown to Grey		2	SS	4				
			3	SS	16		237		
236.2									
3.0	**SILT**, some clay, some sand, trace rootlets Very Loose to Loose Dark Brown Moist		4	SS	6		236		0 14 67 19
			5	SS	2		235		
	Becoming grey, wet						234		
			6	SS	5		233		
			7	SS	8		232		
230.5							231		
8.7	Silty **SAND**, trace clay Very Loose Brown Saturated		8	SS	WH		230		0 65 33 3

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

Ministry of Transportation
Ontario

RECORD OF BOREHOLE No DCR10-05 2 OF 2 METRIC

W.P. 5236-05-01 LOCATION STA 11+857.5, 2.8m LT ORIGINATED BY SLL

HWY 539 BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY MFA

DATUM Geodetic DATE 2010.05.18 - 2010.05.18 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 (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										
228.4	Silty **SAND**, trace clay Very Loose Brown Saturated						229				
10.8	**SAND** and **GRAVEL**, some silt, with cobbles and boulders Very Dense Grey Wet 1.2 m diameter boulder at 11 m		1	RUN			228				
			2	RUN			227				
	0.4 m diameter boulder at 12.5 m		3	RUN			226		o		
			9	SS	100/ 100		225				53 37 10 (SI+CL)
223.8							224				
15.4	**GRANITE BEDROCK**, very strong to extremely strong Rubble zone at 15.37 to 15.57m. Rubble zone at 15.83 to 16.00m. Sub-vertical joints at 16.23, 16.36, 16.38, 16.41, and 16.84m.		4	RUN						FI 4 1	RUN 4# TCR=100%, SCR=100%, RQD=33% UCS=225MPa
			5	RUN			223			3 2 1	RUN 5# TCR=100%, SCR=100%, RQD=90% UCS=229MPa
220.7			6	RUN			222			0 0 0 0 2	RUN 6# TCR=100%, SCR=100%, RQD=93% UCS=264MPa
18.5	END OF BOREHOLE AT 18.5m. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) 2010.05.19 2.4 236.8 2010.05.20 2.3 236.9						221				

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

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

ONTMT4S 6158 (DC FROOD).GPJ 11/19/10

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No DCR10-06 1 OF 1 METRIC

W.P. 5236-05-01 LOCATION STA 11+876.0, 2.6m RT ORIGINATED BY SLL

HWY 539 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MFA

DATUM Geodetic DATE 2010.05.19 - 2010.05.19 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
239.9											
0.0 / 0.1	**ASPHALT:** (50mm)										
	SAND, some gravel, trace silt Brown Moist		1	GS							
239.2 / 0.7	(FILL)										
	Silty **CLAY**, trace sand Soft to Firm Brown (Cl)		1	SS	6		239				
			2	SS	6		238				0 1 47 51
			3	SS	3		237				
235.8			4	SS	3		236				
4.1	**SILT**, trace sand, trace clay Loose Grey to Brown Moist to Wet		5	SS	4		235				
			6	SS	7		234				0 5 89 6
232.4							233				
7.5	Silty **SAND** Loose Brown Moist to Wet		7	SS	9		232				
231.7											
8.2	END OF BOREHOLE AT 8.2m. BOREHOLE OPEN TO 8.2m AND WATER LEVEL AT 4.0m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 2.0m, THEN CUTTINGS TO SURFACE.										

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

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

ONTMT4S 6158 (DC FROOD).GPJ 11/19/10

Appendix B

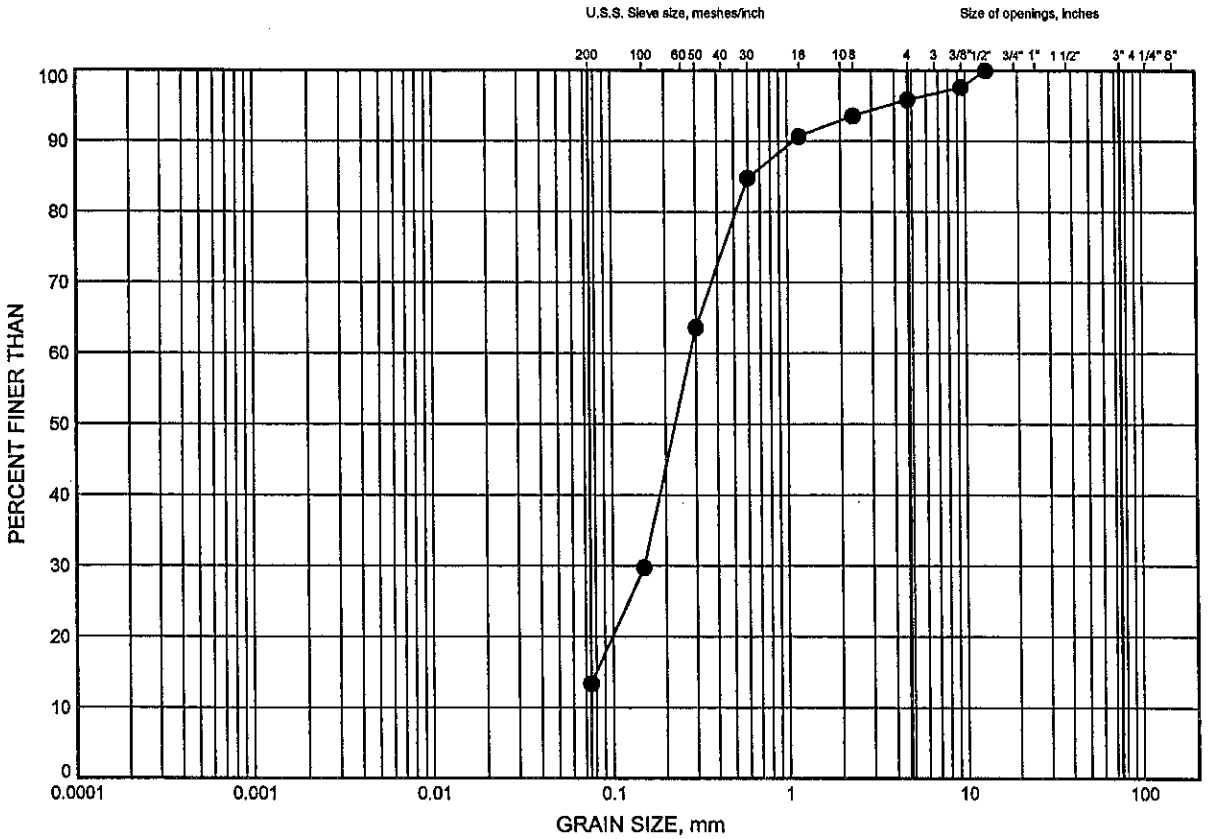
Laboratory Test Results

DEER CREEK (FROOD) BRIDGE

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)
●	DCR10-03	1.83	237.27

W.P.# 5236-05-01
Prepared By AN
Checked By LRB

THURBER

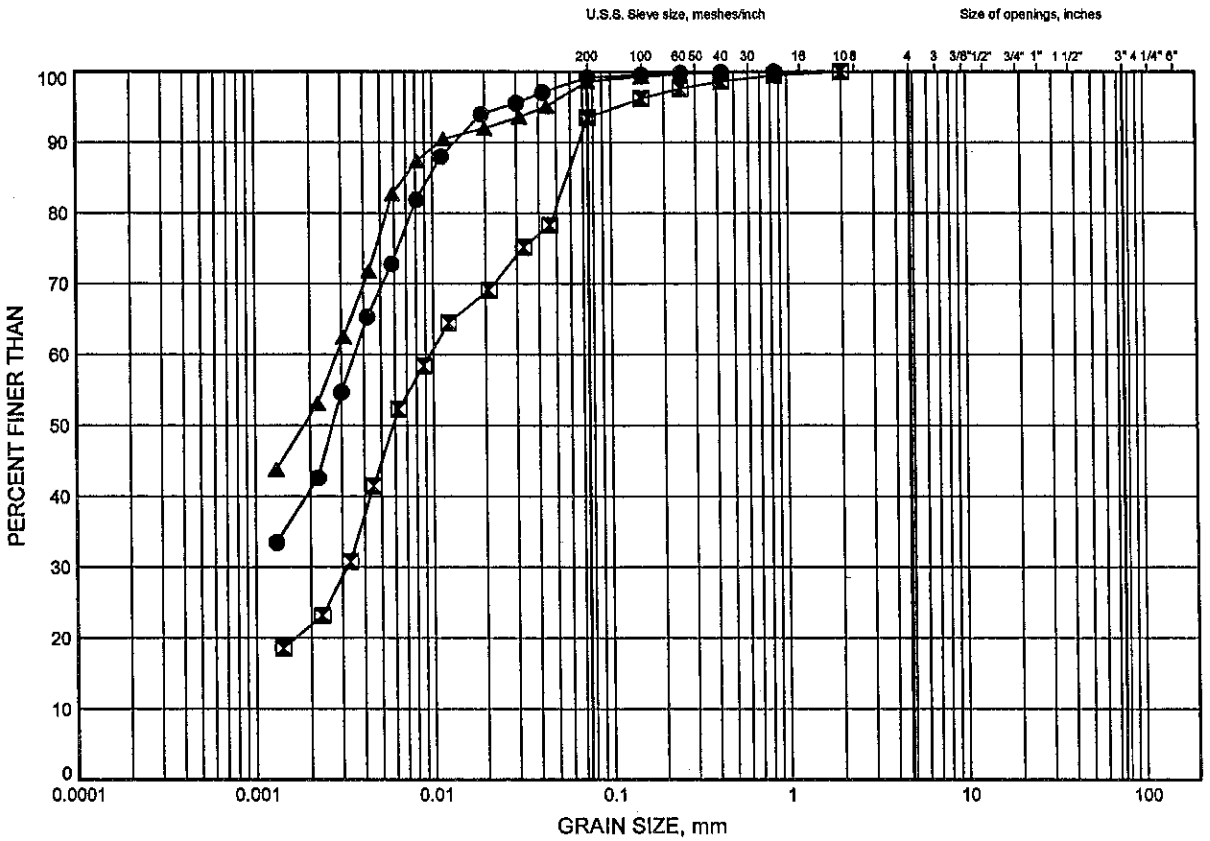
GRAIN SIZE DISTRIBUTION - THURBER 6158.GPJ 11/19/10

DEER CREEK (FROOD) BRIDGE

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)
●	DCR10-01	2.59	236.61
⊠	DCR10-04	2.59	236.51
▲	DCR10-06	1.83	238.07

W.P.# 5236-05-01
Prepared By AN
Checked By LRB

THURBER

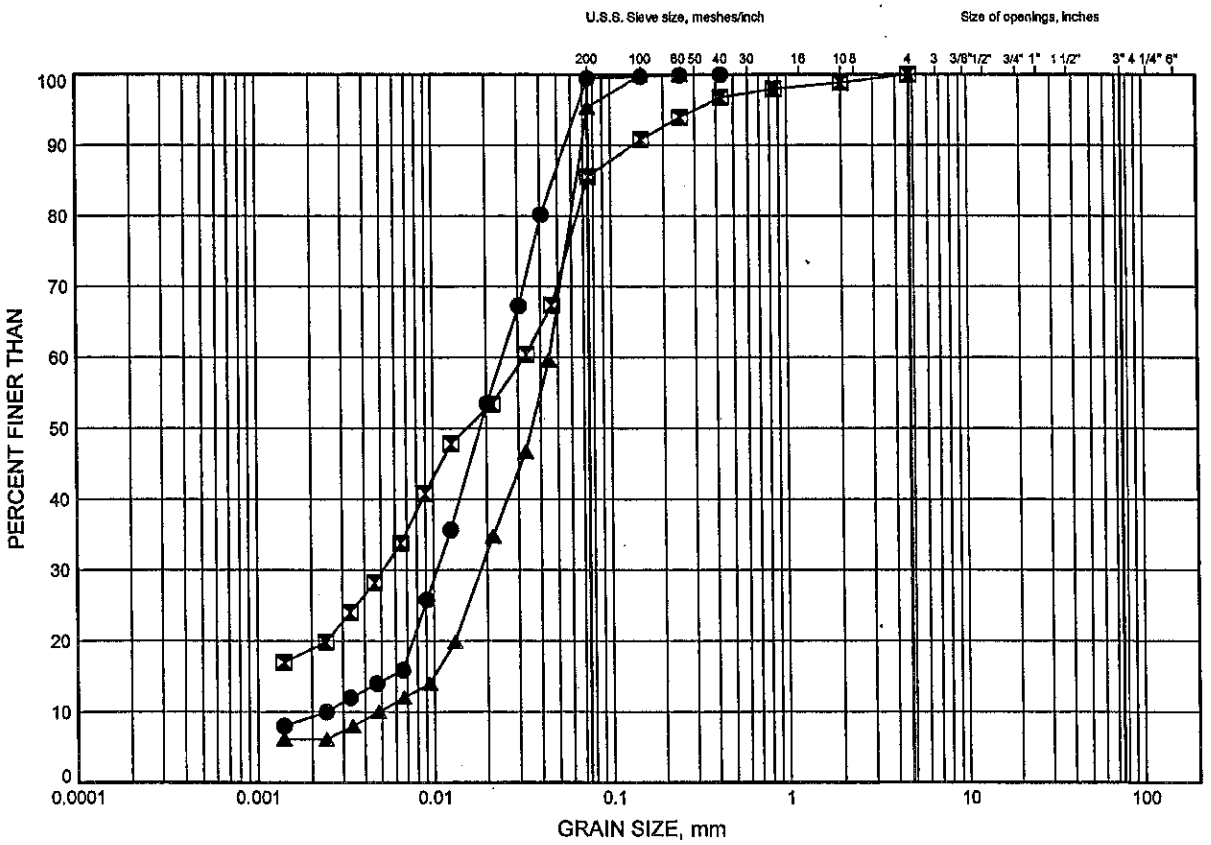
GRAIN SIZE DISTRIBUTION - THURBER 6158.GPJ 11/19/10

DEER CREEK (FROOD) BRIDGE

GRAIN SIZE DISTRIBUTION

FIGURE B3

SILT



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	DCR10-04	6.40	232.70
⊠	DCR10-05	3.35	235.85
▲	DCR10-06	6.40	233.50

W.P.# 5236-05-01

Prepared By AN

Checked By LRB

THURBER

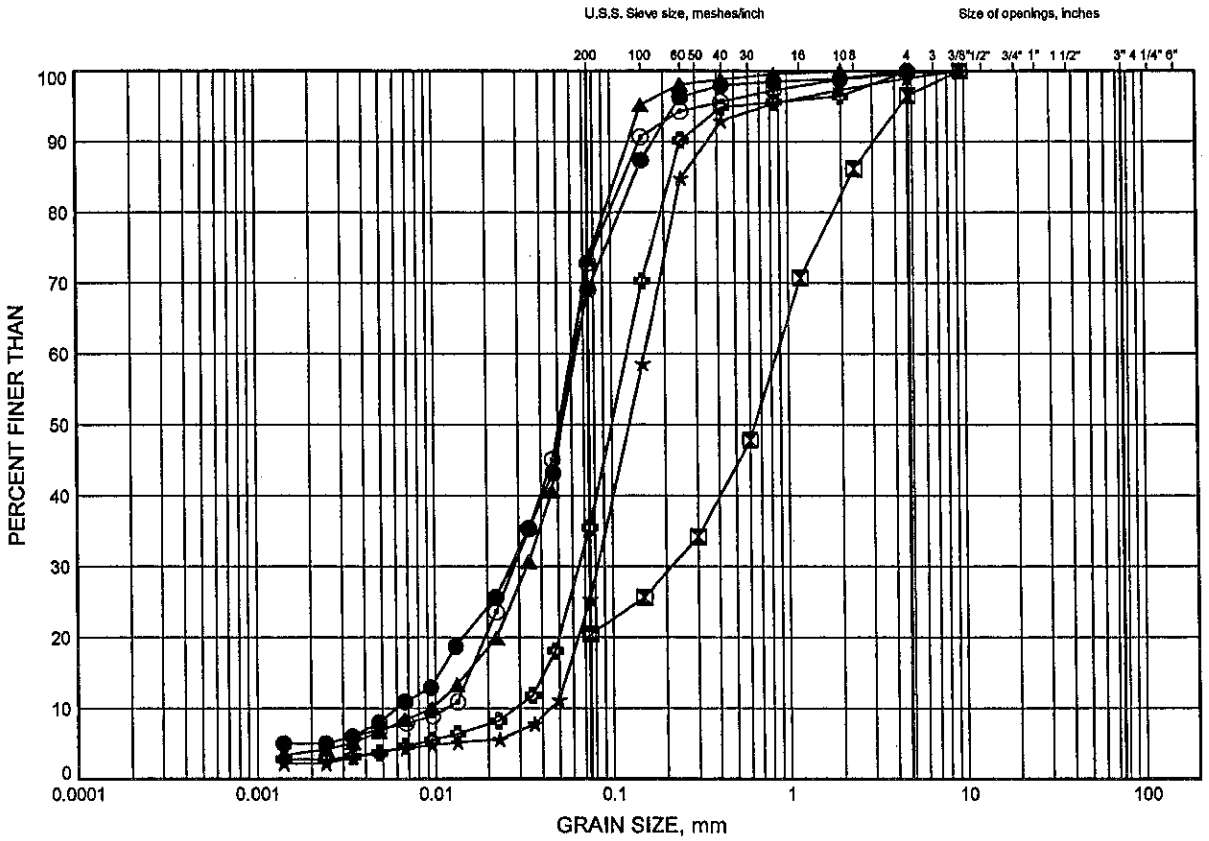
GRAIN SIZE DISTRIBUTION - THURBER 6158.GPJ 11/19/10

DEER CREEK (FROOD) BRIDGE

GRAIN SIZE DISTRIBUTION

FIGURE B4

SANDY SILT to SILTY SAND



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	DCR10-01	6.40	232.80
⊠	DCR10-02	4.88	234.22
▲	DCR10-02	6.40	232.70
★	DCR10-03	6.40	232.70
⊙	DCR10-04	9.45	229.65
✿	DCR10-05	9.45	229.75

W.P.# 5236-05-01.....
Prepared By AN.....
Checked By LRB.....

THURBER

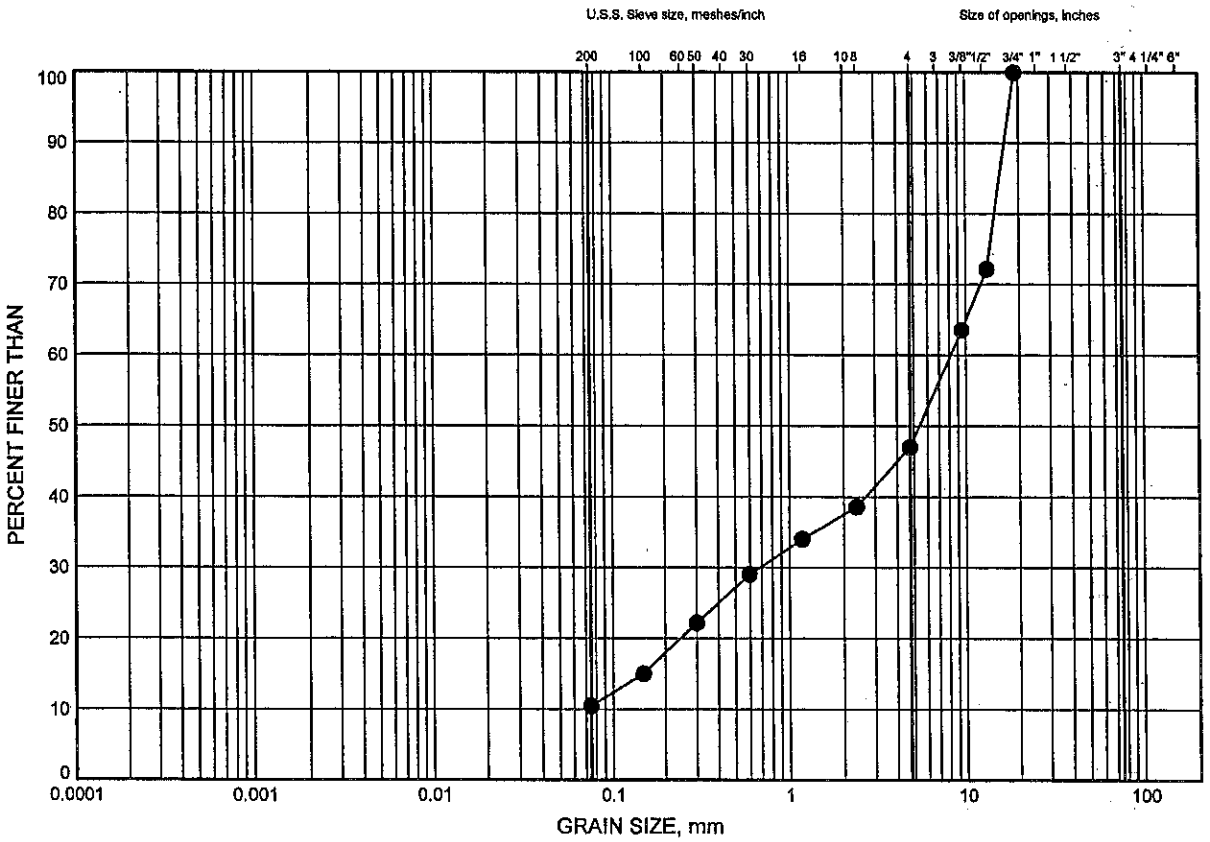
GRAIN SIZE DISTRIBUTION - THURBER 6158.GPJ 11/19/10

DEER CREEK (FROOD) BRIDGE

GRAIN SIZE DISTRIBUTION

FIGURE B5

SAND & GRAVEL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	DCR10-05	14.55	224.65

W.P.# 5236-05-01
Prepared By AN
Checked By LRB

THURBER

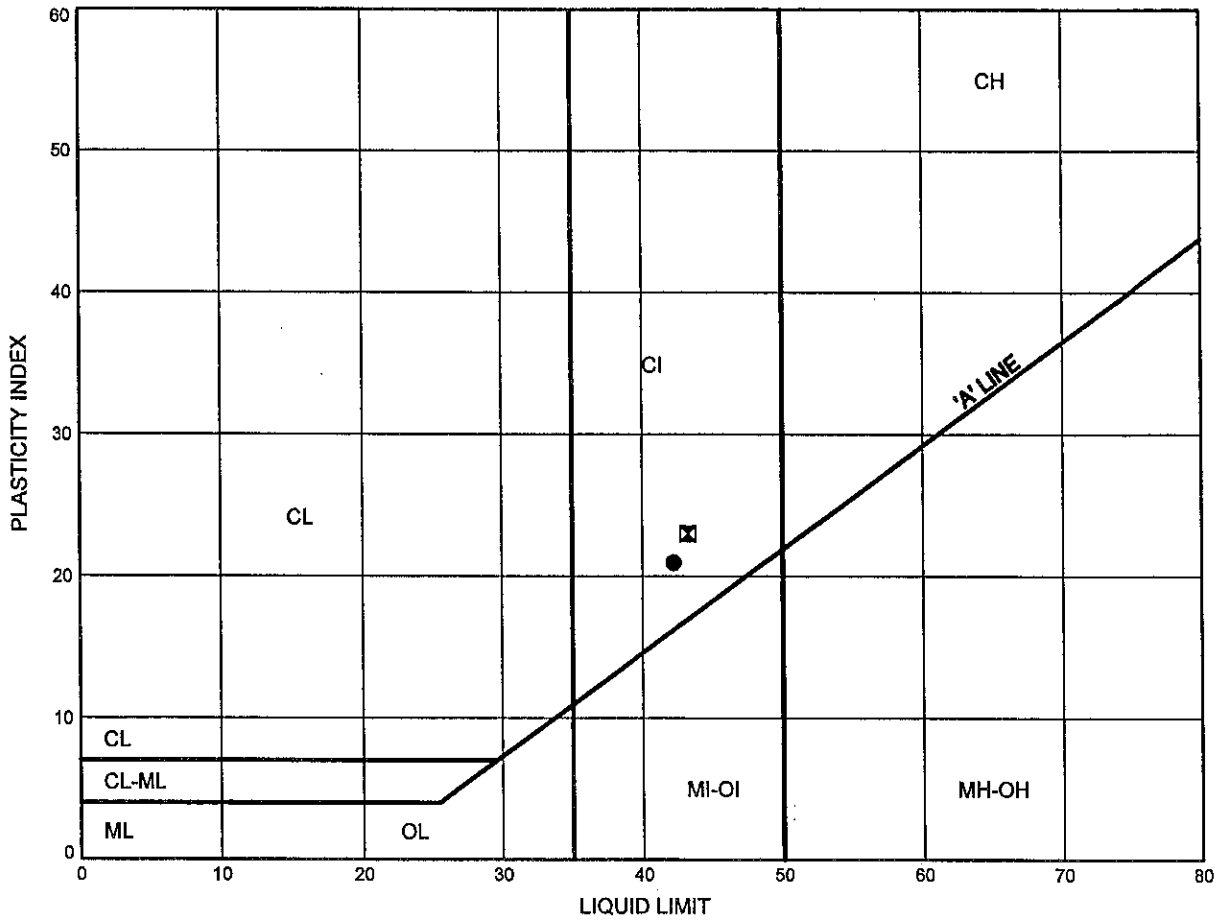
GRAIN SIZE DISTRIBUTION - THURBER 6158.GPJ 11/19/10

DEER CREEK (FROOD) BRIDGE

ATTERBERG LIMITS TEST RESULTS

FIGURE B6

SILTY CLAY



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	DCR10-01	2.59	236.61
⊠	DCR10-06	1.83	238.07

Date November 2010

Project 5236-05-01

THURBER

Prep'd AN

Chkd. LRB

THURBALT 6158.GPJ 11/19/10

TABLE 1 - Point Load Test Results

MMM GROUP LIMITED

DEER CREEK (FROOD) BRIDGE

19-5161-58

9-Jun-10

DCR 10-2	DEPTH			FORCE	AXIAL /	DIAMETER	LENGTH	Is	Is50	BREAK	UCS	ROCK
	FT.	IN.	METERS	(kN)	DIAMETRIC	(mm)	(mm)	(MPa)	(MPa)		(Mpa)	TYPE
RUN #1	32	2	9.80	24.2	D	46.88	176.00	11.011	10.697	ok	256.72	Granite
RUN # 2	34	5	10.49	25.7	D	47.06	138.74	11.605	11.292	ok	271.02	Granite
RUN #3	38	11	11.86	16.2	D	46.90	164.00	7.365	7.156	ok	171.74	Granite

CONCLUSIONS			
	AVERAGE	MAX	MIN
RUN #1:	257	257	257
RUN #2:	271	271	271
RUN #3:	172	172	172

DCR 10-3	DEPTH			FORCE	AXIAL /	DIAMETER	LENGTH	Is	Is50	BREAK	UCS	ROCK
	FT.	IN.	METERS	(kN)	DIAMETRIC	(mm)	(mm)	(MPa)	(MPa)		(Mpa)	TYPE
RUN #5	35	9	10.90	22.8	D	47.16	122.08	10.251	9.985	ok	239.65	Granite
RUN # 6	40	10	12.45	21.5	D	47.03	130.70	9.720	9.456	ok	226.95	Granite
RUN #7	46	0	14.02	8.2	D	47.08	142.60	3.699	3.601	ok	86.42	Granite
Re-Test	46	5	14.15	21.8	D	47.13	155.00	9.814	9.557	ok	229.36	Granite

CONCLUSIONS			
	AVERAGE	MAX	MIN
RUN #5:	240	240	240
RUN #6:	227	227	227
RUN #7:	158	229	86

DCR 10-4	DEPTH			FORCE	AXIAL /	DIAMETER	LENGTH	Is	Is50	BREAK	UCS	ROCK
	FT.	IN.	METERS	(kN)	DIAMETRIC	(mm)	(mm)	(MPa)	(MPa)		(Mpa)	TYPE
RUN #1	47	0	14.33	24.6	D	46.58	168.00	11.338	10.982	ok	263.57	Granite
RUN # 2	52	9	16.08	20.6	D	46.92	146.74	9.357	9.093	ok	218.24	Granite
RUN #3	54	0	16.46	19.8	D	46.99	138.92	8.967	8.720	ok	209.28	Granite

CONCLUSIONS			
	AVERAGE	MAX	MIN
RUN #1:	264	264	264
RUN #2:	218	218	218
RUN #3:	209	209	209

DCR 10-5	DEPTH			FORCE	AXIAL /	DIAMETER	LENGTH	Is	Is50	BREAK	UCS	ROCK
	FT.	IN.	METERS	(kN)	DIAMETRIC	(mm)	(mm)	(MPa)	(MPa)		(Mpa)	TYPE
RUN #3	43	4	13.21	17.9	D	46.99	127.20	8.107	7.883	ok	189.20	Granite
RUN # 4	50	11	15.52	21.2	D	46.83	154.00	9.667	9.386	ok	225.27	Granite
RUN #5	54	2	16.51	21.5	D	46.79	164.00	9.820	9.532	ok	228.76	Granite
RUN # 6	57	8	17.58	24.9	D	46.85	176.00	11.344	11.017	ok	264.41	Granite

CONCLUSIONS			
	AVERAGE	MAX	MIN
RUN #3:	189	189	189
RUN #4:	225	225	225
RUN #5:	229	229	229
RUN #6:	264	264	264

Appendix C

Site Photographs

Photo 1. Looking west across Deer Creek (Frood) Bridge

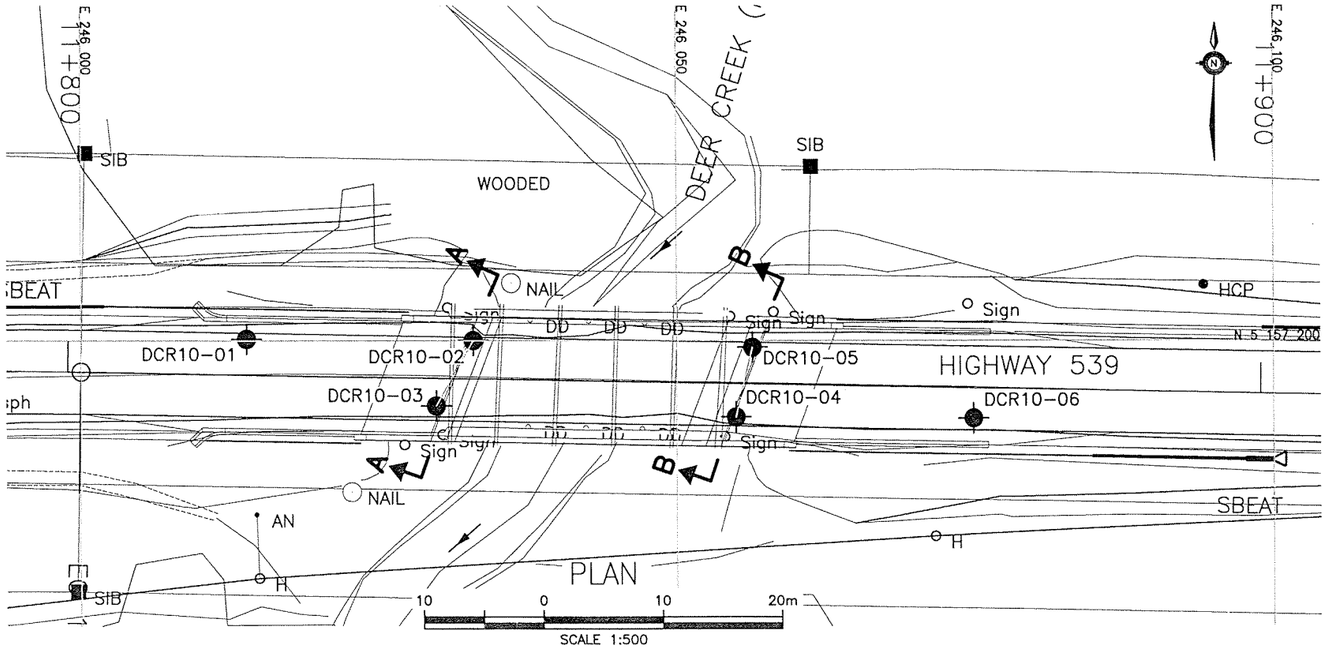
Photo 2. East approach to the Deer Creek (Frood) Bridge (looking west)

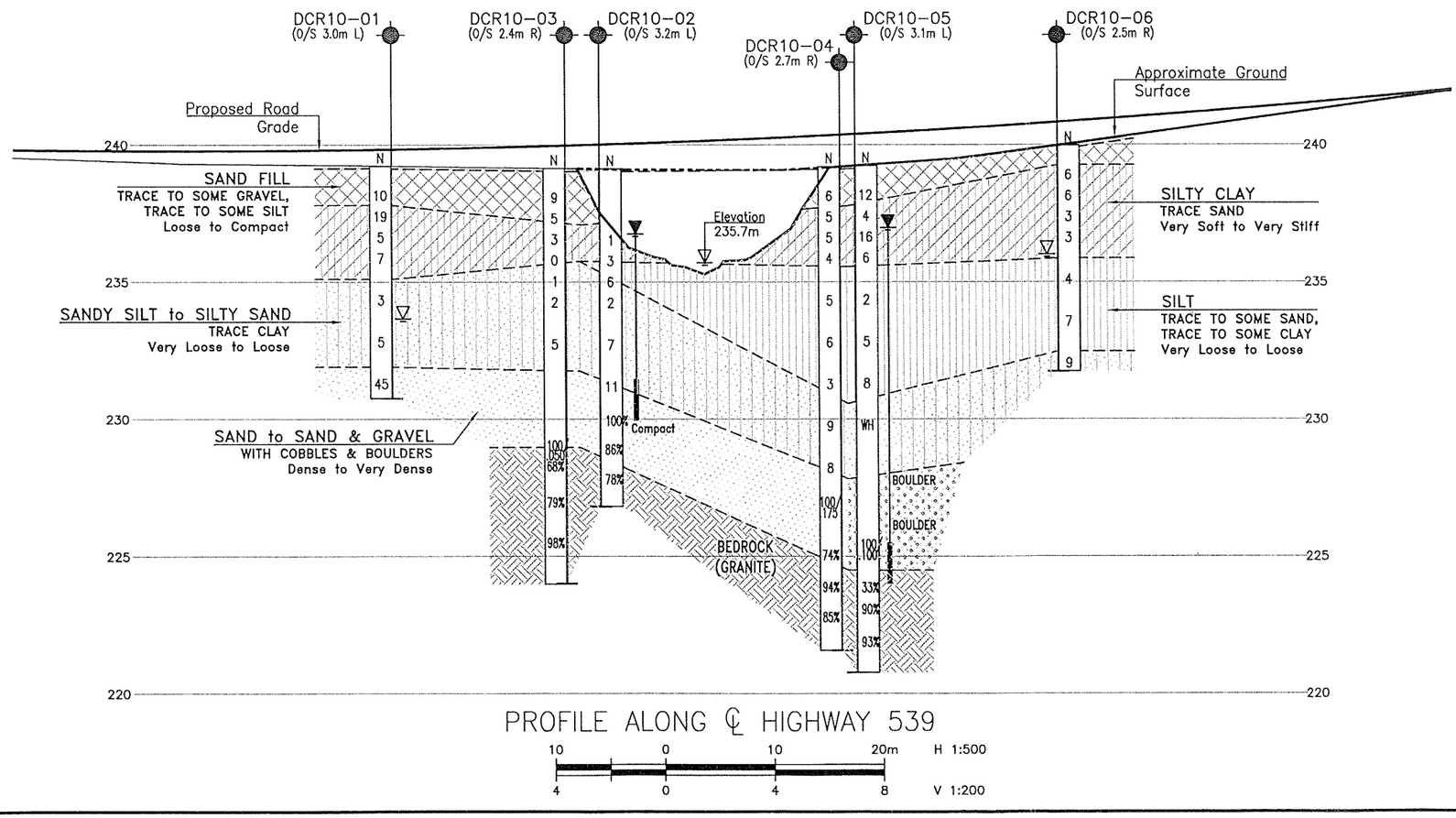
Photo 3. West approach to the Deer Creek (Frood) Bridge (looking west)

Appendix D

Drawings

MINISTRY OF TRANSPORTATION, ONTARIO





PROFILE ALONG ℄ HIGHWAY 539

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

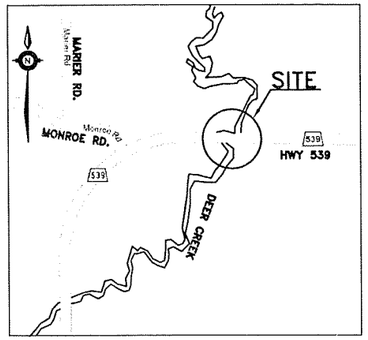
CONT No
WP No 5236-05-01

SHEET

HIGHWAY 539
DEER CREEK
(FROOD) BRIDGE
BOREHOLE LOCATIONS AND SOIL STRATA

MMM GROUP

THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS



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
DCR10-01	239.2	5 157 200.1	246 013.9
DCR10-02	239.1	5 157 200.0	246 032.9
DCR10-03	239.1	5 157 194.6	246 029.8
DCR10-04	239.1	5 157 199.5	246 054.9
DCR10-05	239.2	5 157 193.6	246 056.3
DCR10-06	239.9	5 157 193.5	246 074.8

-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. 41I-265

REGISTERED PROFESSIONAL ENGINEER
A. E. GORMAN
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
April 27/2011
PROVINCE OF ONTARIO

REVISIONS			
DATE	BY	DESCRIPTION	
DESIGN LRB	CHK	CODE	LOAD	DATE APR. 2011
DRAWN AN	CHK	SITE	STRUCT	DWG

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PLOTDATE Apr 26, 2011 - 3:08pm

MINISTRY OF TRANSPORTATION, ONTARIO

METRIC

DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN

CONT No
WP No 5236-05-01

HIGHWAY 539
DEER CREEK
(FROOD) BRIDGE
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

THURBER ENGINEERING LTD.
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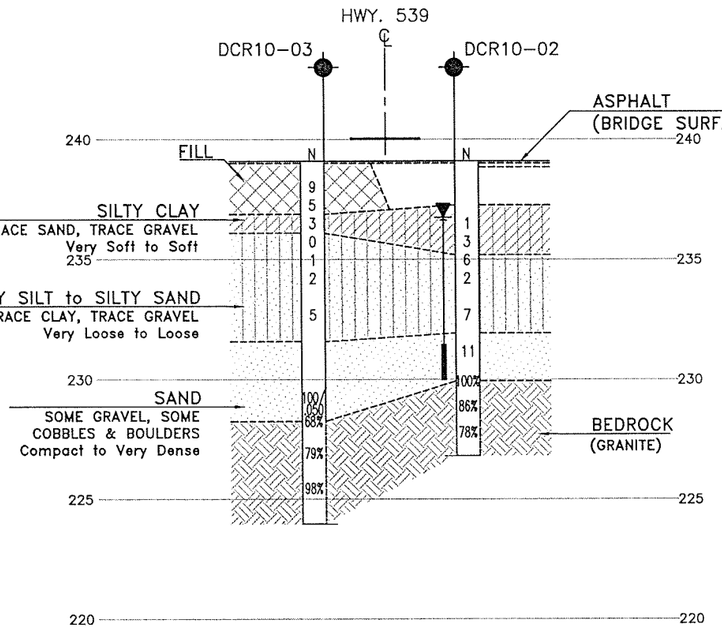
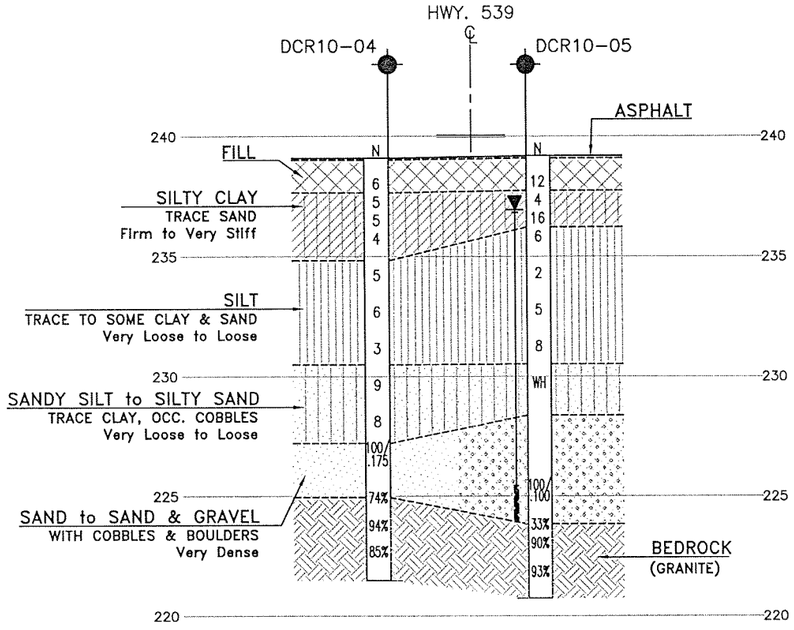


SECTION A-A



SECTION B-B

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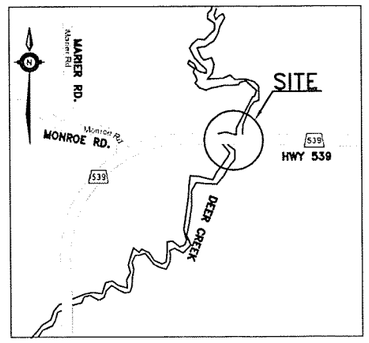
SCALE 1:250



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GEOCRES No. 41I-265

REVISIONS

DATE	BY	DESCRIPTION

DESIGN	LRB	CHK		CODE		LOAD	DATE APR. 2011
DRAWN	AN	CHK		SITE		STRUCT	DWG

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