FOUNDATION INVESTIGATION REPORT
PELICAN RIVER BRIDGE REPLACEMENT
HAUKENESS ROAD, WEST OF HIGHWAY 605
TOWNSHIP OF ETON-RUGBY, ONTARIO
DISTRICT OF KENORA
W.P. 473-00-00, SITE 41S-38

Geocres Number: 52F-36

Report to

GENIVAR

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual findings obtained from a foundation investigation conducted at the location of a proposed bridge replacement. The existing bridge carries Haukeness Road over the Pelican River, just west of Highway 605 in the Township of Eton-Rugby, Ontario.

The purpose of this 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, laboratory test results and written descriptions 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 GENIVAR, under the Ministry of Transportation Ontario (MTO) Agreement Number 6010-E-0027.

2 SITE DESCRIPTION

The Pelican River bridge is located on Haukeness Road just west of Highway 605 in the Township of Eton-Rugby, Ontario. Haukeness Road intersects Highway 605 approximately 8 km north of the intersection of Highway 17 and Highway 605.

Haukeness Road is an unpaved one-lane road. The existing bridge consists of a three span modular bridge supported on timber pile bents. The length of the bridge is 64.1 m.

At this location, the Pelican River flows from north to south. In general, the Pelican River meanders from its lake of origin, which is located approximately 6.5 km northeast of the bridge site, to the Wabigoon River located to the south of the site.

The lands immediately surrounding the bridge site consist of forested areas. Some lands in the area have been developed for agricultural purposes.

Photographs in Appendix C show the general nature of the surrounding land.

The site is underlain by Precambrian rocks and is covered with Pleistocene and recent deposits. These deposits consist of clays, silts and sands.

3 SITE INVESTIGATION AND FIELD TESTING

The site investigation and field testing for this project were carried out on May 30 and 31, 2011 and consisted of drilling and sampling two boreholes (identified as PRB-01 and PRB-02), through the existing highway embankments at the bridge location. Borehole PRB-01 was drilled near the east abutment and Borehole PRB-02 was drilled near the west abutment. Boreholes were advanced to 12.1 m and 17.7 m depth (Elevations 88.5 and 81.1) where the drill rig encountered refusal on bedrock. Bedrock was proved in both boreholes by NQ size diamond coring. Borehole PRB-01 was advanced 3.1 m into bedrock and terminated at 15.2 m depth (Elevation 85.4). Borehole PRB-02 was advanced 3.6 m into bedrock and terminated at 21.3 m depth (Elevation 77.5). No boreholes were drilled at the proposed pier locations for the modular bridge.

The approximate borehole locations are shown on the attached Borehole Locations and Soil Strata Drawing included in Appendix D.

The borehole locations were marked in the field and utility clearances were obtained prior to drilling.

Drilling was carried out using a rubber-tire drill rig and hollow-stem augers were used to advance the boreholes. Overburden samples were obtained at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). In situ vane shear testing was carried out to assess the undrained shear strength of soft to firm cohesive deposits.

The drilling and sampling operations were supervised on a full time basis by a member of Thurber's technical staff. The supervisor logged the boreholes and processed the recovered soil samples for transport 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 were observed in the open boreholes during and upon completion of the drilling operations. One standpipe piezometer consisting of 19 mm diameter PVC pipe with a slotted screen was installed in Borehole PRB-01 and enclosed in filter sand to permit longer term groundwater level monitoring. Borehole PRB-02, where artesian conditions were encountered was

backfilled with bentonite in general accordance with O.REg. 903. This backfilled borehole was periodically inspected after abandonment to confirm that no artesian flow was emerging at the surface of the borehole. The locations and completion details of the boreholes are shown in Table 3.1.

Table 3.1 – Borehole Abandonment Details

Borehole	Piezometer Tip Depth/ Elevation (m)	Abandonment Details
PRB-01	11.9 / 88.7	Piezometer with 1.5 m slotted screen installed with sand filter to 10.1 m, bentonite from 10.1 m to 9.9 m, cuttings from 9.9 m to 0.9 m and then bentonite holeplug to surface.
PRB-02	None installed	Backfilled with bentonite holeplug to surface.

The piezometer in Borehole PRB-01 was decommissioned on June 3, 2011 in general accordance with O. Reg. 903.

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 gradation analysis and Atterberg Limits testing, where appropriate. The results of these tests are summarized on the Record of Borehole sheets included in Appendix A and are presented 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 compressive strength of the bedrock. Results of point load tests on the rock core samples are shown in Table 1 included in Appendix B and on the Record of Borehole sheets in Appendix A.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets included in Appendix A. Details of the encountered soil and rock stratigraphy are presented in these sheets and on the "Borehole Locations and Soil Strata" drawing included in Appendix D. 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 terms, the site was found to be underlain by sand, gravel and clay fill over a native silty clay deposit overlying bedrock. At the west abutment, a layer of sand was encountered between the silty clay deposit and the bedrock. More detailed descriptions of the individual strata are presented below.

5.1 Topsoil

A 40-mm thick layer of topsoil was encountered surficially at the location of Borehole PRB-01 drilled at the east abutment.

5.2 Sand and Gravel Fill

Granular fill was encountered below the topsoil in Borehole PRB-01 and at surface in Borehole PRB-02. In Borehole PRB-01 the granular fill consists of dark brown sand with trace gravel and roots and rootlets. In Borehole PRB-02 the granular fill consists of sand and gravel. The thickness of the cohesionless fill was 800 mm and 50 mm in Boreholes PRB-01 and PRB-02, respectively.

A SPT N-value of 5 blows for 0.3 m penetration was recorded in the sand fill in Borehole PRB-01, indicating a loose relative density.

The moisture content of a sample of the sand fill was measured to be 12%.

5.3 Silty Clay Fill

Brown silty clay fill was encountered below the granular fill in both boreholes. The silty clay fill contains trace to some sand and trace gravel. Roots, rootlets, wood pieces and peat were observed near the top of the silty clay fill layer. The thickness of the silty clay fill layer was 3.2 m and 3.1 m in Boreholes PRB-01 and PRB02, respectively.

The depths to the base of the silty clay fill layer were 4.0 m and 3.1 m (Elevations 96.6 and 95.7) in Boreholes PRB-01 and PRB02, respectively.

SPT N-values recorded in the silty clay fill ranged from 4 to 8 blows for 0.3 m of penetration, indicating a soft to firm condition.

The moisture content of samples from the silty clay fill generally varies between 17% and 52%. Higher moisture content values tend to correspond to greater amounts of organics in the fill.

Selected samples of the silty clay fill underwent gradation analysis testing and Atterberg Limits 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 are included in Figure B1 of Appendix B.

Soil Particles	Percentage (%)
Gravel	0
Sand	4 to 6
Silt	27 to 58
Clay	38 to 67

Index Property	Percentage (%)
Liquid Limit	40 to 50
Plastic Limit	20 to 22

The results of the Atterberg Limits testing indicate that the silty clay fill is of medium plasticity with a group symbol of CI. These results are illustrated in Figure B3 of Appendix B.

5.4 Silty Clay

Native silty clay was encountered below the silty clay fill in both boreholes. The native silty clay is generally grey in colour.

The thickness of the silty clay varied from 8.1 m at the east abutment to 13.7 m at the west abutment. The depths to the base of the silty clay ranged from 12.1 m to 16.8 m (Elevations 88.5 and 82.0).

SPT N-values recorded in the silty clay ranged from 0 to 3 blows for 0.3 m of penetration, indicating a very soft to soft deposit. Typically, N-values in the native silty clay were 0 blows for 0.3 m penetration. In-situ Shear Vane Tests were also performed where low N-values were recorded. The shear strength of the silty clay ranges from 21 to 38 kPa indicating the clay to by soft to firm.

The moisture content of samples collected from the silty clay layer generally varies between 43% and 72%.

Selected samples of the silty clay underwent gradation analysis testing and Atterberg Limits testing, the results of which are summarized below. These results are also presented on the Record of Borehole sheets in Appendix A and the grain size distribution curves for these samples are included in Appendix B, Figure B2.

Soil Particles	Percentage (%)
Gravel	0
Sand	0
Silt	23 to 48
Clay	52 to 77

Index Property	Percentage (%)
Liquid Limit	41 to 50
Plastic Limit	20 to 22

The results of the Atterberg Limits testing indicate that the silty clay is of medium plasticity with a group symbol of CI. These results are also illustrated in Figure B4 or Appendix B.

5.5 Sand

A layer of brown sand containing trace of gravel was encountered below the silty clay at 16.8 m depth (elevation 82.0) at the west abutment in Borehole PRB-02. The sand layer is 0.9 m thick.

The depth to the base of the sand layer was 17.7 m (Elevation 81.1).

A SPT N-value of 6 blows for 0.3 m penetration was recorded in the sand layer, indicating a loose relative density.

The moisture content of a sample of the sand was 17%.

5.6 Bedrock

The overburden soils described above are underlain by bluish-grey and white, fresh granite bedrock. Occasional quartz interbeds, occasional mechanical breaks and sub-vertical fractures were noted throughout the bedrock cores.

Bedrock was proved by coring at each borehole. Table 5.1 summarizes depths and elevations to the top of bedrock in the boreholes.

Table 5.1 – Depths and Elevations of Top of Bedrock

Location	Borehole	Top of Bedrock	
		Depth (m)	Elevation (m)
East abutment	PRB-01	12.1	88.5
West abutment	PRB-02	17.7	81.1

Core recovery in the bedrock was 100% in all cores. The RQD values ranged from 94% 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 5.

The estimated unconfined compressive strength of the rock cores ranged from 30 MPa to 163 MPa, indicating a medium strong to very 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 Appendix B.

5.7 Water Levels

Water levels were observed in the open boreholes upon completion of drilling operations. A standpipe piezometer was installed in Borehole PRB-01 to monitor water levels after completion of drilling. Artesian conditions were observed in the standpipe piezometer in the days following installation. Artesian conditions were encountered upon reaching the sand layer at 16.8 m depth during drilling operations of Borehole PRB-02. Borehole PRB-02 was sealed off /backfilled with bentonite in general accordance with O.Reg. 903 to control artesian conditions.

The water levels measured in the open boreholes and piezometer are summarized in Table 5.2.

Table 5.2 – Water Level Measurements

Borehole	Date	Water Level (m)		Comment
		Depth	Elevation	
PRB-01	May 31, 2011	1.8	98.8	Open borehole
	June 2, 2011 (am)	0.2*	100.8	Piezometer
	June 3, 2011(am)	0.9*	101.5	Piezometer
	June 3, 2011(pm)	1.0*	101.6	Piezometer
	June 4, 2011 (am)	1.1*	101.7	Piezometer
PRB-02	May 31, 2011	Artesian Flow		Open borehole

* Indicates water level above ground surface, artesian conditions.

The piezometric readings reveal that the groundwater level is 0.2 to 1.1 m above ground surface (elevations 100.8 to 101.7), indicating artesian conditions at this site.

The above values are short-term readings and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after the spring snowmelt or after periods of heavy rainfall.

The Pelican River ice/water level was measured at Elevation 97.2 m on March 9, 2011. GA indicate that the NHWL in the Pelican River at Elevation 97.15.

6 MISCELLANEOUS

Borehole locations were selected and established in the field by Thurber Engineering Ltd. Surveyors retained by Genivar provided plan drawings to obtain the co-ordinates and the ground surface elevations for the boreholes.

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

TBT Engineering of Thunder Bay, Ontario supplied a reduced-weight rubber-tire drill rig and conducted the drilling, sampling and in-situ testing operations.

The field program was supervised on a full time basis by Ms. Eckie Siu of Thurber.

Routine laboratory testing was carried out by Thurber Engineering Ltd.

Overall supervision of the field program was conducted by Ms. Lindsey Blaine, E.I.T. Interpretation of the data and preparation of this report were 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.
Geotechnical Engineer

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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

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

$\blacktriangledown$ Water Level

C_{psm} 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

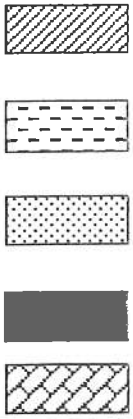
MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels,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

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RECORD OF BOREHOLE No PRB-01 1 OF 2 METRIC

W.P. 473-00-00 LOCATION N 8 152.6 E 540.4 Pelican River Bridge ORIGINATED BY ES

HWY HAUKENESS RD. BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN

DATUM Established on site DATE 2011.05.30 - 2011.05.30 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/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
100.6											
0.0	**TOPSOIL:** (40mm)										
	SAND, trace gravel, roots and rootlets Loose Dark Brown Damp		1	SS	5				○		
99.8	(FILL)										
0.8	Silty **CLAY**, trace to some sand, trace gravel, roots and rootlets Firm Brown (FILL)		2	SS	7				○		
			3	SS	8				○		
	Mottled Brown and Grey		4	SS	6				○		0 6 27 67
			5	SS	5				○		
96.6											
4.0	Silty **CLAY**, occasional peat Soft to Very Soft Grey		6	SS	3				○		
			1	TW				+ 8	○		
			7	SS	0				○		
			8	SS	0				○		0 0 47 53

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

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

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THURBER

RECORD OF BOREHOLE No PRB-01 2 OF 2 METRIC

W.P. 473-00-00 LOCATION N 8 152.6 E 540.4 Pelican River Bridge ORIGINATED BY ES

HWY HAUKENESS RD. BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN

DATUM Established on site DATE 2011.05.30 - 2011.05.30 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										
	Silty **CLAY** Very Soft Grey						90	+ 14			
			9	SS	0				○		
	Trace sand						89				
88.5	Cobbles at 11.6m										
12.1	**BEDROCK**, granite pegmatite, fresh, quartz interbeds, bluish-grey and white		1	RUN			88			FI 1 0 0	RUN #1 TCR=100% SCR=100% RQD=100%
	Some mechanical breaks		2	RUN			87			1 0 0 0	RUN #2 TCR=100% SCR=100% RQD=100%
			3	RUN			86			0 0 0	RUN #3 TCR=100% SCR=100% RQD=100%
85.4	100mm highly broken zone at 14.9m		4	RUN						2	RUN #4 TCR=100% SCR=100% RQD=100%
15.2	END OF BOREHOLE AT 15.2m. BOREHOLE CAVED TO 9.7m UPON COMPLETION. WATER LEVEL AT 1.8m UPON COMPLETION OF BOREHOLE. Piezometer installation consists of 19mm diameter Schedule 40 PVC pipe with a 1.52m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Jun02/11 0.2* 100.8 Jun03/11 0.9* 101.5 Jun04/11 1.1* 101.7 * Artesian conditions, water level above ground surface Piezometer decommissioned June04/11										

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

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

ONTMT4S 0839.GPJ 6/27/12

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No PRB-02 1 OF 3 METRIC

W.P. 473-00-00 LOCATION N 8 143.2 E 471.4 Pelican River Bridge ORIGINATED BY ES

HWY HAUKENESS RD. BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN

DATUM Established on site DATE 2011.05.31 - 2011.05.31 CHECKED BY LRB

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	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/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
98.8											
0.0	**SAND** and **GRAVEL**: (FILL)(50mm)										
	Silty **CLAY**, trace to some sand, trace gravel, occasional wood fibres Soft to Stiff Brown (FILL)		1	SS	4				○		
			2	SS	5		98		○		
			3	SS	8		97		○		0 4 58 38
	Occasional wood fibres and peat		4	SS	4		96		○		
95.7											
3.1	Silty **CLAY** Very Soft Grey		5	SS	0		95	+13	○		
			1	TW			94		○		
			6	SS	0		93		○		0 0 23 77
							92	+24			
			7	SS	0		91		○		
			8	SS	0		90		○		
							89				

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

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

ONTMT4S 0839.GPJ 6/27/12

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No PRB-02 2 OF 3 METRIC

W.P. 473-00-00 LOCATION N 8 143.2 E 471.4 Pelican River Bridge ORIGINATED BY ES

HWY HAUKENESS RD. BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN

DATUM Established on site DATE 2011.05.31 - 2011.05.31 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										
	Silty **CLAY** Very Soft Grey										
			9	SS	0						
			2	TW							
			10	SS	0						0 0 48 52
			11	SS	0						
82.0											
16.8	**SAND**, trace gravel Loose Grey Wet		12	SS	6						
81.1											
17.7	**BEDROCK**, granite pegmatite, fresh, quartz interbeds, bluish-grey and white		1	RUN						FI >5 3 2	RUN #1 TCR=100% SCR=94% RQD=94%
	Sub-vertical fractures (between 25mm to 100mm) at 17.8m, 19.6m, 19.9m 125mm at 18.0m Vertical fracture at 19.0m		2	RUN						0 3 1 1	RUN #2 TCR=100% SCR=100% RQD=98%

Continued Next Page

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

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

ONTMT4S 0839.GPJ 6/27/12

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No PRB-02 3 OF 3 METRIC

W.P. 473-00-00 LOCATION N 8 143.2 E 471.4 Pelican River Bridge ORIGINATED BY ES

HWY HAUKENESS RD. BOREHOLE TYPE Hollow Stem Augers/NQ Coring COMPILED BY AN

DATUM Established on site DATE 2011.05.31 - 2011.05.31 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										
77.5 / 21.3	**BEDROCK**, granite pegmatite, fresh, bluish-grey and white Sub-vertical fractures (between 25mm to 100mm) at 20.8m, 21.1m 150mm at 20.1m 150mm at 20.6m Black mica interbed at 20.8m		3	RUN			78			2 5 3 2 2	RUN #3 TCR=100% SCR=100% RQD=96%
21.3	END OF BOREHOLE AT 21.3m. ARTESIAN CONDITIONS OBSERVED WITHIN THE SAND LAYER. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO SURFACE.										

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

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

ONTMT4S 0839.GPJ 6/27/12

Appendix B

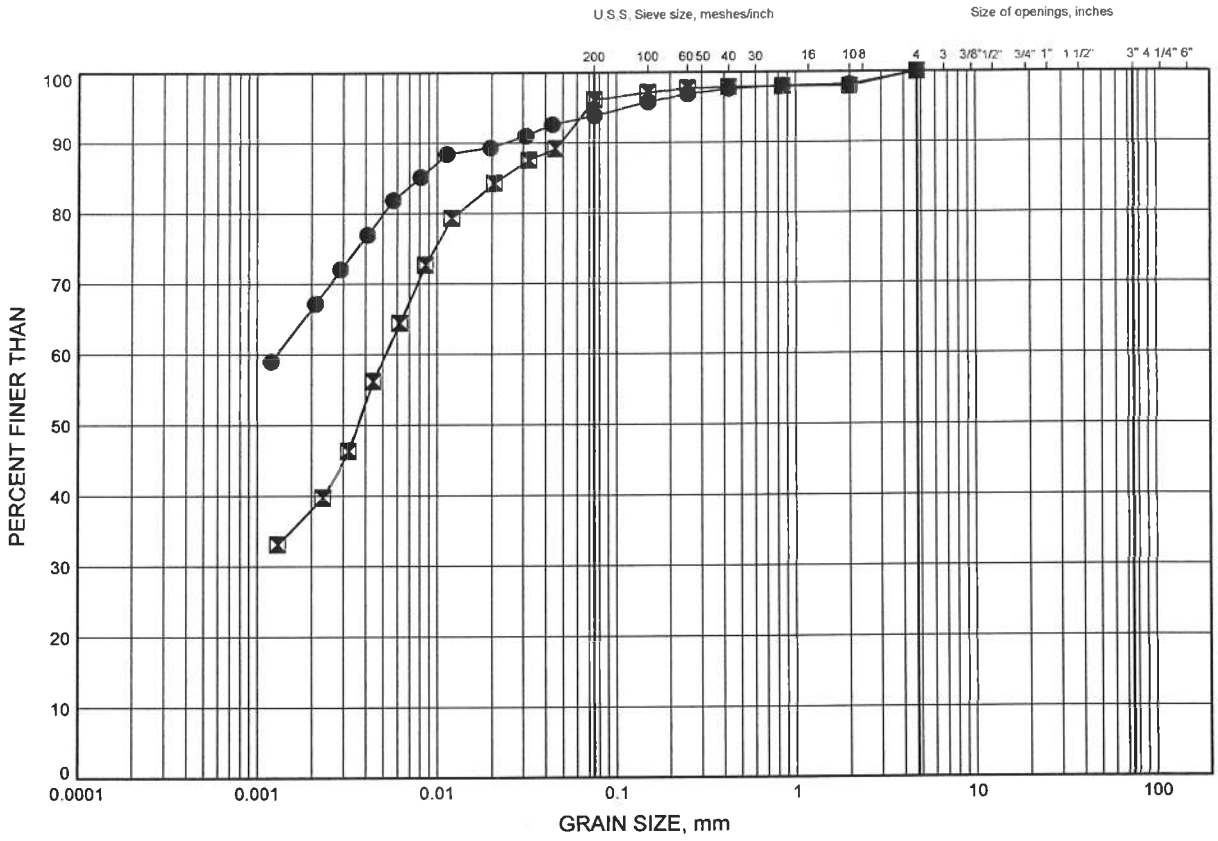
Laboratory Test Results

Pelican River Bridge

GRAIN SIZE DISTRIBUTION

FIGURE B1

SILTY CLAY FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	PRB-01	2.51	98.09
⊠	PRB-02	1.75	97.05

W.P.# 473-00-00
Prepared By AN
Checked By RPR

THURBER

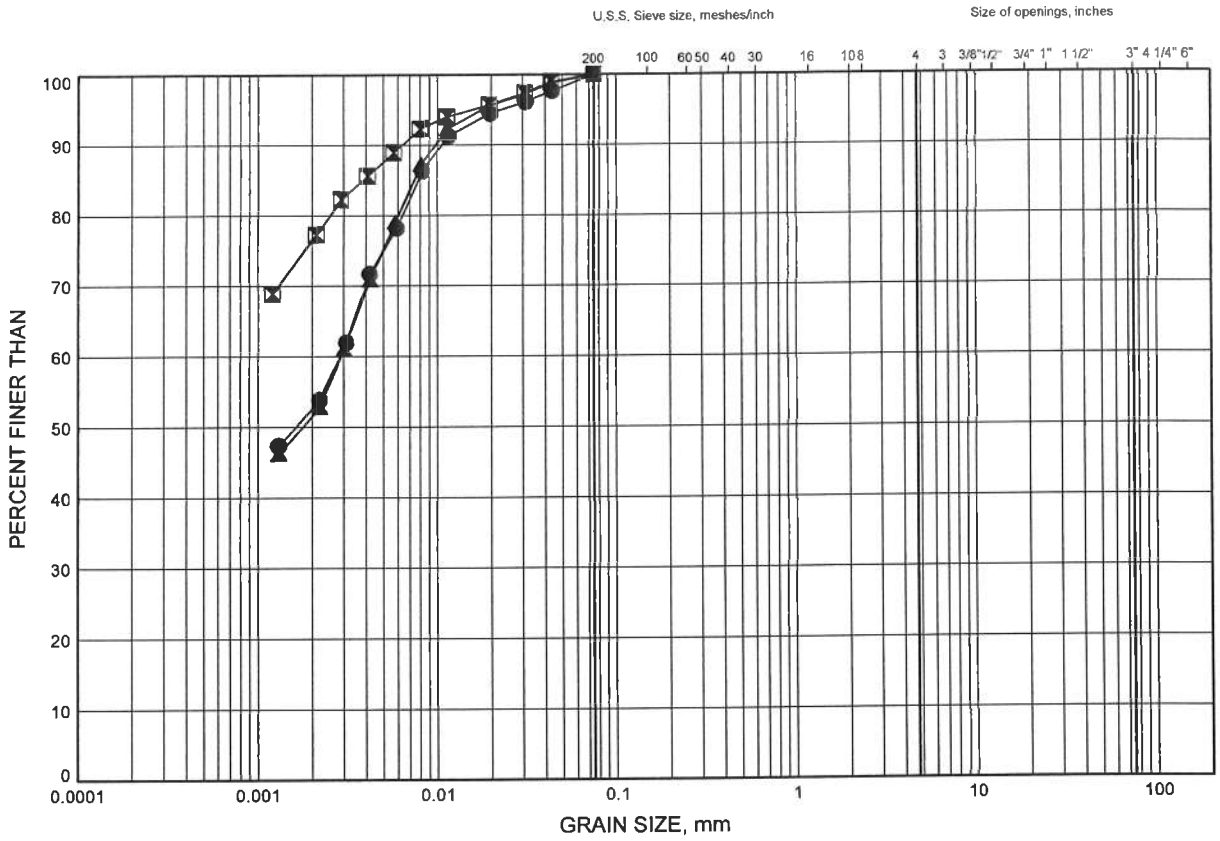
GRAIN SIZE DISTRIBUTION - THURBER 0839.GPJ 6/27/12

Pelican River 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)
●	PRB-01	9.37	91.23
⊠	PRB-02	6.32	92.48
▲	PRB-02	13.94	84.86

W.P.# 473-00-00
Prepared By AN
Checked By RPR

THURBER

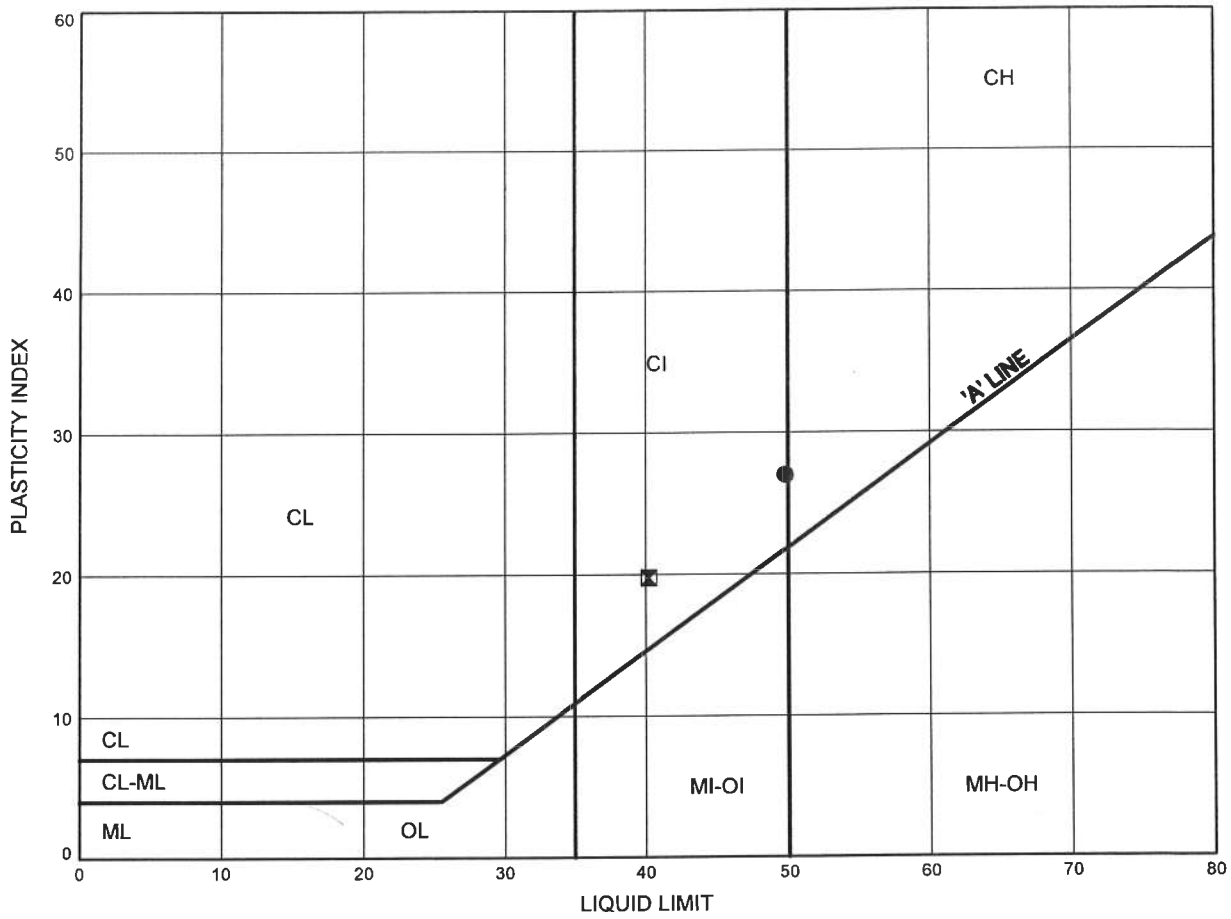
GRAIN SIZE DISTRIBUTION - THURBER 0839.GPJ 6/27/12

Pelican River Bridge

ATTERBERG LIMITS TEST RESULTS

FIGURE B3

SILTY CLAY FILL



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	PRB-01	2.51	98.09
⊠	PRB-02	1.75	97.05

Date June 2012

Project 473-00-00

THURBER

Prep'd AN

Chkd. RPR

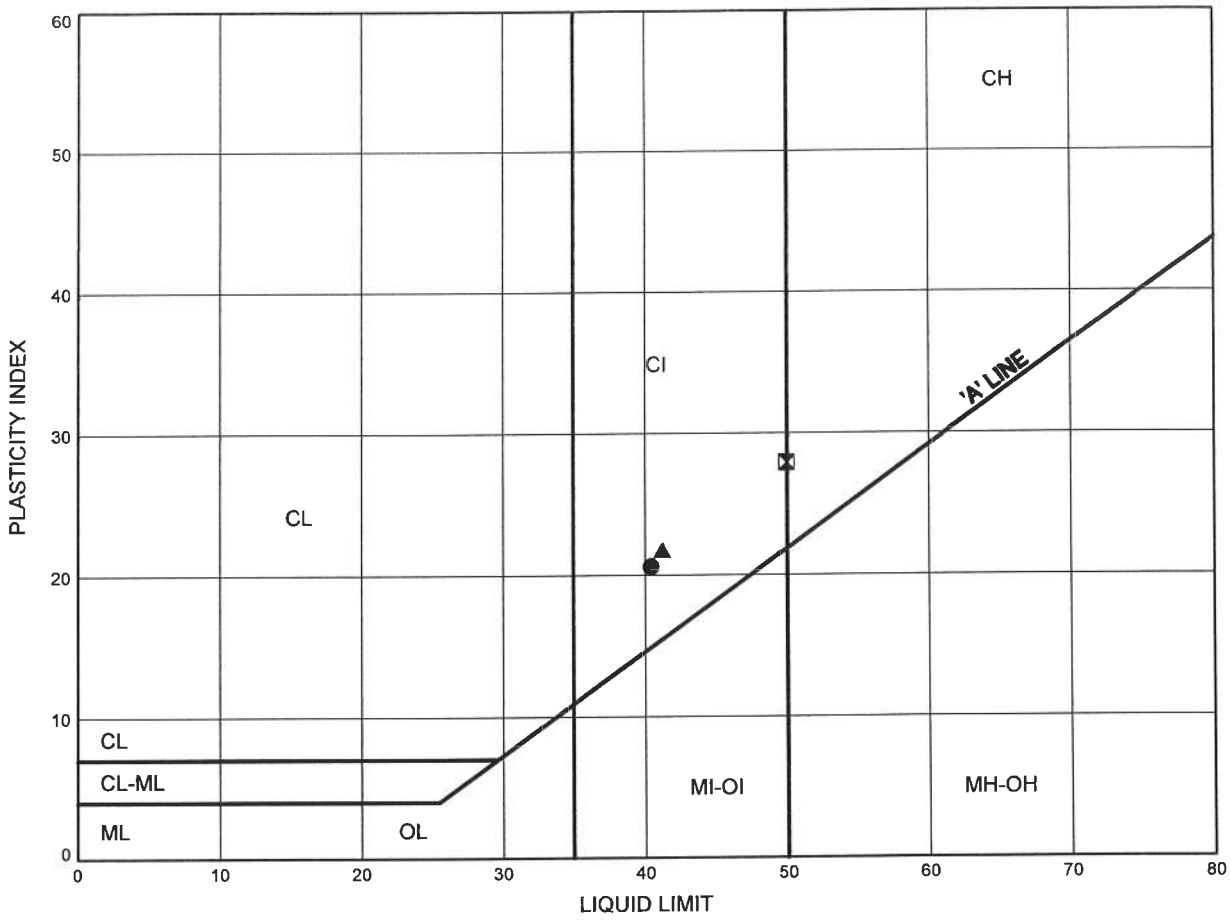
THURBALT 0839.GPJ 6/27/12

Pelican River Bridge

ATTERBERG LIMITS TEST RESULTS

FIGURE B4

SILTY CLAY



SYMBOL	BH	DEPTH (m)	ELEV. (m)
●	PRB-01	9.37	91.23
⊠	PRB-02	6.32	92.48
▲	PRB-02	13.94	84.86

Date June 2012

Project 473-00-00

THURBER

Prep'd AN

Chkd. RPR

THURBALT 0839.GPJ 6/27/12

TABLE 1 - Point Load Test Results

PELICAN RIVER BRIDGE REPLACEMENT

HAUKENESS ROAD, WEST OF HIGHWAY 607

TOWNSHIP OF RUGBY, ONTARIO

Site 41S-38

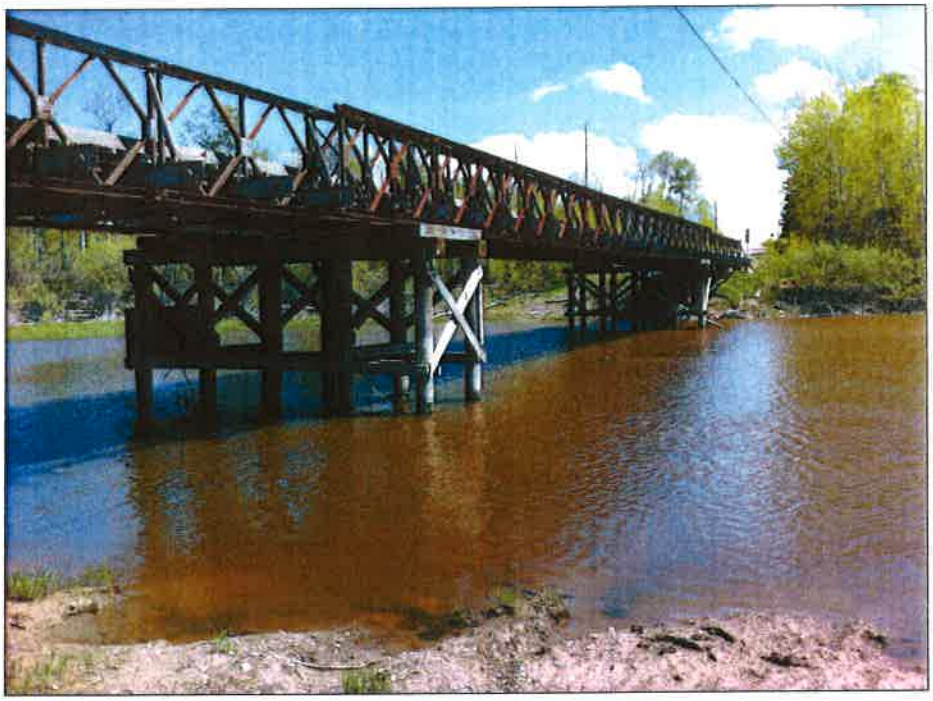
19-5308-39

PRB-01	DEPTH			FORCE	AXIAL /	DIAMETER	LENGTH	UCS (Mpa)	CONCLUSIONS			
	FT.	IN.	METERS	(kN)	DIAMETRIC	(mm)	(mm)					
RUN #1	39	6	12.04	14.7	D	47.74	82.44	151.20				
	40	7	12.37	6.4	D	48.18	115.00	65.07				
	41	7	12.67	11.8	D	47.17	71.59	124.41				
RUN #2	42	0	12.80	6.9	D	47.78	88.36	71.48				
	43	3	13.18	3.0	D	48.18	74.48	30.91				
	44	7.5	13.60	16.0	D	48.65	62.89	159.86				
	45	10	13.97	6.7	D	48.84	67.35	66.70				
RUN #3	47	0	14.33	9.5	D	48.94	88.61	94.48		AVERAGE	MAX	MIN
	47	10	14.58	13.4	D	48.60	59.61	134.03	RUN #1:	114	151	65
	48	6	14.78	14.7	D	48.35	74.92	148.25	RUN #2:	82	160	31
									RUN #3:	126	148	94
RUN #4	49	5	15.06	11.0	D	47.42	68.23	114.64	RUN #4:	115	115	115

PRB-02	DEPTH			FORCE	AXIAL /	DIAMETER	LENGTH	UCS (Mpa)	CONCLUSIONS			
	FT.	IN.	METERS	(kN)	DIAMETRIC	(mm)	(mm)					
RUN #1	58	3	17.75	10.3	D	47.71	106.41	106.33				
	60	2	18.34	8.7	D	47.57	66.24	89.81				
RUN #2	61	4	18.69	4.8	D	47.45	79.16	50.39				
	62	8	19.10	10.8	D	47.32	69.20	113.13				
	63	10	19.46	13.2	D	47.11	87.85	138.70				
	65	6	19.96	15.5	D	47.27	65.33	162.54				
										AVERAGE	MAX	MIN
RUN #3	66	8	20.32	12.2	D	47.33	92.39	127.31	RUN #1:	98	106	90
	68	6	20.88	14.6	D	47.34	66.66	152.97	RUN #2:	116	163	50
	69	3	21.11	13.4	D	47.73	80.03	138.25	RUN #3:	140	153	127

Appendix C

Site Photographs



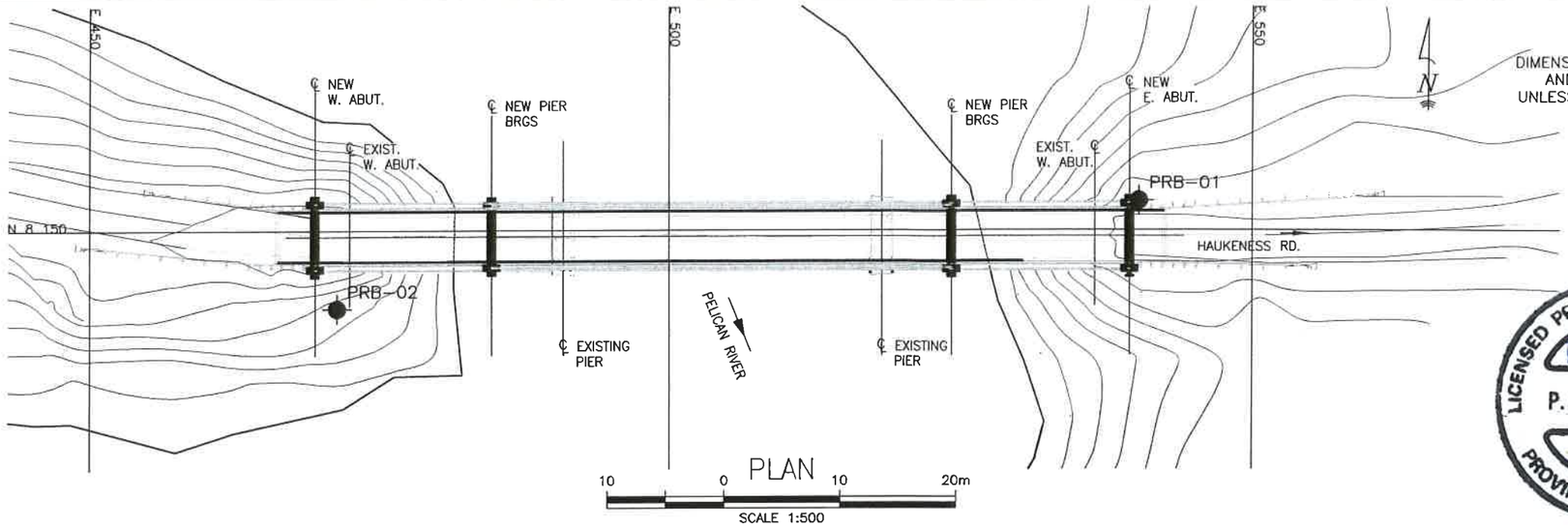
Photograph 1 – Pelican River Bridge, looking northeast

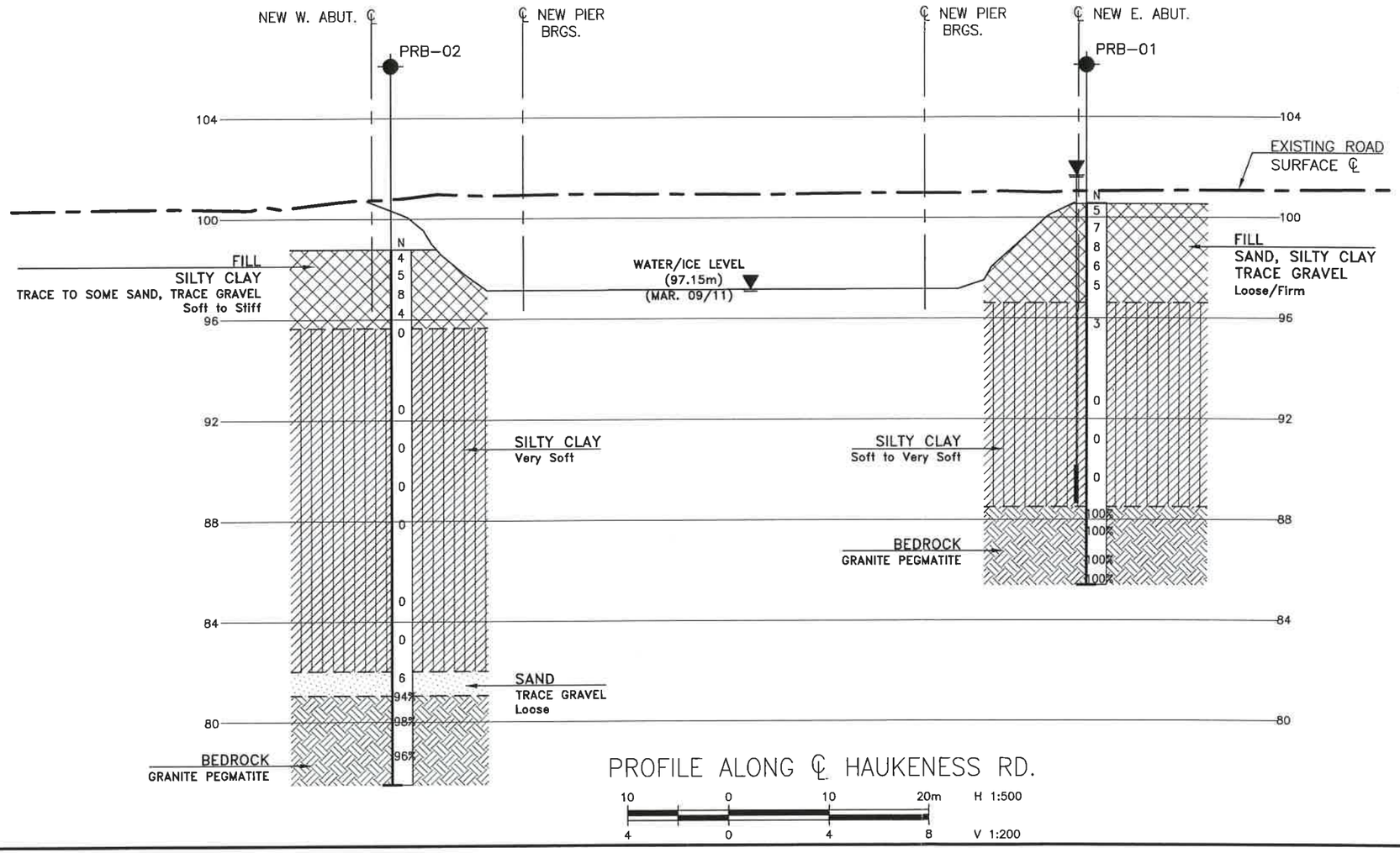
Photograph 2 – Pelican River Bridge, looking east

Appendix D

Borehole Locations and Soil Strata Drawings

MINISTRY OF TRANSPORTATION, ONTARIO





METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
July 3/2012
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
R. Palomeque Reyna
100083209
July 3 2012
PROVINCE OF ONTARIO

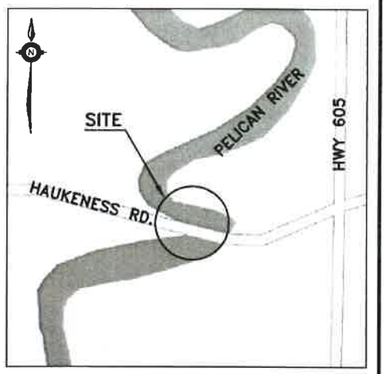
CONT No
WP No 473–00–00

SHEET

PELICAN RIVER BRIDGE REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA

GENIVAR

THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

●	Borehole
⊕	Dynamic Cone Penetration Test
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
PRB–01	98.8	8 152.6	540.4
PRB–02	100.6	8 143.2	471.4

-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) Northing and Easting coordinates obtained from GA drawing provided by MRC.

GEOCRES No. 52F-36

REVISIONS			
DATE	BY	DESCRIPTION	
DESIGN LRB	CHK LRB	CODE	LOAD
DRAWN AN	CHK	SITE	STRUCT
		DATE JUN. 2012	DWG 1

FILENAME: H:\Drafting\19\5306\39\ad0939–BoreholePlan&Profile(PelicanRiver).dwg
PLOTDATE: 6/28/2012 9:52 AM