



THURBER ENGINEERING LTD.

**FOUNDATION INVESTIGATION REPORT
SITE 38S-154 – McLEOD ROAD BRIDGE REPLACEMENT
SAULT STE. MARIE DISTRICT, ALGOMA COUNTY
G.W.P. 5148-13-00
ASSIGNMENT NUMBER: 5014-E-0032**

GEOCRES NUMBER: 41J-103

**SUBMITTED TO
McINTOSH PERRY CONSULTING ENGINEERS**

Latitude: 46.438676
Longitude: -83.82055

**April 2019
Thurber File: 10870**



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**FOUNDATION INVESTIGATION AND DESIGN REPORT
SITE 38S-154 – MCLEOD ROAD BRIDGE REPLACEMENT
SAULT STE. MARIE DISTRICT, ALGOMA COUNTY
G.W.P. 5148-13-00
ASSIGNMENT NUMBER: 5014-E-0032**

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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual data obtained from a foundation investigation conducted by Thurber Engineering Ltd. (Thurber) for the replacement of the McLeod Road Bridge crossing of the Thessalon River located within the Sault Ste. Marie district. Thurber carried out the investigation as a subconsultant to McIntosh Perry Consulting Engineers (MPCE) as part of Agreement No. 5014-E-0032.

No previous foundation investigation information for the subject site was available. Base plan mapping and survey data was provided by MPCE for the preparation of this report.

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

2 SITE DESCRIPTION

Site 38S-154 is located on McLeod Road, 350 m west of the McLeod Road Junction with Centre Line Road near Leeburn, Ontario. The location of the structure is shown on the inset Key Plan on the Borehole Locations and Soil Strata Drawing No. 1 in Appendix A.

The existing four-span, Bailey Bridge structure carries a single lane of traffic over the Thessalon River. The bridge is approximately 37 m long, 4.0 m wide with approximate span lengths of 7.9 m, 10.3 m, 10.3 m, and 7.9 m. It is noted that for project orientation purposes, McLeod Road, will be assumed to run north-south and the Thessalon River flow is from west to east.

McLeod Road at this location has one lane in each direction with a rural cross-section and gravel surface. The lands surrounding the project limits are typically agricultural and forest with some residential properties. Storm water drainage in the area is to existing ditches. Select site photographs are presented in Appendix D.

3 SITE INVESTIGATION

3.1 Field Investigation

The field investigation plan was finalized after discussion with the MTO Foundations Section. Approximate locations of boreholes are shown on the Drawing No. 1 provided in Appendix A. The field investigation for this site was completed in two stages. The initial field investigation included advancing four boreholes drilled between February 8, 2016 and February 14, 2016 along the existing alignment.

Subsequent to the initial field investigation and after further discussions with the MTO Foundations Section a new alignment was proposed for the replacement bridge. The new alignment is to be located approximately 6.5 m east of the existing center line at the south abutment and 9.2 m at the north abutment. A supplementary investigation was carried out along the new alignment that included advancing three boreholes drilled between July 18 and 21, 2016. The locations and elevations of both the initial and supplementary boreholes are shown Drawing No. 1 and are summarized in Table 3-1.

Table 3-1: Borehole Summary

Borehole	Location	Northing (m)	Easting (m)	Ground Surface Elevation (m)	Depth (m)
301	Existing South approach	5144320.6	318552.0	198.7	6.7
302	Existing South abutment	5144323.9	318557.0	198.4	31.1
303	Existing North abutment	5144346.5	318590.8	198.2	31.1
304	Existing North approach	5144349.7	318595.7	198.2	6.7
305	Proposed North abutment	5144342.2	318593.9	197.8	46.3
306	Proposed North abutment	5144336.9	318598.6	197.1	10.5
307	Proposed South abutment	5144318.9	318556.3	197.1	46.3

As a component of our standard procedures and due diligence, Thurber contacted Ontario One Call to provide utility locate clearances for the intended borehole locations.

The boreholes were advanced with either a CME truck or track mounted drill rig equipped with hollow stem augers and NW casing. Marathon Drilling of Greely, Ontario supplied and operated the drilling equipment to carry out the drilling, sampling, and in-situ testing. The subsurface stratigraphy encountered in the boreholes was recorded in the field by Thurber personnel. Split spoon samples were collected at regular depth intervals in the boreholes via the completion of Standard Penetration Tests (SPT), following the methods described in ASTM Standard D1586-11. In-situ shear vane testing was carried out within the cohesive strata. Thin-walled tube samples of soft to firm cohesive deposits were collected at selected locations. All soil samples recovered from the boreholes were placed in moisture-proof containers and the samples were transported to Thurber's Ottawa geotechnical laboratory for further examination and testing.

PVC piezometers with an inside diameter of 25 mm were installed in both Boreholes 303 and 306 to allow for the measurement of the groundwater level at the site. Piezometer construction details are illustrated on the Record of Borehole sheets for Boreholes 303 and 306, provided in Appendix B. The piezometers were decommissioned on July 22, 2016.

The boreholes without piezometer installations were backfilled with a low-permeability combination of auger cuttings, sand and bentonite pellets in general accordance with the intent of Ontario MOE Regulation 903. Boreholes advanced within road areas were capped with granular material.

The as-drilled locations of the boreholes and ground surface elevations at the borehole locations were surveyed by Thurber on February 16, 2016 and July 21, 2016. The vertical datum used was a temporary benchmark (TBM) provided by MPCE, located south of the existing bridge located at Station 1+965.5, 7.0 m right of the road edge. The TBM was a steel spike in the west root of a 350 mm diameter ash tree. The TBM has a geodetic elevation of 200.183 m. The location of the TBM is indicated on Drawing No. 1 in Appendix A.

3.2 Laboratory Testing

Geotechnical laboratory testing consisted of natural moisture content determination and visual identification of all soil samples in accordance with the current MTO standards. Grain size distribution analyses, Atterberg Limits testing and consolidation testing were also carried out on selected samples to MTO and ASTM standards. Also, samples of the native soils were submitted to Paracel Laboratories in Ottawa, Ontario for analysis of pH, water soluble sulphate and chloride concentrations, resistivity and conductivity.

The laboratory test results are presented on the Record of Borehole sheets in Appendix B and are illustrated on the figures in Appendix C.

4 DESCRIPTION OF SUBSURFACE CONDITIONS

4.1 Overview / General

Reference is made to the Record of Borehole sheets in Appendix B for details of the soil stratigraphy encountered in the boreholes. A stratigraphic profile for the site is presented on Drawing No. 1 provided in Appendix A for illustrative purposes. An overall description of the stratigraphy is given in the following paragraphs; however, the factual data presented in the Record of Boreholes governs any interpretation of the site conditions.

In general, the stratigraphy along the proposed alignment is characterized by fill overlying a clay layer, overlying a sandy silt to silty sand deposit. A silty sand or clay with frequent wood pieces layer with a thickness ranging from ranging from 1.6 m to 3.1 m was encountered above the clay strata in the boreholes advanced along the north side of the Thessalon River.

More detailed descriptions of the individual strata are presented below.

4.2 Fill

Sand with Gravel Fill

A fill layer consisting predominantly of sand and gravel with varying amounts of silt was encountered at surface in all boreholes except Borehole 306.

The top of this layer ranges from Elevation 197.1 m to Elevation 198.7 m and has a thickness ranging from 0.3 m to 2.4 m. The SPT 'N' values in Boreholes 303 and 305 ranged from 11 to 18 blows per 0.3 m of penetration; indicating a compact condition.

The moisture content of the samples tested ranged from 5% to 18%. The results of a grain size analysis test completed on a sample of this material indicated a gravel content of 15%, sand content of 56%, and a fines content (combined silt and clay size particles) of 29%. Grain size analysis results are illustrated on Figure 1 in Appendix C.

Clay Fill

A clay fill layer with trace amounts of sand and organics was encountered at the surface in Borehole 306. The top of this layer was at Elevation 197.1 m and has a thickness of 2.3 m. The SPT 'N' values ranged from 4 to 8 blows per 0.3 m of penetration indicating a firm consistency. The moisture content of the samples tested ranged from 22% to 36%.

Boulders and Cobbles Fill

A fill layer consisting predominantly of boulders and cobbles was encountered below the granular fill in Borehole 307. The top of this layer was at Elevation 196.8 m and the observed thickness was 2.1 m.

4.3 Clay with layers of Silty Sand and Silt with Frequent Wood Pieces

On the north side of the river, the boreholes (Boreholes 303, 304, 305 and 306) indicate the presence of highly variable soil between the fill and deep clay deposit that included clay (CL), clay with wood pieces, silt (ML) and silty sand (SM) with wood pieces. These layers are discontinuous between borehole locations. The base of this variable deposit ranges from elevation 191.7 m to 192.1 m. The thickness of this variable deposit ranged from 3.0 m to 4.7 m.

The SPT 'N' values ranged from WH (Weight of Hammer) to 7; indicating a very loose to loose or very soft to soft condition.

The moisture content of the samples tested ranged from 20% to 69%. The results of grain size analysis conducted on samples of this material are summarized in Table 4-1 and are illustrated on Figures 9 and 10 in Appendix C.

Table 4-1: Gradation Results

Soil Particles	%
Gravel	0 to 4
Sand	28 to 81
Silt and Clay	18 to 72

The results of Atterberg Limits testing completed on samples of this material are summarized in Table 4-2 and are illustrated on Figure 11 in Appendix C.

Table 4-2: Atterberg Limits Test Results

Liquid Limit	30 to 46
Plastic Limit	12 to 25
Plasticity Index	18 to 24

Organic content testing was completed on eight samples of this material with results ranging from 3.9% to 14.1% organic content.

4.4 Clay Crust (CH)

A brown native clay crust deposit was encountered beneath the granular fill materials in Boreholes 301 and 302.

The top of this layer ranges from elevation 196.9 m to 198.1 m and has a thickness ranging from 1.5 m to 2.1 m. The SPT 'N' values ranged from 3 to 10 blows per 0.3 m of penetration indicating a soft to stiff consistency.

The moisture content of the samples tested ranged from 30% to 68%. The results of grain size analysis conducted on samples of this material are summarized in Table 4-3 and are illustrated on Figure 2 in Appendix C.

Table 4-3: Gradation Results for Clay Crust

Soil Particles	%
Gravel	0
Sand	0
Silt	45 and 31
Clay	55 and 69

The results of Atterberg Limits testing completed on samples of this material are summarized in Table 4-4 and are illustrated on Figure 3 in Appendix C.

Table 4-4: Atterberg Limits Test Results for Clay Crust

Liquid Limit	51 and 64
Plastic Limit	21
Plasticity Index	30 and 43

4.5 Clay (CL to CI) to Silty Clay (CL-ML)

A grey clay deposit was encountered beneath the silty sand or clay with frequent wood pieces in the boreholes advanced on the north side of the Thessalon River (Boreholes 303, 304, 305, and 306), below the boulders and cobbles fill in Borehole 307 and below the clay crust material in Boreholes 301 and 302.

The top of this layer ranges from elevation 194.8 to 196.6 m on the south side of the Thessalon River and from 191.7 to 192.1 m on the north side of the Thessalon River. The thickness of the clay unit ranged from 10.7 m to 22.9 m where completely penetrated. Boreholes 301, 304 and 306 were terminated in this strata. In general, the upper portion of the deposit is described as clay (CL to CI) while the lower portion (below approximate elevation 182 m) generally has increased silt content and occasional silt and sandy silt seams and is described as clay (CL to CI) to silty clay (CL-ML).

In-situ shear vane test results indicated undrained shear strengths ranging from 15 kPa to 81 kPa; indicating a soft to stiff consistency. The moisture content of the samples tested ranged from 23% to 61%. The results of grain size analysis conducted on samples of this material are summarized in Table 4-5 and are illustrated on Figures 4 to 6 in Appendix C.

Table 4-5: Gradation Results for Clay to Silty Clay

Soil Particles	%
Gravel	0
Sand	0 to 2
Silt	35 to 81
Clay	18 to 64

The results of Atterberg Limits testing completed on samples of this material are summarized in Table 4-6 and are illustrated on Figures 7 to 8 in Appendix C.

Table 4-6: Atterberg Limits Test Results for Clay to Silty Clay

Liquid Limit	23 to 46
Plastic Limit	17 to 27
Plasticity Index	6 to 23

The results of oedometer (one-dimensional consolidation) tests carried out on undisturbed clay samples are summarized in Table 4-7. Copies of the oedometer test results are provided in Appendix C. The results of the tests indicate that the clay is slightly over-consolidated.

Table 4-7: Consolidation Test Results for Clay

Parameter	Sample		
Borehole	302	305	305
Sample	ST-2	ST-10	ST-14
Depth / Elevation (m) (mid-sample)	11.0 / 187.4	7.9 / 189.9	14.0 / 183.8
Moisture Content, (%)	46	51	45
Unit Weight, (γ) (kN/m ³)	17.1	17.0	17.3
Specific Gravity (G_s)	2.809	2.730	2.730
Initial Void Ratio (e_o)	1.342	1.371	1.252
Pre-consolidation Pressure, (kPa)	120	125	135
Compression Index (C_c)	0.581	0.869	0.576
Recompression Index (C_r)	0.051	0.057	0.040

4.6 Sandy Silt to Silty Sand

A sandy silt to silty sand layer was encountered beneath the clay strata in all deep boreholes. Boreholes 302, 303, 305 and 307 were terminated in this strata. The top of this layer ranges from elevation 181.4 m to 171.9 m. The SPT 'N' values ranged from 4 to 47; indicating a loose to dense condition; but typically compact.

The moisture content of the samples tested ranged from 20% to 39%. The results of grain size analysis conducted on samples of this material are summarized in Table 4-8 and are illustrated on Figures 12 and 14 in Appendix C.

Table 4-8: Gradation Results for Sandy Silt to Silty Sand

Soil Particles	%
Gravel	0 to 8
Sand	1 to 83
Silt	53 to 84
Clay	5 to 15

The results of Atterberg Limits testing completed on samples of this material indicated a non-plastic silt.

4.7 Groundwater Conditions

The groundwater level in the piezometer installed in Borehole 303 was recorded on February 19, 2016, at a depth of 5.5 m; corresponding to elevation 192.7 m.

The groundwater level in the piezometer installed in Borehole 306 was recorded on July 21, 2016, at a depth of 2.8 m; corresponding to elevation 194.6 m.

The water level in the Thessalon River was measured by Thurber on July 20, 2016, at elevation 194.4. The water level in the Thessalon River was indicated on the base plan at

elevation 194.0 m dated February 10, 2016. The high water mark was indicated at elevation 195.0 m.

These observations are considered 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.

5 MISCELLANEOUS

Thurber staked and/or marked the borehole locations in the field and obtained utility clearances prior to drilling. Thurber surveyed the borehole locations and determined the ground surface elevations based on contract drawings provided by McIntosh Perry Consulting Engineers Ltd. Marathon Drilling of Greely, Ontario supplied and operated the drilling equipment to carry out the drilling, sampling, and in-situ testing. The drilling, and sampling operations in the field were supervised on a full time basis by Mr. Nick Weil and Mr. Justin Gray of Thurber. Laboratory testing was carried out by Thurber in its MTO-approved laboratory in Ottawa.

Overall project management and direction of the field program was provided by Paul Carnaffan, P.Eng. Interpretation of the field data and preparation of this report was completed by Kenton Power, P.Eng. The report was reviewed by Paul Carnaffan, P.Eng. and Dr. P.K. Chatterji, P.Eng., the Designated Principal Contact for MTO Foundations Projects.



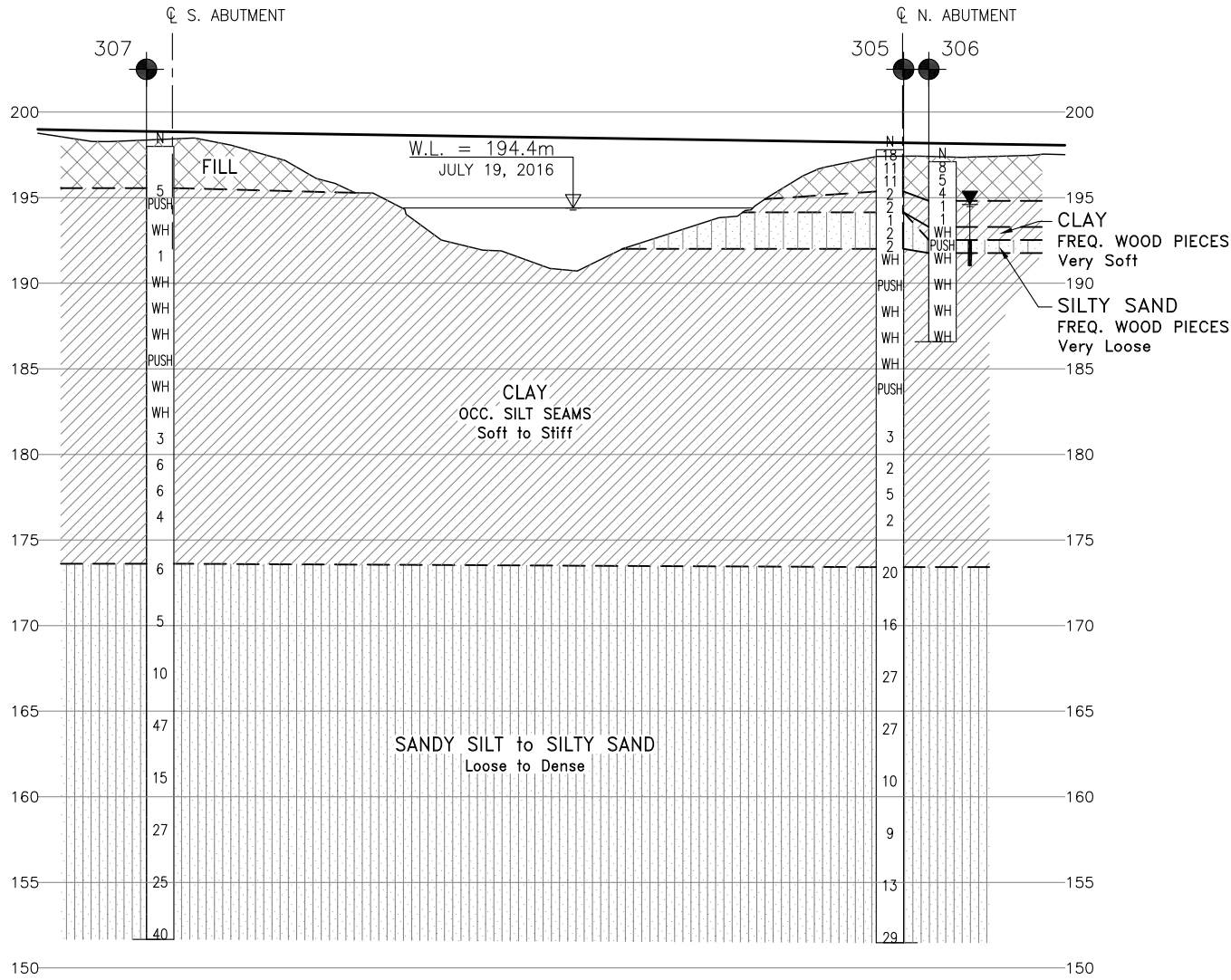
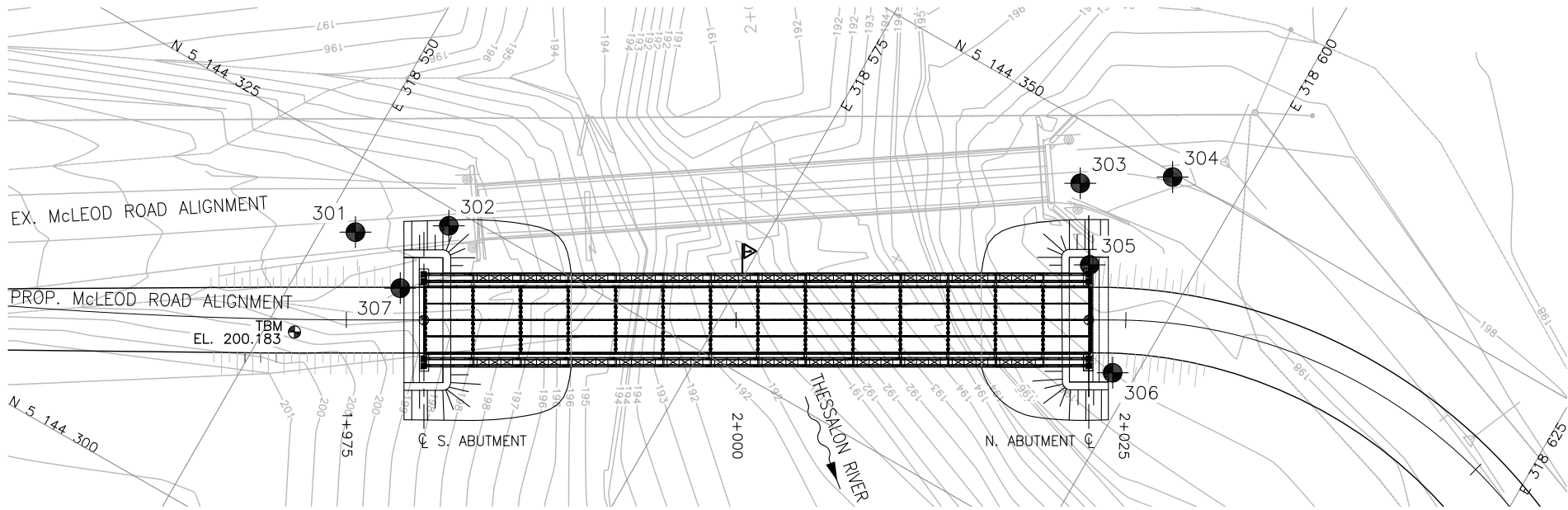
Paul Carnaffan, M.Eng., P.Eng.
Principal, Senior Geotechnical Engineer



P.K. Chatterji, Ph.D., P.Eng.
Review Principal, Designated MTO Contact

APPENDIX A

BOREHOLE LOCATIONS AND SOIL STRATA DRAWINGS



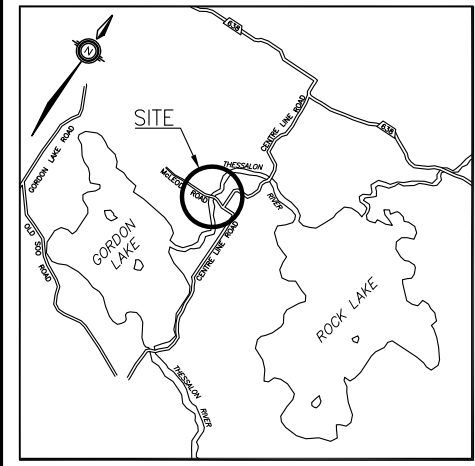
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN



CONT No
GWP No 5148-13-00

McLEOD ROAD
BRIDGE REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA

McINTOSH PERRY



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
301	198.7	5 144 320.6	318 552.0
302	198.4	5 144 323.9	318 557.0
303	198.2	5 144 346.5	318 590.8
304	198.2	5 144 349.7	318 595.7
305	197.8	5 144 342.2	318 593.9
306	197.1	5 144 336.9	318 598.6
307	198.0	5 144 318.9	318 556.3

-NOTES-

- The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- This drawing is for subsurface information only. Surface details and features are for conceptual illustration.
- Borehole locations are shown in MTM Zone 13 coordinates.

GEOCRES No. 41J-103

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	KP	CHK -	CODE
DRAWN	MFA	CHK KP	SITE 38S-154 STRUCT
			LOAD
			DATE
			APR 2019
			DWG 1

APPENDIX B
RECORD OF BOREHOLE SHEETS



SYMBOLS, ABBREVIATIONS AND TERMS USED ON TEST HOLE RECORDS

TERMINOLOGY DESCRIBING COMMON SOIL GENESIS

Topsoil	mixture of soil and humus capable of supporting vegetative growth
Peat	mixture of fragments of decayed organic matter
Till	unstratified glacial deposit which may include particles ranging in sizes from clay to boulder
Fill	material below the surface identified as placed by humans (excluding buried services)

TERMINOLOGY DESCRIBING SOIL STRUCTURE:

Desiccated	having visible signs of weathering by oxidization of clay materials, shrinkage cracks, etc.
Fissured	having cracks, and hence a blocky structure
Varved	composed of alternating layers of silt and clay
Stratified	composed of alternating successions of different soil types, e.g. silt and sand
Layer	> 75 mm in thickness
Seam	2 mm to 75 mm in thickness
Parting	< 2 mm in thickness

RECOVERY:

For soil samples, the recovery is recorded as the length of the soil sample recovered.

N-VALUE:

Numbers in this column are the field results of the Standard Penetration Test: the number of blows of a 63.5 kg hammer falling 0.76 m, required to drive a 50 mm O.D. split spoon sampler 0.3 m into undisturbed soil. For samples where insufficient penetration was achieved and N-value cannot be presented, the number of blows are reported over the sampler penetration in millimetres (e.g. 50/75).

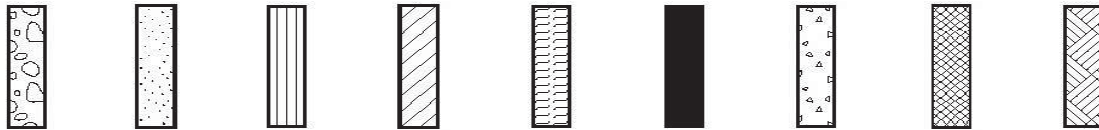
DYNAMIC CONE PENETRATION TEST (DCPT):

Dynamic cone penetration tests are performed using a standard 60 degree apex cone connected to an "A" size drill rods with the same standard fall height and weight as the Standard Penetration Test. The DCPT value is the number of blows of the hammer required to drive the cone 0.3 m into the soil. The DCPT is used as a probe to assess soil variability.



STRATA PLOT:

Strata plots symbolize the soil and bedrock description. They are combinations of the following basic symbols. The dimensions within the strata symbols are not indicative of the particle size, layer thickness, etc.



Boulders
Cobbles
Gravel Sand Silt Clay Organics Asphalt Concrete Fill Bedrock

TEXTURING CLASSIFICATION OF SOILS

Classification	Particle Size
Boulders	Greater than 200 mm
Cobbles	75 – 200 mm
Gravel	4.75 – 75 mm
Sand	0.075 – 4.75 mm
Silt	0.002 – 0.075 mm
Clay	Less than 0.002 mm

TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

Descriptive Term	Undrained Shear Strength (kPa)
Very Soft	12 or less
Soft	12 – 25
Firm	25 – 50
Stiff	50 – 100
Very Stiff	100 – 200
Hard	Greater than 200

NOTE: Clay sensitivity is defined as the ratio of the undisturbed strength over the remolded strength.

SAMPLE TYPES

SS	Split spoon samples
ST	Shelby tube or thin wall tube
DP	Direct push sample
PS	Piston sample
BS	Bulk sample
WS	Wash sample
HQ, NQ, BQ etc.	Rock core sample obtained with the use of standard size diamond coring equipment

TERMS DESCRIBING CONSISTENCY (COHESIONLESS SOILS ONLY)

Descriptive Term	SPT "N" Value
Very Loose	Less than 4
Loose	4 – 10
Compact	10 – 30
Dense	30 – 50
Very Dense	Greater than 50

MODIFIED UNIFIED SOIL CLASSIFICATION

Major Divisions		Group Symbol	Typical Description
COARSE GRAINED SOIL	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	SILT AND CLAY SOILS $W_L < 35\%$	ML	Inorganic silts, 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.
		OL	Organic silts and organic silty-clays of low plasticity.
	SILT AND CLAY SOILS $35\% < W_L < 50\%$	MI	Inorganic compressible fine sandy silt with clay of medium plasticity, clayey silts.
		CI	Inorganic clays of medium plasticity, silty clays.
		OI	Organic silty clays of medium plasticity.
	SILT AND CLAY SOILS $W_L > 50\%$	MH	Inorganic silts, micaceous or diatomaceous fine sandy of silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other organic soils.

Note - W_L = Liquid Limit



EXPLANATION OF ROCK LOGGING TERMS

ROCK WEATHERING CLASSIFICATION

Fresh (FR)	No visible signs of weathering.
Fresh Jointed (FJ)	Weathering limited to surface of major discontinuities.
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock materials.
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 structures are preserved.

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 0.1 m in length or larger, as a percentage of total core length
Unconfined Compressive Strength: (UCS)	Axial stress required to break the specimen.
Fracture Index: (FI)	Frequency of natural fractures per 0.3 m of core run.

DISCONTINUITY SPACING

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

STRENGTH CLASSIFICATION

Rock Strength	Approximate Uniaxial Compressive Strength (MPa)
Extremely Strong	Greater than 250
Very Strong	100 – 250
Strong	50 – 100
Medium Strong	25 – 50
Weak	5 – 25
Very Weak	1 – 5
Extremely Weak	0.25 – 1

METRIC

SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		<div><div></div><div>PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT</div><div>w_p w w_L</div><div>WATER CONTENT (%)</div></div> <th rowspan="2">UNIT WEIGHT γ kN/m³</th> <th rowspan="2">REMARKS & GRAIN SIZE DISTRIBUTION (%)</th>	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)																															
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa																																		
198.7 0.0	Silty Sand with Gravel - occasional cobbles - frost to 1.4 m FILL CLAY (CH) - clay crust Stiff Brown		1	AS	-						15 56 29 (SI+CL)																															
198.1 0.6			2	SS	10												0 0 45 55																									
			3	SS	8																																					
196.6 2.1			CLAY (CI) Firm Grey																													0 0 48 52										
																																	4	SS	1							
																																	5	SS	WH							
	6	SS				WH																																				
192.0 6.7	Borehole terminated at 6.7 m																																									

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No 302

1 OF 4

METRIC

GWP# 5148-13-00 LOCATION Lat: 46.438456°, Long: -83.820969° 38S-154 McLeod Rd Bridge, MTM Z13: N 5 144 323.9 E 318 557.0 ORIGINATED BY NW
HWY McLeod Road BOREHOLE TYPE HSA, and NW casing COMPILED BY KCP
DATUM Geodetic DATE 2016.02.10 - 2016.02.14 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
								○ UNCONFINED + FIELD VANE					
								● QUICK TRIAXIAL × LAB VANE					
198.4						20 40 60 80 100			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L		
0.0	Silty Sand with Gravel - occasional cobbles - frost to 1.4 m FILL		1	AS	-								
			2	AS	-								
196.9							197						
1.5	CLAY (CH) - Clay crust Soft to firm Brown		3	SS	5								
			4	SS	3								
			1	ST	Push								
194.8							195						
3.6	CLAY (CI) Soft to firm Grey							8.0 +					
								6.5 +					
			5	SS	WH								
							193	5.0 +					
								4.8 +					
			6	SS	WH								
								7.2 +					
							191	6.0 +					
			7	SS	WH								
							190	4.4 +					
								6.4 +					
			8	SS	WH		189						

Continued Next Page

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

DOUBLE LINE 10870 MCLEOD RD.GPJ 2012TEMPLATE(MTO).GDT 11/4/19

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

DOUBLE LINE 10870 MCLEOD RD.GPJ 2012TEMPLATE(MTO).GDT 11/4/19

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

DOUBLE LINE 10870 MCLEOD RD.GPJ 2012TEMPLATE(MTO).GDT 11/4/19

RECORD OF BOREHOLE No 302

4 OF 4

METRIC

GWP# 5148-13-00 LOCATION Lat: 46.438456°, Long: -83.820969° 38S-154 McLeod Rd Bridge, MTM Z13: N 5 144 323.9 E 318 557.0 ORIGINATED BY NW
 HWY McLeod Road BOREHOLE TYPE HSA, and NW casing COMPILED BY KCP
 DATUM Geodetic DATE 2016.02.10 - 2016.02.14 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
	Continued From Previous Page																
167.3	SANDY SILT (ML) Loose Grey		18	SS	6		168									0 43 57 (SI+CL)	
31.1	Borehole terminated at 31.1 m																

DOUBLE LINE 10870 MCLEOD RD.GPJ 2012TEMPLATE(MTO).GDT 11/4/19

RECORD OF BOREHOLE No 303

1 OF 4

METRIC

GWP# 5148-13-00 LOCATION Lat: 46.438659°, Long: -83.820529° 38S-154 McLeod Rd Bridge, MTM Z13: N 5 144 346.5 E 318 590.8 ORIGINATED BY NW
HWY McLeod Road BOREHOLE TYPE HSA, and NW casing COMPILED BY KCP
DATUM Geodetic DATE 2016.02.08 - 2016.02.09 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa								
								<div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div></div><div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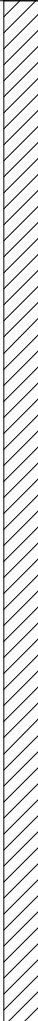

Continued Next Page

+ 3, x 3: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

METRIC

SOIL PROFILE			SAMPLES		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES
Continued From Previous Page					
181.4 16.8	CLAY (Cl) Soft to stiff Grey - varved from 13.5 m to 15.9 m - occasional silt seams				
			12	SS	WH
			13	SS	WH
			14	SS	WH
			15	SS	WH
	SANDY SILT (ML) Loose to compact Grey		16	SS	WH

+³, ×³: Numbers refer to Sensitivity

DOUBLE LINE 10870 MCLEOD RD.GPJ 2012TEMPLATE(MTO).GDT 11/4/19

METRIC

SOIL PROFILE					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES	GROUND WATER CONDITIONS	DYNAMIC CONE PENETRATION RESISTANCE PLOT
			NUMBER	TYPE	"N" VALUES
	Continued From Previous Page				
	SANDY SILT (ML) Loose to compact Grey		17	SS	5
			18	SS	10
			19	SS	12
			20	SS	4
169.3 29.0	SILTY SAND (SM) Loose to compact Grey				

+³, ×³: Numbers refer to Sensitivity

DOUBLE LINE 10870 MCLEOD RD.GPJ 2012TEMPLATE(MTO).GDT 11/4/19

RECORD OF BOREHOLE No 303

4 OF 4

METRIC

GWP# 5148-13-00 LOCATION Lat: 46.438659°, Long: -83.820529° 38S-154 McLeod Rd Bridge, MTM Z13: N 5 144 346.5 E 318 590.8 ORIGINATED BY NW
 HWY McLeod Road BOREHOLE TYPE HSA, and NW casing COMPILED BY KCP
 DATUM Geodetic DATE 2016.02.08 - 2016.02.09 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20	40	60	80	100		
	Continued From Previous Page							SHEAR STRENGTH kPa						
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
								WATER CONTENT (%)						
								20	40	60	80	100		
167.1	SILTY SAND (ML) loose to compact Grey		21	SS	25		168						o	0 83 17 (SI+CL)
31.1	Borehole terminated at 31.1 m Groundwater level was measured at 5.5 m BGS on February 2, 2016													

DOUBLE LINE 10870 MCLEOD RD.GPJ 2012TEMPLATE(MTO).GDT 11/4/19

RECORD OF BOREHOLE No 304

1 OF 1

METRIC

GWP# 5148-13-00 LOCATION Lat: 46.438688°, Long: -83.820465° 38S-154 McLeod Rd Bridge, MTM Z13: N 5 144 349.7 E 318 595.7 ORIGINATED BY NW
 HWY McLeod Road BOREHOLE TYPE HSA COMPILED BY KCP
 DATUM Geodetic DATE 2016.02.09 - 2016.02.09 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa							WATER CONTENT (%)		
								<div><div><div></div><div></div><div></div><div></div><div></div></div><div>20406080100</div></div>							<div><div><div></div><div></div><div></div></div><div>W P W W L</div></div>		
198.2																	
0.0	Sandy gravel trace silt Brown FILL - frost from 0 m to 1.5 m	<div></div>	1	AS	-		198						<div></div>				
			2	AS	-		197						<div></div>				
196.6																	
1.5	SILT (ML) some clay Loose Brown	<div></div>	3	SS	5		196						<div></div>				
			4	SS	7								<div></div>				
195.1																	
3.0	CLAY (Cl), sandy with organics - frequent wood pieces Soft to stiff	<div></div>	5	SS	5		195						<div></div>				
			6	SS	3		194						<div></div>	3.9% organic content			
			7	SS	5								<div></div>	0 33 45 22 6.2% organic content			
			8	SS	4		193						<div></div>				
192.0																	
6.2	CLAY (Cl) Soft to stiff Grey	<div></div>	9	SS	WH		192						<div></div>				
191.5																	
6.7	Borehole terminated at 6.7 m																

DOUBLE LINE 10870 MCLEOD RD.GPJ 2012TEMPLATE(MTO).GDT 11/4/19





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

RECORD OF BOREHOLE No 305

1 OF 5

METRIC

GWP# 5148-13-00 LOCATION Lat: 46.438620°, Long: -83.820488° 38S-154 McLeod Rd Bridge, MTM Z13: N 5 144 342.2 E 318 593.9 ORIGINATED BY JAG
 HWY McLeod Road BOREHOLE TYPE HSA, and NW casing COMPILED BY JM
 DATUM Geodetic DATE 2016.07.18 - 2016.07.19 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)
197.8								20	40	60	80	100					
0.0	Silty Sand with Gravel Compact Brown FILL		1	SS	18												
			2	SS	11												
			3	SS	11												
195.3																	
2.4	CLAY (CI) Soft Brown to grey		4	SS	2												
			5	SS	2												
194.1																	
3.7	SILTY SAND (SM) - frequent wood pieces Very loose Grey		6	SS	1												
			7	SS	2												
			8	SS	2												
192.0																	
5.8	CLAY (CL to CI) Firm to stiff Grey																
			9	SS	WH												
			10	ST	PUSH												
			11	SS	WH												

DOUBLE LINE 10870 MCLEOD RD.GPJ 2012TEMPLATE(MTO).GDT 11/4/19

Continued Next Page

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

RECORD OF BOREHOLE No 305

2 OF 5

METRIC

GWP# 5148-13-00 LOCATION Lat: 46.438620°, Long: -83.820488° 38S-154 McLeod Rd Bridge, MTM Z13: N 5 144 342.2 E 318 593.9 ORIGINATED BY JAG
 HWY McLeod Road BOREHOLE TYPE HSA, and NW casing COMPILED BY JM
 DATUM Geodetic DATE 2016.07.18 - 2016.07.19 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL LIMIT MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)				GR	SA	SI	CL
								20 40 60 80 100	W _p W W _L								
	Continued From Previous Page							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE									
	CLAY (CL to CI) Firm to stiff Grey 																

Continued Next Page

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

DOUBLE LINE 10870 MCLEOD RD.GPJ 2012TEMPLATE(MTO).GDT 11/4/19

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

DOUBLE LINE 10870 MCLEOD RD.GPJ 2012TEMPLATE(MTO).GDT 11/4/19

RECORD OF BOREHOLE No 305

4 OF 5

METRIC

GWP# 5148-13-00 LOCATION Lat: 46.438620°, Long: -83.820488° 38S-154 McLeod Rd Bridge, MTM Z13: N 5 144 342.2 E 318 593.9 ORIGINATED BY JAG
 HWY McLeod Road BOREHOLE TYPE HSA, and NW casing COMPILED BY JM
 DATUM Geodetic DATE 2016.07.18 - 2016.07.19 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)			
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE												
	Continued From Previous Page							20	40	60	80	100								
	SANDY SILT (ML) to SILTY SAND (SM) Loose to compact Grey		21	SS	27		167										0 9 83 8			
							166													
							165													
							164										8 51 41 (SI+CL)			
							163													
							162													
							161										0 14 75 11			
							160													
						159														
			24	SS	9		158													

Continued Next Page

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

METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)					
								20 40 60 80 100	w _p w w _L						
	Continued From Previous Page							○ UNCONFINED + FIELD VANE							
	SANDY SILT (ML) to SILTY SAND (SM) Loose to compact Grey						157								
								156							
								155							
								154							
								153							
151.5			25	SS	13									0 59 41 (SI+CL)	
46.3	Borehole terminated at 46.3 m		26	SS	29		152								

+³, ×³: Numbers refer to Sensitivity

METRIC

SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)		
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa		w P			w	w L
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
197.1 0.0	SILTY CLAY , trace sand - trace organics Firm Brown FILL		1	SS	8									
			2	SS	5									
			3	SS	4									
194.8 2.3	CLAY (CL) Very soft Grey		4	SS	1									
			5	SS	1									
193.3 3.8	CLAY (CL) - frequent wood pieces Very soft Grey		6	SS	WH							8.3% organic content		
192.5 4.6	SILTY SAND (SM) - frequent wood pieces Very loose Grey		7	ST	PUSH									
191.7 5.3	CLAY (Cl) Soft to firm Grey		8	SS	WH									
			9	SS	WH								0 1 49 50	
			10	SS	WH									

+³, ×³: Numbers refer to Sensitivity

DOUBLE LINE 10870 MCLEOD RD.GPJ 2012TEMPLATE(MTO).GDT 11/4/19

RECORD OF BOREHOLE No 306

2 OF 2

METRIC

GWP# 5148-13-00 LOCATION Lat: 46.438573°, Long: -83.820427° 38S-154 McLeod Rd Bridge, MTM Z13: N 5 144 336.9 E 318 598.6 ORIGINATED BY JAG
 HWY McLeod Road BOREHOLE TYPE HSA COMPILED BY JM
 DATUM Geodetic DATE 2016.07.20 - 2016.07.20 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
							20	40	60	80	100						
	Continued From Previous Page																
186.5	CLAY (Cl) Soft to firm Grey		11	SS	WH												
10.5	Borehole terminated at 10.5 m Groundwater level was measured at 2.8 m BGS on July 21, 2016																

DOUBLE LINE 10870 MCLEOD RD.GPJ 2012TEMPLATE(MTO).GDT 11/4/19

RECORD OF BOREHOLE No 307

1 OF 5

METRIC

GWP# 5148-13-00 LOCATION Lat: 46.438411°, Long: -83.820978° 38S-154 McLeod Rd Bridge, MTM Z13: N 5 144 318.9 E 318 556.3 ORIGINATED BY JAG
 HWY McLeod Road BOREHOLE TYPE HSA, and NW casing COMPILED BY JM
 DATUM Geodetic DATE 2016.07.20 - 2016.07.21 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									WATER CONTENT (%)		
								○ UNCONFINED	+	FIELD VANE	● QUICK TRIAXIAL						×	LAB VANE	
197.1							20	40	60	80	100	20	40	60					
0.0	Silty Sand with gravel																		
196.8	FILL																		
0.3	Boulders and Cobbles - Rockfill																		
	FILL																		
194.7																			
2.4	CLAY (CL to CI) Firm to stiff grey		1	SS	5														
			2	ST	PUSH														
			3	SS	WH														
			4	SS	1														
			5	SS	WH														

Continued Next Page

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

DOUBLE LINE 10870 MCLEOD RD.GPJ 2012TEMPLATE(MTO).GDT 11/4/19

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

DOUBLE LINE 10870 MCLEOD RD.GPJ 2012TEMPLATE(MTO).GDT 11/4/19

METRIC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W P W W L				WATER CONTENT (%)	
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
	Continued From Previous Page		13	SS	6		177								
							176								
			14	SS	4		175								
							174								
							173								
172.7	CLAY (CL to CI) Firm to stiff Grey						172								
24.4							171								
	SANDY SILT (ML) to SILTY SAND (SM) Loose to dense Grey		15	SS	6		170								
							169								
			16	SS	5		168								

+³, ×³: Numbers refer to Sensitivity

DOUBLE LINE 10870 MCLEOD RD.GPJ 2012TEMPLATE(MTO).GDT 11/4/19

RECORD OF BOREHOLE No 307

4 OF 5

METRIC

GWP# 5148-13-00 LOCATION Lat: 46.438411°, Long: -83.820978° 38S-154 McLeod Rd Bridge, MTM Z13: N 5 144 318.9 E 318 556.3 ORIGINATED BY JAG
 HWY McLeod Road BOREHOLE TYPE HSA, and NW casing COMPILED BY JM
 DATUM Geodetic DATE 2016.07.20 - 2016.07.21 CHECKED BY PC

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				W P W W L				GR SA SI CL																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
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+³, ×³: Numbers refer to Sensitivity 20 15 10 5 0 (%) STRAIN AT FAILURE

METRIC

[illegible]

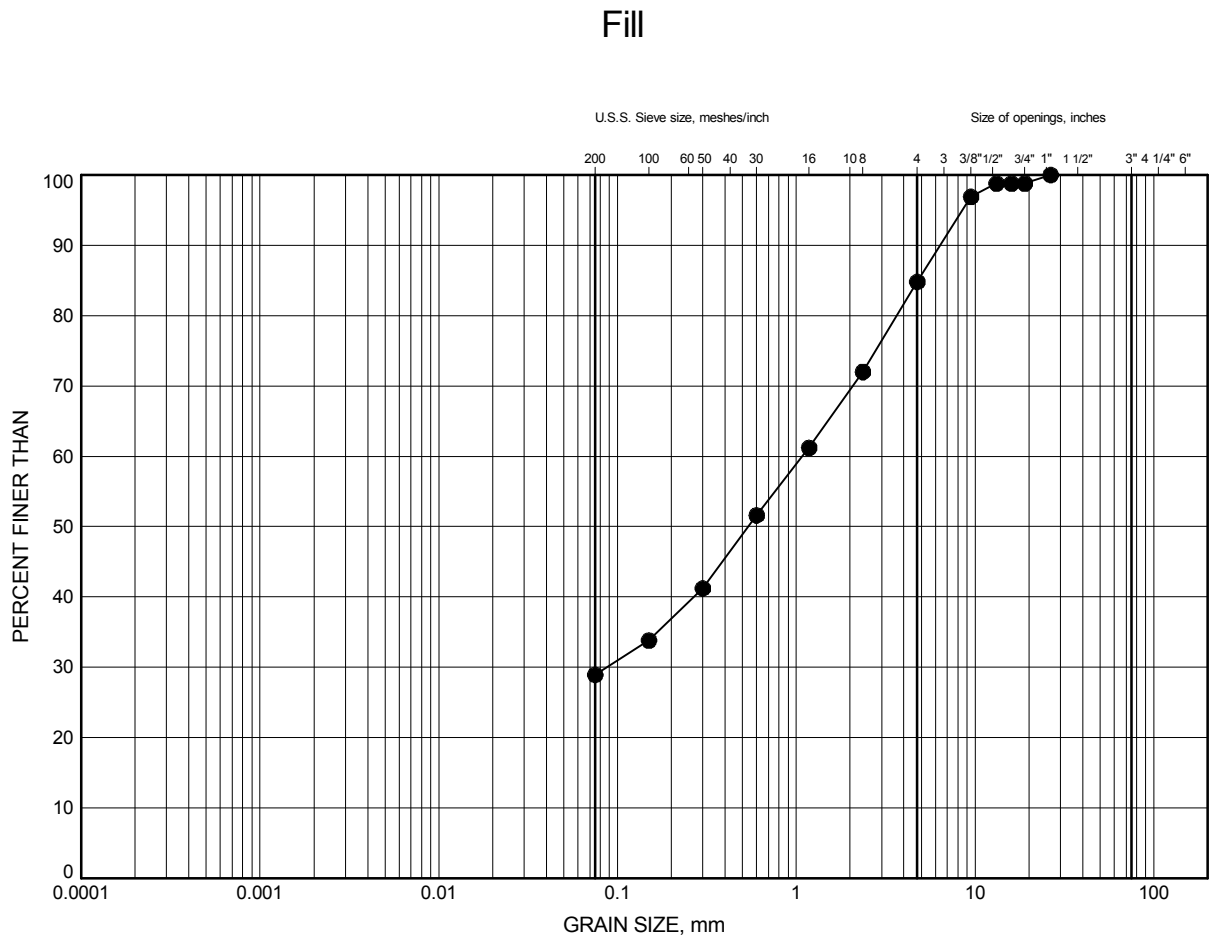
+³, ×³: Numbers refer to Sensitivity

APPENDIX C
LABORATORY TEST RESULTS

38S-154 McLeod Rd Bridge

GRAIN SIZE DISTRIBUTION

FIGURE 1



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	301	0.30	198.39

Date April 2019
GWP# 5148-13-00

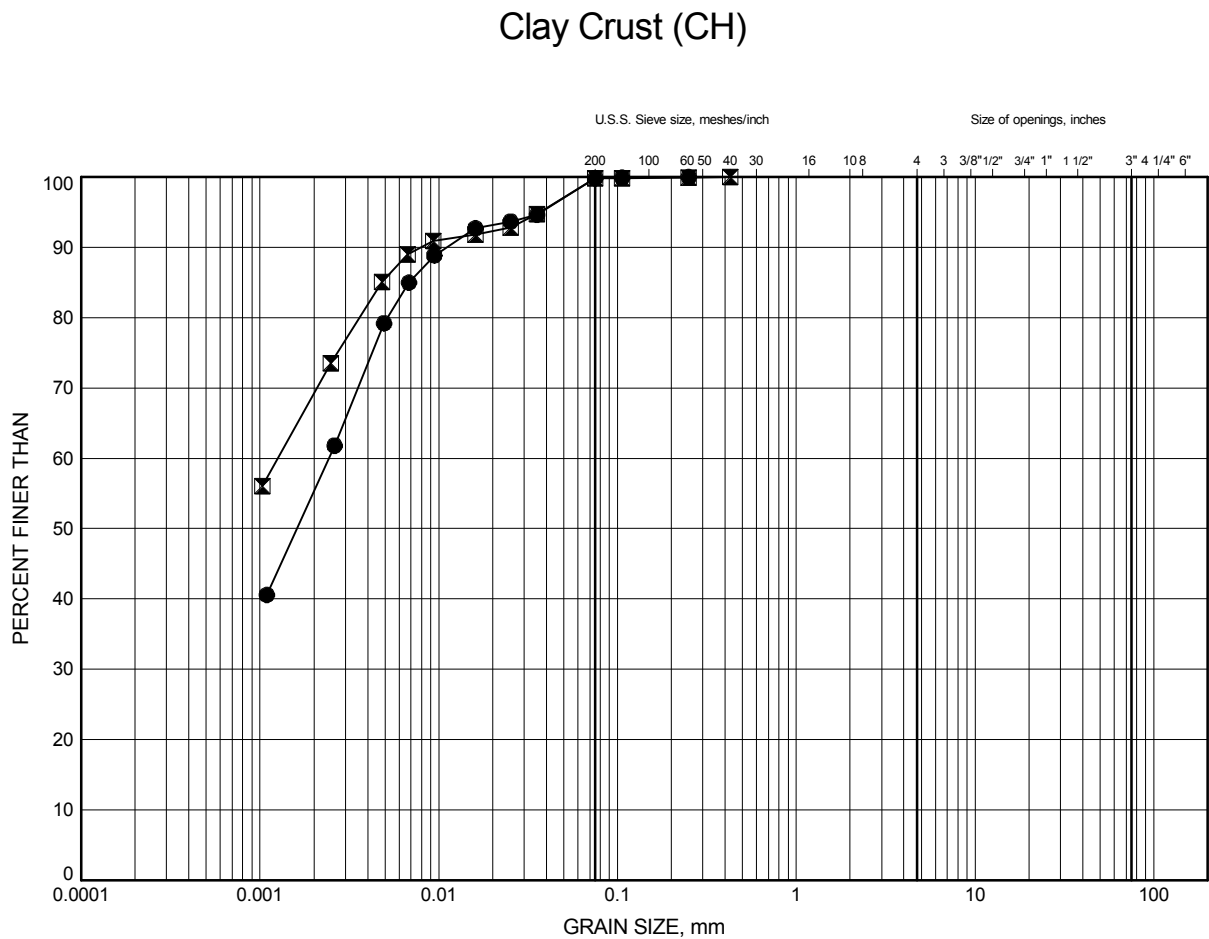


Prep'd DJP
Chkd. PC

38S-154 McLeod Rd Bridge

GRAIN SIZE DISTRIBUTION

FIGURE 2



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	301	1.07	197.63
⊠	302	2.59	195.80

Date April 2019
GWP# 5148-13-00

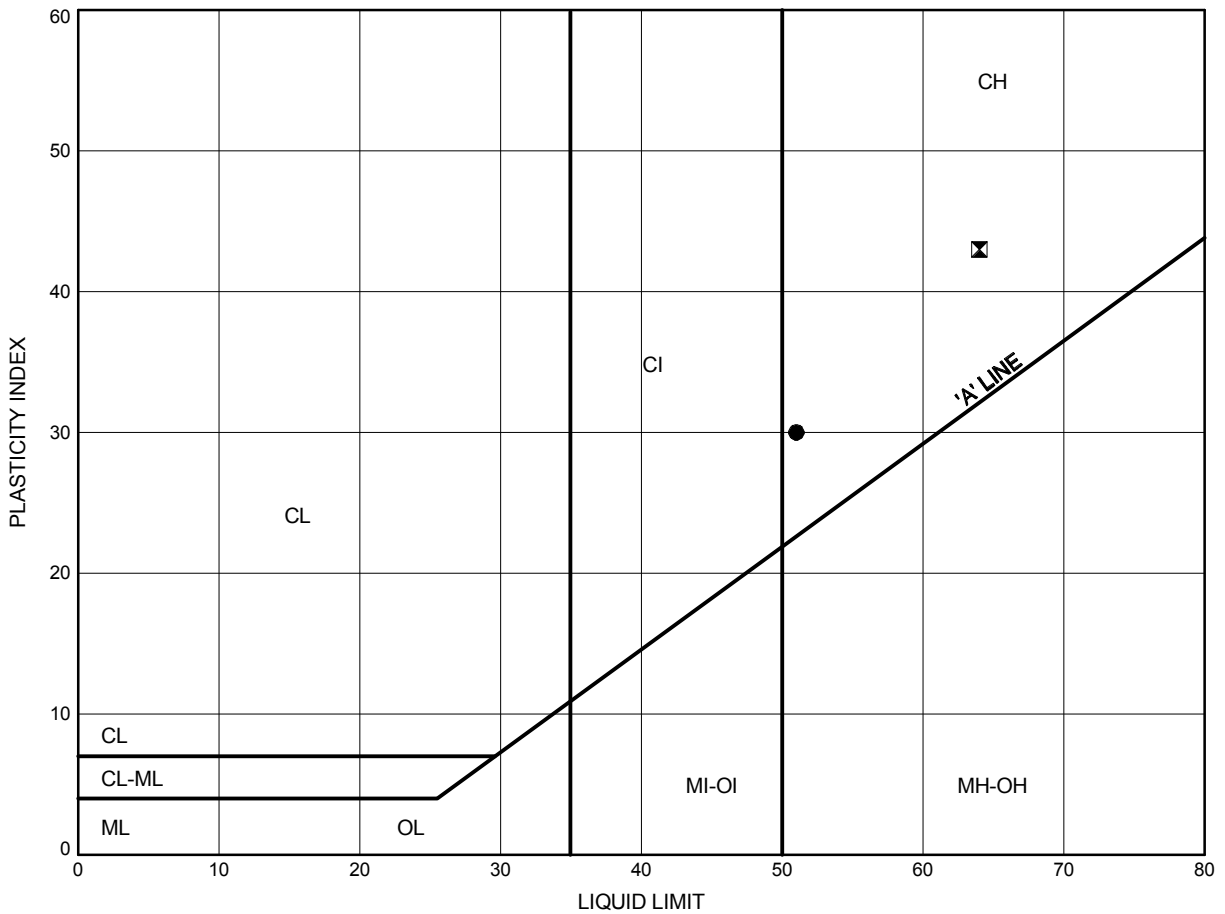


Prep'd DJP
Chkd. PC

38S-154 McLeod Rd Bridge
ATTERBERG LIMITS TEST RESULTS

FIGURE 3

Clay Crust (CH)



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	301	1.07	197.63
⊠	302	2.59	195.80

Date ..April 2019.....
 GWP# ..5148-13-00.....



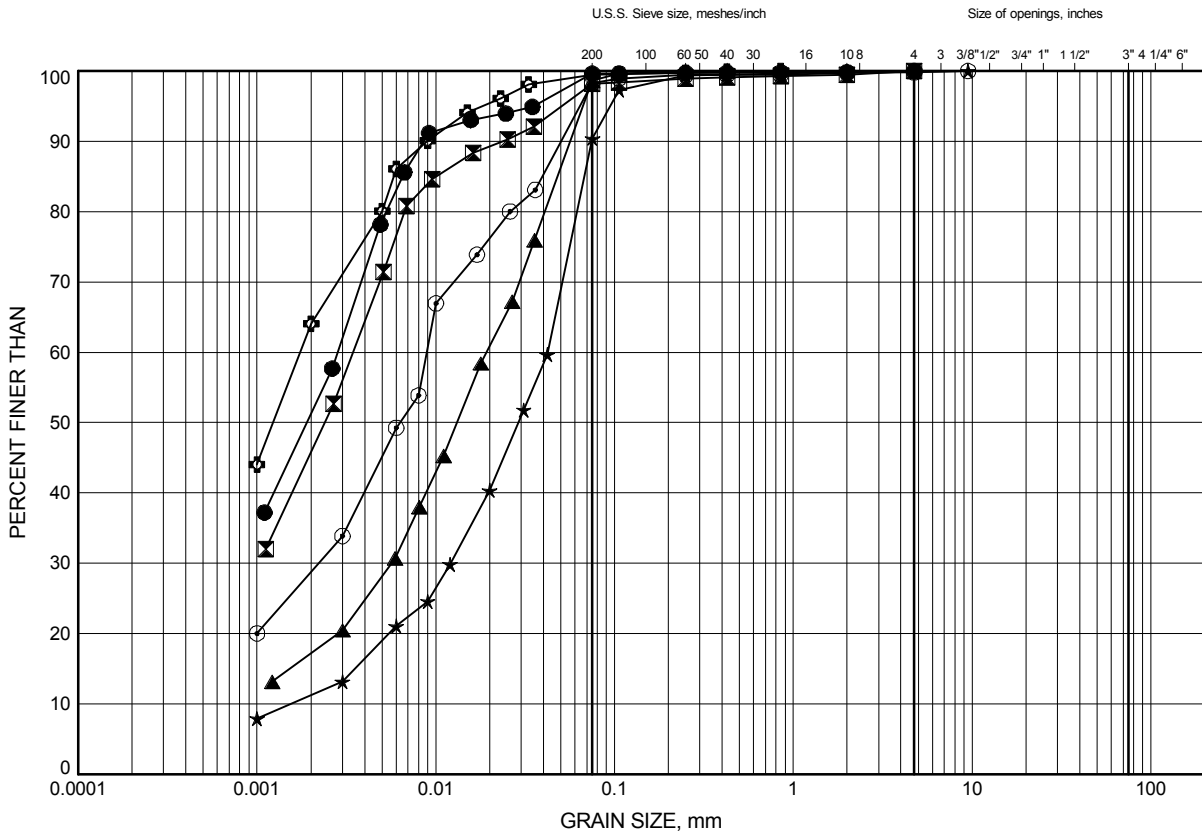
Prep'dDJP.....
 Chkd.PC.....

38S-154 McLeod Rd Bridge

GRAIN SIZE DISTRIBUTION

FIGURE 4

Clay (CL to CI) to Silty Clay (CL-ML)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	301	4.88	193.82
⊠	302	9.45	188.94
▲	302	17.07	181.32
★	302	20.12	178.28
⊙	302	23.16	175.23
⊕	305	6.40	191.38

Date April 2019

GWP# 5148-13-00



Prep'd DJP

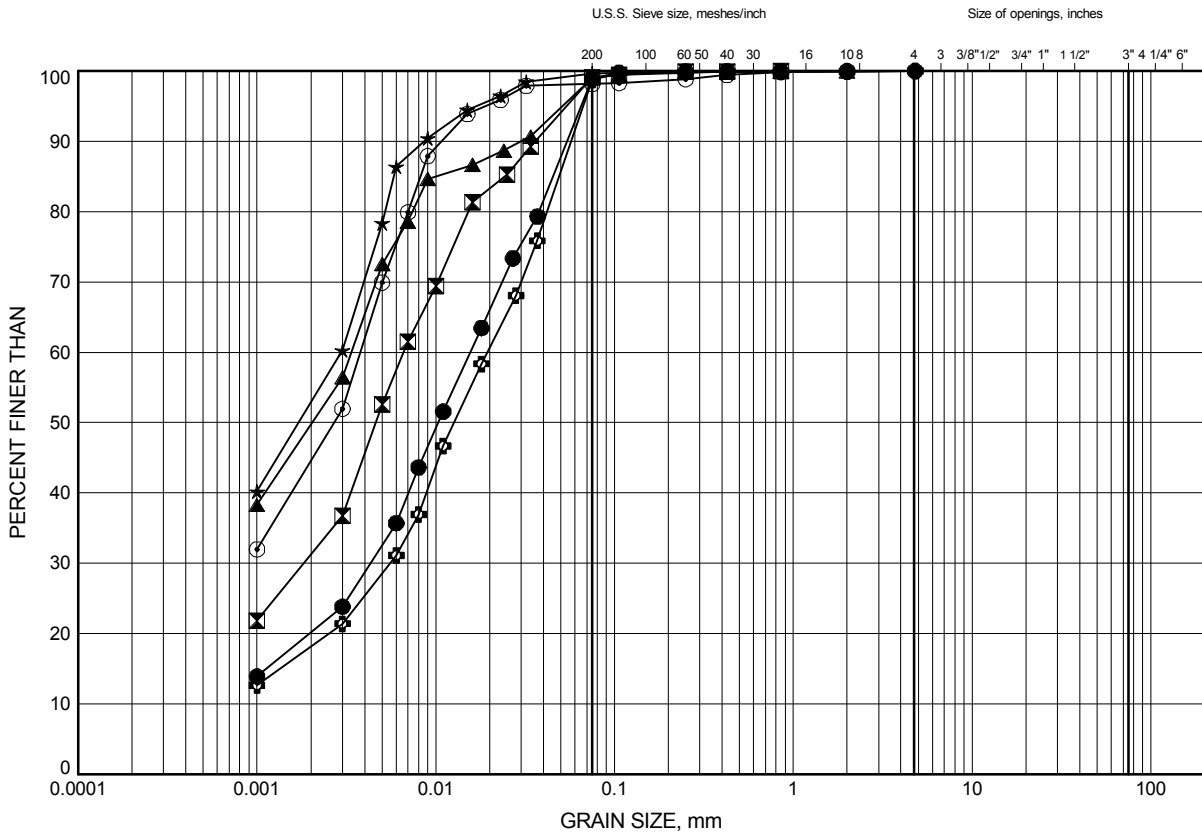
Chkd. PC

38S-154 McLeod Rd Bridge

GRAIN SIZE DISTRIBUTION

FIGURE 5

Clay (CL to CI) to Silty Clay (CL-ML)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	305	16.76	181.02
⊠	305	21.64	176.14
▲	306	7.16	189.90
★	307	4.88	192.24
⊙	307	10.97	186.15
⊕	307	17.07	180.05

Date April 2019

GWP# 5148-13-00



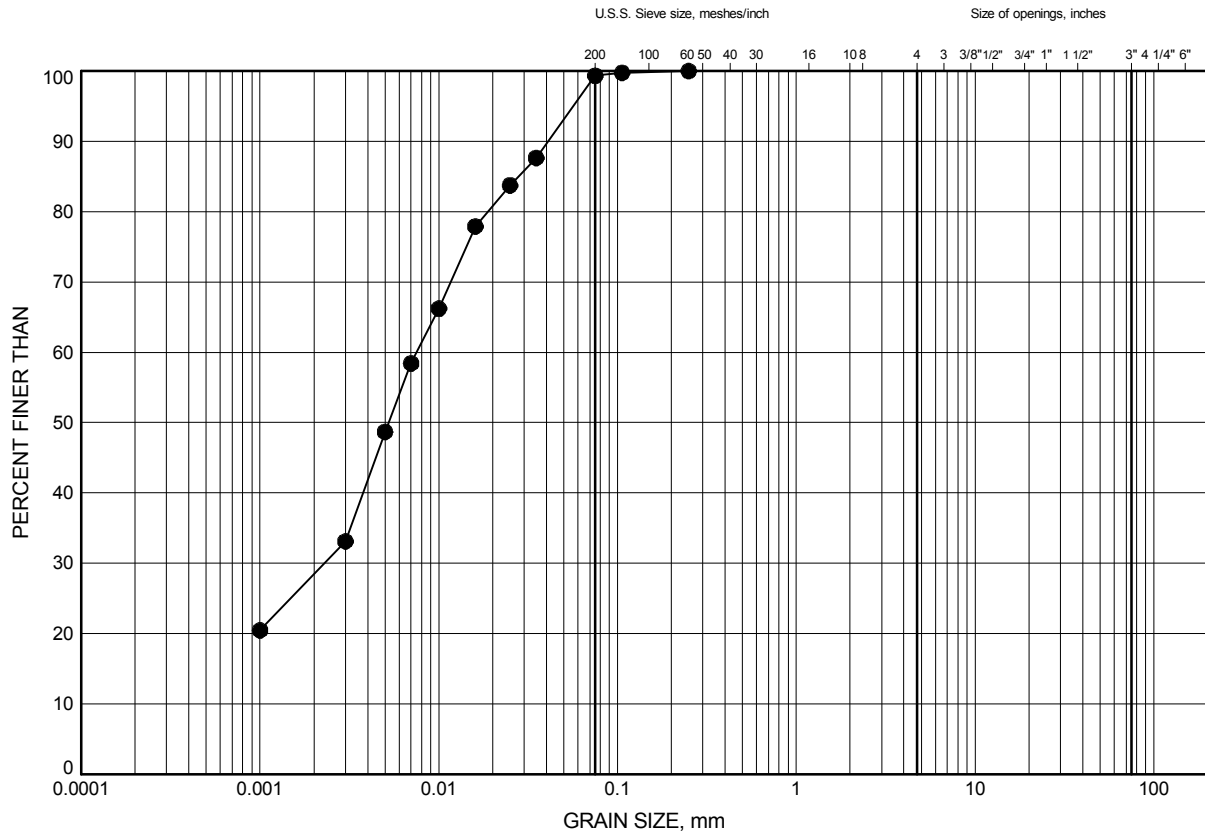
Prep'd DJP

Chkd. PC

38S-154 McLeod Rd Bridge
GRAIN SIZE DISTRIBUTION

FIGURE 6

Clay (CL to CI) to Silty Clay (CL-ML)



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	307	21.64	175.48

Date April 2019
GWP# 5148-13-00

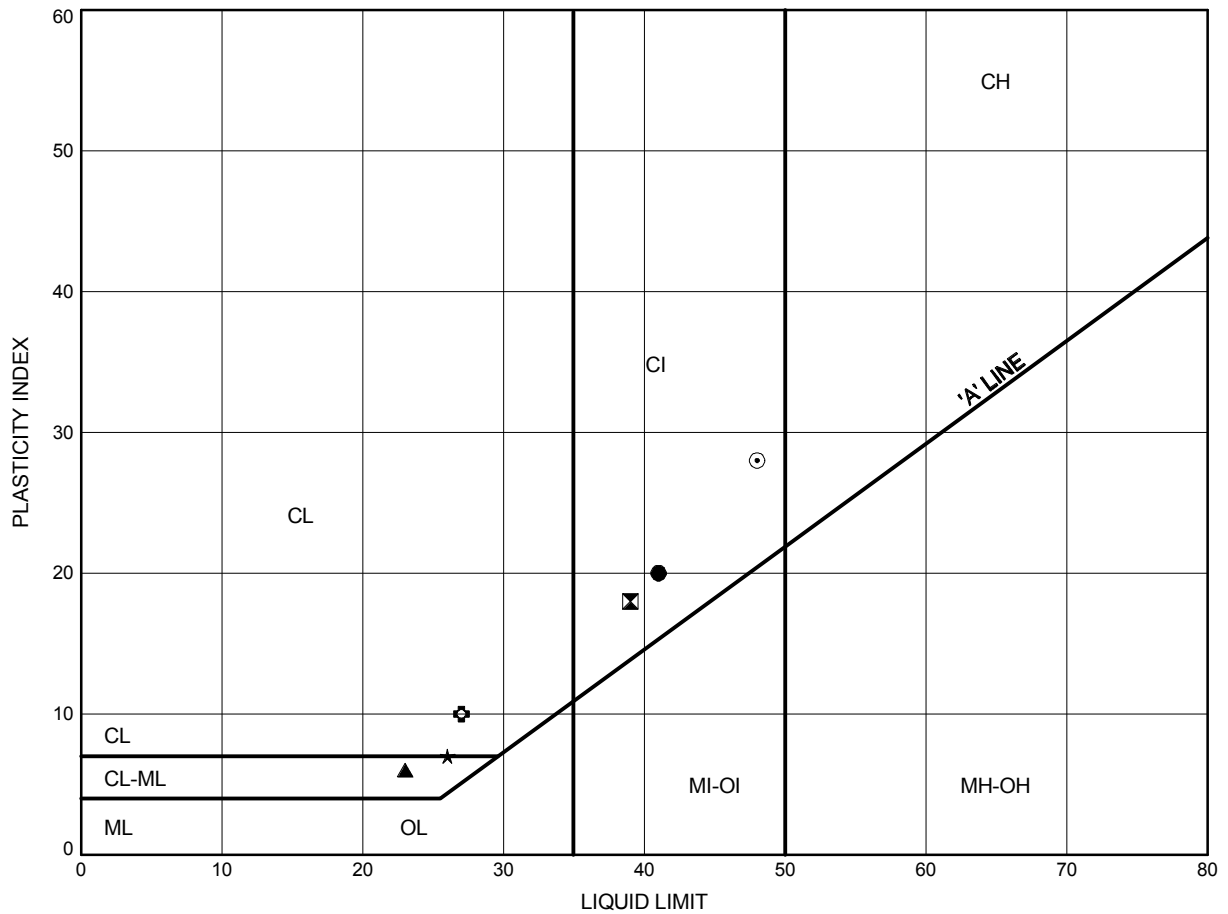


Prep'd DJP
Chkd. PC

38S-154 McLeod Rd Bridge
ATTERBERG LIMITS TEST RESULTS

FIGURE 7

Clay (CI to CL) to Silty Clay (CL-ML)



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	301	4.88	193.82
⊠	302	9.45	188.94
▲	302	17.07	181.32
★	302	23.16	175.23
⊙	305	6.40	191.38
⊕	305	16.76	181.02

Date April 2019
 GWP# 5148-13-00

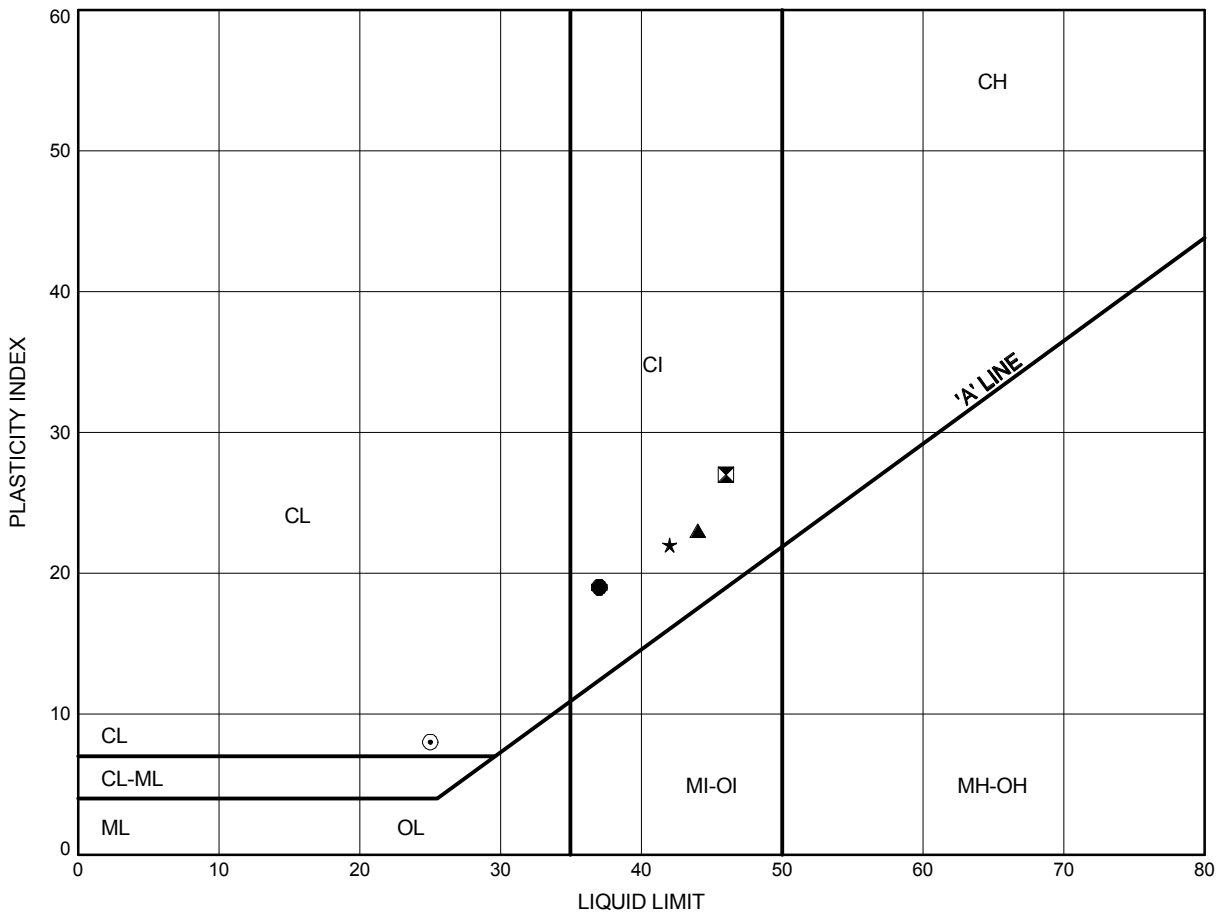


Prep'd DJP
 Chkd. PC

38S-154 McLeod Rd Bridge
ATTERBERG LIMITS TEST RESULTS

FIGURE 8

Clay (CI to CL) to Silty Clay (CL-ML)



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	305	21.64	176.14
⊠	306	7.16	189.90
▲	307	4.88	192.24
★	307	10.97	186.15
⊙	307	17.07	180.05
⊕	307	21.64	175.48

Date ..April 2019.....
 GWP# ..5148-13-00.....



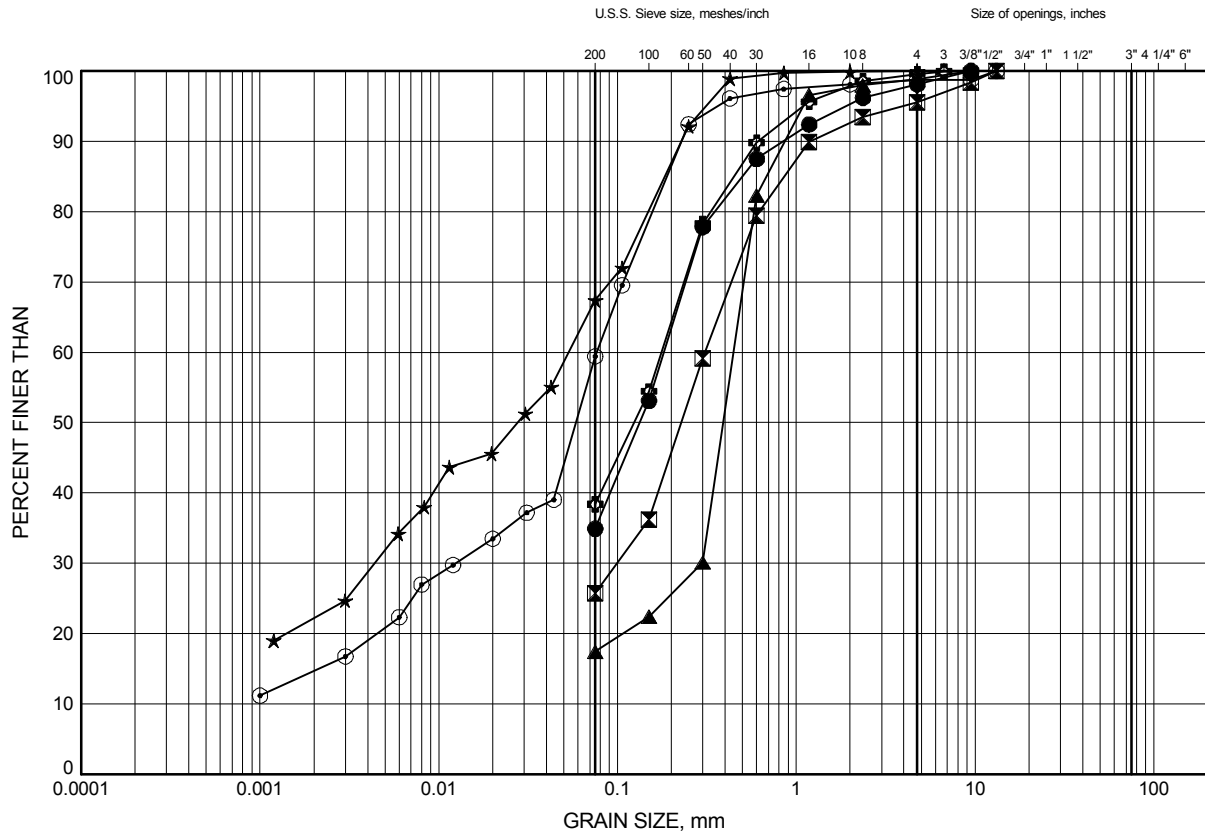
Prep'dDJP.....
 Chkd.PC.....

38S-154 McLeod Rd Bridge

GRAIN SIZE DISTRIBUTION

FIGURE 9

Clay with layers of Silty Sand and Silt with Frequent Wood Pieces



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	303	4.11	194.09
⊠	303	4.88	193.33
▲	303	5.64	192.57
★	304	4.11	194.05
⊙	305	3.35	194.43
⊕	305	4.11	193.67

Date April 2019
GWP# 5148-13-00



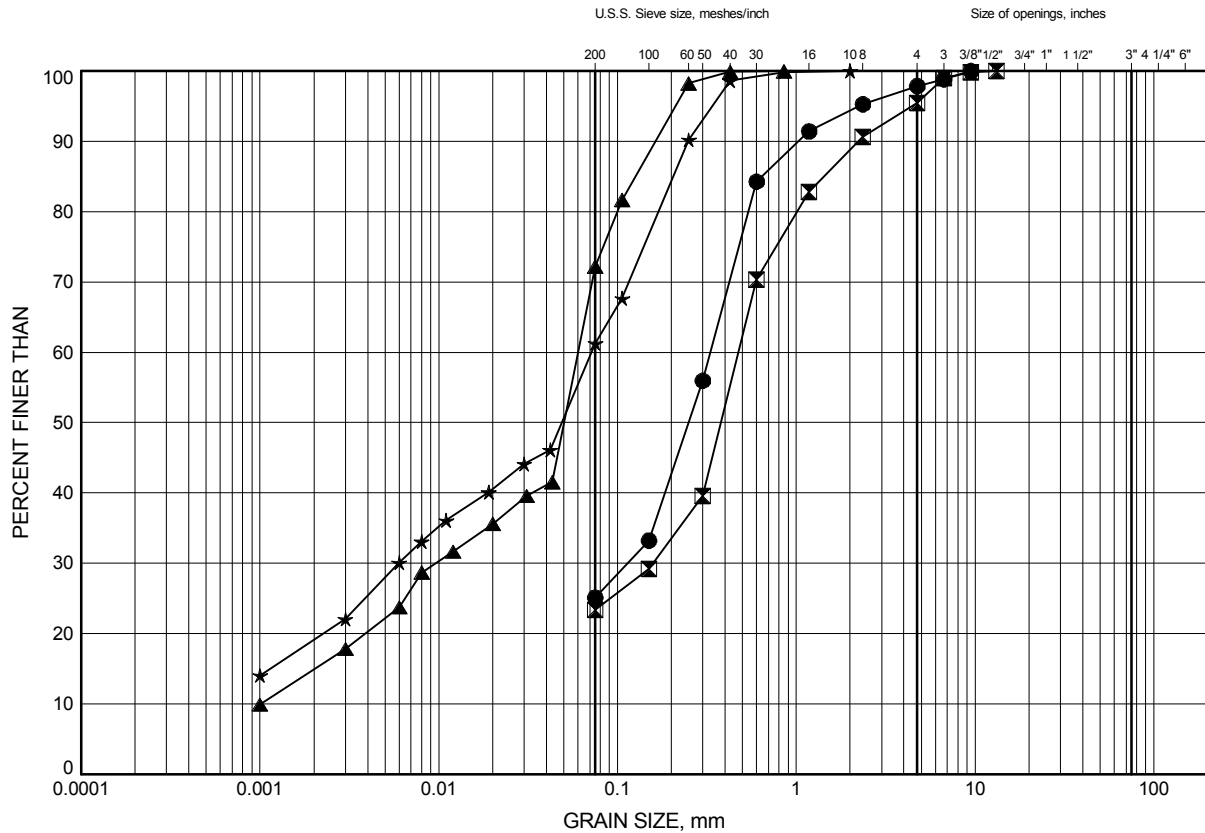
Prep'd DJP
Chkd. PC

38S-154 McLeod Rd Bridge

GRAIN SIZE DISTRIBUTION

FIGURE 10

Clay with layers of Silty Sand and Silt with Frequent Wood Pieces



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	305	4.88	192.91
⊠	305	5.56	192.22
▲	306	2.59	194.47
★	306	4.11	192.95

Date April 2019
GWP# 5148-13-00



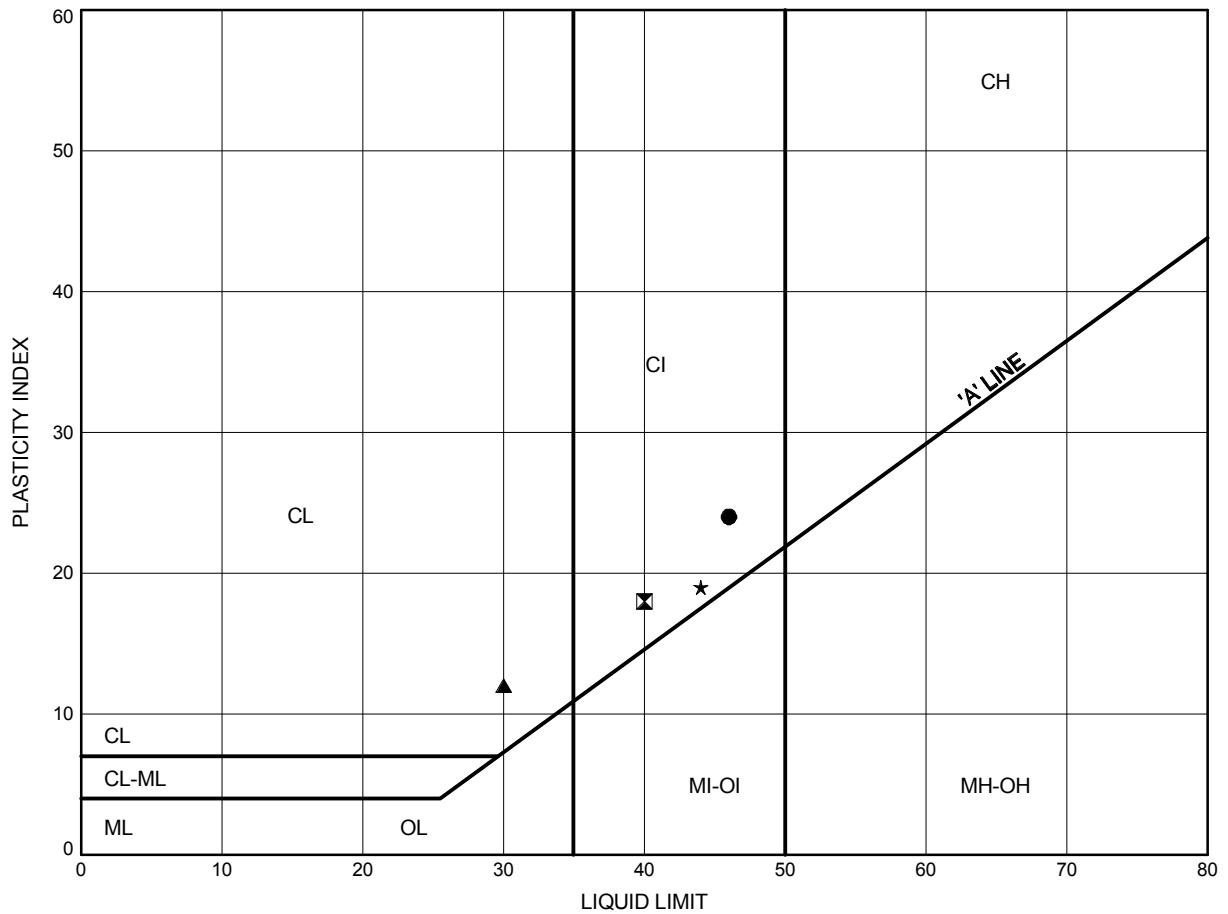
Prep'd DJP
Chkd. PC

38S-154 McLeod Rd Bridge

ATTERBERG LIMITS TEST RESULTS

FIGURE 11

Clay with layers of Silty Sand and Silt with Frequent Wood Pieces



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	304	4.11	194.05
⊠	305	3.35	194.43
▲	306	2.59	194.47
★	306	4.11	192.95

Date April 2019
GWP# 5148-13-00



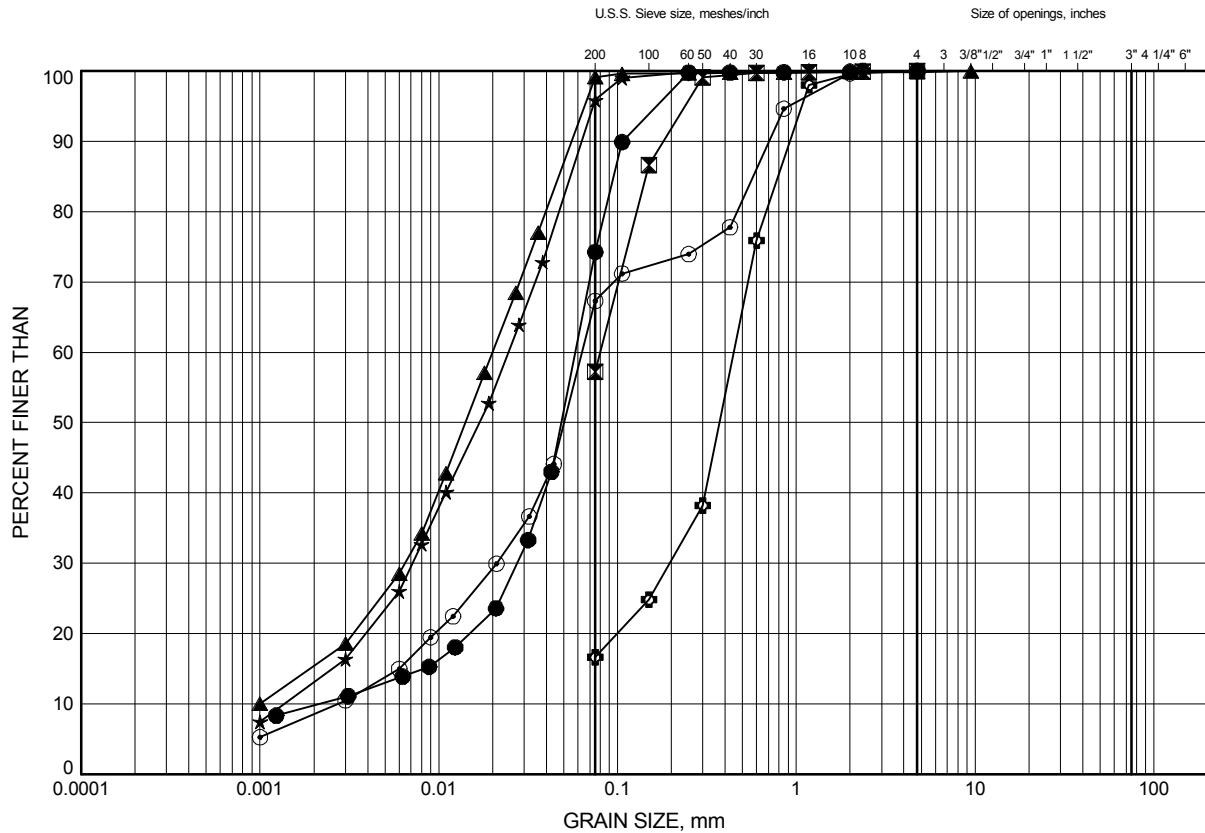
Prep'd DJP
Chkd. PC

38S-154 McLeod Rd Bridge

GRAIN SIZE DISTRIBUTION

FIGURE 12

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)
●	302	29.26	169.13
⊠	302	30.78	167.61
▲	303	17.07	181.14
★	303	20.12	178.09
⊙	303	26.21	172.00
⊕	303	30.78	167.42

Date April 2019

GWP# 5148-13-00



Prep'd DJP

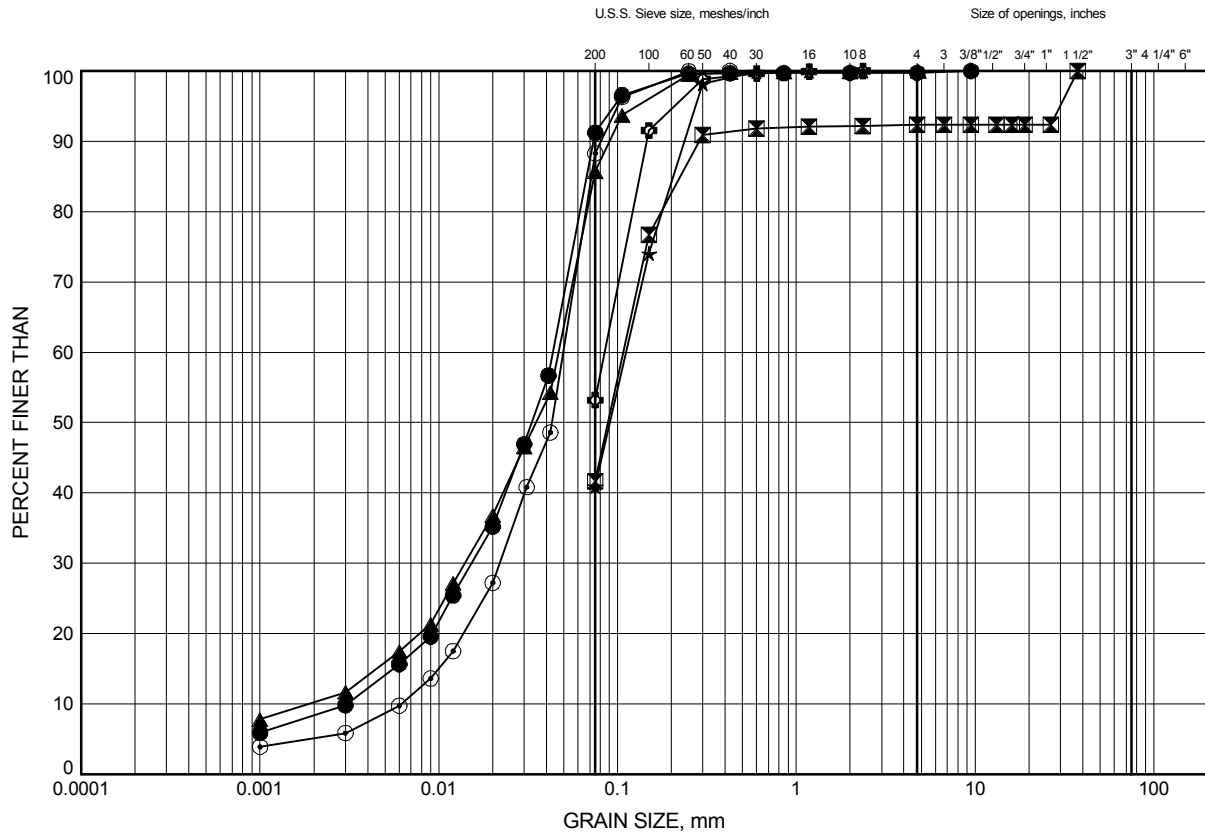
Chkd. PC

38S-154 McLeod Rd Bridge

GRAIN SIZE DISTRIBUTION

FIGURE 13

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)
●	305	30.78	167.00
⊠	305	33.83	163.95
▲	305	36.88	160.90
★	305	42.98	154.81
⊙	307	24.69	172.43
⊕	307	33.83	163.29

Date April 2019

GWP# 5148-13-00



Prep'd DJP

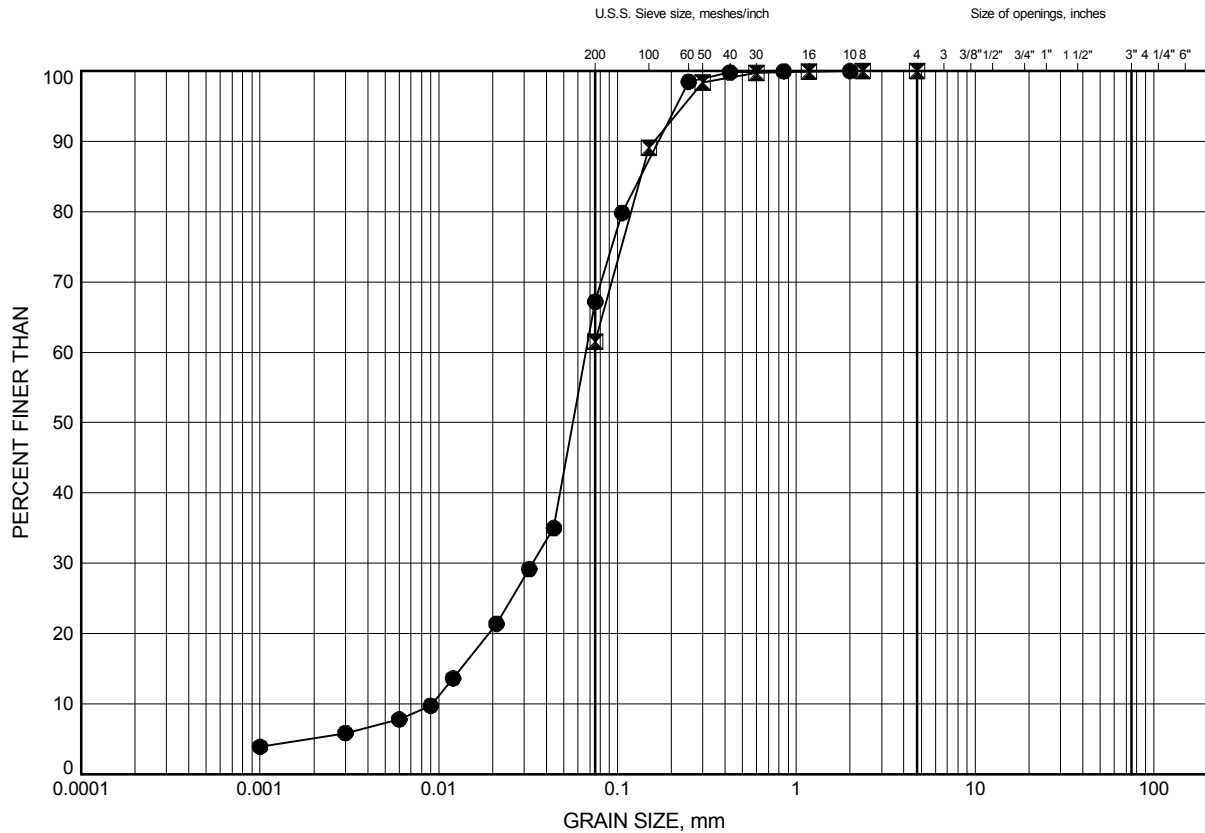
Chkd. PC

38S-154 McLeod Rd Bridge

GRAIN SIZE DISTRIBUTION

FIGURE 14

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)
●	307	36.88	160.24
⊠	307	42.98	154.14

Date April 2019
GWP# 5148-13-00



Prep'd DJP
Chkd. PC



Stantec

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100B – 2781 Lancaster Rd
Ottawa, ON K1B 1A7
Tel: (613) 738-6075
Fax: (613) 738-6067

March 30, 2016
File: 122410864

Attention: **Kenton Power, Thurber Engineering File #10870**

Reference: **ASTM D2974 Organic Matter of Peat & Other Soils**

The table below summarizes four (4) test results for Organic Matter of Peat and Other Soils.

Source	Location	Depth	% Organic Content
BH-303 SS-6	LRB McLeod Road	12'6"-14'6"	14.07
BH-303 SS-7	LRB McLeod Road	15'-17'	13.55
BH-304 SS-6	LRB McLeod Road	12'6"-14'6"	6.15
BH-304 SS-5	LRB McLeod Road	10'-12'	3.90

Sincerely,

Stantec Consulting Ltd.

Brian Prevost

Brian Prevost
Laboratory Supervisor
Tel: 613-738-6075
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brian.prevost@stantec.com



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August 16, 2016
File: 122410864

Attention: Kenton Power, Thurber Engineering File #10870

Reference: ASTM D2974 Organic Matter of Peat & Other Soils

The table below summarizes four test results for Organic Matter of Peat and Other Soils.

Source	Location	Depth	Organic Content
<i>BH305 SS-6</i>	McLeod Road	12'6"-14'6"	8.3%
<i>BH305 SS-7</i>	McLeod Road	15'-17'	11.8%
<i>BH305 SS-8A</i>	McLeod Road	17'6"-19'6"	9.8%
<i>BH306 SS-6</i>	McLeod Road	12'6"-14'6"	8.2%

Sincerely,

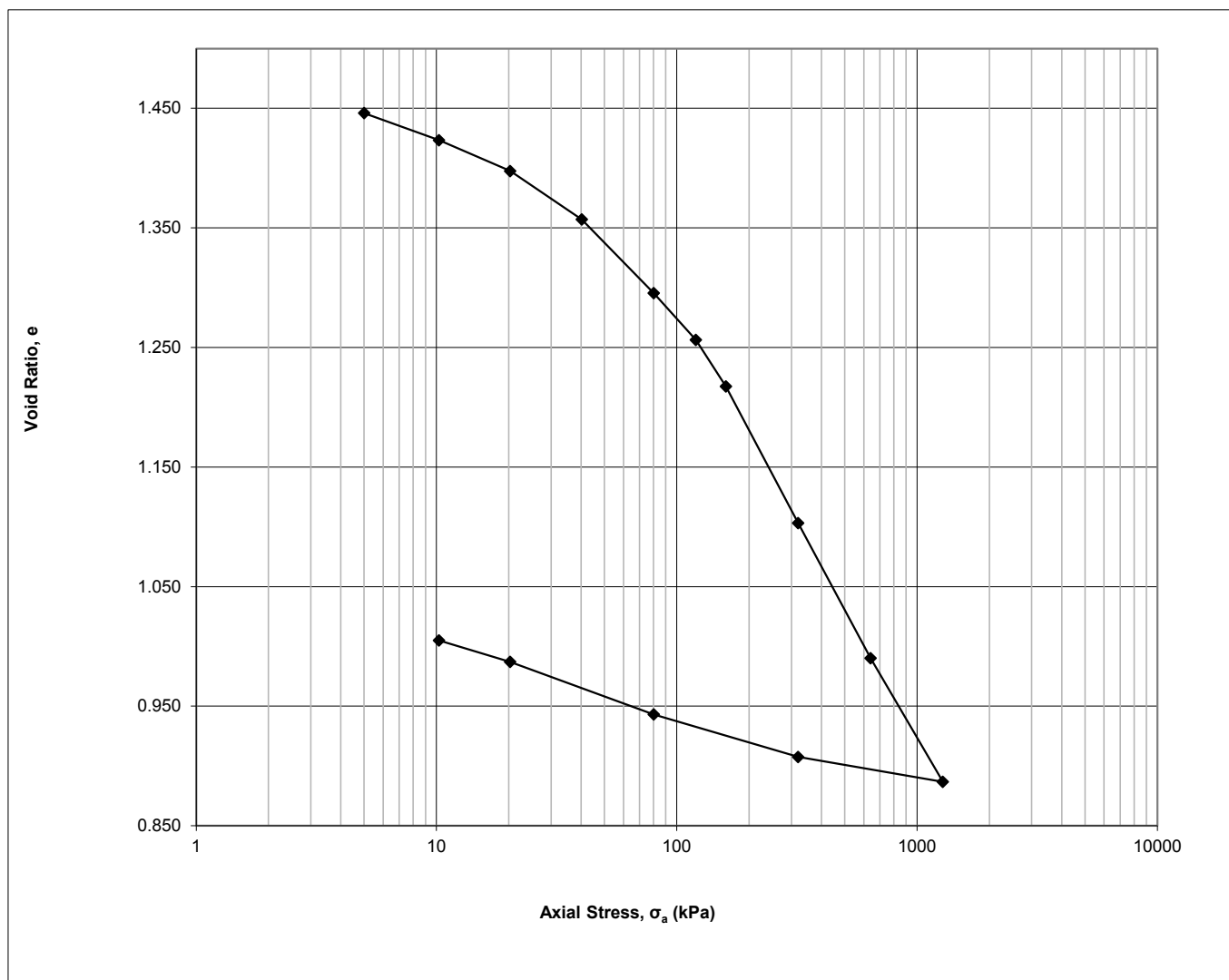
Stantec Consulting Ltd.

Brian Prevost

Brian Prevost
Laboratory Supervisor
Tel: 613-738-6075
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brian.prevost@stantec.com

Project
Project No.
Borehole No.
Sample No.
Sample Depth

Thurber Consulting Ltd., LRB McLeod Road, Project # 10870
122410864
BH 302
ST-1
10-12 ft



One-Dimensional Consolidation Test using Incremental Loading
ASTM D2435/D2435M - 11

2016-04-22
2016-04-22

Date:
Date:

Checked by: MO
Approved by: RH

Specimen Details

Project Name	Thurber Consulting Ltd., LRB McLeod Road, Project # 10870
Project Location	Sault Ste. Marie
Borehole	BH 302
Sample No.	ST-1
Depth	10-12 ft
Sample Date	09/02/2016
Test Number	One
Technician Name	Daniel Boateng

Soil Description & Classification

Silty Clay	
Specific Gravity of Solids	2.699
Average water content of trimmings %	64
Additional Notes (information source, occurrence and size of large isolated particles etc.)	
Sample was sensitive and severely desiccated	

Initial Specimen Conditions

Height	mm	20.00
Diameter	mm	50.00
Area	mm ²	1963
Volume	mm ³	39270
Mass	g	71.26
Dry Mass	g	43.33
Density	Mg/m ³	1.815
Dry Density	Mg/m ³	1.103
Water Content	%	64.46
Degree of Saturation	%	120.3
Height of Solids	mm	8.18
Initial Void Ratio		1.446

Final Specimen Conditions

Water Content	%	49.43
Final Void Ratio		1.005

One-Dimensional Consolidation Test using Incremental Loading
ASTM D2435/D2435M - 11

Specimen Details

Project Name	Thurber Consulting Ltd., LRB McLeod Road, Project # 10870
Project Location	Sault Ste. Marie
Borehole	BH 302
Sample No.	ST-1
Depth	10-12 ft
Sample Date	09/02/2016
Test Number	One
Technician Name	Daniel Boateng

Test Procedure

Date Started	25/02/2016
Date Finished	09/03/2016
Machine Number	C
Cell Number	C
Ring Number	C
Trimming Procedure	Turntable
Moisture Condition	Inundated
Axial Stress at Inundation	5 kPa
Water Used	Distilled
Test Method	A
Interpretation Procedure for c_v	2

All Departures from Outlined ASTM D2435/D2435M-11 Procedure
Calculations

Load Increment	Increment Duration	Axial Stress σ_a kPa	Corrected Deformation ΔH mm	Specimen Height H mm	Axial Strain ϵ_a %	Void Ratio e
Seating	1440.0	5	0.0000	20.0000	0.00	1.446
1	1440.0	10	0.1855	19.8145	0.93	1.423
2	1440.0	20	0.3967	19.6033	1.98	1.398
3	1440.0	40	0.7287	19.2713	3.64	1.357
4	1440.0	80	1.2311	18.7689	6.16	1.296
5	1440.0	120	1.5524	18.4476	7.76	1.256
6	1440.0	160	1.8692	18.1308	9.35	1.217
7	1440.0	320	2.8050	17.1950	14.03	1.103
8	1440.0	640	3.7277	16.2723	18.64	0.990
9	1440.0	1280	4.5738	15.4262	22.87	0.887
10	1440.0	320	4.4033	15.5967	22.02	0.908
11	1440.0	80	4.1130	15.8870	20.57	0.943
12	1440.0	20	3.7536	16.2464	18.77	0.987
13	1440.0	10	3.6063	16.3937	18.03	1.005
14						
15						
16						
17						
18						
19						

One-Dimensional Consolidation Test using Incremental Loading

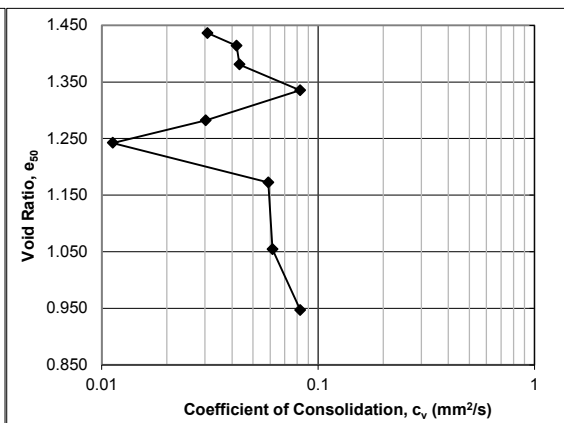
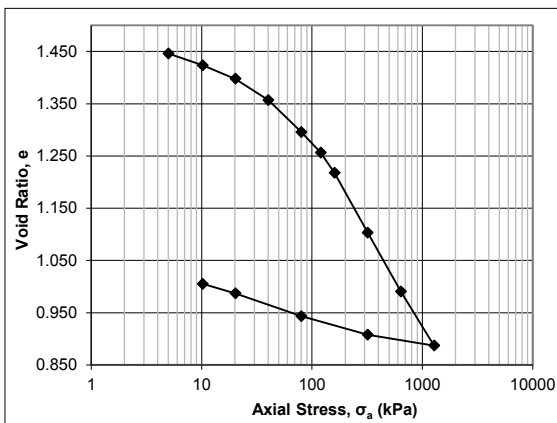
ASTM D2435/D2435M - 11

Specimen Details

Job Ref.	Thurber Consulting Ltd., LRB McLeod Road, Project # 10870
Job Location	Sault Ste. Marie
Borehole	BH 302
Sample No.	ST-1
Depth	10-12 ft
Sample Date	09/02/2016
Test Number	One
Technician Name	Daniel Boateng

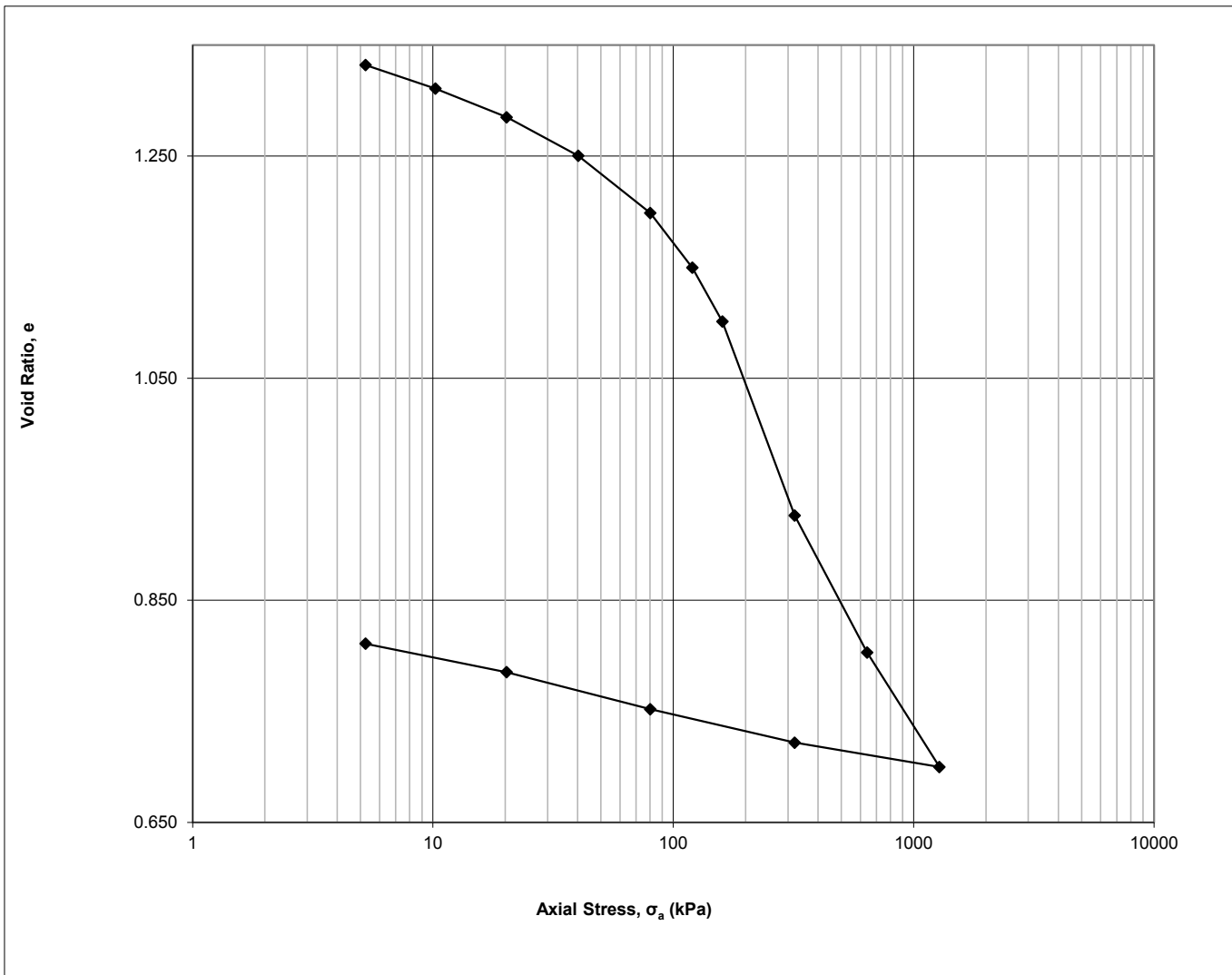
Calculations

Load Increment	Axial Stress σ_a , average kPa	Calculated using Interpretation Procedure 2				Interpretation Procedure 1		Interpretation Procedure 2	
		Corrected Deformation ΔH_{50} mm	Specimen Height H_{50} mm	Axial Strain $\epsilon_{a,50}$ %	Void Ratio e_{50}	Time t_{50} sec	Coeff. Consol. c_v mm ² /s	Time t_{90} sec	Coeff. Consol. c_v mm ² /s
Seating	5								
1	10	0.0797	19.9203	0.40	1.436	558	3.50E-02	2731	3.08E-02
2	15	0.2635	19.7365	1.32	1.414	614	3.12E-02	1965	4.20E-02
3	30	0.5345	19.4655	2.67	1.381	515	3.62E-02	1853	4.34E-02
4	60	0.9056	19.0944	4.53	1.335	448	3.98E-02	936	8.26E-02
5	100	1.3403	18.6597	6.70	1.282	881	1.94E-02	2440	3.02E-02
6	140	1.6668	18.3332	8.33	1.242	485	3.43E-02	6335	1.12E-02
7	240	2.2386	17.7614	11.19	1.172	267	5.82E-02	1136	5.88E-02
8	480	3.2022	16.7978	16.01	1.054	242	5.75E-02	971	6.16E-02
9	960	4.0822	15.9178	20.41	0.947	107	1.17E-01	650	8.27E-02
10	800	4.4343	15.5657	22.17	0.904				
11	200	4.2115	15.7885	21.06	0.931				
12	50	3.9020	16.0980	19.51	0.969				
13	15	3.7467	16.2533	18.73	0.988				
14									
15									
16									
17									
18									
19									



Project
Project No.
Borehole No.
Sample No.
Sample Depth

Thurber Consulting Ltd., LRB McLeod Road, Project # 10870
122410864
BH 302
ST-2
35-37 ft



One-Dimensional Consolidation Test using Incremental Loading
ASTM D2435/D2435M - 11

2016-04-22
2016-04-22

Date:
Date:

Checked by: MO
Approved by: RH

Specimen Details

Project Name	Thurber Consulting Ltd., LRB McLeod Road, Project # 10870
Project Location	Sault Ste. Marie
Borehole	BH 302
Sample No.	ST-2
Depth	35-37 ft
Sample Date	09/02/2016
Test Number	Two
Technician Name	Daniel Boateng

Soil Description & Classification

Clay	
Specific Gravity of Solids	2.809
Average water content of trimmings %	46
Additional Notes (information source, occurrence and size of large isolated particles etc.)	
Significant amounts of sand seams present in sample	

Initial Specimen Conditions

Height	mm	20.00
Diameter	mm	50.00
Area	mm ²	1963
Volume	mm ³	39270
Mass	g	68.56
Dry Mass	g	47.10
Density	Mg/m ³	1.746
Dry Density	Mg/m ³	1.199
Water Content	%	45.56
Degree of Saturation	%	95.4
Height of Solids	mm	8.54
Initial Void Ratio		1.342

Final Specimen Conditions

Water Content	%	28.13
Final Void Ratio		0.811

One-Dimensional Consolidation Test using Incremental Loading
ASTM D2435/D2435M - 11

Specimen Details

Project Name	Thurber Consulting Ltd., LRB McLeod Road, Project # 10870
Project Location	Sault Ste. Marie
Borehole	BH 302
Sample No.	ST-2
Depth	35-37 ft
Sample Date	09/02/2016
Test Number	Two
Technician Name	Daniel Boateng

Test Procedure

Date Started	25/02/2016
Date Finished	09/03/2016
Machine Number	D
Cell Number	D
Ring Number	D
Trimming Procedure	Turntable
Moisture Condition	Inundated
Axial Stress at Inundation	3 kPa
Water Used	Distilled
Test Method	A
Interpretation Procedure for c_v	2

All Departures from Outlined ASTM D2435/D2435M-11 Procedure
Calculations

Load Increment	Increment Duration	Axial Stress σ_a kPa	Corrected Deformation ΔH mm	Specimen Height H mm	Axial Strain ϵ_a %	Void Ratio e
Seating	1440.0	3	0.0000	20.0000	0.00	1.342
1	1440.0	5	0.0868	19.9132	0.43	1.332
2	1440.0	10	0.2672	19.7328	1.34	1.311
3	1440.0	20	0.4877	19.5123	2.44	1.285
4	1440.0	40	0.7836	19.2164	3.92	1.250
5	1440.0	80	1.2239	18.7761	6.12	1.199
6	1440.0	120	1.6452	18.3548	8.23	1.149
7	1440.0	160	2.0587	17.9413	10.29	1.101
8	1440.0	320	3.5504	16.4496	17.75	0.926
9	1440.0	640	4.6028	15.3972	23.01	0.803
10	1439.0	1280	5.4832	14.5168	27.42	0.700
11	1439.0	320	5.2962	14.7038	26.48	0.722
12	1440.0	80	5.0389	14.9611	25.19	0.752
13	1440.0	20	4.7539	15.2461	23.77	0.785
14	1440.0	5	4.5353	15.4647	22.68	0.811
15						
16						
17						
18						
19						

One-Dimensional Consolidation Test using Incremental Loading

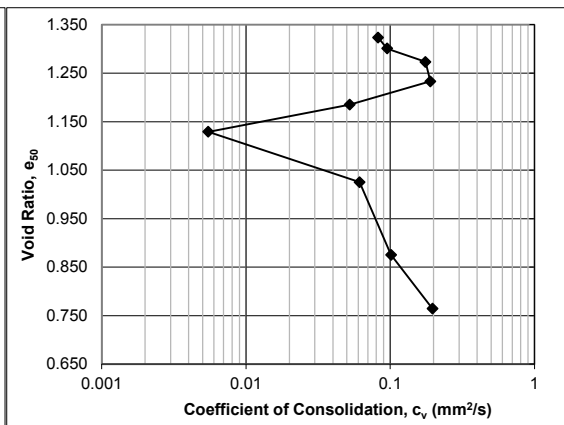
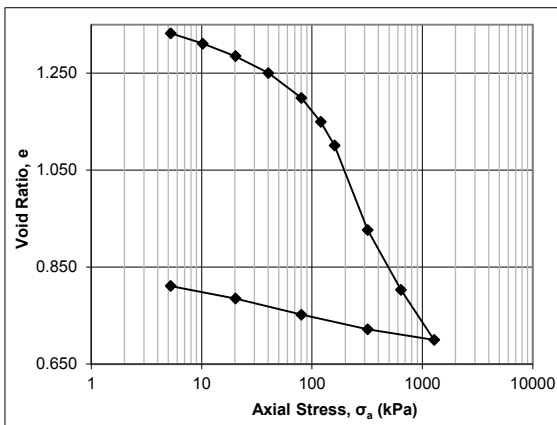
ASTM D2435/D2435M - 11

Specimen Details

Job Ref.	Thurber Consulting Ltd., LRB McLeod Road, Project # 10870
Job Location	Sault Ste. Marie
Borehole	BH 302
Sample No.	ST-2
Depth	35-37 ft
Sample Date	09/02/2016
Test Number	Two
Technician Name	Daniel Boateng

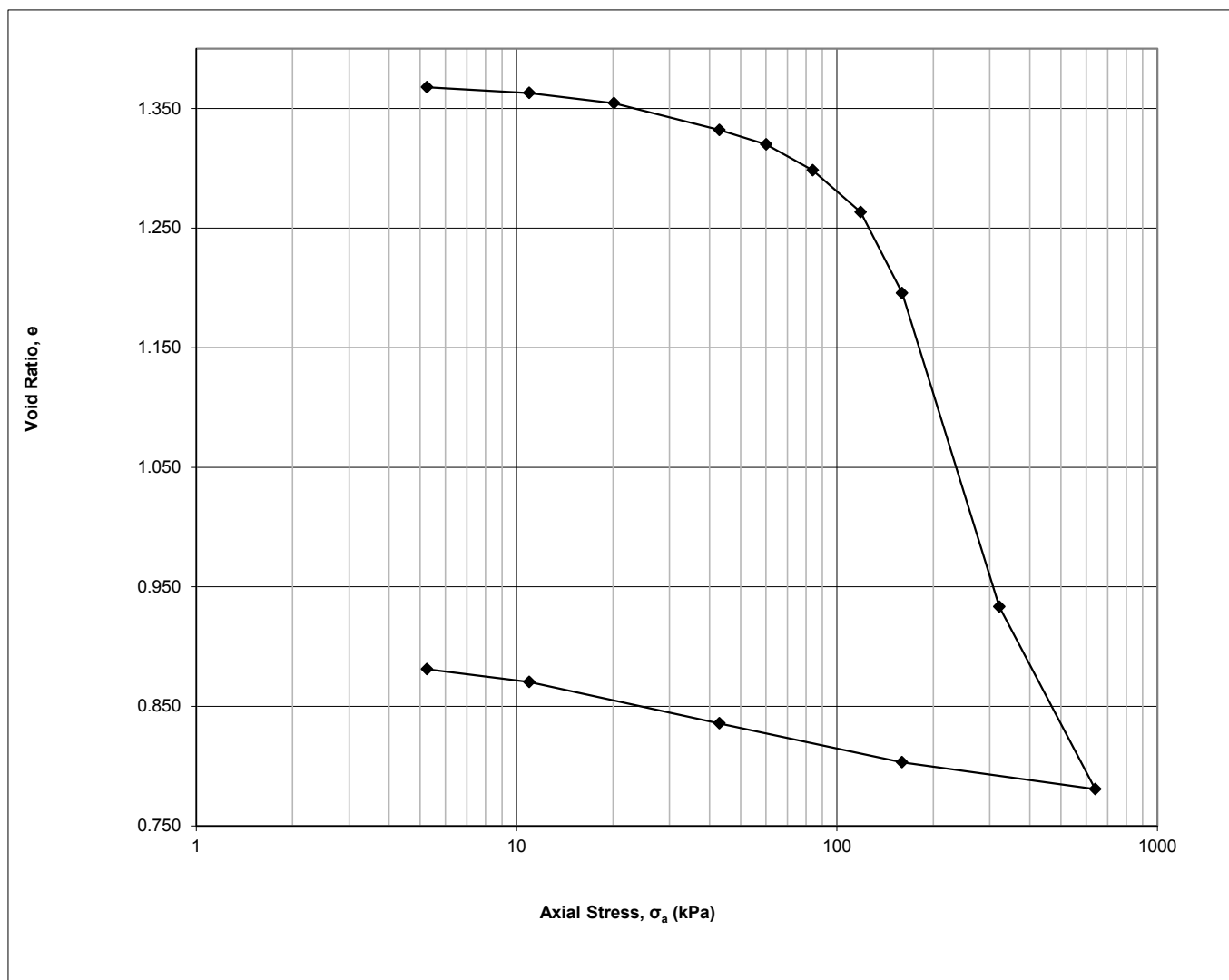
Calculations

Load Increment	Axial Stress $\sigma_{a, average}$ kPa	Calculated using Interpretation Procedure 2				Interpretation Procedure 1		Interpretation Procedure 2	
		Corrected Deformation ΔH_{50} mm	Specimen Height H_{50} mm	Axial Strain $\epsilon_{a, 50}$ %	Void Ratio e_{50}	Time t_{50} sec	Coeff. Consol. c_v mm ² /s	Time t_{90} sec	Coeff. Consol. c_v mm ² /s
Seating	3								
1	5	0.0204	19.9796	0.10	1.340	363	5.41E-02	273	3.10E-01
2	8	0.1601	19.8399	0.80	1.323	250	7.76E-02	1011	8.25E-02
3	15	0.3524	19.6476	1.76	1.301	303	6.26E-02	859	9.53E-02
4	30	0.5881	19.4119	2.94	1.273	283	6.53E-02	455	1.76E-01
5	60	0.9326	19.0674	4.66	1.233	296	6.01E-02	406	1.90E-01
6	100	1.3409	18.6591	6.70	1.185	77	2.24E-01	1408	5.24E-02
7	140	1.8181	18.1819	9.09	1.129	334	4.93E-02	12787	5.48E-03
8	240	2.7063	17.2937	13.53	1.025	146	1.02E-01	1034	6.13E-02
9	480	3.9853	16.0147	19.93	0.875	105	1.21E-01	536	1.01E-01
10	960	4.9333	15.0667	24.67	0.764	92	1.20E-01	245	1.97E-01
11	800	5.3142	14.6858	26.57	0.720				
12	200	5.1025	14.8975	25.51	0.745				
13	50	4.8579	15.1421	24.29	0.773				
14	13	4.7321	15.2679	23.66	0.788				
15									
16									
17									
18									
19									



Project
Project No.
Borehole No.
Sample No.
Sample Depth

Thurber Engineering, File# 10870
122410864
BH 305
ST 10
25-27 ft



One-Dimensional Consolidation Test using Incremental Loading
ASTM D2435/D2435M - 11

16-Aug-16
16-Aug-16

Date: Date:

D. Boateng
R. Hache

Checked by:
Approved by:

Specimen Details

Project Name	Thurber Engineering, File# 10870
Project Location	ON
Borehole	BH 305
Sample No.	ST 10
Depth	25-27 ft
Sample Date	July 18, 2016
Test Number	One
Technician Name	Daniel Boateng

Soil Description & Classification

Silty Clay	
Specific Gravity of Solids	2.730
Average water content of trimmings %	51
Additional Notes (information source, occurrence and size of large isolated particles etc.)	

Initial Specimen Conditions

Height	mm	19.01
Diameter	mm	50.02
Area	mm ²	1965
Volume	mm ³	37356
Mass	g	64.79
Dry Mass	g	43.01
Density	Mg/m ³	1.734
Dry Density	Mg/m ³	1.151
Water Content	%	50.64
Degree of Saturation	%	100.0
Height of Solids	mm	8.02
Initial Void Ratio		1.371

Final Specimen Conditions

Water Content	%	37.31
Final Void Ratio		0.881

One-Dimensional Consolidation Test using Incremental Loading

ASTM D2435/D2435M - 11

Specimen Details

Project Name	Thurber Engineering, File# 10870
Project Location	ON
Borehole	BH 305
Sample No.	ST 10
Depth	25-27 ft
Sample Date	July 18, 2016
Test Number	One
Technician Name	Daniel Boateng

Test Procedure

Date Started	July 26, 2016
Date Finished	August 11, 2016
Machine Number	Manual Frame A
Cell Number	A
Ring Number	A
Trimming Procedure	Turntable
Moisture Condition	Inundated
Axial Stress at Inundation kPa	5
Water Used	Distilled
Test Method	A
Interpretation Procedure for c_v	2

All Departures from Outlined ASTM D2435/D2435M-11 Procedure

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Calculations

Load Increment	Increment Duration min	Axial Stress σ_a kPa	Corrected Deformation ΔH mm	Specimen Height H mm	Axial Strain ϵ_a %	Void Ratio e
Seating	0.0	5	0.0000	19.0100	0.00	1.371
1	1440.0	5	0.0260	18.9840	0.14	1.368
2	1440.0	11	0.0650	18.9450	0.34	1.363
3	1440.0	20	0.1330	18.8770	0.70	1.355
4	1440.0	43	0.3130	18.6970	1.65	1.332
5	1440.0	60	0.4100	18.6000	2.16	1.320
6	1440.0	84	0.5830	18.4270	3.07	1.298
7	1440.0	119	0.8630	18.1470	4.54	1.263
8	1440.0	160	1.4070	17.6030	7.40	1.196
9	1440.0	321	3.5100	15.5000	18.46	0.933
10	1440.0	640	4.7330	14.2770	24.90	0.781
11	1440.0	160	4.5530	14.4570	23.95	0.803
12	1440.0	43	4.2920	14.7180	22.58	0.836
13	1440.0	11	4.0150	14.9950	21.12	0.870
14	1440.0	5	3.9280	15.0820	20.66	0.881

One-Dimensional Consolidation Test using Incremental Loading

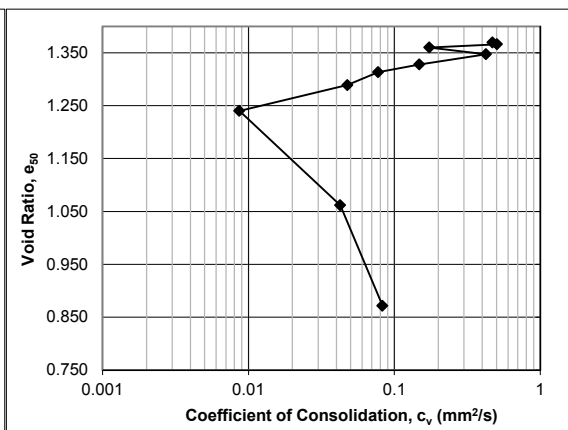
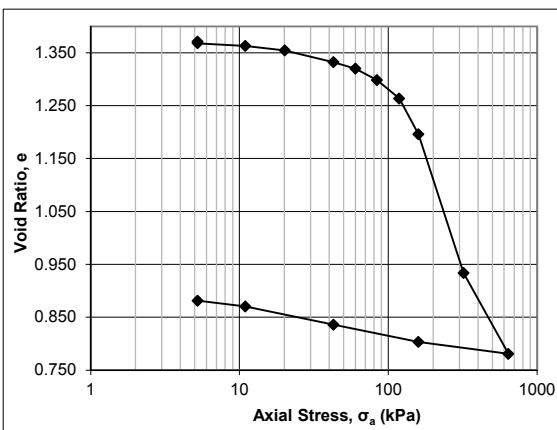
ASTM D2435/D2435M - 11

Specimen Details

Project Name	Thurber Engineering, File# 10870
Project Location	ON
Borehole	BH 305
Sample No.	ST 10
Depth	25-27 ft
Sample Date	July 18, 2016
Test Number	One
Technician Name	Daniel Boateng

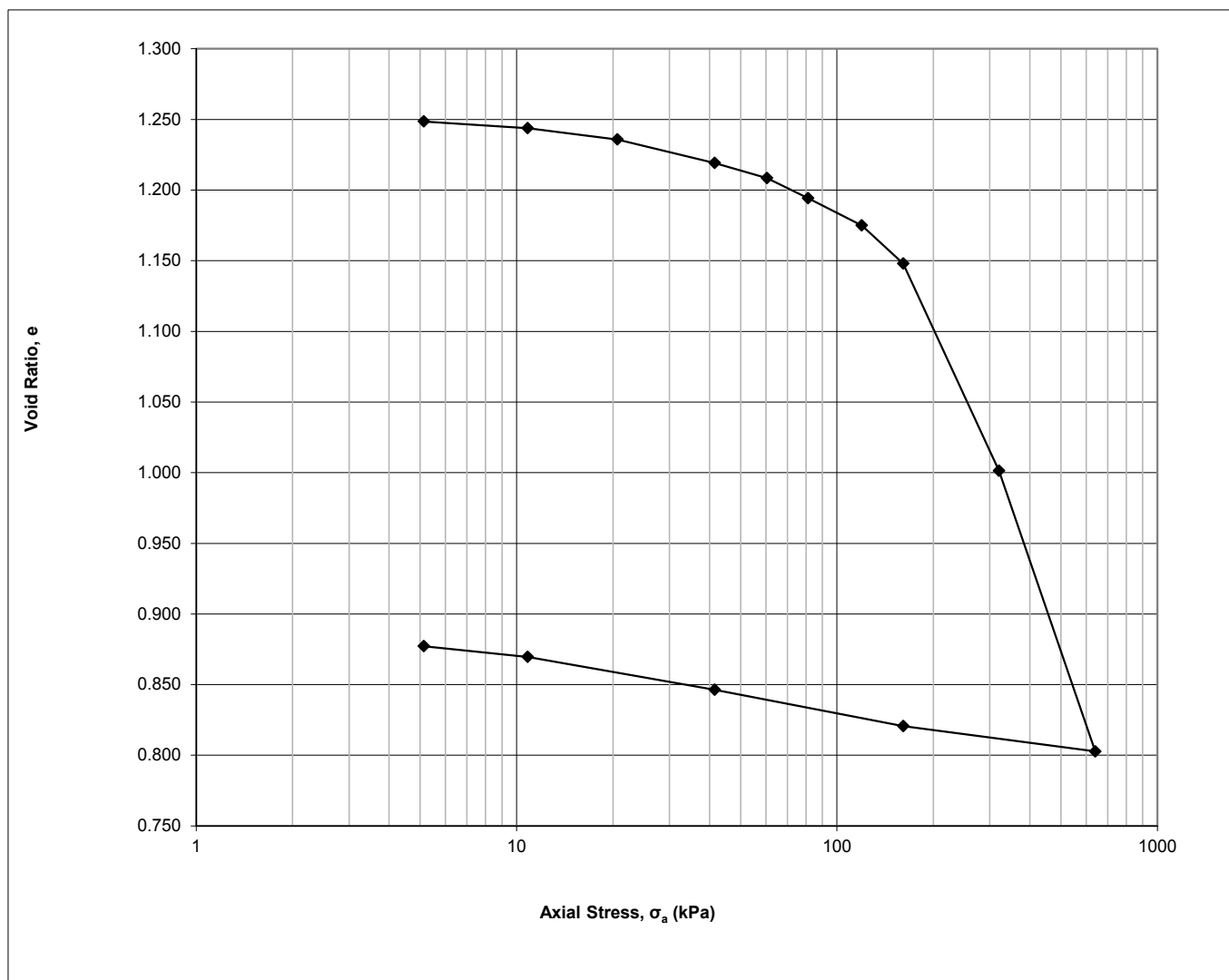
Calculations

Load Increment	Axial Stress σ_a , average kPa	Calculated using Interpretation Procedure 2				Interpretation Procedure 1		Interpretation Procedure 2	
		Corrected Deformation ΔH_{50} mm	Specimen Height H_{50} mm	Axial Strain $\epsilon_{a,50}$ %	Void Ratio e_{50}	Time t_{50} sec	Coeff. Consol. c_v mm ² /s	Time t_{90} sec	Coeff. Consol. c_v mm ² /s
Seating	3								
1	5	0.0129	18.9971	0.07	1.370			163	4.71E-01
2	8	0.0412	18.9688	0.22	1.366			151	5.05E-01
3	16	0.0904	18.9196	0.48	1.360			437	1.74E-01
4	32	0.1900	18.8200	1.00	1.347			177	4.25E-01
5	52	0.3456	18.6644	1.82	1.328			497	1.49E-01
6	72	0.4651	18.5449	2.45	1.313			943	7.73E-02
7	101	0.6586	18.3514	3.46	1.289			1498	4.77E-02
8	139	1.0497	17.9603	5.52	1.240			7901	8.66E-03
9	240	2.4805	16.5295	13.05	1.062			1363	4.25E-02
10	481	4.0048	15.0052	21.07	0.872			577	8.28E-02
11	400	4.6021	14.4079	24.21	0.797				
12	101	4.4126	14.5974	23.21	0.821				
13	27	4.1654	14.8446	21.91	0.852				
14	8	3.9931	15.0169	21.01	0.873				



Project
Project No.
Borehole No.
Sample No.
Sample Depth

Thurber Engineering, File# 10870
122410864
BH 305
ST 14
45-47 ft



One-Dimensional Consolidation Test using Incremental Loading
ASTM D2435/D2435M - 11

16-Aug-16
16-Aug-16

Date: Date:

D. Boateng
R. Hache

Checked by:
Approved by:

Specimen Details

Project Name	Thurber Engineering, File# 10870
Project Location	ON
Borehole	BH 305
Sample No.	ST 14
Depth	45-47 ft
Sample Date	July 18, 2016
Test Number	Two
Technician Name	Daniel Boateng

Soil Description & Classification

Silty Clay	
Specific Gravity of Solids	2.730
Average water content of trimmings %	45
Additional Notes (information source, occurrence and size of large isolated particles etc.)	

Initial Specimen Conditions

Height	mm	19.03
Diameter	mm	50.86
Area	mm ²	2032
Volume	mm ³	38662
Mass	g	68.09
Dry Mass	g	46.87
Density	Mg/m ³	1.761
Dry Density	Mg/m ³	1.212
Water Content	%	45.27
Degree of Saturation	%	98.7
Height of Solids	mm	8.45
Initial Void Ratio		1.252

Final Specimen Conditions

Water Content	%	33.38
Final Void Ratio		0.877

One-Dimensional Consolidation Test using Incremental Loading

ASTM D2435/D2435M - 11

Specimen Details

Project Name	Thurber Engineering, File# 10870
Project Location	ON
Borehole	BH 305
Sample No.	ST 14
Depth	45-47 ft
Sample Date	July 18, 2016
Test Number	Two
Technician Name	Daniel Boateng

Test Procedure

Date Started	July 26, 2016
Date Finished	August 26, 2016
Machine Number	Manual Frame B
Cell Number	B
Ring Number	B
Trimming Procedure	Turntable
Moisture Condition	Inundated
Axial Stress at Inundation kPa	5
Water Used	Distilled
Test Method	B
Interpretation Procedure for c_v	2

All Departures from Outlined ASTM D2435/D2435M-11 Procedure

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Calculations

Load Increment	Increment Duration min	Axial Stress σ_a kPa	Corrected Deformation ΔH mm	Specimen Height H mm	Axial Strain ϵ_a %	Void Ratio e
Seating	0.0	5	0.0000	19.0300	0.00	1.252
1	1440.0	5	0.0280	19.0020	0.15	1.249
2	1440.0	11	0.0690	18.9610	0.36	1.244
3	1440.0	21	0.1360	18.8940	0.71	1.236
4	1440.0	42	0.2770	18.7530	1.46	1.219
5	1440.0	61	0.3670	18.6630	1.93	1.208
6	1440.0	81	0.4880	18.5420	2.56	1.194
7	1440.0	120	0.6500	18.3800	3.42	1.175
8	1440.0	161	0.8780	18.1520	4.61	1.148
9	1440.0	320	2.1180	16.9120	11.13	1.001
10	1440.0	640	3.7960	15.2340	19.95	0.803
11	1440.0	161	3.6450	15.3850	19.15	0.821
12	1440.0	42	3.4280	15.6020	18.01	0.846
13	1440.0	11	3.2310	15.7990	16.98	0.870
14	1440.0	5	3.1670	15.8630	16.64	0.877

One-Dimensional Consolidation Test using Incremental Loading

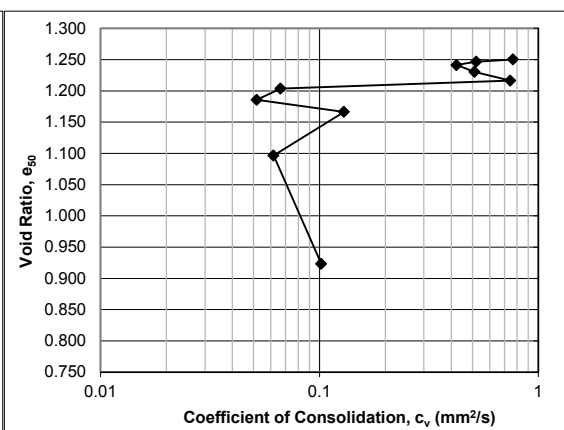
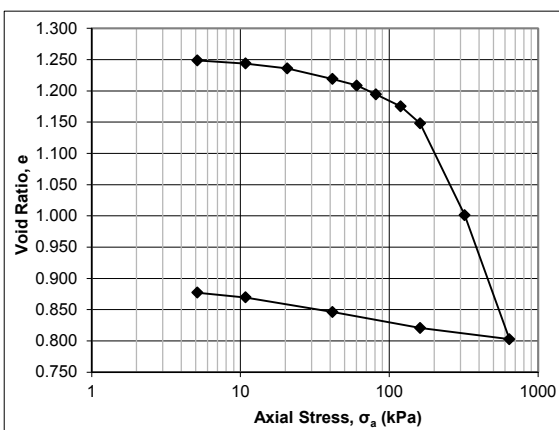
ASTM D2435/D2435M - 11

Specimen Details

Project Name	Thurber Engineering, File# 10870
Project Location	ON
Borehole	BH 305
Sample No.	ST 14
Depth	45-47 ft
Sample Date	July 18, 2016
Test Number	Two
Technician Name	Daniel Boateng

Calculations

Load Increment	Axial Stress σ_a , average kPa	Calculated using Interpretation Procedure 2				Interpretation Procedure 1		Interpretation Procedure 2	
		Corrected Deformation ΔH_{50} mm	Specimen Height H_{50} mm	Axial Strain $\epsilon_{a,50}$ %	Void Ratio e_{50}	Time t_{50} sec	Coeff. Consol. c_v mm ² /s	Time t_{90} sec	Coeff. Consol. c_v mm ² /s
Seating	3								
1	5	0.0130	19.0170	0.07	1.250			100	7.67E-01
2	8	0.0432	18.9868	0.23	1.247			147	5.21E-01
3	16	0.0903	18.9397	0.47	1.241			180	4.23E-01
4	31	0.1820	18.8480	0.96	1.230			147	5.11E-01
5	51	0.3007	18.7293	1.58	1.216			100	7.45E-01
6	71	0.4074	18.6226	2.14	1.204			1107	6.64E-02
7	100	0.5615	18.4685	2.95	1.185			1399	5.17E-02
8	140	0.7223	18.3077	3.80	1.166			549	1.29E-01
9	241	1.3133	17.7167	6.90	1.096			1077	6.18E-02
10	480	2.7768	16.2532	14.59	0.923			549	1.02E-01
11	401	3.6843	15.3457	19.36	0.816				
12	101	3.5241	15.5059	18.52	0.835				
13	26	3.3406	15.6894	17.55	0.857				
14	8	3.2148	15.8152	16.89	0.871				



Certificate of Analysis
Client: Thurber Engineering Ltd.

Client PO:
Report Date: 01-Mar-2016

Order Date: 25-Feb-2016

Project Description: 10870

Client ID:	McLeod Rd BH302	Centreline Rd	-	-
	SS3 5-7	BH202 SS5 10-12	-	-
Sample Date:	14-Feb-16	17-Feb-16	-	-
Sample ID:	1609281-01	1609281-02	-	-
MDL/Units	Soil	Soil	-	-

Physical Characteristics

% Solids	0.1 % by Wt.	73.8	72.3	-	-
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General Inorganics

pH	0.05 pH Units	7.68	7.65	-	-
Resistivity	0.10 Ohm.m	39.5	24.1	-	-

Anions

Chloride	5 ug/g dry	69	201	-	-
Sulphate	5 ug/g dry	31	16	-	-

Certificate of Analysis
Client: Thurber Engineering Ltd.
Client PO:

Report Date: 16-Aug-2016

Order Date: 10-Aug-2016

Project Description:

Client ID:	307 SS1	305 SS4	-	-
Sample Date:	10-Aug-16	10-Aug-16	-	-
Sample ID:	1633200-01	1633200-02	-	-
MDL/Units	Soil	Soil	-	-

Physical Characteristics

% Solids	0.1 % by Wt.	64.6	80.1	-	-
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General Inorganics

pH	0.05 pH Units	7.71	5.08	-	-
Resistivity	0.10 Ohm.m	50.3	281	-	-

Anions

Chloride	5 ug/g dry	16	9	-	-
Sulphate	5 ug/g dry	37	14	-	-

APPENDIX D

SELECT PHOTOGRAPHS OF THE BRIDGE LOCATION



Figure 1: Looking southwest towards the existing McLeod Road Bridge



Figure 2: Looking north along the proposed alignment from south abutment



Figure 3: Looking south along the proposed alignment from north abutment



Figure 4: Looking west across the proposed location of the north abutment towards the existing McLeod Road Bridge



Figure 5: Looking south towards location of Borehole 307 (south abutment)



Figure 6: Looking upstream from the McLeod Road Bridge



Figure 7: Looking downstream from Borehole 306