

**FOUNDATION INVESTIGATION REPORT
MARGUERATT ROAD CULVERT REPLACEMENT
NEW LISKEARD DISTRICT, ONTARIO**

G.W.P. No. 5032-14-00, SITE NO. 47-343

Geocres Number: 31M-110

Report to

MMM GROUP LIMITED

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5014-E-0024\Reports & Memos\Margueratt Road
Culvert\FINAL FIR\Margueratt Road Culvert Final FIR-Oct
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1 INTRODUCTION

This report presents the factual data obtained from a foundation investigation conducted by Thurber Engineering Ltd. (Thurber) at the culvert on Margueratt Road (Ingram Concession 3) over an unnamed creek, located in the Township of Ingram, New Liskeard District, Ontario.

The purpose of this investigation was to obtain subsurface information at the culvert location and, based on the data obtained, to provide borehole location plans, stratigraphic profiles, records of boreholes, laboratory test results, and a written description of the subsurface conditions.

Thurber was retained by MMM Group Limited to carry out this foundation investigation under the MTO Assignment Number 5014-E-0024.

2 SITE DESCRIPTION

The culvert site is located on Margueratt Road (Ingram Concession 3), 2.5 km east of Highway 569 in the Township of Ingram, New Liskeard District, Ontario. This culvert allows an unnamed creek to flow, from north to south, under Margueratt Road.

The existing structure is an 18 m long, twin 2.1 m diameter corrugated steel pipe (CSP) culvert with approximately 1 m of fill above the culverts. The embankment in the vicinity of the culvert was approximately 3 m in height. The year the structure was constructed is unknown. It is understood that the culverts are in poor condition with deterioration and deformation of the culvert barrels, and breakdown of the structural steel coatings. The twin culvert is proposed for full replacement.

Margueratt Road is a 2-lane gravel road with a grade level at the existing culvert at approximate Elevation 207 m.

The site is located approximately 18 km east of Englehart with residential properties nearby. Naturally low-lying, swampy areas are present near the inlet and outlet of the culvert, with vegetation consisting of tall grass and shrubs with frequent trees. Local topography is of low relief with no

visible bedrock outcrops. Areas surrounding the properties are heavily forested. The area in the immediate vicinity of the culvert is undulating and generally sloping downwards from the road grade to the creek.

Based on published geological information, the general area of the project is covered by glacioacustrine sediments of clays and silts deposited during the Pleisocene period. These deposits are mostly varved clays, but massive clays are also present in some areas. Due to the different rates of seasonal deposition during various periods of glaciation, the lower zones of the deposits display much thicker varves than in the upper zones. Below the varved clays are glacial outwash deposits of silts, sands and gravel underlain by Upper Ordovician shale, limestone, dolostone, and siltstone of the Liskeard Group.

Selected photographs of the culvert area are included in Appendix D for reference.

3 SITE INVESTIGATION AND FIELD TESTING

This borehole investigation and field testing program was carried out in two segments. The first between May 23 and May 25, 2015 and the second between June 22 and June 26, 2015. The program consisted of drilling and sampling 6 boreholes (numbered MR-01 to MR-06) to depths ranging from 12.2 to 14.3 m, and extending two boreholes (MR-04 and MR-03) to 17.4 and 45.7 m by conducting Dynamic Cone Penetration Tests (DCPTs). Of these boreholes, two were located near the culvert inlet (MR-01 and MR-02), two were located near the culvert outlet (MR-05 and MR-06), and two were located on the shoulders of the road embankment (MR-03 and MR-04).

Prior to the start of drilling, the borehole locations were marked/staked in the field and utility clearances were obtained. The coordinates and ground surface elevations for the boreholes were derived from topographic plans provided to Thurber by MMM Group Limited. The approximate borehole locations are shown on the Borehole Locations and Soil Strata drawing included in Appendix C.

A track-mounted CME 45 hi-torque drill rig was used to advance boreholes MR-03 and MR-04 to the target depth using hollow stem augers and NW casing/wash boring techniques. A portable tripod drill rig was used to advance boreholes MR-01, MR-02, MR-05, and MR-06 due to difficult access for a conventional drill rig beyond the road embankment. Soil samples were obtained at selected intervals using a 50 mm diameter split spoon sampler in conjunction with Standard Penetration Testing (SPT). Field vane shear testing using an MTO “N” size vane were carried out in very soft to soft cohesive soils. Dynamic cone penetration tests (DCPT) were conducted below the last sample in boreholes MR-03 and MR-04 to specified depths. Groundwater conditions in the open boreholes were observed throughout the drilling operations. The details regarding borehole completion are summarized in Table 3.1.

Table 3.1 - Borehole Completion and Backfilling Details

Borehole	Borehole Depth/ Elevation (m)	Borehole Backfilling Details
MR-01	12.2/193.2	Bentonite holeplug and cuttings from 12.2 m to ground surface
MR-02	12.2/193.1	Bentonite holeplug and cuttings from 12.2 m to ground surface
MR-03	14.3/192.8	Bentonite holeplug and cuttings from 14.3 m to 0.2 m and granular to ground surface
MR-04	14.3/192.6	Bentonite holeplug and cuttings from 14.3 m to 0.2 m and granular to ground surface
MR-05	12.2/193.5	Bentonite holeplug and cuttings from 12.2 m to ground surface
MR-06	12.2/193.1	Bentonite holeplug and cuttings from 12.2 m to ground surface

The results of the field drilling and sampling are presented on the Record of Borehole sheets in Appendix A.

A member of Thurber's technical staff supervised the drilling and sampling operations on a full time basis. The supervisor logged the boreholes, secured the recovered soil samples in labelled containers, and transported the samples to Thurber's laboratory for further examination and testing.

4 LABORATORY TESTING

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

In order to assess the potential for sulphate attack on concrete foundations, as well as the potential for corrosion on metal associated with the structure, a sample of the existing sandy silt embankment fill, and a sample of surface water from the creek upstream of the bridge were collected. The samples were submitted to AGAT Laboratories in Mississauga, Ontario for analytical testing of corrosivity parameters and sulphate. The results of the analytical testing are summarized in Section 6 below and are presented in Appendix B.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

5.1 General

Reference is made to the Record of Borehole sheets in Appendix A for details of the soil stratigraphy encountered in the boreholes. A stratigraphic profile and selected cross-sections for this culvert site are presented on the Borehole Locations and Soil Strata Drawings in Appendix C 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 subsurface conditions encountered in the boreholes located on the road shoulder consist of granular fill overlying deposits of silty sand to sand, clayey silt, and an extensive layer of silty clay with occasional silt interlayers. At the culvert inlet and outlet beyond the road embankment, a layer of topsoil overlies the sand, clayey silt and clay layers. Groundwater levels are generally in the order of 0.4 to 2.4 m below original ground surface. More detailed descriptions of the individual stratum are presented below.

5.2 Topsoil

A layer of topsoil between 130 and 150 mm in thickness was encountered at the ground surface in Boreholes MR-01 and MR-05 located near the culvert inlet and outlet areas respectively. The topsoil thickness may vary between and beyond the borehole locations, and the limited data is not suitable for estimating topsoil quantities.

5.3 Embankment Fill

Embankment fill was encountered at ground surface in Boreholes MR-03 and MR-04. The upper part of the fill is brown to grey in colour and typically consists of a sand to sand and gravel with organic inclusions and rootlets at shallow depths. Where encountered, the embankment fill extended to depths of 1.4 to 1.7 m below the existing ground surface (base Elevation 205.7 to 205.2 m).

In Borehole MR-04, a 2.4 m sand fill layer underlies the upper sand and gravel fill with the inclusion of a 200 mm boulder at 2.1 m. This sand fill layer extends to a depth of 4.1 m (base Elevation 202.8 m). In Borehole MR-03, a sandy silt to silty sand fill layer 2.7 m in thickness underlies the upper sand and gravel fill with the inclusion of a 350 mm thick wood layer at 3.3 m. The lower boundary of the silty sand to sandy silt fill can be found at depths of 2.3 to 4.1 m respectively (base Elevations 204.8 and 203.0 m)

SPT N-values measured in the cohesionless fill ranged from 2 blows per 0.3 m penetration to 14 blows per 0.3 m penetration, but mostly between 7 and 11 blows per 0.3 m penetration indicating a typically loose to compact state.

Measured moisture contents of the recovered fill samples ranged between 2% and 310% in the wood layer, with most values ranging between 10% and 33%. No grain size analyses were conducted on samples of the gravelly sand to sand and gravel fill due to poor recoveries. The results of the grain size analysis conducted on the sand and sandy silt fill are presented on Figure B1 in Appendix B. These results are summarized in the following table.

Soil Particles	%
Gravel	0 to 1
Sand	68 to 84
Silt	20
Clay	12
Silt and Clay	15

5.4 Silty Sand to Sand

Sand to silty sand layers were found in boreholes MR-02 and MR-06 from surface, underlying the embankment fill in MR-03, beneath the silty clay layer in MR-01, and overlain by a layer of topsoil in MR-05. This brown to grey soil typically consists of trace gravel, trace to some clay, and occasional roots and rootlets at shallow depths. The thickness of the silty sand to sandy silt ranged from 1.5 to 2.4 m with a lower boundary at depths of 2.2 to 5.6 m (base Elevations 203.5 to 201.5 m).

SPT N-values measured in the silty sand to sandy silt ranged from 0 to 12 blows per 0.3 m penetration with most values between 3 and 9 blows per 0.3 m penetration indicating a typically loose to compact state.

Measured moisture contents of the recovered silty sand to sandy silt samples ranged between 15% and 53% with most values ranging between 17% and 40%. Grain size analyses conducted on samples of the silty sand to sand are presented in Figure B2. The results are summarized in the following table.

Soil Particles	%
Gravel	1 to 7
Sand	56 to 91
Silt	18 to 29
Clay	12 to 15
Silt and Clay	8 to 10

5.5 Clayey Silt

A clayey silt layer was encountered beneath the silty sand to sand layer in Boreholes MR-01, MR-02, MR-05, and MR-06, and underlying the sand fill in Borehole MR-04. The clayey silt ranged in composition from some sand to sandy. The thickness of the clayey silt ranged from 1.1 to 1.9 m with a lower boundary at depths of 4.1 to 5.6 m (base Elevations 201.6 to 201.2 m).

The measured N-values in the clayey silt ranged between 1 and 9 blows per 0.3 m penetration with most values between 1 and 3 blows per 0.3 m penetration indicating a typically very soft to soft consistency.

The measured water contents of samples recovered from this deposit typically ranged from 19% to 30%. Grain size analyses conducted on samples of the clayey silt are presented in Figure B3, and Atterberg Limits test results are presented in Figure B6 in Appendix B. The results are summarized in the following table.

Soil Particles	%
Gravel	0
Sand	19 to 38
Silt	32 to 60
Clay	19 to 30
Soil Property	%
Liquid Limit	34 to 38
Plasticity Index	8 to 13

The results of the Atterberg Limits tests indicate that the clayey silt is typically of low plasticity (ML) to intermediate plasticity (MI).

5.6 Silty Clay to Clay

A silty clay to clay layer was encountered in all six boreholes drilled at the site. All boreholes were terminated within the grey silty clay to clay with some silt at depths of 12.2 to 14.3 m (base Elevations 193.2 to 192.6 m).

The measured N-values in the silty clay range between 0 and 1 blows per 0.3 m penetration. In conjunction with measured field vane shear strengths ranging from 29 to 50 kPa, the silty clay to clay was found to have a typically firm consistency.

The measured water contents of samples recovered from these soils typically ranged from 43% to 79%. Grain size analyses conducted on samples of the silty clay are presented in Figure B4 and Figure B5, and Atterberg Limits test results are presented in Figure B7 and Figure B8 in Appendix B. The results are summarized in the following table.

Soil Particles	%
Gravel	0
Sand	0
Silt	16 to 44
Clay	56 to 84
Soil Property	%
Liquid Limit	60 to 65
Plasticity Index	31 to 38

The results of the Atterberg Limits tests indicate that the silty clay is typically of high plasticity (CH) with occasional intermediate plasticity (CI) zones.

Below the sampled depth in Borehole MR-03, a DCPT was carried out within the silty clay to a depth of 45.7 m (base Elevation 161.4 m). No practical refusal was encountered (100 blows per 0.3 m penetration).

5.7 Groundwater Conditions

Free water was observed in most of the boreholes upon completion of drilling and are presented below.

Table 5.1 – Water Level Measurements in Open Borehole

Borehole	Date of Reading	Water Level	
		Depth (m)	Elevation (m)
MR-01	June 04, 2015	0.7	204.7
MR-02	June 05, 2015	0.7	204.6
MR-03	May 25, 2015	11.3	195.8
MR-04	May 25, 2015	2.4	204.5
MR-05	June 07, 2015	0.4	205.3
MR-06	June 06, 2015	0.8	204.5

The groundwater level should be assumed to coincide with the local creek water level. Based on the observations and measurements above, the groundwater level adjacent to the creek is at approximate Elevation 205 m. The groundwater levels are expected to vary seasonally and are subject to severe weather events such as rainstorms.

6 CORROSIVITY AND SULPHATE TEST RESULTS

A sample of the existing silty sand embankment fill soil and a sample of the surface water from the creek were submitted for analytical testing of corrosivity parameters and sulphate. The results of the analytical tests are shown in Table 6.1. The laboratory certificates of analysis are presented in Appendix B.

Table 6.1 – Analytical Test Results

Parameter	Units (Soil)	Units (Water)	Test Results	
			MR-3 SS3/4A 5'-7'8"	Margueratt Road Culvert
			(Soil, 1.5-2.3 m deep)	(Creek Water)
Sulphide	%	mg/L	0.01	<0.05
Chloride	µg/g	mg/L	9	0.27
Sulphate	µg/g	mg/L	6	1.99
pH	pH Units	pH Units	6.87	6.87
Electrical Conductivity	mS/cm	µS/cm	0.083	49
Resistivity	ohm.cm	ohm.cm	12000	20400
Redox Potential	mV	mV	338	324
Langlier Index	-	-	-	-2.06
Total Hardness (as CaCO ₃)	-	mg/L	-	25.4
Total Dissolved Solids	-	mg/L	-	40
Alkalinity (as CaCO ₃)	-	mg/L	-	23

7 MISCELLANEOUS

Thurber staked and/or marked the borehole locations in the field and obtained utility clearances prior to drilling. Thurber obtained the northing and easting coordinates and ground surface elevations from measurements taken in the field relative to the topographic plans provided by MMM Group Limited.

Eastern Ontario Diamond Drilling of Hawkesbury, Ontario supplied and operated a track-mounted CME-45 hi-torque drill rig and a portable tripod drill rig to carry out the drilling, sampling and in-situ testing operations on the embankment shoulders and near the culvert inlet and outlet. The drilling and sampling operations in the field were supervised on a full time basis by Ms. Deanna Pizycki and Mr. Amir Fereidouni of Thurber. Geotechnical laboratory testing was carried out by Thurber in its MTO-approved laboratory.

A sample of creek water and a sample of embankment fill soil was submitted to AGAT Laboratories in Mississauga, Ontario for testing against selected corrosivity parameters.

Overall supervision of the field program, interpretation of the data, and preparation of the report were carried out by Mr. Stephane Loranger, CET, Ms. Deanna Pizycki, EIT and Mr. Mark Farrant P.Eng. The report was reviewed by Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

THURBER ENGINEERING LTD.

Deanna Pizycki
OCT 22, 2015

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Mark Farrant, M.Eng., P.Eng.
Geotechnical Engineer



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

Appendix A

Record of Borehole Sheets

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

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

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

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

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

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

NOTE: Hierarchy of Soil Strength Prediction

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


4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

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

5. LEGEND FOR RECORDS OF BOREHOLES

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

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

 Water Level
 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.

EXPLANATION OF ROCK LOGGING TERMS


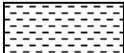



ROCK WEATHERING CLASSIFICATION

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.

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

SYMBOLS

	CLAYSTONE
	SILTSTONE
	SANDSTONE
	COAL
	BEDROCK

STRENGTH CLASSIFICATION

Rock Strength	Approximate Uniaxial Compressive Strength (MPa)	Approximate Uniaxial Compressive Strength (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

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 % 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.

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			

RECORD OF BOREHOLE No MR-01

1 OF 2

METRIC

GWP# 5032-14-00 LOCATION Margueratt Road Culvert N 5 296 315.0 E 405 041.6 ORIGINATED BY AHF
 HWY BOREHOLE TYPE Tripod COMPILED BY MFA
 DATUM Geodetic DATE 2015.06.25 - 2015.06.25 CHECKED BY MEF

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			20 40 60 80 100	○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	W _P W W _L	WATER CONTENT (%)	GR SA SI CL								
205.4	GROUND SURFACE																			
0.0	TOPSOIL: (130mm)																			
0.1	Silty CLAY , some roots and rootlets, trace sand		1	SS	4															
204.7	Soft																			
0.7	Brown																			
	Wet																			
	SAND , trace silt, trace gravel, trace to some clay, occasional roots and rootlets		2	SS	5															
	Loose																			
	Grey		3	SS	9															
	Wet																			
			4	SS	6															
202.4																				
3.0	Clayey SILT , sandy Very Soft Grey		5	SS	1															
201.3																				
4.1	CLAY , some silt Firm Grey		6	SS	1															
			7	SS	1															
			8	SS	1															
			9	SS	1															

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

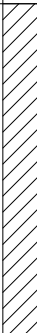
20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MR-01

2 OF 2

METRIC

GWP# 5032-14-00 LOCATION Margueratt Road Culvert N 5 296 315.0 E 405 041.6 ORIGINATED BY AHF
 HWY BOREHOLE TYPE Tripod COMPILED BY MFA
 DATUM Geodetic DATE 2015.06.25 - 2015.06.25 CHECKED BY MEF

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									
								20 40 60 80 100									
	Continued From Previous Page																
193.2							195			6.5 +							
			10	SS	1												
12.2	END OF BOREHOLE AT 12.2m. BOREHOLE OPEN TO 10.2m AND WATER LEVEL AT 0.7m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.									6.7 +							

RECORD OF BOREHOLE No MR-02

1 OF 2

METRIC

GWP# 5032-14-00 LOCATION Margueratt Road Culvert N 5 296 315.1 E 405 051.1 ORIGINATED BY AHF
 HWY BOREHOLE TYPE Tripod COMPILED BY MFA
 DATUM Geodetic DATE 2015.06.24 - 2015.06.24 CHECKED BY MEF

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								
205.3	GROUND SURFACE															
0.0	SAND , some silt, some clay, trace gravel, occasional roots and rootlets Loose Grey Moist		1	SS	5		205									
			2	SS	4		204									0 70 18 12
	Compact Wet		3	SS	12		203									
203.1							203									
2.2	Clayey SILT , sandy Very Soft Grey		4	SS	2		202									0 38 32 30
			5	SS	1		201									
201.2							200									
4.1	CLAY , some silt Firm Grey		6	SS	1		199									0 0 18 82
			7	SS	1		198									
			8	SS	1		197									
			9	SS	0		196									

Continued Next Page

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

RECORD OF BOREHOLE No MR-02

2 OF 2

METRIC

GWP# 5032-14-00 LOCATION Margueratt Road Culvert N 5 296 315.1 E 405 051.1 ORIGINATED BY AHF
 HWY BOREHOLE TYPE Tripod COMPILED BY MFA
 DATUM Geodetic DATE 2015.06.24 - 2015.06.24 CHECKED BY MEF

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%)				
							20	40	60	80	100	W _p	W	W _L			
	Continued From Previous Page																
			10	SS	1		195										
							194										
193.1																	
12.2	END OF BOREHOLE AT 12.2m. WATER LEVEL AT 0.7m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.																

RECORD OF BOREHOLE No MR-03

1 OF 5

METRIC

GWP# 5032-14-00 LOCATION Margueratt Road Culvert N 5 296 306.7 E 405 051.4 ORIGINATED BY DJP
 HWY BOREHOLE TYPE Hollow Stem Augers/Casing/Dynamic Cone Penetration Test COMPILED BY MFA
 DATUM Geodetic DATE 2015.05.23 - 2015.05.25 CHECKED BY MEF

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		WATER CONTENT (%)							
								20 40 60 80 100	20 40 60								
						○ UNCONFINED + FIELD VANE		w _P w w _L									
						● QUICK TRIAXIAL × LAB VANE											
207.1	GROUND SURFACE						20	40	60	80	100		GR	SA	SI	CL	
0.0	SAND , trace to some gravel, trace organics Loose to Compact Brown Dry to Moist (FILL)		1	SS	4												
			2	SS	13												
205.7																	
1.4	SILT , sandy to some sand, trace to some clay Compact Brown Moist to Wet (FILL)		3	SS	11												
204.8	sand layer (50mm) at 1.7m																
2.3	Silty SAND , some clay, trace gravel Loose Grey Wet to Moist (FILL) wood (350mm) at 3.3m		4	SS	2											0 68 20 12	
			5	SS	8												
203.0																	
4.1	SAND , some silt Loose Grey Wet		6	SS	7											0 90 10 (SI+CL)	
201.5																	
5.6	Silty CLAY Firm Grey		7	SS	0												
			8	SS	1												0 0 21 79
			9	SS	0												

Continued Next Page

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

RECORD OF BOREHOLE No MR-03

2 OF 5

METRIC

GWP# 5032-14-00 LOCATION Margueratt Road Culvert N 5 296 306.7 E 405 051.4 ORIGINATED BY DJP
 HWY BOREHOLE TYPE Hollow Stem Augers/Casing/Dynamic Cone Penetration Test COMPILED BY MFA
 DATUM Geodetic DATE 2015.05.23 - 2015.05.25 CHECKED BY MEF

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	W _p W W _L	WATER CONTENT (%)				
	Continued From Previous Page						197							
			10	SS	0		196	32						
			11	SS	0		195							
			12	SS	0		194							
192.8							193							0 0 41 59
14.3	End of sampling at 14.3m and start of DCPT.						192							
							191							
							190							
							189							
							188							

Continued Next Page

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

RECORD OF BOREHOLE No MR-03

3 OF 5

METRIC

GWP# 5032-14-00 LOCATION Margueratt Road Culvert N 5 296 306.7 E 405 051.4 ORIGINATED BY DJP
 HWY _____ BOREHOLE TYPE Hollow Stem Augers/Casing/Dynamic Cone Penetration Test COMPILED BY MFA
 DATUM Geodetic DATE 2015.05.23 - 2015.05.25 CHECKED BY MEF

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			20 40 60 80 100	20 40 60	W _p W W _L				
	Continued From Previous Page						187							
							186							
							185							
							184							
							183							
							182							
							181							
							180							
							179							
							178							

Continued Next Page

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

RECORD OF BOREHOLE No MR-03

4 OF 5

METRIC

GWP# 5032-14-00 LOCATION Margueratt Road Culvert N 5 296 306.7 E 405 051.4 ORIGINATED BY DJP
 HWY BOREHOLE TYPE Hollow Stem Augers/Casing/Dynamic Cone Penetration Test COMPILED BY MFA
 DATUM Geodetic DATE 2015.05.23 - 2015.05.25 CHECKED BY MEF

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			20 40 60 80 100	20 40 60	W _p W W _L				
	Continued From Previous Page						177							
							176							
							175							
							174							
							173							
							172							
							171							
							170							
							169							
							168							

Continued Next Page

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

RECORD OF BOREHOLE No MR-03

5 OF 5

METRIC

GWP# 5032-14-00 LOCATION Margueratt Road Culvert N 5 296 306.7 E 405 051.4 ORIGINATED BY DJP
 HWY BOREHOLE TYPE Hollow Stem Augers/Casing/Dynamic Cone Penetration Test COMPILED BY MFA
 DATUM Geodetic DATE 2015.05.23 - 2015.05.25 CHECKED BY MEF

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								
	Continued From Previous Page						167	20	40	60	80	100				
							166									
							165									
							164									
							163									
							162									
161.4																
45.7	END OF BOREHOLE AND DCPT AT 45.7m. WATER LEVEL AT 11.3m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.															

ONTMT4S 19-5161-252.GPJ 2015TEMPLATE(MTO).GDT 10/22/15

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No MR-04

2 OF 2

METRIC

GWP# 5032-14-00 LOCATION Margueratt Road Culvert N 5 296 299.7 E 405 041.1 ORIGINATED BY DJP
 HWY BOREHOLE TYPE Casing/Hollow Stem Augers/Dynamic Cone Penetration Test COMPILED BY MFA
 DATUM Geodetic DATE 2015.05.25 - 2015.05.25 CHECKED BY MEF

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																
	occasional silt seams		9	SS	0		196										
								195									
			10	SS	0			194	53								
192.6			11	SS	0			193									0 0 44 56
14.3	End of sampling at 14.3m and start of DCPT. All DCPT resistances recorded as 0 blows/0.3m.						192										
							191										
							190										
189.5																	
17.4	END OF BOREHOLE AND DCPT AT 17.4m. WATER LEVEL AT 2.4m UPON COMPLETION.																

ONTMT4S 19-5161-252.GPJ 2015TEMPLATE(MTO).GDT 10/22/15

RECORD OF BOREHOLE No MR-05

1 OF 2

METRIC

GWP# 5032-14-00 LOCATION Margueratt Road Culvert N 5 296 291.8 E 405 052.4 ORIGINATED BY AHF
 HWY BOREHOLE TYPE Tripod COMPILED BY MFA
 DATUM Geodetic DATE 2015.06.25 - 2015.06.26 CHECKED BY MEF

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					WATER CONTENT (%) w _p w w _L				GR	SA	SI	CL			
205.7	GROUND SURFACE																						
0.0	TOPSOIL: (150mm)																						
0.2	Silty SAND , some clay, occasional roots and rootlets Very Loose Brown to Grey Moist Loose Wet		1	SS	0														0	56	29	15	
			2	SS	5																		
	trace gravel																						
			3	SS	3																		
203.5																							
2.2	Clayey SILT , some sand Soft to Very Soft Grey		4	SS	3															0	19	60	21
			5	SS	1																		
201.6																							
4.1	CLAY , some silt Firm Grey																						
			6	SS	1																		
			7	SS	1																		
					</																		

Continued Next Page

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

RECORD OF BOREHOLE No MR-05

2 OF 2

METRIC

GWP# 5032-14-00 LOCATION Margueratt Road Culvert N 5 296 291.8 E 405 052.4 ORIGINATED BY AHF
 HWY BOREHOLE TYPE Tripod COMPILED BY MFA
 DATUM Geodetic DATE 2015.06.25 - 2015.06.26 CHECKED BY MEF

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																
			10	SS	1		195										
							194										
193.5																	
12.2	END OF BOREHOLE AT 12.2m. BOREHOLE OPEN TO 9.0m AND WATER LEVEL AT 0.4m UPON COMPLETION.																

RECORD OF BOREHOLE No MR-06

1 OF 2

METRIC

GWP# 5032-14-00 LOCATION Margueratt Road Culvert N 5 296 292.1 E 405 041.7 ORIGINATED BY AHF
 HWY BOREHOLE TYPE Tripod COMPILED BY MFA
 DATUM Geodetic DATE 2015.06.23 - 2015.06.23 CHECKED BY MEF

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 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%) w _P w w _L				GR	SA	SI	CL
205.3	GROUND SURFACE							20	40	60	80	100							
0.0	Silty SAND , trace gravel, trace clay, occasional roots and rootlets Loose Brown Moist Very Loose		1	SS	4		205							○					
			2	SS	2		204							○					
	becoming trace silt becoming Grey Wet		3	SS	9		203							○					1 91 8 (SI+CL)
202.9							202							○					
2.4	Clayey SILT , sandy Stiff to Very Soft Grey		4	SS	9									○					
			5	SS	1									○					0 34 47 19
201.2														○					
4.1	CLAY , some silt Firm Grey		6	SS	1									○					
														○					
			7	SS	1								○						
													○						
			8	SS	0								○						
													○						
			9	SS	1								○						
													○						

Continued Next Page

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

RECORD OF BOREHOLE No MR-06

2 OF 2

METRIC

GWP# 5032-14-00 LOCATION Margueratt Road Culvert N 5 296 292.1 E 405 041.7 ORIGINATED BY AHF
 HWY BOREHOLE TYPE Tripod COMPILED BY MFA
 DATUM Geodetic DATE 2015.06.23 - 2015.06.23 CHECKED BY MEF

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																
	silty		10	SS	1		195										
193.1							194										
12.2	END OF BOREHOLE AT 12.2m. BOREHOLE OPEN TO 9.9m AND WATER LEVEL AT 0.8m UPON COMPLETION.																

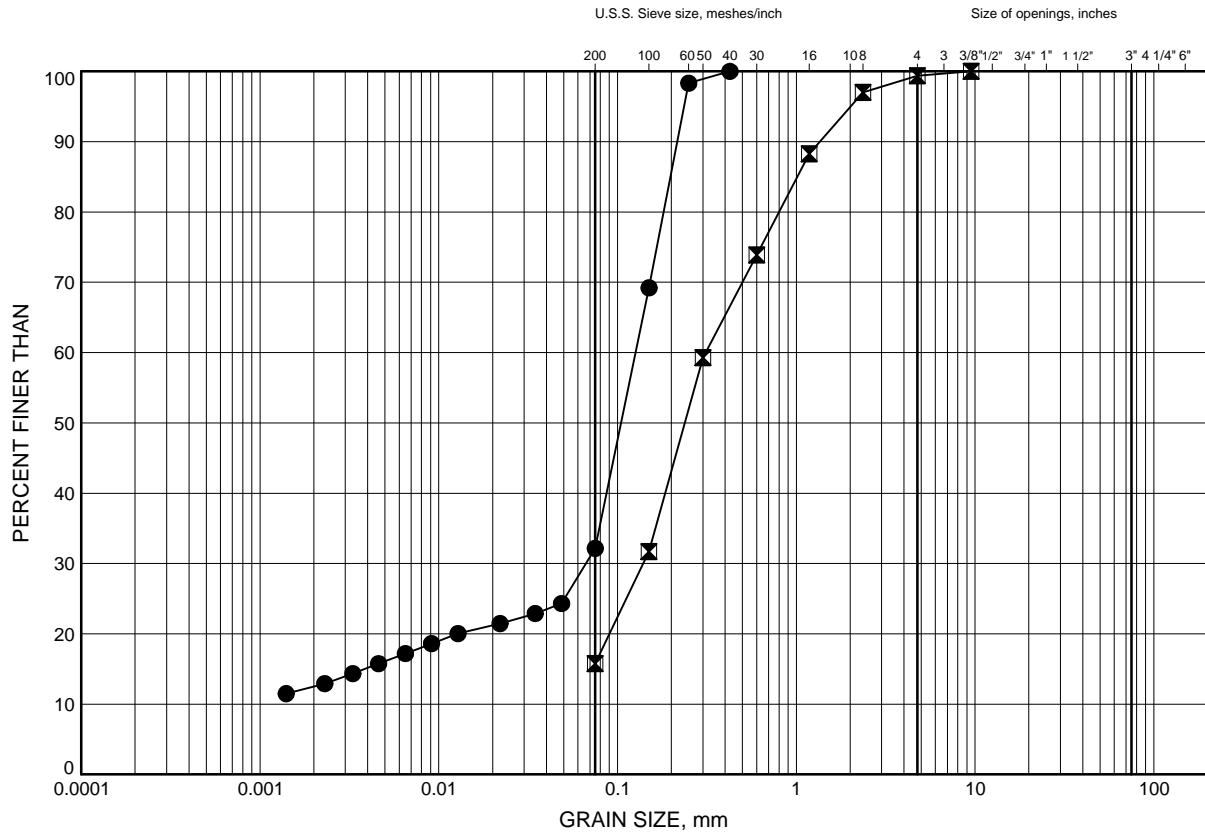
Appendix B

Geotechnical and Analytical Laboratory Test Results

Margueratt Road Culvert GRAIN SIZE DISTRIBUTION

FIGURE B1

Embankment FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MR-03	2.62	204.48
⊠	MR-04	2.59	204.31

Date ..October 2015.....

GWP# ..5032-14-00.....



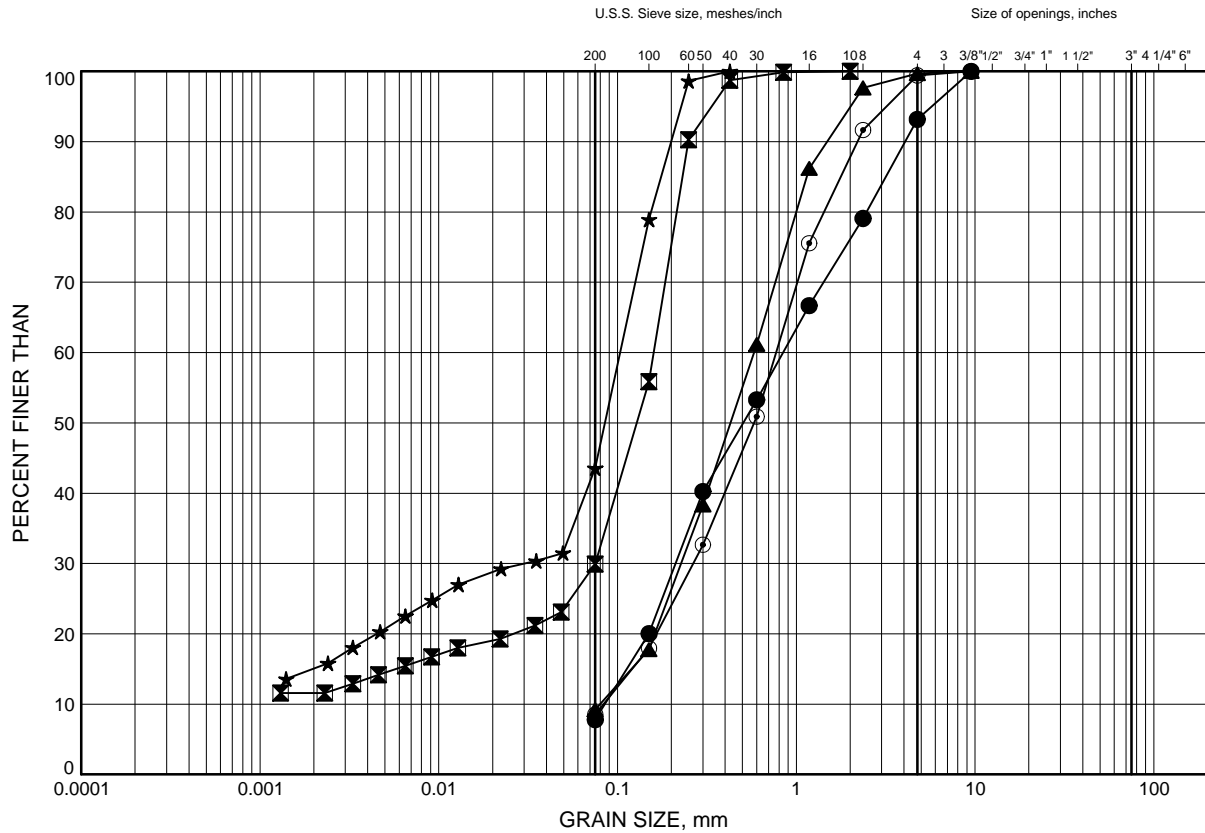
Prep'dAN.....

Chkd.AMP.....

Margueratt Road Culvert GRAIN SIZE DISTRIBUTION

FIGURE B2

Silty SAND to SAND



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MR-01	1.83	203.57
⊠	MR-02	1.07	204.23
▲	MR-03	4.88	202.22
★	MR-05	0.30	205.40
⊙	MR-06	1.83	203.47

Date ..October 2015.....

GWP# ..5032-14-00.....



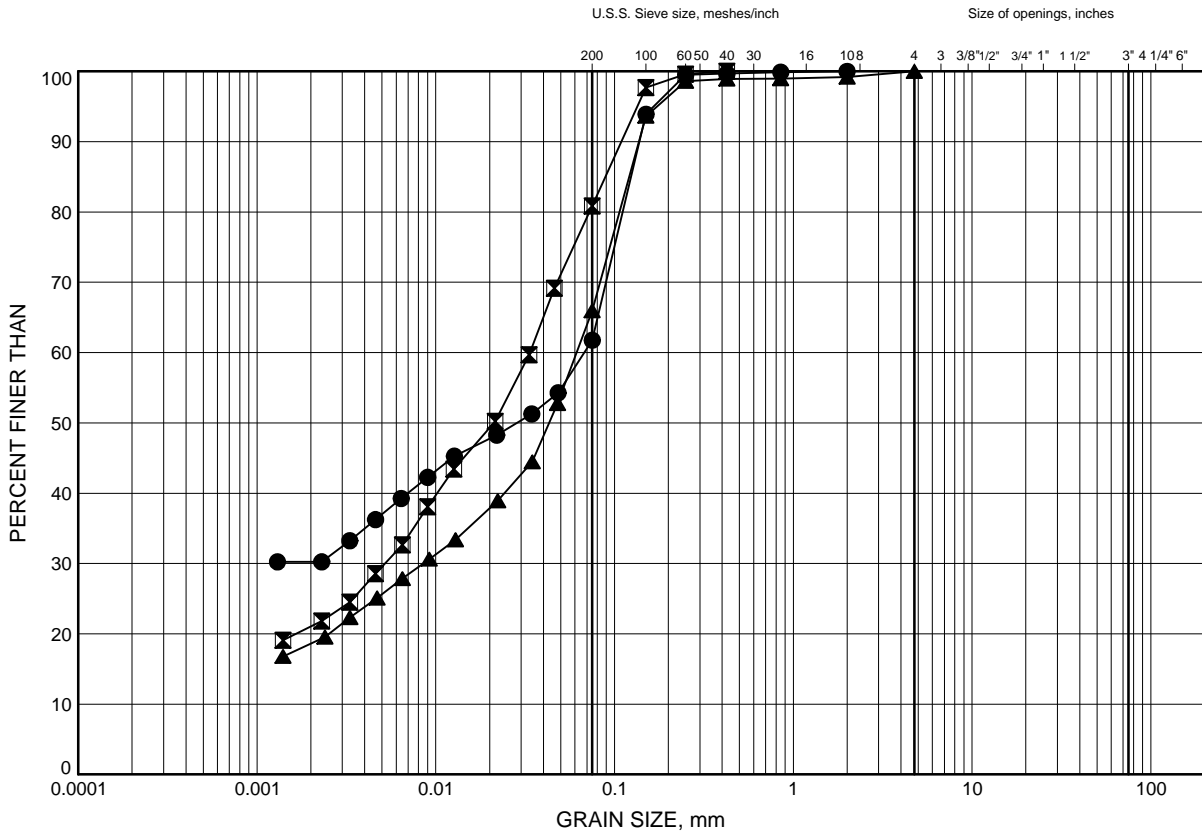
Prep'dAN.....

Chkd.AMP.....

Margueratt Road Culvert GRAIN SIZE DISTRIBUTION

FIGURE B3

Clayey SILT



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MR-02	3.35	201.95
⊠	MR-05	2.59	203.11
▲	MR-06	3.35	201.95

Date ..October 2015.....

GWP# ..5032-14-00.....

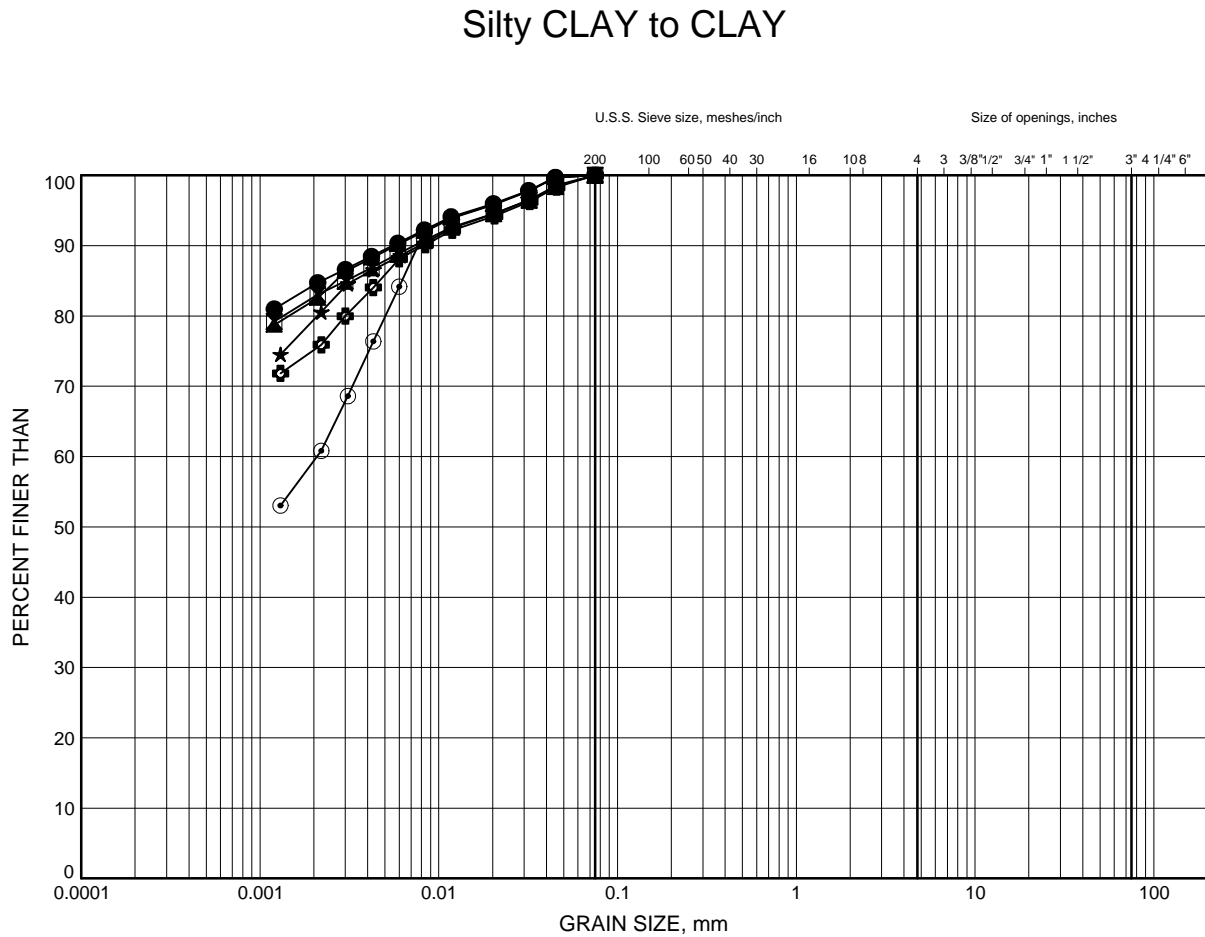


Prep'dAN.....

Chkd.AMP.....

Margueratt Road Culvert GRAIN SIZE DISTRIBUTION

FIGURE B4



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MR-01	4.88	200.52
⊠	MR-01	9.45	195.95
▲	MR-02	6.40	198.90
★	MR-03	7.92	199.18
⊙	MR-03	14.02	193.08
⊕	MR-04	7.92	198.98

Date October 2015

GWP# 5032-14-00

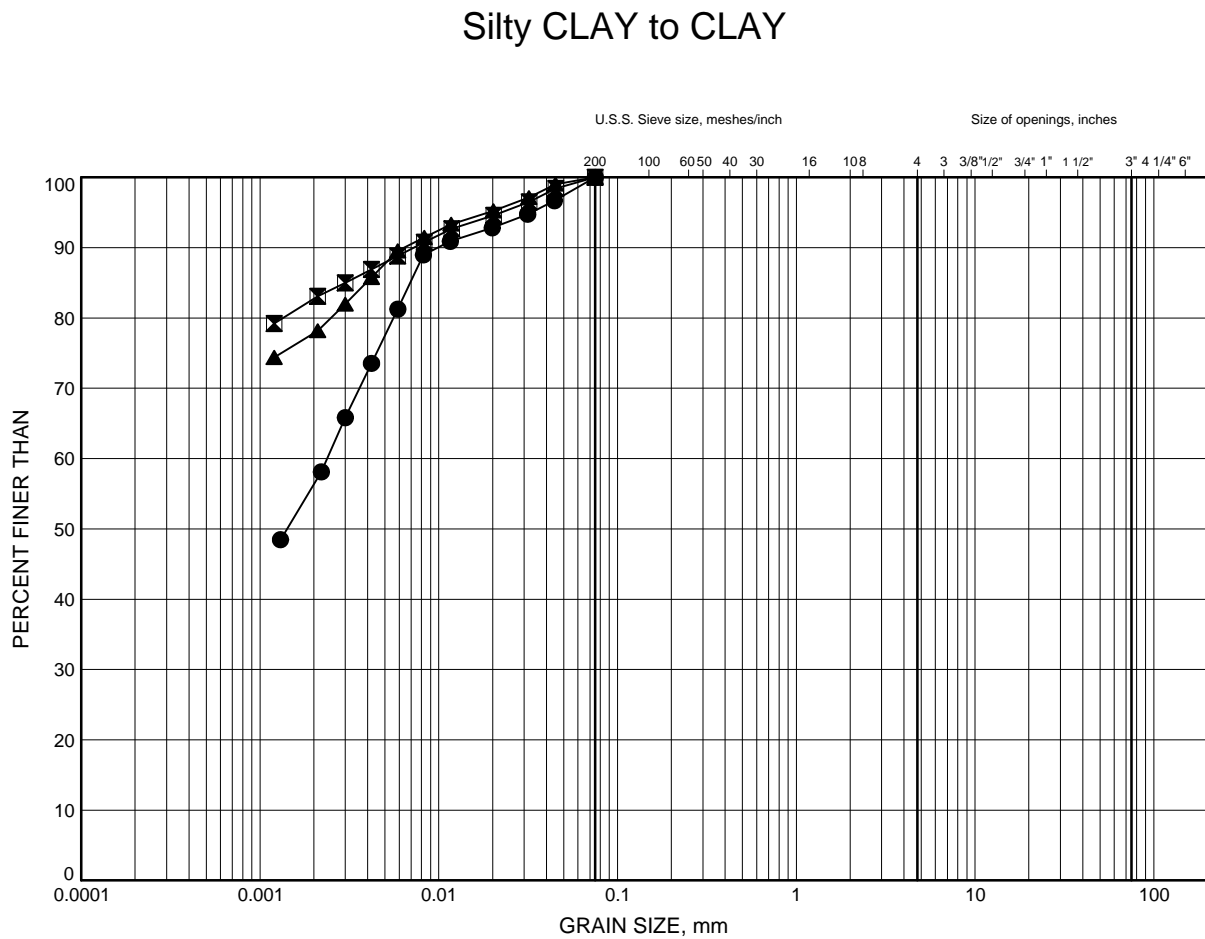


Prep'd AN

Chkd. AMP

Margueratt Road Culvert
GRAIN SIZE DISTRIBUTION

FIGURE B5



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MR-04	14.02	192.88
⊠	MR-05	7.92	197.78
▲	MR-06	10.97	194.33

Date ..October 2015.....
GWP# ..5032-14-00.....

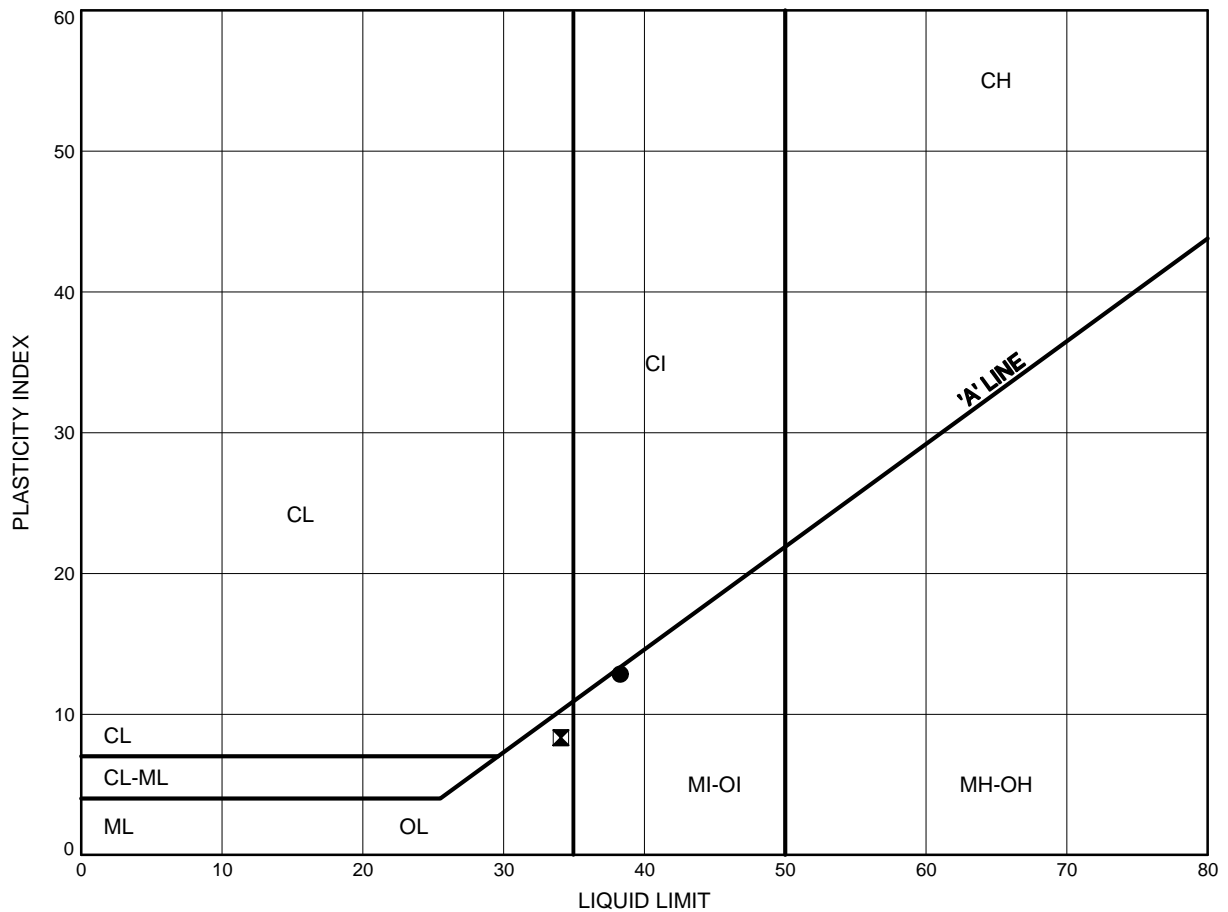


Prep'dAN.....
Chkd.AMP.....

Margueratt Road Culvert
ATTERBERG LIMITS TEST RESULTS

FIGURE B6

Clayey SILT



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MR-02	3.35	201.95
⊠	MR-06	3.35	201.95

Date ..October 2015.....
 GWP# ..5032-14-00.....

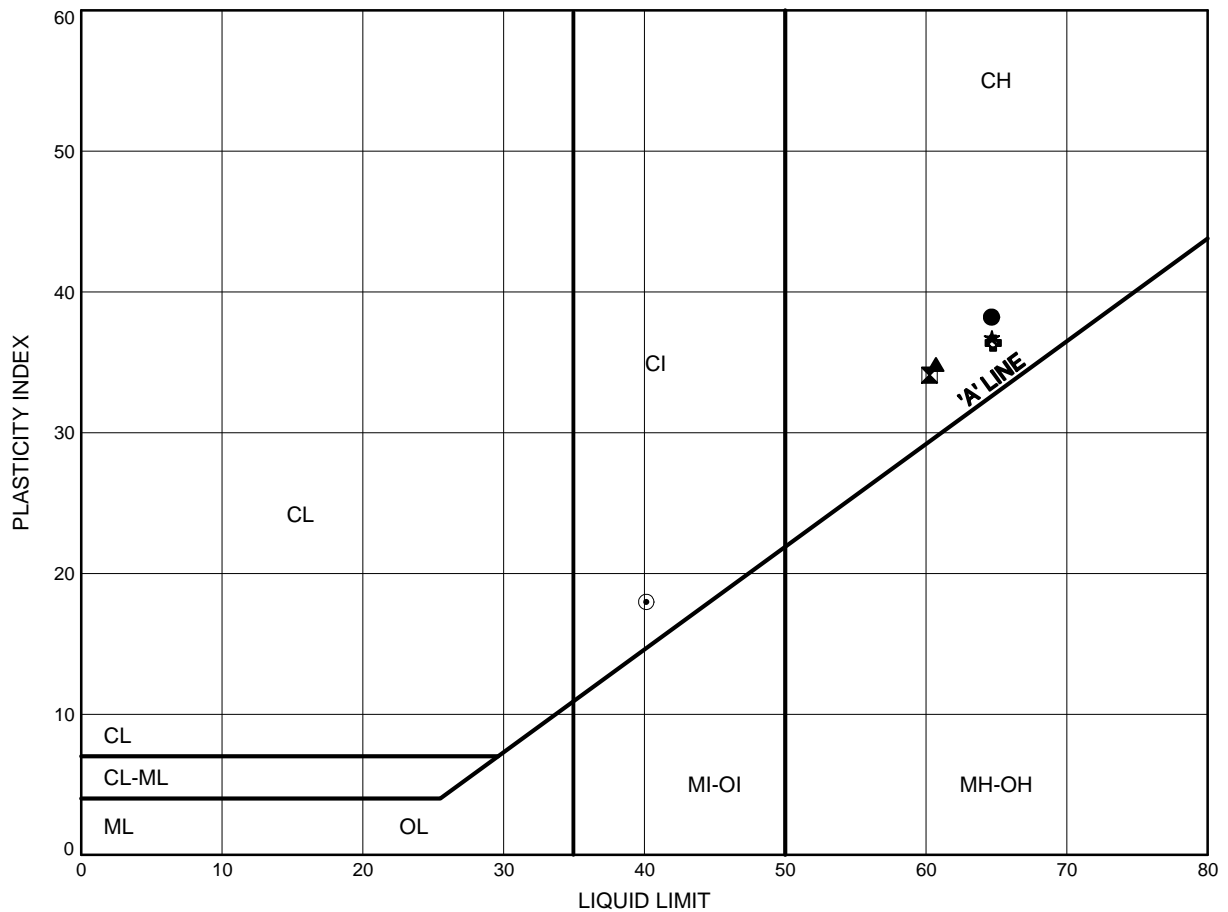


Prep'dAN.....
 Chkd.AMP.....

Margueratt Road Culvert
ATTERBERG LIMITS TEST RESULTS

FIGURE B7

Silty CLAY to CLAY



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MR-01	4.88	200.52
⊠	MR-01	9.45	195.95
▲	MR-02	6.40	198.90
★	MR-03	7.92	199.18
⊙	MR-03	14.02	193.08
⊕	MR-04	7.92	198.98

Date ..October 2015.....
 GWP# ..5032-14-00.....

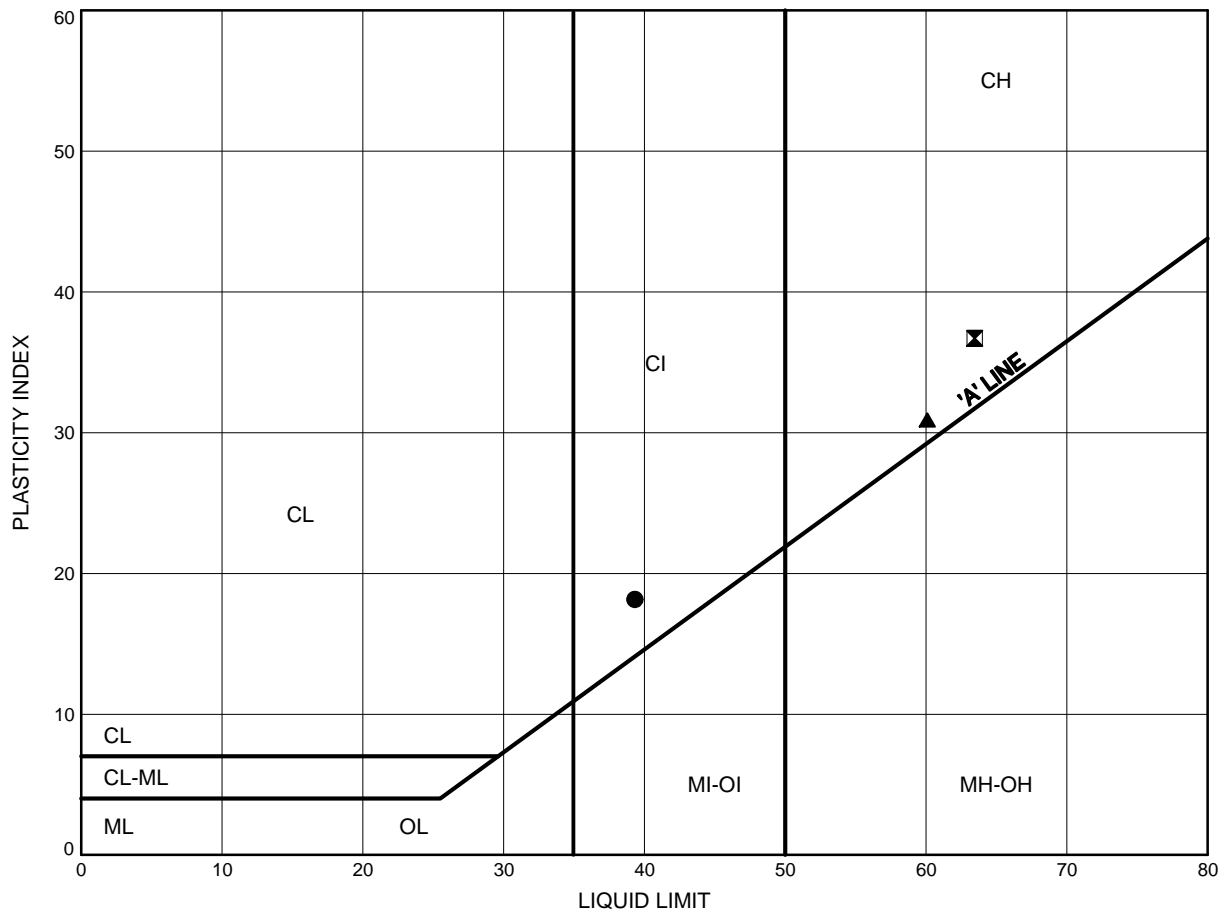


Prep'dAN.....
 Chkd.AMP.....

Margueratt Road Culvert
ATTERBERG LIMITS TEST RESULTS

FIGURE B8

Silty CLAY to CLAY



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MR-04	14.02	192.88
⊠	MR-05	7.92	197.78
▲	MR-06	10.97	194.33

Date October 2015
 GWP# 5032-14-00



Prep'd AN
 Chkd. AMP

Certificate of Analysis

CLIENT NAME: THURBER ENGINEERING LTD

PROJECT: 19-5161-252

SAMPLING SITE:

AGAT WORK ORDER: 15T980955

ATTENTION TO: MARK FARRANT

SAMPLED BY:

Corrosivity Package							
SAMPLE TYPE: Soil		SAMPLE ID: 6615973			DATE RECEIVED: Jun 04, 2015		
DATE SAMPLED: May 23, 2015				DATE REPORTED: Jun 09, 2015			
SAMPLE DESCRIPTION: MR-3 SS3/4A 5'-7'8"							
PARAMETER	UNIT	RESULT	G / S	RDL	DATE ANALYZED	INITIAL	DATE PREPARED
Sulfide	%	0.01		0.01	Jun 09, 2015	FM	Jun 08, 2015
Chloride (2:1)	µg/g	9		2	Jun 09, 2015	WZ	Jun 09, 2015
Sulphate (2:1)	µg/g	6		2	Jun 09, 2015	WZ	Jun 09, 2015
pH (2:1)	pH Units	6.87		NA		BG	Jun 09, 2015
Electrical Conductivity (2:1)	mS/cm	0.083		0.005	Jun 09, 2015	TM	Jun 09, 2015
Resistivity (2:1)	ohm.cm	12000		1	Jun 09, 2015	SYS	Jun 09, 2015
Redox Potential (2:1)	mV	338		5	Jun 09, 2015	TM	Jun 09, 2015

COMMENTS:

RDL - Reported Detection Limit; G / S - Guideline / Standard
* Sulphide analysis was performed at AGAT Laboratories Vancouver.

EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).

Certified By:



Certificate of Analysis

CLIENT NAME: THURBER ENGINEERING LTD

PROJECT: 19-5161-252

SAMPLING SITE:

AGAT WORK ORDER: 15T990314

ATTENTION TO: MARK FARRANT

SAMPLED BY:

Inorganic Chemistry (Water)							
SAMPLE TYPE: Water		SAMPLE ID: 6698925			DATE RECEIVED: Jun 29, 2015		
DATE SAMPLED: Jun 26, 2015				DATE REPORTED: Jul 07, 2015			
SAMPLE DESCRIPTION: Margueratt Road Culvert							
PARAMETER	UNIT	RESULT	G / S	RDL	DATE ANALYZED	INITIAL	DATE PREPARED
Electrical Conductivity	uS/cm	49		2	Jul 03, 2015	JC	Jul 03, 2015
pH	pH Units	6.87		NA	Jul 03, 2015	JC	Jul 03, 2015
Langelier Index		-2.06			Jul 06, 2015	SYS	Jul 06, 2015
Total Hardness (as CaCO3)	mg/L	25.4		0.5	Jul 03, 2015	SYS	Jul 03, 2015
Total Dissolved Solids	mg/L	40		20	Jul 06, 2015	AP	Jul 03, 2015
Alkalinity (as CaCO3)	mg/L	23		5	Jul 03, 2015	JC	Jul 03, 2015
Chloride	mg/L	0.27		0.10	Jul 03, 2015	WZ	Jul 03, 2015
Sulphate	mg/L	1.99		0.10	Jul 03, 2015	WZ	Jul 03, 2015
Calcium	mg/L	6.18		0.05	Jul 03, 2015	PB	Jul 03, 2015
Magnesium	mg/L	2.42		0.05	Jul 03, 2015	PB	Jul 03, 2015
Resistivity	ohms.cm	20400			Jul 03, 2015	SYS	Jul 03, 2015
Sulphide	mg/L	<0.05		0.05	Jul 02, 2015	SN	Jul 02, 2015
Redox Potential	mV	324		5	Jul 06, 2015	BG	Jul 06, 2015

COMMENTS:

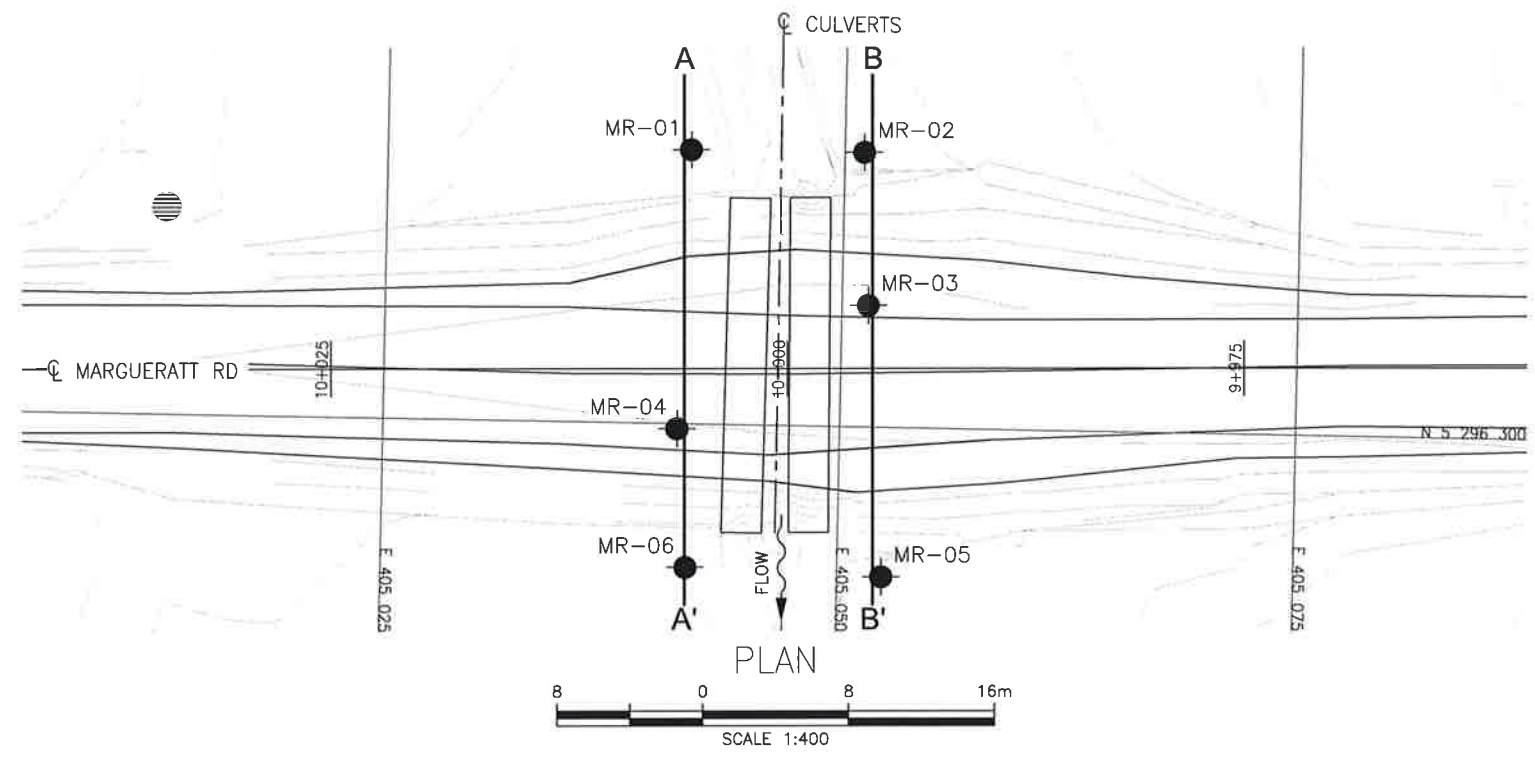
RDL - Reported Detection Limit; G / S - Guideline / Standard

Certified By:



Appendix C

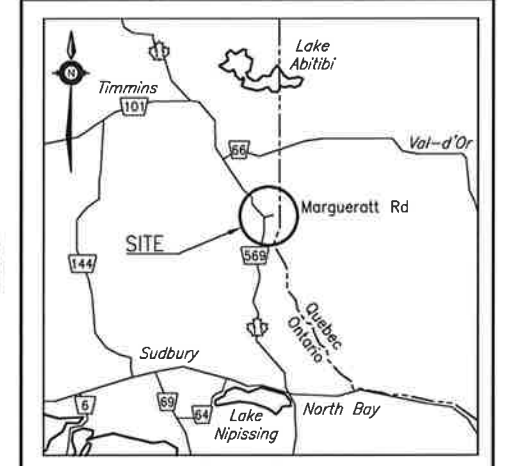
Borehole Locations and Soil Strata Drawings



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



CONT No GWP No 5032-14-00	SHEET
MARGUERATT ROAD CULVERT REPLACEMENT BOREHOLE LOCATIONS AND SOIL STRATA	



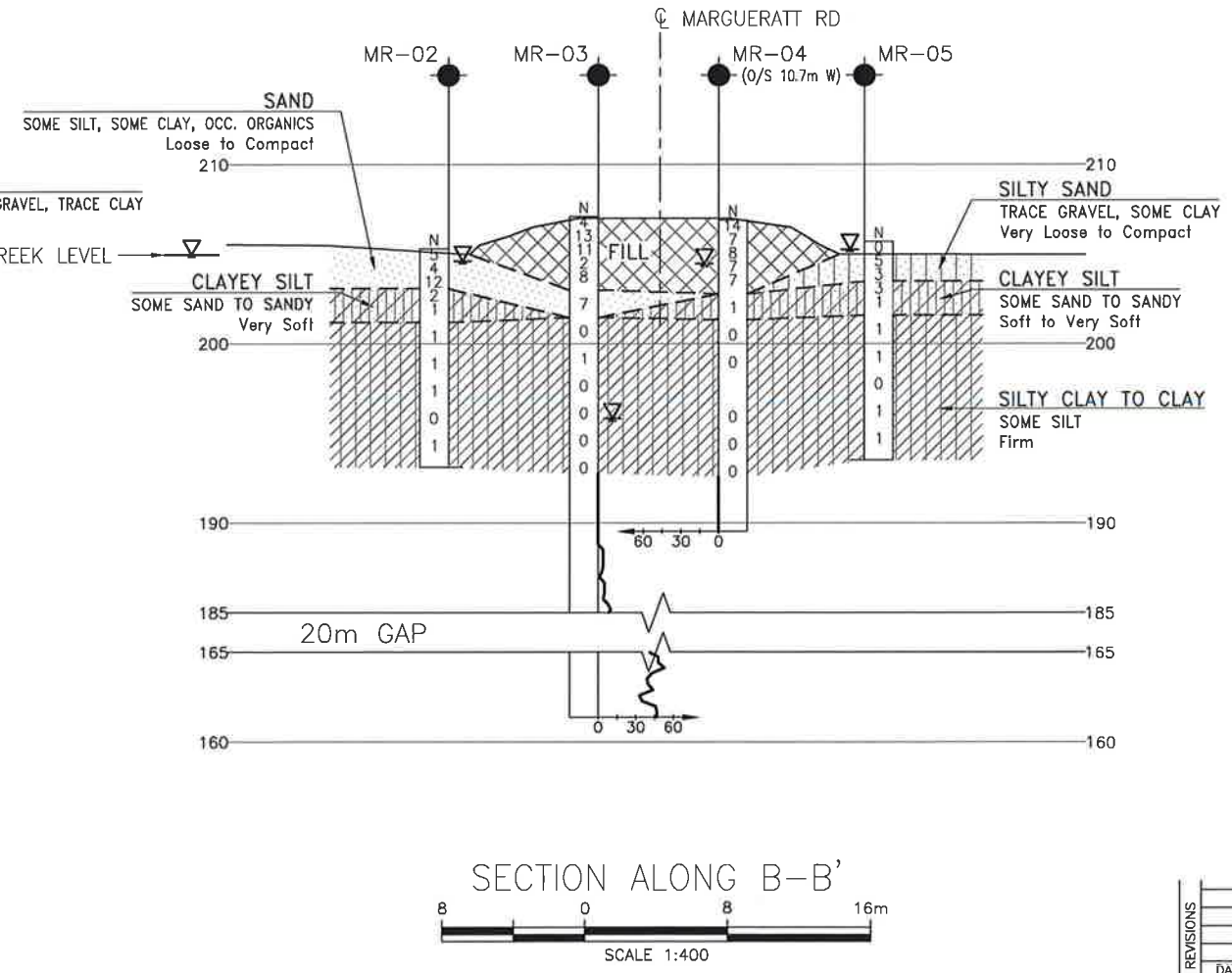
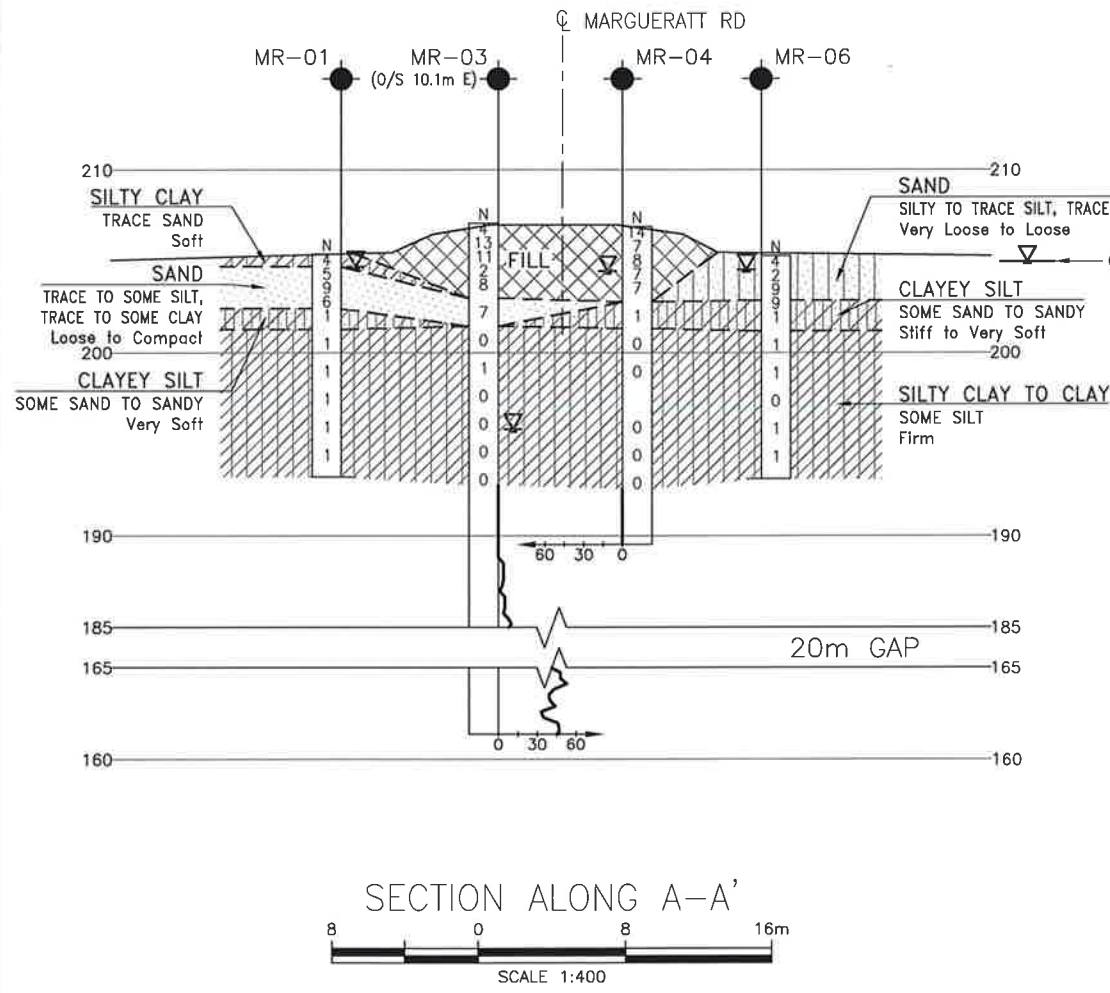
LEGEND

●	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
MR-01	205.4	5 296 315.1	405 041.6
MR-02	205.3	5 296 315.1	405 051.1
MR-03	207.1	5 296 306.7	405 051.4
MR-04	206.9	5 296 299.7	405 041.1
MR-05	205.7	5 296 291.8	405 052.4
MR-06	205.3	5 296 292.1	405 041.7

- 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.

GEOCRES No. 31M-110



REVISIONS	DATE	BY	DESCRIPTION
DESIGN	DJP	CHK MEF	CODE
DRAWN	MFA	CHK DJP	SITE 47-343/C/STRUCT
			DWG 1

Appendix D

Selected Photographs of Culvert Location

Margueratt Road Culvert Replacement
Margueratt Road, Site No. 47-343



Photo 1: Margueratt Road Culvert Inlet



Photo 2: Margueratt Road Culvert Outlet

Margueratt Road Culvert Replacement
Margueratt Road, Site No. 47-343



Photo 3: Erosion of Watercourse at North East Inlet



Photo 4: Beaver Dam at North East Inlet



Photo 5: Road Surface Looking West