



THURBER ENGINEERING LTD.



**FOUNDATION INVESTIGATION REPORT
KITCHEN CREEK CULVERT REPLACEMENT
HIGHWAY 11
DISTRICT OF RAINY RIVER, ONTARIO**

G.W.P. No. 6324-14-00, W.P. No. 6324-14-01, SITE No. 45-277C

GEOCRES Number: 52C-51

Report

to

HATCH

Date: January 13, 2017
File: 13004

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GEOCRES NUMBER: 52C-51

1. INTRODUCTION

This report presents the factual data obtained from a foundation investigation carried out by Thurber Engineering Ltd. (Thurber) for the proposed replacement of the Kitchen Creek Culvert on Highway 11, located west of Fort Francis, within the Township of Crozier, in the District of Rainy River, Ontario.

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

Thurber was retained by Hatch Ltd. (Hatch) to carry out this foundation investigation under the Ministry of Transportation Ontario (MTO) Agreement Number 6015-E-0018-003.

In the preparation of this report and in addition to the borehole drilled under the current assignment, reference has been made to information on subsurface conditions contained in an earlier preliminary foundation report and a structural design report. The titles of these reports are listed as follows:

- Preliminary Foundation Investigation and Design Report, Kitchen Creek Culvert, Highway 11, District of Rainy River, Township of Crozier, prepared by Golder Associates (Golder), dated September 8, 2015; Geocres No. 52C-41. The information presented in the above report was reviewed and incorporated in the current report, as appropriate. (Reference 1).
- Structural Design Report, Kitchen Creek Culvert, Site No. 45-277C, Highway 11, prepared by Hatch Mott MacDonald and dated December 2015. (Reference 2).

Client: Hatch

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Reference should be made to the Golder report for a written description of the subsurface conditions, borehole location plan, stratigraphic profile and laboratory test results. It should be noted that Golder is solely responsible for the subsurface information provided in the preliminary Foundation Investigation and Design Report (FIDR). The borehole logs from the Golder report are attached in Appendix E.

2. SITE DESCRIPTION

The site is located on Highway 11, approximately 10.5 km west of the junction of Highway 11 and Highway 602 near Fort Francis, within the Township of Crozier, in the District of Rainy River, Ontario. Highway 11 generally runs in an approximate east-west direction at the culvert site. The culvert allows Kitchen creek to flow in a southerly direction under Highway 11.

The Structural Design Report (Reference 2) provided to Thurber by Hatch indicates that the existing structure consists of an open footing concrete culvert covered by approximately 2.3 m of fill. The culvert is 21 m long, 5 m wide. A Biennial Inspection on July 26 2013 notes areas of cracking, exposed rusting rebar, and scaling. The structure components were considered to be in good to poor condition.

The grade level of Highway 11 at the existing culvert is at an approximate Elevation of 354.5 m. The culvert invert is at approximately Elevation 348.8 m at the inlet (north end). The creek water level was measured at Elevation 349.5 m by others in November, 2012 and at an Elevation 349.8 m by Golder in February, 2015. The highest groundwater level measured was at Elevation 350.73.

Kitchen Creek runs through a golf course to the south of the existing culvert and the lands to the north of the culvert contain a mix of forested areas and agricultural lands. The lands surrounding the site are relatively flat.

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

Based on published geological information, the culvert lies within modern alluvium deposits of fine sand, silt, clay and organics associated with Kitchen Creek, underlain by deposits of silty clay. Several areas of glaciolacustrine fine-grained deposits of silt and clay, and swamp and organic deposits of peat and muck were identified on geological maps within the area of the site. The bedrock at the site is identified as mafic to intermediate metavolcanic rock.

3. INVESTIGATION PROCEDURES

The borehole investigation and field testing program for this project was carried out on July 24, 2016, and consisted of drilling and sampling one (1) borehole, designated as Borehole 16-05. Borehole 16-05 was located on Highway 11, approximately 10 m east of the existing culvert on the paved shoulder of the east bound lane. The borehole was located near the alignment of the proposed stream diversion pipe.

Utility clearances were obtained prior to the start of drilling. The ground surface elevation for the borehole was derived from cross sections and topographic plans provided to Thurber by Hatch. The approximate location of the borehole is shown on the Borehole Locations and Soil Strata Drawing included in Appendix D.

A rubber track mounted CME 55 drill rig was used to advance Borehole 16-05 using hollow stem augers. The borehole was advanced to a depth of 15.8 m (Elevation 338.7) below the existing road surface. A Dynamic Cone Penetration Test (DCPT) was carried out below the sampled portion of the borehole to a cone refusal depth of 27.4 m (Elevation 327.1) below the existing grade.

Samples of the overburden soils were obtained from the borehole at selected intervals using a split spoon sampler in conjunction with Standard Penetration Testing (SPT). Field vane shear testing using an MTO “N” size vane was carried out in soft to firm cohesive soils.

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

Groundwater conditions were observed in the open borehole throughout the drilling operations and in the open borehole upon completion of drilling. The borehole was backfilled in general accordance with Ontario Regulation 903.

Completion details of the borehole are summarized in Table 3.1.

Table 3.1 – Borehole Completion Details

Borehole Number	Borehole Depth / Base Elevation (m)	Piezometer Tip Depth / Elevation (m)	Completion Details
16-05	15.8 / 338.7	None installed	Borehole backfilled with cuttings and asphalt reinstated at surface.

The previous investigation conducted by Golder (Reference 1) included four (4) boreholes, numbered KT-1 to KT-4. Boreholes KT-1 and KT-4 were advanced at the toe of the slope near the culvert outlet and inlet to depths of 9.8 m, and Boreholes KT-2 and KT-3 were advanced from the existing highway platform to depths of approximately 14.9 m and 10.1 m, respectively. The approximate locations of the Golder boreholes are shown on the Borehole Locations and Soil Strata Drawing included in Appendix D, and on the 2015 Golder report's Borehole Locations and Soil Strata Drawing included in Appendix E. The subsurface information, including the Record of Borehole sheets and the Borehole Locations and Soil Strata drawings, from both the current and preliminary investigations should be included in the contract documents.

4. LABORATORY TESTING

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

In order to assess the potential for sulphate attack on concrete foundations, as well as the potential for corrosion associated with the structure, a sample of the existing native soil, and a sample of the surface water from the creek upstream of the existing culvert were collected. The samples were submitted to SGS Canada Inc., a CALA accredited analytical laboratory in Lakefield, Ontario, for analytical testing of corrosivity parameters and sulphate content. The results of the analytical testing are summarized in Section 6 and are presented in Appendix B.

5. DESCRIPTION OF SUBSURFACE CONDITIONS

Reference is made to the Record of Borehole sheets included in Appendices A and E. Details of the encountered soil stratigraphy are presented on the Record of Borehole sheets and on the "Borehole Locations and Soil Strata" drawings included in Appendices D and E. A general

description of the stratigraphy, based on the conditions encountered in the boreholes, is given in the following paragraphs. However, the factual data presented on the Record of Borehole sheets takes precedence over this general description and must be used for interpretation of the site conditions. It must be recognized and expected that soil conditions may vary between and beyond the borehole locations.

The borehole logs from the previous Golder investigation are presented in Appendix E and are generally consistent with the results of the current investigation.

In general, the subsurface conditions encountered in the borehole from the current investigation consisted of embankment fill consisting of silty clay and silty sand underlain by a deposit of native silty clay. Trace to some organics were noted within the fill and within the upper 2.0 m of the native silty clay.

Descriptions of the individual strata are presented below.

5.1 Pavement Structure

Borehole 16-05 was drilled in the paved shoulder of Highway 11. The pavement structure consisted of approximately 100 mm of asphalt over approximately 600 mm of granular base.

In Boreholes KT-2 and KT-3, the pavement structure consists of 170 mm of asphalt over sand to gravelly sand fill.

5.2 Fill

Embankment fill was encountered beneath the road structure. The fill consisted of layers of cohesionless and cohesive soils. Each layer is described below:

- A layer of brown sand to gravelly sand containing some silt was encountered in Boreholes KT-2 and KT-3 below the asphalt. The thickness of this sand to gravelly sand fill layer was 1.0 m and 2.8 m. Auger grinding was noted within this layer in the upper 0.8 to 1.2 m, inferring the presence of cobbles.
- Cohesive fill was contacted below the sand to gravelly sand fill, at 1.2 m and 3.0 m depth, in Boreholes KT-2 and KT-3, and below the pavement structure, at 0.7 m depth, in Borehole 16-05. The cohesive fill consisted of brown to grey clay and silty clay containing some sand to sandy, trace gravel and trace of organics. A lower layer of silty clay fill was encountered at 3.0 m depth in Borehole 16-05. The clay/silty clay fill thickness ranged

from 1.8 m to 3.4 m. Auger grinding was also noted within the clay fill between 1.5 and 3 m depth in Borehole KT-2, inferring the presence of cobbles.

- Below the cohesive fill, a layer of brown to grey silty sand and sand fill was contacted at depths of 3.0 m and 5.3 m in Boreholes KT-2 and KT-3, respectively. A layer of sandy silt fill was contacted within the silty clay fill, at 2.2 m depth, in Borehole 16-05. The thickness of the sand, silty sand and sandy silt fill ranged from 0.7 m to 2.3 m.

The depths to the base of the fill varied from 4.9 m to 6.0 m (Elevations 348.5 to 349.6), below the existing road surface.

SPT 'N' values in the cohesionless fill ranged from 9 to 14 blows per 0.3 m of penetration, indicating a loose to compact state. Higher SPT 'N' values, ranging from 89 blows per 0.3 m of penetration to 50 blows per 0.15 m of penetration were noted in the upper frozen gravelly sand fill in Boreholes KT-2 and KT-3.

Within the silty clay fill, the SPT 'N' values ranged from 3 to 14, indicating a soft to stiff consistency, in Boreholes 16-05 and KT-2. In Borehole KT-3, the SPT 'N' values in the frozen silty clay fill ranged from 26 to 66 blows per 0.3 m of penetration. It must be noted that the high SPT 'N' values in the upper sand / clay fill might not be representative, as the sand/silty clay fill was frozen.

The measured moisture content of the fill ranged from 5% to 33%.

The results of grain size distribution analyses conducted on selected samples of the fill are presented on the Record of Borehole sheets included in Appendices A and E and are summarized in the following table. The results from the grain size distribution analyses from Thurber (Borehole 16-05) are presented on Figure B1 in Appendix B.

Soil Particle	Percentage (%)	
	Cohesionless Fill	Cohesive Fill
Gravel %	1 to 21	0 to 1
Sand %	61 to 82	18 to 46
Silt %	-	24 to 34
Clay %	-	30 to 50
Silt and Clay %	17 to 18	-

Soil Property	Percentage (%)
Liquid Limit	48 - 53
Plasticity Limit	21 - 25

The results of the Atterberg Limits testing indicate the silty clay is medium to high plastic with group symbols CI to CH.

5.3 Peat

A 700-mm thick layer of dark brown peat was contacted surficially in Borehole KT-1, which extended to Elevation 349.5. The peat was described as amorphous containing trace to some sand.

5.4 Silty Clay

Native silty clay was encountered beneath the fill in Boreholes 16-05, KT-2 and KT-3 and below the peat in Borehole KT-1. In Borehole KT-4, the silty clay was contacted surficially. The silty clay contains trace to some sand and trace gravel. Occasional organics were noted within the upper 2.0 m of the silty clay. A clayey silt zone was noted in Borehole KT-1 from 4.1 m to 7.0 m depth (Elevations 346.1 to 343.2).

All the boreholes were terminated within the silty clay at depths ranging from 9.8 m to 15.8 m (Elevations 338.7 to 344.4). A Dynamic Cone Penetration Test was conducted in the inferred silty clay, from the bottom of Borehole 16-05, until reaching refusal of 100 blows per 0.3 m of penetration at a depth of 27.4 m (Elevation 327.1).

SPT 'N' values recorded in the native silty clay varied between 3 and 15 blows for 0.3 m penetration. The vane shear test (VST) measured in-situ undrained shear strength was greater than 100 kPa. Based on the SPT and VST data, the consistency of the lower silty clay is typically stiff to very stiff.

Natural moisture contents ranged from 19% to 39%.

The results of grain size distribution analyses and Atterberg Limit tests conducted on selected samples of the silty clay, are presented on the Record of Borehole sheets included in Appendices A and E and are summarized in the following table. The results from the grain size distribution analyses from Thurber (Borehole 16-05) are presented on Figures B2 and B3 in Appendix B.

Soil Particle	Percentage (%)
Gravel	0 to 2
Sand	10 to 18
Silt	25 to 48
Clay	32 to 65
Soil Property	Percentage (%)
Liquid Limit	15 to 28
Plasticity Limit	32 to 64

The results of the Atterberg Limits testing indicate the silty clay is medium to high plastic with group symbols CI to CH, with the exception of the low plasticity clayey silt zone (CL) in Borehole KT-1.

5.5 Groundwater Conditions

Groundwater conditions were observed during drilling operations and groundwater levels were measured in the open boreholes upon completion of drilling. The groundwater levels measured in the open borehole are summarized in Table 5.1 below. Groundwater levels reported in the Golder report (Reference 1) are also included.

Table 5.1 – Groundwater Measurements

Borehole	Date	Water Level (m)		Remark
		Depth	Elevation	
16-05	July 24, 2016	10.1	344.4	Open borehole
KT-1	March 21, 2015	0.0	350.2	Reported by Golder
KT-2	February 12, 2015	Dry	-	Reported by Golder
KT-3	February 15, 2015	Dry	-	Reported by Golder
KT-4	March 21, 2015	Dry	-	Reported by Golder

A water level measurement near the inlet of the creek was reported on the drawings provided by Hatch, which indicate a creek water level at Elevation 349.5 m from November 2012. The creek level when frozen, was reported by Golder at Elevation 349.8 in February 2015. The high water level is reported to be at Elev. 350.73 m. The groundwater level should be assumed to reflect the local creek water level.

The groundwater levels above are short-term readings and seasonal fluctuations of the groundwater levels are to be expected. In particular, the groundwater levels may be at a higher elevation after periods of significant or prolonged precipitation.

6. CORROSIVITY AND SULPHATE TEST RESULTS

A sample of the silty clay from Borehole 16-05, 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	
			16-05, SS#4, 3.0 m - 3.7 m	Kitchen Creek Culvert
			(Silty Clay)	(Creek Water)
Sulphide	%	mg/L	<0.02	0.04
Chloride	µg/g	mg/L	300	4
Sulphate	µg/g	mg/L	110	<10
pH	No unit	No unit	7.70 to 8.29	7.51
Electrical Conductivity	µS/cm	µS/cm	384	104
Resistivity	Ohms.cm	MOhms.cm	2600	957
Redox Potential	mV	mV	211	370

7. MISCELLANEOUS

Thurber obtained subsurface 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 Hatch.

RPM Drilling Inc. of Thunder Bay, Ontario supplied and operated the drilling, sampling and in-situ testing equipment for the field investigation. The field investigation was supervised on a full time basis by Mr. Omar Ali of Thurber. Overall supervision of the field program was provided by Mr. Mark Farrant, P.Eng. of Thurber.

Geotechnical laboratory testing was carried out at Thurber's geotechnical laboratory. Analytical

laboratory testing was carried out by SGS Canada Inc.

Interpretation of the field data and preparation of this report was carried out by Mr. Cory Zanatta, EIT and Ms. R. Palomeque Reyna, P.Eng. The report was reviewed by Mr. Keli Shi, P.Eng., and Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

Thurber Engineering Ltd.

Cory Zanatta
Geotechnical Engineer-In-Training



Keli Shi, 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 Sample	GS Grab Sample
	TW Thin Wall Shelby Tube Sample		TP Thin Wall Piston Sample	
	PH Sampler Advanced by Hydraulic Pressure		PM Sampler Advanced by Manual Pressure	
	WH Sampler Advanced by Self Static Weight		RC Rock Core	SC Soil Core

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

 Water Level
 C_{pen} Shear Strength Determination by Pocket Penetrometer

- (1) SPT 'N' Value Standard Penetration Test 'N' Value – refers to the number of blows from a 63.5kg hammer free falling a height of 0.76m to advance a standard 50 mm outside diameter split spoon sampler for 0.3 m depth into undisturbed ground.
- (2) DCPT Dynamic Cone Penetration Test – Continuous penetration of a 50 mm outside diameter, 60° conical steel point attached to "A" size rods driven by a 63.5 kg hammer free falling a height of 0.76 m. The resistance to cone penetration is the number of hammer blows required for each 0.3 m advance of the conical point into undisturbed ground.

UNIFIED SOILS CLASSIFICATION

MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS	SILTS AND CLAYS W _L < 50%	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays. (W _L < 30%).
		CI	Inorganic clays of medium plasticity, silty clays. (30% < W _L < 50%).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS W _L > 50%	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.
CLAY SHALE			
SANDSTONE			
SILTSTONE			
CLAYSTONE			
COAL			

RECORD OF BOREHOLE No 16-05

1 OF 3

METRIC

W.P. 6324-14-01 LOCATION Kitchen Creek Culvert Replacement N 5 386 901.4 E 263 794.5 ORIGINATED BY OA
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2016.07.24 - 2016.07.24 CHECKED BY MEF

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			SHEAR STRENGTH kPa						
354.5	GROUND SURFACE							20	40	60	80	100		
0.0	ASPHALT: (100mm)													
0.1	SAND and GRAVEL Grey Moist (FILL)		1	GS			354						○	
353.8														
0.7	Silty CLAY , some sand to sandy, trace gravel Firm to Stiff Grey Moist (FILL)		1	SS	7		353						○	
			2	SS	14								○	
352.3														
2.2	Sandy SILT , trace gravel, pieces of wood Compact Grey Wet (FILL)		3	SS	11		352						○	
351.5														
3.0	Silty CLAY , trace sand, trace gravel, trace to some organics Soft Grey Wet		4	SS	3		351						○	
							350						○	
													○	
349.6			5	SS	7		349							
4.9	Silty CLAY , some sand, trace gravel Firm to Stiff Brown to Grey Moist													
			6	SS	6		348						┌─○─┐	
							347							
			7	SS	14		346						○	
							345						○	
			8	SS	7									

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No 16-05

2 OF 3

METRIC

W.P. 6324-14-01 LOCATION Kitchen Creek Culvert Replacement N 5 386 901.4 E 263 794.5 ORIGINATED BY OA
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2016.07.24 - 2016.07.24 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	W _p W W _L	WATER CONTENT (%)				
	Continued From Previous Page													
	Silty CLAY , some sand Firm to Soft Grey Moist		9	SS	8		344						0 13 25 62	
							343							
	Wet		10	SS	5		342							
							341							
			11	SS	3		340							
							339						0 10 25 65	
338.7	End of sampling at 15.8m and start DCPT		12	SS	5		338							
15.8							337							
							336							
							335							

Continued Next Page

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

RECORD OF BOREHOLE No 16-05

3 OF 3

METRIC

W.P. 6324-14-01 LOCATION Kitchen Creek Culvert Replacement N 5 386 901.4 E 263 794.5 ORIGINATED BY OA
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
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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	W _p	W	W _L	WATER CONTENT (%)		
	Continued From Previous Page						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE							
327.1 27.4	END OF BOREHOLE AT 27.4m UPON DYNAMIC CONE PENETRATION REFUSAL. WATER LEVEL AT 10.1m UPON COMPLETION OF DRILLING. BOREHOLE BACKFILLED WITH AUGER CUTTINGS TO 0.1m, THEN ASPHALT TO SURFACE.													

ONTMT4S 13004-MTO-GPJ 2015TEMPLATE(MTO)GDT 9/28/16

Appendix B

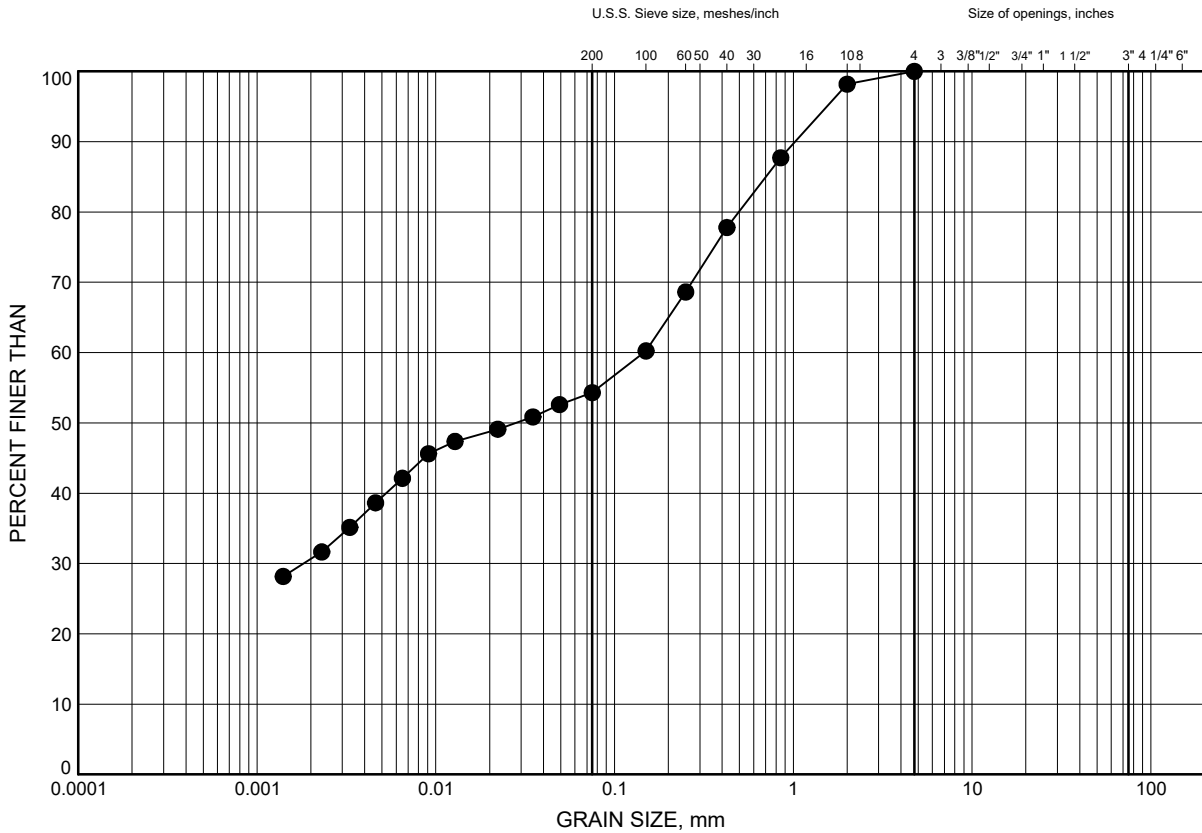
Geotechnical and Analytical Laboratory Test Results

Kitchen Creek Culvert Replacement

GRAIN SIZE DISTRIBUTION

FIGURE B1

Silty CLAY FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	16-05	1.83	352.67

Date September 2016
W.P. 6324-14-01

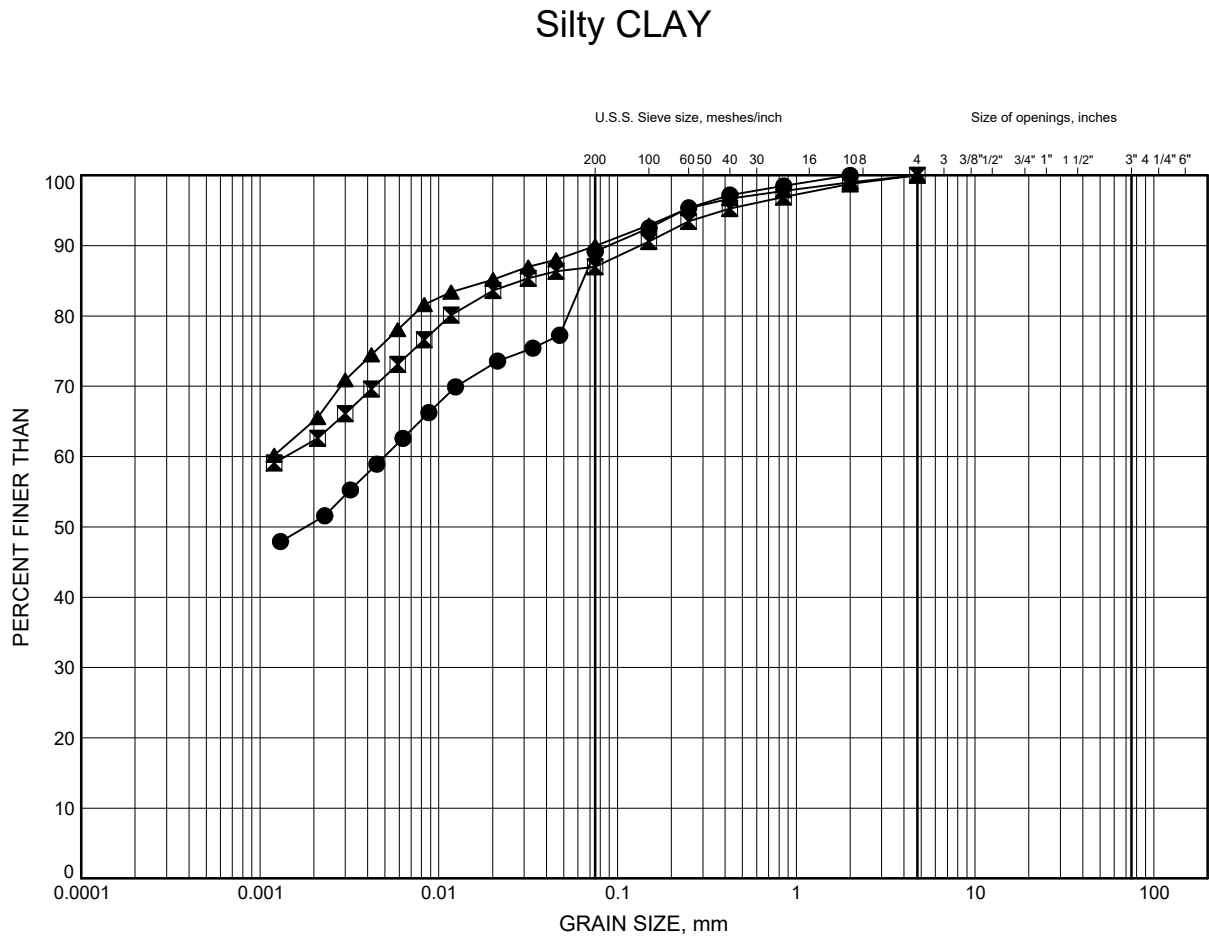


Prep'd AN
Chkd. RPR

Kitchen Creek Culvert Replacement

GRAIN SIZE DISTRIBUTION

FIGURE B2



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	16-05	6.40	348.10
⊠	16-05	10.97	343.53
▲	16-05	15.54	338.96

Date September 2016
W.P. 6324-14-01

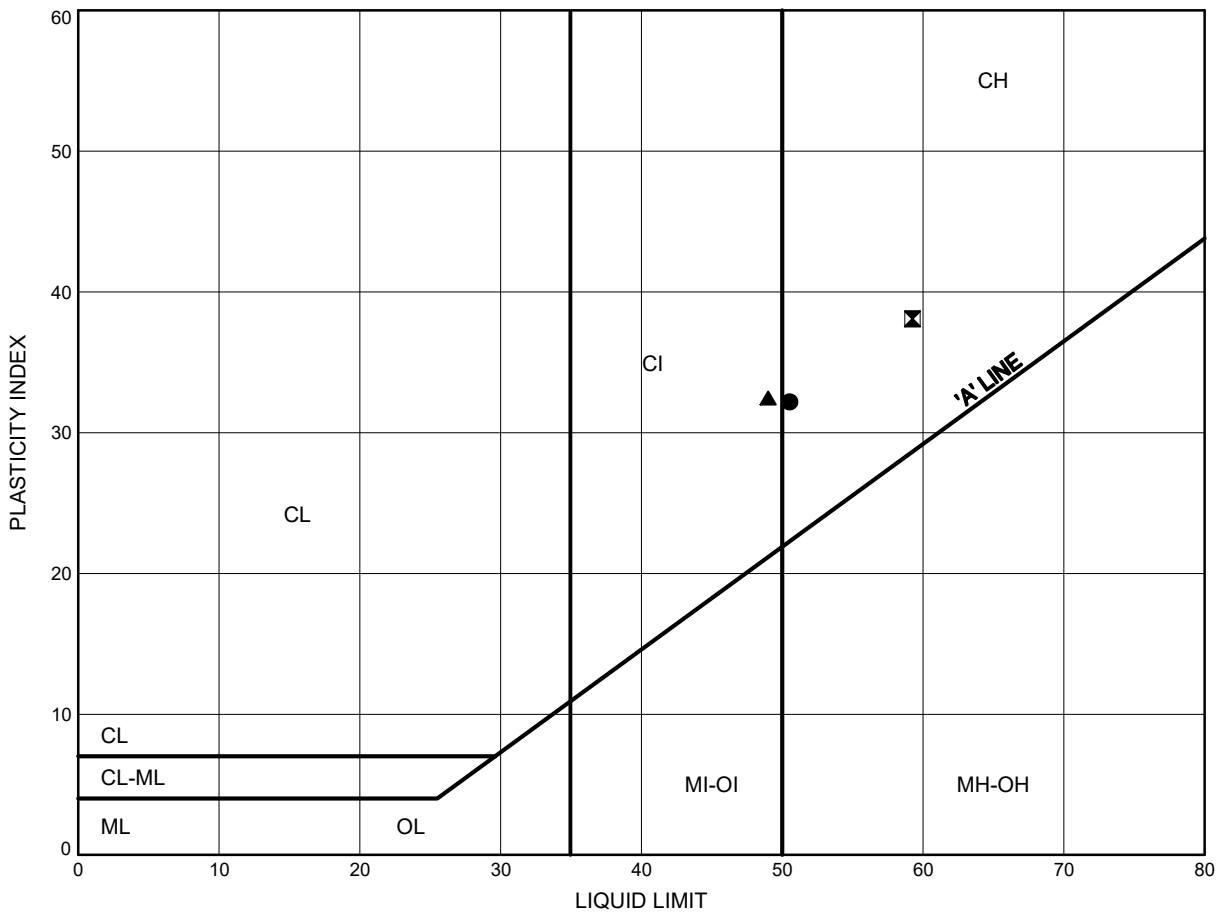


Prep'd AN
Chkd. RPR

Kitchen Creek Culvert Replacement
ATTERBERG LIMITS TEST RESULTS

FIGURE B3

Silty CLAY



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	16-05	6.40	348.10
⊠	16-05	10.97	343.53
▲	16-05	15.54	338.96

Date September 2016
 W.P. 6324-14-01



Prep'd AN
 Chkd. RPR

**SGS Canada Inc.**

P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - K0L 2H0
Phone: 705-652-2000 FAX: 705-652-6365

Project : 13004**Thurber Engineering Ltd.****Attn : Mark Farrant**

103, 2010 Winston Park Drive, Oakville
, L6H 5R7
Phone: 905-829-8666 x 228, Fax:

09-August-2016

Date Rec. : 03 August 2016
LR Report: CA14113-AUG16
Reference: 13004

Copy: #1

CERTIFICATE OF ANALYSIS

Final Report

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Approval Date	4: Analysis Approval Time	5: BH-16-05 SS4 10'-12'
Sample Date & Time					24-Jul-16
Temperature Upon Receipt [°C]	---	---	---	---	24.2
Corrosivity Index [none]	09-Aug-16	13:32	09-Aug-16	14:29	2
pH [no unit]	08-Aug-16	11:40	09-Aug-16	09:32	7.70
Soil Redox Potential [mV]	08-Aug-16	18:47	09-Aug-16	08:27	211
Sulphide [%]	08-Aug-16	10:07	09-Aug-16	09:35	< 0.02
% Moisture (wet wt) [%]	05-Aug-16	07:02	05-Aug-16	09:08	25.3
pH [no unit]	04-Aug-16	09:56	04-Aug-16	15:49	8.29
Chloride [µg/g]	05-Aug-16	18:51	09-Aug-16	09:15	300
Sulphate [µg/g]	05-Aug-16	18:51	09-Aug-16	09:15	110
Conductivity [uS/cm]	04-Aug-16	09:56	04-Aug-16	15:49	384
Resistivity (calculated) [Ohms.cm]	09-Aug-16	13:31	09-Aug-16	14:29	2600

Deanna Edwards, B.Sc, C.Chem
Project Specialist
Environmental Services, Analytical



SGS Canada Inc.

P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - K0L 2H0
Phone: 705-652-2000 FAX: 705-652-6365

Project : 13004

LR Report : CA14113-AUG16

Temperature of Samples upon receipt 24 degrees C
No cooling agent present

Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.

**SGS Canada Inc.**

P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - K0L 2H0
Phone: 705-652-2000 FAX: 705-652-6365

Project : 13004**LR Report : CA14113-AUG16**

Method Descriptions

Parameter	SGS Method Code	Reference Method Code
Anions by IC	ME-CA-[ENV]IC-LAK-AN-001	EPA300/MA300-Ions1.3
Carbon/Sulphur	ME-CA-[ENV]ARD-LAK-AN-020	ASTM E1918
Conductivity	ME-CA-[ENV]EWL-LAK-AN-006	SM 2510
pH	ME-CA-[ENV]EWL-LAK-AN-001	SM 4500



SGS Canada Inc.

P.O. Box 4300 - 185 Concession St.

Lakefield - Ontario - KOL 2H0

Phone: 705-652-2000 FAX: 705-652-6365

Project : 13004

LR Report : CA14113-AUG16

Quality Control Report

Inorganic Analysis												
Parameter	Reporting Limit	Unit	Method Blank				LCS / Spike Blank			Matrix Spike / Reference Material		
							RPD	Acceptance Criteria	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)
						%	Low	High		Low	High	
Anions by IC - QCBatchID: DIO0053-AUG16												
Chloride	0.4	µg/g	<0.4		0	20	109	80	120	111	75	125
Sulphate	0.4	µg/g	<0.4		3	20	101	80	120	101	75	125
Carbon/Sulphur - QCBatchID: ECS0007-AUG16												
Sulphide	0.02	%	<0.02		NV	20	113	80	120			
Conductivity - QCBatchID: EWL0045-AUG16												
Conductivity	2	uS/cm	2		1	10	99	90	110	NA		
pH - QCBatchID: EWL0045-AUG16												
pH	0.05	no unit	NA		0		100			NA		

**SGS Canada Inc.**

P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - K0L 2H0
Phone: 705-652-2000 FAX: 705-652-6365

Project : 13004**02-August-2016****Thurber Engineering Ltd.****Attn : Mark Farrant**

103, 2010 Winston Park Drive, Oakville
, L6H 5R7
Phone: 905-829-8666 x 228, Fax:

Date Rec. : 27 July 2016
LR Report: CA15442-JUL16
Reference: 13004

Copy: #1

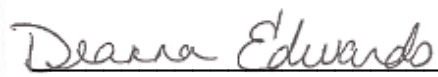
CERTIFICATE OF ANALYSIS

Final Report

Analysis	1: Analysis Start Date	2: Analysis Start Time	3: Analysis Approval Date	4: Analysis Approval Time	5: Kitchen Creek Culvert
Sample Date & Time					N/A
Temperature Upon Receipt [°C]	---	---	---	---	21.0
Corrosivity Index [none]	02-Aug-16	13:33	02-Aug-16	13:33	16
pH [no unit]	27-Jul-16	06:49	28-Jul-16	15:17	7.51
Redox Potential [mV]	27-Jul-16	13:39	02-Aug-16	10:54	370
Sulphide [mg/L]	29-Jul-16	13:00	29-Jul-16	12:19	0.04
Chloride [mg/L]	27-Jul-16	11:45	28-Jul-16	10:10	4
Sulphate [mg/L]	27-Jul-16	12:42	29-Jul-16	14:35	< 10
Conductivity [uS/cm]	27-Jul-16	06:49	28-Jul-16	15:17	104
Resistivity (calculated) [MOhms.cm]	02-Aug-16	13:27	02-Aug-16	13:27	957

Temperature of Samples upon receipt 15 degrees C
No cooling agent present

Corrosivity Index is based on the American Water Works Corrosivity Scale according to AWWA C-105. An index greater than 10 indicates the soil matrix may be corrosive to cast iron alloys.


Deanna Edwards, B.Sc, C.Chem
Project Specialist
Environmental Services, Analytical

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Phone: 705-652-2000 FAX: 705-652-6365

Project : 13004**LR Report : CA15442-JUL16**

Method Descriptions

Parameter	SGS Method Code	Reference Method Code
Anions by discrete analyzer	ME-CA-[ENV]EWL-LAK-AN-026	US EPA 325.2
Anions by discrete analyzer	ME-CA-[ENV]EWL-LAK-AN-026	US EPA 375.4
Conductivity	ME-CA-[ENV]EWL-LAK-AN-006	SM 2510
pH	ME-CA-[ENV]EWL-LAK-AN-006	SM 4500
Redox Potential		SM 2580
Sulphide by SFA	ME-CA-[ENV]SFA-LAK-AN-008	SM 4500



SGS Canada Inc.

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Phone: 705-652-2000 FAX: 705-652-6365

Project : 13004

LR Report : CA15442-JUL16

Quality Control Report

Inorganic Analysis												
Parameter	Reporting Limit	Unit	Method Blank		RPD		LCS / Spike Blank			Matrix Spike / Reference Material		
					Acceptance Criteria	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)		
							Low	High		Low	High	
Anions by discrete analyzer - QCBatchID: DIO0458-JUL16												
Chloride	1	mg/L	<1		1	20	96	80	120	91	75	125
Sulphate	1	mg/L	1		1	20	93	80	120	109	75	125
Conductivity - QCBatchID: EWL0410-JUL16												
Conductivity	2	uS/cm	< 2		0	10	98	90	110	NA		
pH - QCBatchID: EWL0385-JUL16												
pH	0.05	no unit	NA		0		100			NA		
Redox Potential - QCBatchID: EWL0394-JUL16												
Redox Potential	no	mV	NA		1	20	107	80	120	NA		
Sulphide by SFA - QCBatchID: SKA0211-JUL16												
Sulphide	0.02	mg/L	<0.02		0	20	92	80	120	NV	75	125

Appendix C

Site Photographs



Photo 1: Kitchen Creek Culvert, looking west



Photo 2: Kitchen Creek Culvert, north side of the culvert (inlet)



Photo 3: Kitchen Creek Culvert, looking east



Photo 4: Kitchen Creek Culvert, outlet (south side)



Photo 5: Kitchen Creek Culvert, inlet (north side)

Appendix D

Borehole Locations and Soil Strata Drawing

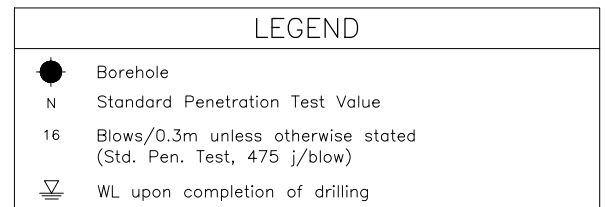


Appendix E

Factual Data from Golder Foundation Investigation Report



**Golder
Associates**



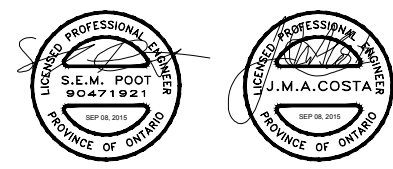
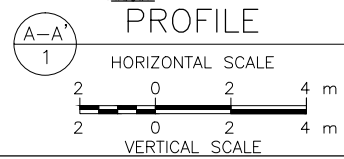
NOTES

This drawing is for subsurface information only. The proposed structure details/works are shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contracts Documents.

The boundaries between soil strata have been established only at borehole locations. Between boreholes the boundaries are assumed from geological evidence.

The complete Foundation Investigation and Design Report for this project and other related documents may be examined at the Materials Engineering and Research Office, Downsview. Information contained in this report and related documents is specifically excluded in accordance with Section GC 2.01 of OPS General Conditions.

Base plans provided in digital format by MTO, drawing file no. BC301111, received FEB 20, 2015.



NO.	DATE	BY	REVISION
Geocres No. 52C-41			
HWY. 11		PROJECT NO. 1411523	DIST. .
SUBM'D. AC		CHKD. .	DATE: 8/25/2015
DRAWN: JJJ		CHKD. SEMP	SITE: 45-277/C
		APPD. JMAC	DWG. 1

PROJECT 1411523		RECORD OF BOREHOLE No KT-1				1 OF 1 METRIC								
G.W.P. 6324-14-00		LOCATION N 5386888.1; E 263784.8				ORIGINATED BY MR								
DIST _____ HWY 11		BOREHOLE TYPE Portable equipment - NW Casing and Wash Boring				COMPILED BY AC								
DATUM GEODETIC		DATE March 20 and 21, 2015				CHECKED BY SEMP								
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						
350.2	GROUND SURFACE							20 40 60 80 100	20 40 60					
0.0	PEAT, Amorphous, trace to some sand Dark brown Frozen		1	SS	10		350							
349.5														
0.7	SILTY CLAY to CLAY, trace to some sand, trace gravel Firm to very stiff Grey Wet		2	SS	5		349						OC=3.3%	
	Trace organics above 1.5 m depth.		3	SS	10		348							
			4	SS	10		347							
	Clayey silt zone encountered from 4.1 m to 7.0 m depth. Very stiff		5	SS	14		346							
			6	SS	13		345							
			7	SS	15		342							
			8	SS	15		341							
340.4	END OF BOREHOLE													
9.8	Note: 1. Water level at ground surface (Elev. 350.2 m) upon completion of drilling.													

SUD-MTO 001 1411523.GPJ GAL-MISS.GDT 31/08/15 DATA INPUT:

PROJECT 1411523				RECORD OF BOREHOLE No KT-2				1 OF 2 METRIC						
G.W.P. 6324-14-00				LOCATION N 5386904.1; E 263777.6				ORIGINATED BY DM						
DIST _____ HWY 11				BOREHOLE TYPE 108 mm I. D. Hollow Stem Augers				COMPILED BY AC						
DATUM GEODETIC				DATE February 12, 2015				CHECKED BY SEMP						
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						
354.5	GROUND SURFACE													
0.0	ASPHALT (170 mm)													
0.2	Sand to gravelly, some silt (FILL) Brown Frozen		1	SS	50/0 15									
353.3	Augers Grinding from surface to 1.2 m depth on inferred cobbles. Clay, some sand, trace gravel (FILL) Stiff Brown to grey Frozen* to moist		2	SS	26*									1 18 31 50
351.5	Augers grinding between 1.5 m and 3.0 m depth on inferred cobbles.		3	SS	10									
349.7	Sandy silt, trace clay, trace organics (FILL) Loose to compact Brown to grey Moist		4	SS	9									
349.2			5	SS	13									
349.7	Sand, some silt (FILL) Compact Brown to grey Moist		6	SS	12									1 82 (17)
349.2			7	SS	9									
349.2	CLAY, trace to some sand, trace gravel Stiff to very stiff Grey Wet		8	SS	9									
			9	SS	12									2 13 34 51
			10	SS	13									
			11	SS	9									
			12	SS	8									1 11 34 54
			13	SS	7									
			14	SS	5									
339.6														

SUD-MTO 001 1411523.GPJ GAL-MISS.GDT 03/09/15 DATA INPUT:

Continued Next Page

+³, ×³: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

PROJECT <u>1411523</u>	RECORD OF BOREHOLE No KT-2	2 OF 2	METRIC
G.W.P. <u>6324-14-00</u>	LOCATION <u>N 5386904.1; E 263777.6</u>	ORIGINATED BY <u>DM</u>	
DIST <u> </u> HWY <u>11</u>	BOREHOLE TYPE <u>108 mm I. D. Hollow Stem Augers</u>	COMPILED BY <u>AC</u>	
DATUM <u>GEODETIC</u>	DATE <u>February 12, 2015</u>	CHECKED BY <u>SEMP</u>	

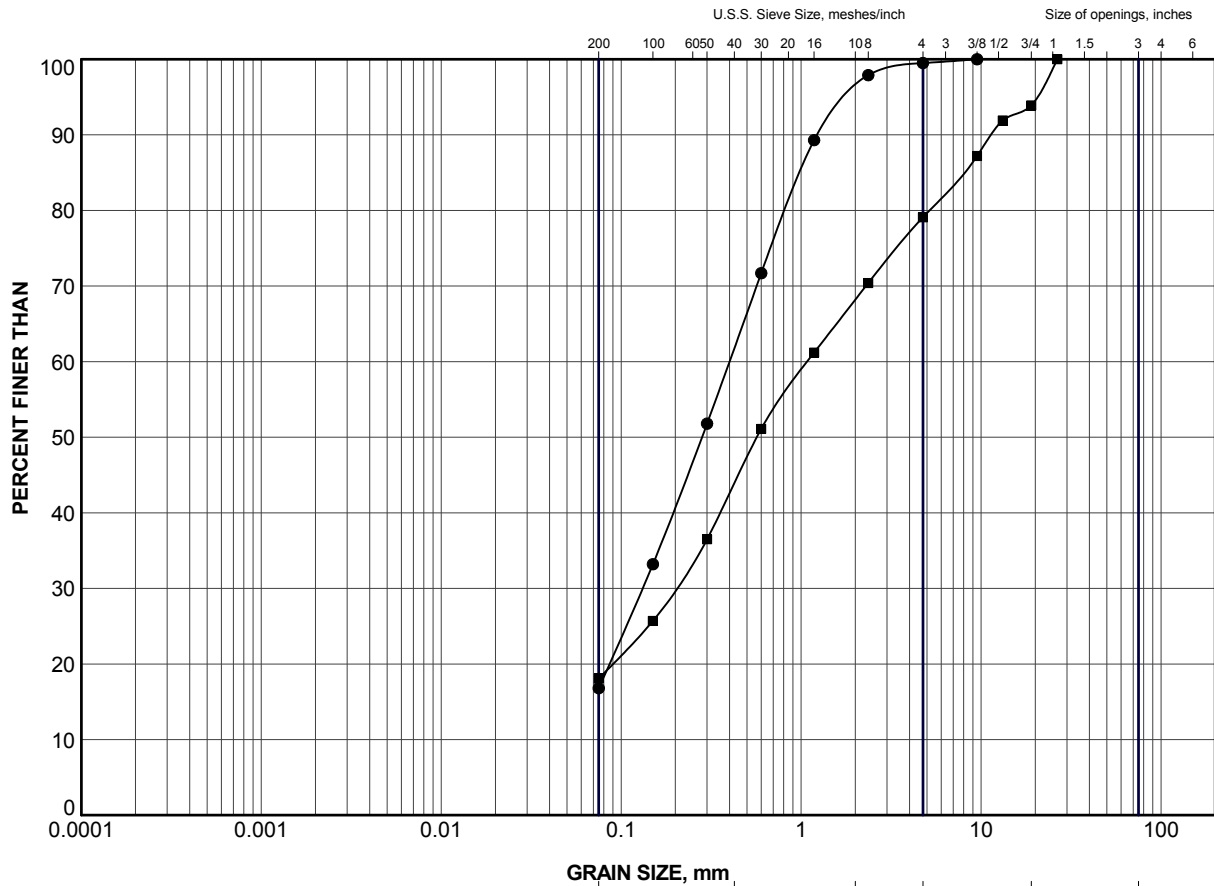
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					W _p	W	W _L		GR	SA	SI	CL	
								20	40	60	80	100	WATER CONTENT (%)				20	40	60		
	-- CONTINUED FROM PREVIOUS PAGE --																				
14.9	END OF BOREHOLE Note: 1. Borehole dry upon completion of drilling.																				

SUD-MTO 001 1411523.GPJ GAL-MISS.GDT 31/08/15 DATA INPUT:

PROJECT 1411523			RECORD OF BOREHOLE No KT-3			1 OF 1 METRIC														
G.W.P. 6324-14-00			LOCATION N 5386907.6; E 263785.6			ORIGINATED BY DM														
DIST _____ HWY 11			BOREHOLE TYPE 108 mm I. D. Hollow Stem Augers			COMPILED BY AC														
DATUM GEODETIC			DATE February 15, 2015			CHECKED BY SEMP														
SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT			REMARKS & GRAIN SIZE DISTRIBUTION (%)					
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × REMOULDED					WATER CONTENT (%) W _p — W — W _L			γ	GR	SA	SI	CL
354.5	GROUND SURFACE							20	40	60	80	100	20	40	60					
0.0	ASPHALT (170 mm)																			
0.2	Sand to gravelly sand, some silt (FILL) Brown to grey Frozen*		1	SS	50/0/15		354													
	Augers grinding in the upper 0.8 m on inferred cobbles.																			
			2	SS	100*		353													
			3	SS	89*		352						○				21	61	(18)	
351.5	Silty clay with sand, trace organics (FILL) Grey Frozen		4	SS	66*		351													
3.0			5	SS	65*		350							○			0	34	34	32
			6	SS	35*		349													
349.2	Silty sand, trace to some clay, trace organics, trace concrete fragments, decomposed wood pieces (FILL)		7	SS	14		349													
5.3	Compact Black Wet		8	SS	8		348							○			0	10	33	57
348.5	CLAY, trace to some sand Stiff to very stiff Grey Wet						347													
6.0	Sand interlayers in Sample 8.		9	SS	9		346													
			10	SS	7		345													
344.4	END OF BOREHOLE																			
10.1	Note: 1. Borehole dry upon completion of drilling.																			

SUD-MTO 001 1411523.GPJ GAL-MISS.GDT 03/09/15 DATA INPUT:


+ 3, × 3: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

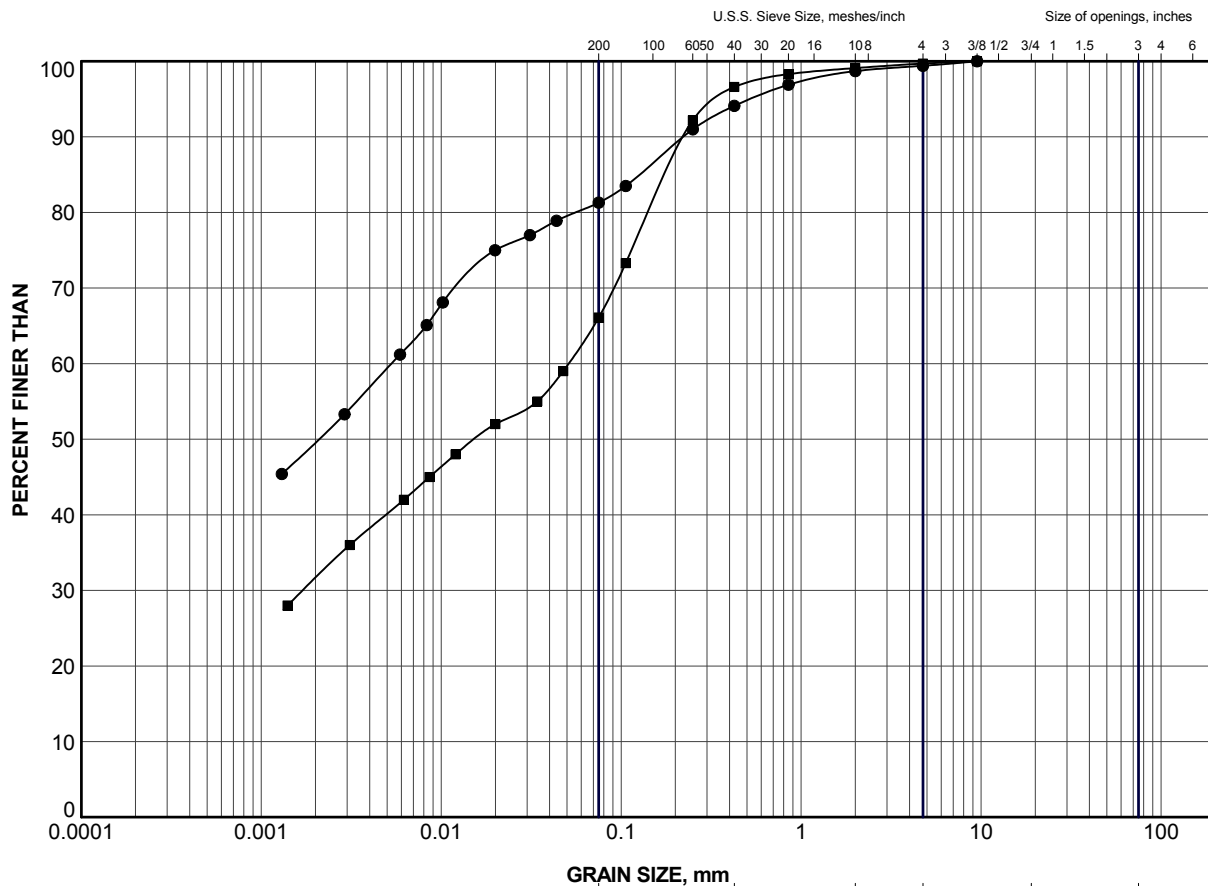


GRAIN SIZE, mm						
CLAY AND SILT	fine	medium	coarse	fine	coarse	Cobble Size
	SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	KT-2	6B	349.5
■	KT-3	3	351.9


PROJECT					
HIGHWAY 11 KITCHEN CREEK CULVERT STA 11+993					
TITLE					
GRAIN SIZE DISTRIBUTION SAND to GRAVELLY SAND (FILL)					
PROJECT No. 1411523			FILE No. 1411523.GPJ		
DRAWN	TB	Jun 2015	SCALE	N/A	REV.
CHECK	SEMP	Jun 2015			
APPR	JMAC	Jun 2015			
			FIGURE B1		

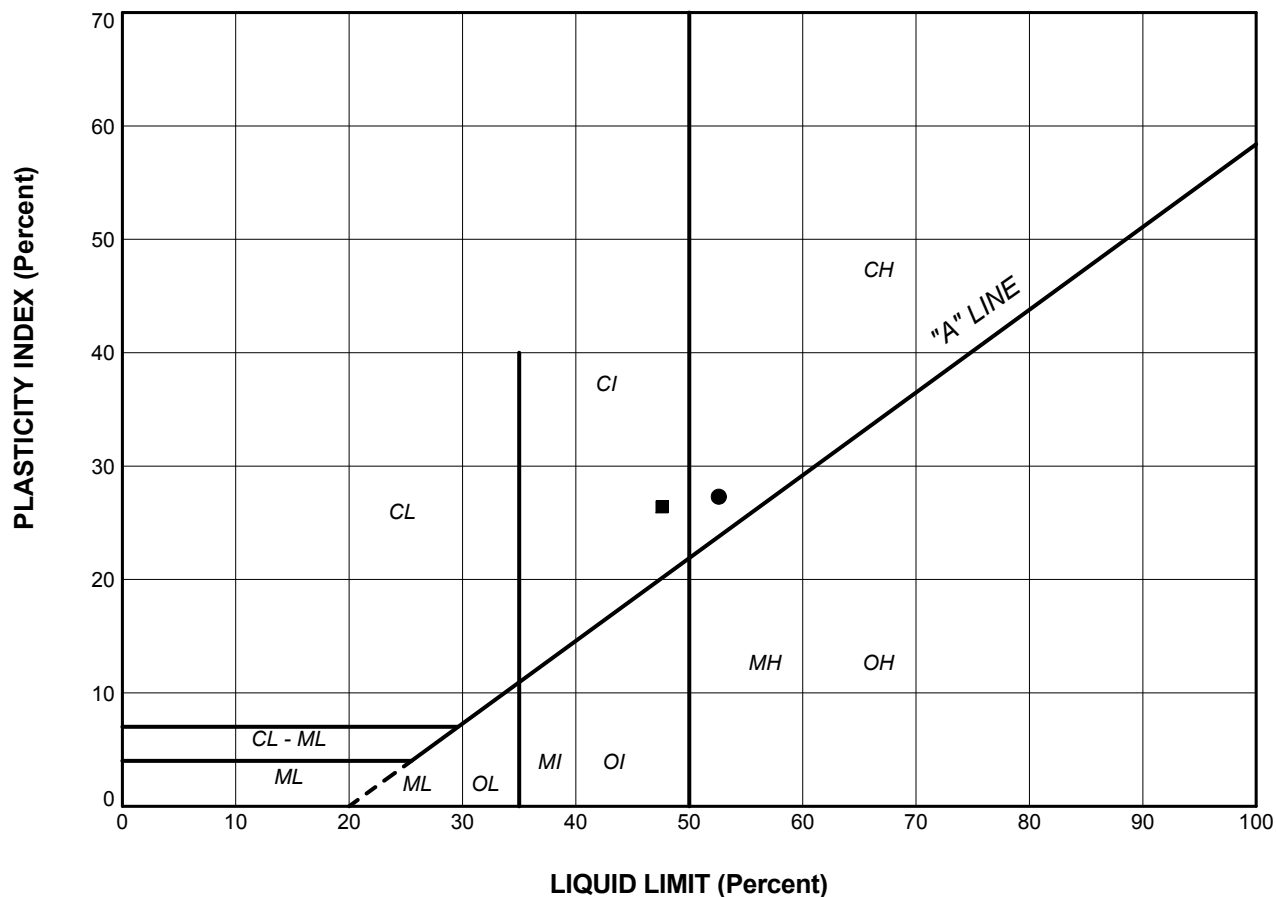



GRAVEL SIZE, mm						Cobble Size
CLAY AND SILT	fine	medium	coarse	fine	coarse	
	SAND SIZE			GRAVEL SIZE		

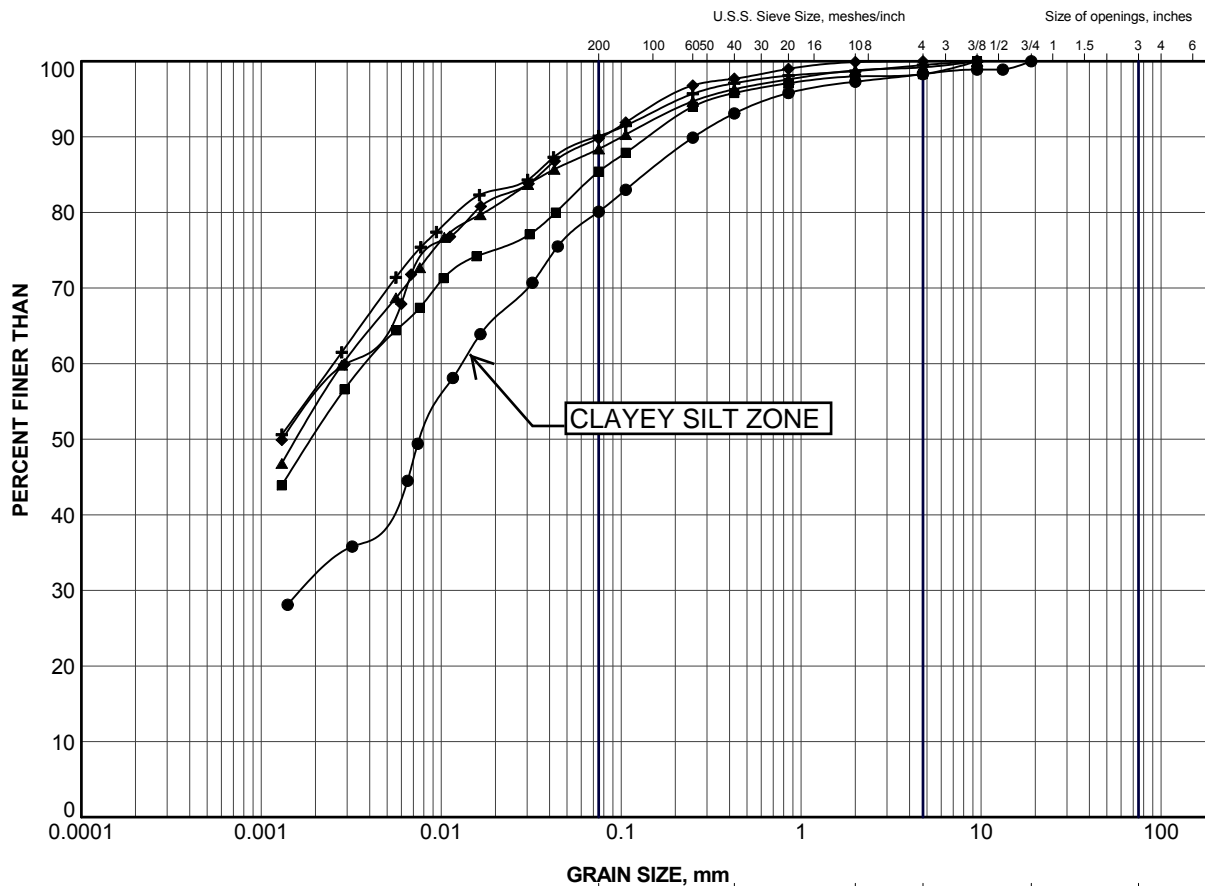
LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	KT-2	2	352.7
■	KT-3	5	350.4

PROJECT					
HIGHWAY 11 KITCHEN CREEK CULVERT STA 11+993					
TITLE					
GRAIN SIZE DISTRIBUTION SILTY CLAY with SAND to CLAY (FILL)					
PROJECT No.		1411523		FILE No. 1411523.GPJ	
DRAWN	TB	Jun 2015	SCALE	N/A	REV.
CHECK	SEMP	Jun 2015			
APPR	JMAC	Jun 2015			
 Golder Associates SUDBURY, ONTARIO			FIGURE B2		



PROJECT					
HIGHWAY 11 KITCHEN CREEK CULVERT STA 11+993					
TITLE					
PLASTICITY CHART SILTY CLAY with SAND to CLAY (FILL)					
PROJECT No. 1411523			FILE No. 1411523.GPJ		
DRAWN	TB	Jun 2015	SCALE	N/A	REV.
CHECK	SEMP	Jun 2015			
APPR	JMAC	Jun 2015			
 Golder Associates SUDBURY, ONTARIO			FIGURE B3		



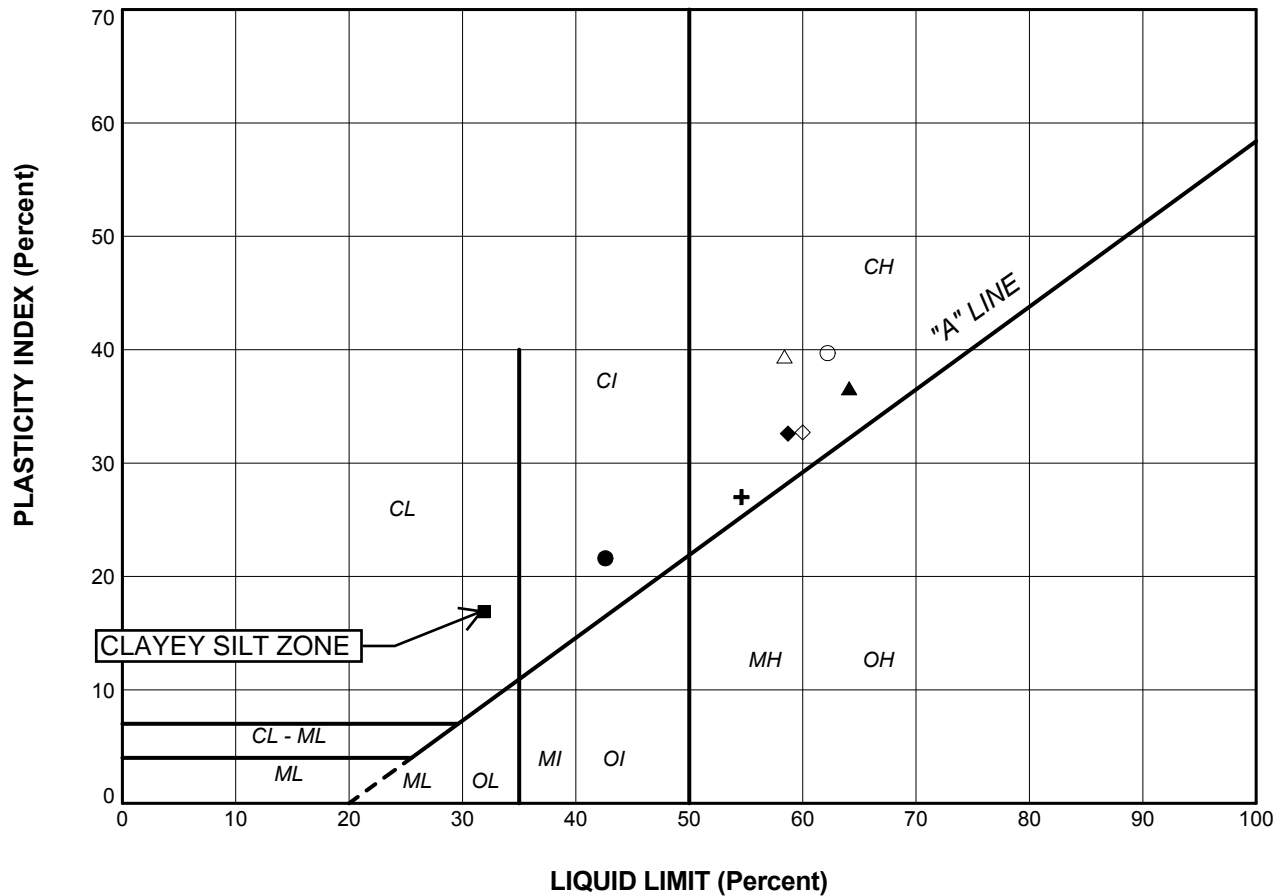
CLAY AND SILT	SAND SIZE, mm			GRAVEL SIZE, mm		Cobble Size
	fine	medium	coarse	fine	coarse	
	SAND SIZE			GRAVEL SIZE		

LEGEND

SYMBOL	BOREHOLE	SAMPLE	ELEV (m)
●	KT-1	5	345.3
■	KT-2	9	346.6
▲	KT-2	12	343.5
+	KT-3	8	348.1
◆	KT-4	4	347.6

PROJECT					
HIGHWAY 11 KITCHEN CREEK CULVERT STA 11+993					
TITLE					
GRAIN SIZE DISTRIBUTION CLAY					
PROJECT No.		1411523		FILE No. 1411523.GPJ	
DRAWN	TB	Jun 2015	SCALE	N/A	REV.
CHECK	SEMP	Jun 2015	FIGURE B4		
APPR	JMAC	Jun 2015			





LEGEND

SYMBOL	BOREHOLE	SAMPLE	LL(%)	PL(%)	PI
●	KT-1	2	42.6	21.0	21.6
■	KT-1	5	31.9	15.0	16.9
▲	KT-1	7	64.1	27.5	36.6
+	KT-2	9	54.6	27.6	27.0
◆	KT-2	12	58.7	26.1	32.6
◇	KT-3	8	60.0	27.3	32.7
○	KT-4	4	62.2	22.5	39.7
△	KT-4	6	58.4	19.0	39.4

PROJECT				
HIGHWAY 11 KITCHEN CREEK CULVERT STA 11+993				
TITLE				
PLASTICITY CHART SILTY CLAY to CLAY				
PROJECT No. 1411523		FILE No. 1411523.GPJ		
DRAWN	TB	Jun 2015	SCALE	N/A
CHECK	SEMP	Jun 2015	REV.	
APPR	JMAC	Jun 2015	FIGURE B5	

