

**FOUNDATION INVESTIGATION REPORT
CULVERT REPLACEMENT AT MONDOR CREEK
SITE NO. 39E-229
HIGHWAY 11
COCHRANE DISTRICT, ONTARIO
G.W.P. No. 5169-10-00**

GEOCRES Number: 42H-53

Report to

URS Canada Inc.

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H:\19\4406\9 Highways 11, 583, 652 Culverts 5012-E-0033-
Foundations\Reports & Memos\Mondor Creek\1944069 Hwy
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PART 1: FACTUAL INFORMATION

1 INTRODUCTION

This report presents the factual data obtained from a foundation investigation conducted by Thurber Engineering Ltd. (Thurber) at the twin culverts on Highway 11 over Mondor Creek, located in the Township of Lamarche, Cochrane Area, Ontario.

The foundations terms of reference indicates that there is no record of any previous foundation investigation carried out at or near the subject culvert.

The purpose of this investigation was to obtain subsurface information at the twin 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 URS Canada Inc. (URS) to carry out this foundation investigation under the MTO Assignment Number 5012-E-0033.

2 SITE DESCRIPTION

The culvert site is located on Highway 11, 4.2 km south of Highways 579/652 in the Township of Lamarche, Cochrane District, Ontario. This culvert allows Mondor Creek to flow, from west to east, under Highway 11.

The existing structure is a twin 3.7 m span by 2.7 m high by 39 m long steel plate pipe arch (SPPA) in 5.0 m of fill. The structure was constructed in 1976. It is understood that the structure is in poor condition with deterioration of several elements.

The grade of the existing Highway 11 in the vicinity of the twin culverts ranges between approximate Elevations 263.5 and 264.0 m. The embankment fill height at the culverts is up to approximately 5 m.

The site is located within the town limits of Cochrane with residential and commercial 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 occasional trees. Local topography is of low relief

with no visible bedrock outcrops. Areas surrounding the properties are heavily forested. The property to the southwest of the twin culverts features remnants of a motel building. The area in the immediate vicinity of the culvert is undulating and generally sloping downwards from the highway grade to the creek. Rockfill is visible in the vicinities of the culvert inlet and outlet.

Based on published geological information, the general area of the project is covered by glacio-lacustrine sediments of clays and silts laid down by the Glacial Lake Barlow-Ojibway. 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 Early Precambrian metasedimentary rocks.

3 SITE INVESTIGATION AND FIELD TESTING

This borehole investigation and field testing program was carried out between October 10 and October 31, 2013. The program consisted of drilling and sampling 11 boreholes (numbered MC13-01 to MC13-11) to depths ranging from 8.2 to 34.7 m. Of these boreholes, two were located at the culvert inlet (MC13-10 and 13-11), two were located at the culvert outlet (MC13-01 and 13-02), three were located at the embankment crest (MC13-04, 13-08 and 13-09), two were located on the road for roadway protection (MC13-05 and 13-07) and two were located further away for the detour lane on the east side (MC13-03 and 13-06).

Prior to the start of drilling, the borehole locations were marked/staked in the field and utility clearances were obtained. The co-ordinates and elevations of the as-drilled boreholes were subsequently provided by Callon Dietz obtained from the DTM, based on borehole location sketches provided by Thurber. The approximate borehole locations are shown on a Borehole Locations and Soil Strata drawing included in Appendix C.

A truck-mounted drill rig was used to drill and sample the boreholes on the highway and the shoulder, and a track-mounted drill rig was used to drill and sample the culvert inlet and outlet boreholes. In addition, a portable tripod drill rig was used to advance boreholes at locations of difficult access beyond the highway. Hollow stem augers and/or NW casing were used to advance the boreholes until the target depth was reached. 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 soft to firm cohesive soils. A limited number of thin walled Shelby tube (73 mm inside diameter) samples were obtained at selected locations. Below the last sample, dynamic cone penetration tests (DCPT) were conducted until refusal was reached in all but Boreholes MC13-01, 13-03 and 13-06. Groundwater conditions in the open boreholes were observed throughout the drilling operations. The details of standpipe piezometer installations and borehole completion are summarized in Table 3.1.

Table 3.1
Borehole Completion and Standpipe Piezometer Installation Details

Borehole Number	Standpipe Piezometer Installations				Completion Details
	Tip Location (Depth/Elev.)	Screen Depth (m)	Screen Elevation (m)	Filter Stratum	
MC13-01	7.5 / 251.9	4.2 to 8.2	255.2 – 251.2	Silty Clay	Bentonite holeplug to surface
MC13-02	-	None Installed			Bentonite holeplug mixed with auger cuttings to surface
MC13-03	-	None Installed			Bentonite holeplug to 0.1 m, sand and gravel to surface
MC13-04	-	None Installed			Bentonite holeplug to 1.8 m and auger cuttings to surface
MC13-05	-	None Installed			Bentonite holeplug to 1.8 m and auger cuttings to surface
MC13-06	-	None Installed			Bentonite holeplug to 1.9 m and auger cuttings to surface
MC13-07	-	None Installed			Bentonite holeplug to 0.1 m, sand and gravel to surface
MC13-08	-	None Installed			Bentonite holeplug to 0.1 m, sand and gravel to surface
MC13-09	-	None Installed			Bentonite holeplug to surface
MC13-10	-	None Installed			Bentonite holeplug mixed with auger cuttings to surface
MC13-11	5.9 / 252.8	3.9 to 6.4	254.8 – 252.3	Silty Clay	Bentonite seal to 3.3 m, auger cuttings to 0.3 m, bentonite holeplug to surface

Results of 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). Two samples were selected from the Shelby tubes for laboratory consolidation (oedometer) testing. 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. A

sample of creek water was submitted to a qualified analytical laboratory for testing against selected corrosivity parameters.

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 highway shoulder consist of granular fill overlying an extensive deposit of silty clay with some clayey silt to silt interlayers. The silty clay underlies a thin veneer of topsoil or is exposed at ground surface beyond the highway. Groundwater levels are generally in the order of 0.3 to 3 m below original ground surface. More detailed descriptions of the individual stratum are presented below.

5.2 Topsoil

A layer of topsoil between 25 and 75 mm in thickness was encountered at ground surface in Boreholes MC13-01, 13-02, 13-09, and 13-10 located near the culvert inlet and outlet areas. The topsoil thickness may vary between and beyond the borehole locations, and the limited data is not suitable for estimating topsoil quantities.

5.3 Fill

Embankment fill was encountered at ground surface in Boreholes MC13-03, 13-04, 13-05, 13-06, 13-07, and 13-08. This fill typically consists of brown sand and gravelly sand with some inferred cobbles, organic inclusions and rootlets at shallow depths. In Borehole MC13-05, a 1.2 m thick layer of silty clay fill underlies the upper gravelly sand fill with inclusions of wood fragments (with nails). Where encountered, the embankment fill was found extending to 2.0 to 4.5 m depths (base Elevations from 262.0 to 259.3 m).

SPT N-values measured in the cohesionless fill ranged from 11 blows per 0.3 m penetration to greater than 50 blows for less than 0.3 m penetration, but mostly between 24 and 60 blows per 0.3 m penetration indicating a typically compact to very dense state. The high 'N' values may be attributed to the presence of cobbles or boulders. Measured moisture contents of the recovered fill samples ranged between 2% and 30%, with most values ranging from 5% to 15%. Grain size analyses conducted on samples of the gravelly sand fill are presented on Figures B1 and B2 in Appendix B. These results are summarized in the following tables.

Soil Particles	%
<u>Gravelly Sand Fill</u>	
Gravel	22 to 36
Sand	53 to 65
Silt and Clay	6 to 13

5.4 Silty Clay

Silty clay was encountered in all eleven boreholes drilled at the site. This grey soil typically contained trace to some sand and trace gravel. Boreholes MC13-01, 13-02, 13-03, 13-04, 13-06, 13-08, 13-09, 13-10, and 13-11 terminated within the silty clay at depths of 7.0 to 23.5 m (base Elevations 255.2 to 240.0 m). Where the silty clay was fully penetrated in Boreholes MC13-05 and 13-07, the base of the silty clay was encountered at depths of 22.6 to 23.3 m (base Elevations 241.2 to 240.5 m).

The weathered crust of the silty clay deposit is approximately 1.5 to 4 m thick (base elevations between 254.5 and 260.3 m). It has a relatively stiff consistency and typically brown in colour. Within the crust, the SPT N-values typically ranged between 3 and 39 blows per 0.3 m penetration, with most values lying between 4 and 14 blows. In conjunction with measured field vane shear strengths ranging from 48 to greater than 98 kPa, the silty clay crust was found to have a typically stiff to firm consistency with occasional hard zones. Below the crust, the silty clay becomes grey with measured N-values ranging between 0 and 6 blows per 0.3 m penetration. In conjunction with measured field vane shear strengths ranging from 10 to 67 kPa, the lower portion of the silty clay was found to have a typically stiff to firm consistency with some very soft and occasional stiff zones.

Two laboratory consolidation (oedometer) tests were carried out on undisturbed specimens prepared from Shelby tube samples obtained in Boreholes MC13-04 and MC13-08. Inferred parameters from the tests are summarized in the following table.

Borehole and Sample Number	Existing Overburden Pressure, p'_o (kPa)	Pre-consolidation Pressure, p'_c (kPa)	Compression Index, C_c	Recompression Index, C_r	Initial Void Ratio, e_0	Over-consolidation Ratio, OCR
MC 13-04 TW1	150	150	0.28	0.030	0.67	1.0
MC 13-08 TW1	125	140	0.27	0.038	0.89	1.1

The coefficient of consolidation, C_v , value is estimated to be in the order of $0.0035 \text{ cm}^2/\text{s}$, or about $11 \text{ m}^2/\text{yr}$, within the range of stresses anticipated to be acting on the foundation soils.

The parameters obtained from these tests are considered representative of the lightly over-consolidated to normally consolidated portion of the silty clay deposit just below the weathered crust.

A specific gravity value of 2.75 and 2.73 were measured for the tested specimens from MC13-04 and 13-08, respectively. These values correspond to a unit weight of approximately 19 kN/m^3 .

Detailed results of these oedometer tests are included in Appendix B.

The measured water contents of samples recovered from these soils typically ranged from 20% to 60%. Occasional values of greater than 60% at shallow depths are attributed to the organic contents in the soil. Grain size analyses conducted on samples of the silty clay are presented on Figures B3 to B7, and Atterberg Limits test results are presented in Figures B10 to B12 in Appendix B. The results are summarized in the following tables.

Soil Particles	%
<u>Silty Clay</u>	
Gravel	0 to 12
Sand	0 to 16
Silt	18 – 75
Clay	16 - 73
Soil Property	%
Liquid Limit	34 to 62
Plasticity Index	16 to 38

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

5.5 Clayey Silt to Silt

Layers of clayey silt and silt were encountered beneath the silty clay in Boreholes MC13-05 and 13-07. These soils were grey in colour and contained trace clay and sand.

Both boreholes terminated within the clayey silt to silt at depths of 25.0 m (base Elevation 238.8 m). SPT N-values measured within the clayey silt varied between 10 and 12 blows per 0.3 m penetration indicating a stiff consistency. An N-value of 13 blows was measured within the silt indicating a compact state.

Measured water contents of samples recovered from these soils ranged from 18% to 35%. Grain size analyses conducted on samples of each of these soils are presented on Figures B8 and B9 in Appendix B. The results are summarized in the following table.

Soil Particles	%
<u>Clayey Silt</u>	
Gravel	0
Sand	0
Silt	87
Clay	13
<u>Silt</u>	
Gravel	0
Sand	0
Silt	90
Clay	10

Below the sampled depth of each of Boreholes MC13-02, 13-04, 13-05, 13-07, 13-08, 13-09, 13-10 and 13-11, a DCPT was carried out to practical refusal (100 blows per 0.3 m) at depths of 18.6 to 34.7 m (Elevations 240.1 to 229.1 m).

5.6 Groundwater Conditions

Free water was observed in most of the boreholes upon completion of drilling. Standpipe piezometers were installed in Boreholes MC13-01 and MC13-11 to permit longer term monitoring. Water levels observed in the open boreholes and those measured in the two installed standpipes are presented below.

Borehole	Date of Reading	Water Level Depth (m)	Water Level Elevation (m)
MC13-01	Nov. 1, 2013	0.3	259.1
	Nov. 7, 2013	0.3	259.1
MC13-02	Oct. 14, 2013	Dry	-
MC13-03	Oct. 30, 2013	0.2 m	263.5
MC13-04	Oct.15, 2013	11.0 m	252.8
MC13-05	Oct.10, 2013	10.0 m	253.8
MC13-06	Oct.11, 2013	5.6 m	258.4
MC13-07	Oct.28, 2013	2.8 m	261.0
MC13-08	Oct.31, 2013	0.2 m	263.6
MC13-09	Oct.12, 2013	-	-

MC13-10	Oct.12, 2013	Borehole caved to 0.6 m	
MC13-11	Nov.1, 2013	3.5	255.2
	Nov.7, 2013	3.4	255.3

Where surface water is present, the groundwater level should be assumed to coincide with the local surface or creek water level. Based on the observations and measurements above, the groundwater level adjacent to the creek is at approximate Elevation 259 m. The groundwater levels are expected to vary seasonally and are subject to severe weather events such as rainstorms.

6 MISCELLANEOUS

Thurber staked and/or marked the borehole locations in the field and obtained utility clearances prior to drilling. Callon Dietz provided the northing and easting coordinates and ground surface elevations using their local DTM based on borehole location sketches provided by Thurber.

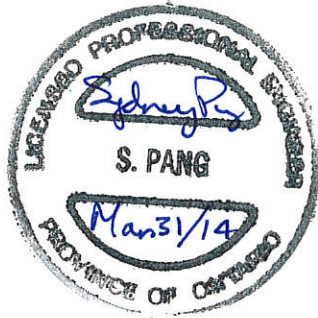
Downing Drilling of Hawkesbury, Ontario supplied and operated a truck-mounted drill rig, a track-mounted CME 55 drill rig, and a tri-pod rig to carry out the drilling, sampling and in-situ testing operations.

The drilling and sampling operations in the field were supervised on a full time basis by Mr. Stephane Loranger, Ms. Katrina Young and Ms. Eckie Siu of Thurber. Geotechnical laboratory testing was carried out by Thurber in its MTO-approved laboratory.

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

Overall project management was provided by Mr. Alastair Gorman, P.Eng. Direction of the field and laboratory program was provided by Dr. Sydney Pang, P.Eng. Interpretation of the field data and preparation of this report was completed by Ms. Katrina Young and Dr. Pang. The report was reviewed by Mr. Gorman and Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.

THURBER ENGINEERING LTD.



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Senior Foundations Engineer



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Appendix A

Record of Borehole Sheets

19-4406-9

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




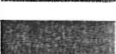

ROCK WEATHERING CLASSIFICATION

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		Field Estimation of Hardness*
	(MPa)	(psi)	
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 MC13-01

1 OF 1

METRIC

GWP# 5169-10-00 LOCATION Mondor Creek N 5 431 434.7 E 302 604.2 ORIGINATED BY JG
 HWY 11 BOREHOLE TYPE Tripod COMPILED BY AN
 DATUM Geodetic DATE 2013.10.25 - 2013.10.25 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT w _P	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa									
259.4								20	40	60	80	100					
0.0	TOPSOIL: (75mm)																
0.1	Silty CLAY some sand, some organics Firm Brown Moist		1	SS	4												
			2	SS	4												
			3	SS	7												
256.8	Becoming soft Grey		4	SS	2												
2.6			5	SS	2												
			6	SS	2												
			7	SS	3												
			8	SS	4												
251.2	END OF BOREHOLE AT 8.23 m. Piezometer installation consists of 19 mm diameter Schedule 40 PVC pipe with a 1.52 m slotted screen.																
8.2	WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Nov. 1/13 0.3 259.1 Nov. 7/13 0.3 259.1																

ONTMT4S 4069.GPJ 2012TEMPLATE(MTO).GDT 3/20/14

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

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No MC13-02

2 OF 3

METRIC

GWP# 5169-10-00 LOCATION Mondor Creek N 5 431 416.0 E 302 604.2 ORIGINATED BY KMY
HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.10.14 - 2013.10.14 CHECKED BY SKP

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 DCPT continued						249							
							248							
							247							
							246							
							245							
							244							
							243							
							242							
							241							
							240							

Continued Next Page

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

RECORD OF BOREHOLE No MC13-02

3 OF 3

METRIC

GWP# 5169-10-00 LOCATION Mondor Creek N 5 431 416.0 E 302 604.2 ORIGINATED BY KMY
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.10.14 - 2013.10.14 CHECKED BY SKP




SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE LIQUID LIMIT CONTENT		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			
	Continued From Previous Page							20 40 60 80 100	○ UNCONFINED + FIELD VANE				
	DCPT continued							20 40 60 80 100	● QUICK TRIAXIAL × LAB VANE				
236.8							239						
22.3	END OF BOREHOLE AND DCPT AT 22.3m. BOREHOLE OPEN AND DRY UPON COMPLETION. BOREHOLE BACKFILLED WITH AUGER CUTTINGS AND BENTONITE HOLEPLUG TO SURFACE.						238						
							237						

RECORD OF BOREHOLE No MC13-03

1 OF 2

METRIC

GWP# 5169-10-00 LOCATION Mondor Creek N 5 431 520.8 E 302 587.3 ORIGINATED BY ES
 HWY 11 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2013.10.30 - 2013.10.30 CHECKED BY SKP

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			20	40	60	80	100	W _P	W		W _L	GR	SA	SI	CL		
263.7																						
0.0	SAND , trace to some gravel Dense to Compact Brown Moist (FILL)		1	SS	31													36	54	10 (SI+CL)		
			2	SS	41																	
			3	SS	18																	
	4	SS	11																			
260.9																						
2.8	Silty CLAY , some sand, trace gravel Soft to Very Soft Grey Wet		5	SS	2																	
			1	TW	PH																	
			6	SS	0														0	0	60	40
			7	SS	0																	
			8	SS	0																	
						</																

Continued Next Page

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

METRIC


[illegible]

RECORD OF BOREHOLE No MC13-04

1 OF 4

METRIC

GWP# 5169-10-00 LOCATION Mondor Creek N 5 431 434.5 E 302 587.7 ORIGINATED BY SLL
 HWY 11 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2013.10.15 - 2013.10.15 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC NATURAL LIQUID LIMIT MOISTURE CONTENT LIMIT				UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)					GR	SA	SI	CL
								20 40 60 80 100				w P w w L								
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE												
263.8																				
0.0	Gravelly SAND Dense Brown Moist (FILL)		1	SS	39									○				36 54 10 (SI+CL)		
263.2																				
0.6			SAND , trace gravel and silt, occasional cobbles Dense to very Dense Brown Moist (FILL)	2	SS	47									○					
				3	SS	60										○				28 63 9 (SI+CL)
	4	SS		60										○						
							263													
							262													
							261													

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10

(%) STRAIN AT FAILURE

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No MC13-04

3 OF 4

METRIC

GWP# 5169-10-00 LOCATION Mondor Creek N 5 431 434.5 E 302 587.7 ORIGINATED BY SLL
 HWY 11 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2013.10.15 - 2013.10.15 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
	Continued From Previous Page							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE						
	Silty CLAY , trace gravel Soft Grey Wet		16	SS	5		243	3.0						0 0 43 57
	With clayey silt varves		17	SS	2		241							
240.3	End of sampling at 23.5m and start of DCPT at 24.1m						240	4.0						
23.5							239							
							238							
							237							
							236							
							235							
							234							

Continued Next Page

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

RECORD OF BOREHOLE No MC13-04

4 OF 4

METRIC

GWP# 5169-10-00 LOCATION Mondor Creek N 5 431 434.5 E 302 587.7 ORIGINATED BY SLL
 HWY 11 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2013.10.15 - 2013.10.15 CHECKED BY SKP







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						
								20 40 60 80 100						
230.1								20 40 60 80 100						
33.7	END OF BOREHOLE AND DCPT AT 33.7m UPON REFUSAL ON PROBABLE BEDROCK OR BOULDER. BOREHOLE OPEN TO 18.4m AND WATER LEVEL AT 11.0m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.8m THEN CUTTINGS TO SURFACE.													

RECORD OF BOREHOLE No MC13-05

1 OF 4

METRIC

GWP# 5169-10-00 LOCATION Mondor Creek N 5 431 393.2 E 302 587.8 ORIGINATED BY SLL
 HWY 11 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2013.10.10 - 2013.10.10 CHECKED BY SKP

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 (%)				GR	SA	SI	CL			
								20	40	60	80	100	W _P	W	W _L								
263.8	0.0	Gravelly SAND , trace to some silt Dense to Very Dense Brown Moist (FILL)		1	SS	37								○					26	63	11 (SI+CL)		
				2	SS	47										○							
				3	SS	59										○							
				4	SS	50										○					30	64	6 (SI+CL)
260.8																							
3.0	260.5	3.3	Wood fragments with 0.25m long nail inside spoon Brown to Grey	5	SS	24																	
				6	SS	6										○							
259.3	4.5	Silty CLAY , with wood fragments Firm Brown Moist (FILL)		7	SS	7											○						
				8	SS	3										●	—			0	9	28	63
256.6	7.2	Soft																					
				9	SS	WH										○							
																							
				10	SS	WH										○							
																							

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MC13-05

2 OF 4

METRIC

GWP# 5169-10-00 LOCATION Mondor Creek N 5 431 393.2 E 302 587.8 ORIGINATED BY SLL
 HWY 11 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2013.10.10 - 2013.10.10 CHECKED BY SKP

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			20	40	60	80	100	W _P	W		W _L	GR	SA	SI	CL
								SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				WATER CONTENT (%)								
	Continued From Previous Page							20	40	60	80	100	20	40	60					
247.5 16.3	Silty CLAY , trace gravel Soft Grey Wet 																			

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity



20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MC13-05

3 OF 4

METRIC

GWP# 5169-10-00 LOCATION Mondor Creek N 5 431 393.2 E 302 587.8 ORIGINATED BY SLL
 HWY 11 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2013.10.10 - 2013.10.10 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		WATER CONTENT (%)								
								20 40 60 80 100	w _p w w _L									
Continued From Previous Page																		
241.2 22.6	Silty CLAY Soft Grey Wet		17	SS	3		243		+									
	18		SS	4				242										
									4.0 +									
	Clayey SILT Stiff Grey Wet		19	SS	10		241											
								240										
			20	SS	12													
238.8 25.0	End of sampling at 25.0m and start of DCPT at 25.6m						239									0 0 87 13		
							238											
							237											
							236											
							235											
							234											

Continued Next Page

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

RECORD OF BOREHOLE No MC13-05

4 OF 4

METRIC

GWP# 5169-10-00 LOCATION Mondor Creek N 5 431 393.2 E 302 587.8 ORIGINATED BY SLL
 HWY 11 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2013.10.10 - 2013.10.10 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC NATURAL LIQUID LIMIT MOISTURE LIMIT CONTENT			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		
	Continued From Previous Page							○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE		WATER CONTENT (%)				
	DCPT continued													
229.8														
34.0	END OF BOREHOLE AND DCPT AT 34.0m. BOREHOLE OPEN TO 17.8m AND WATER LEVEL AT 10.0m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 1.8m, THEN CUTTINGS TO SURFACE.													

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

RECORD OF BOREHOLE No MC13-06

1 OF 1

METRIC

GWP# 5169-10-00 LOCATION Mondor Creek N 5 431 321.2 E 302 588.1 ORIGINATED BY SLL
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.10.11 - 2013.10.11 CHECKED BY SKP

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						WATER CONTENT (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
								○ UNCONFINED + FIELD VANE						w P w w L																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
								● QUICK TRIAXIAL × LAB VANE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
264.0							20	40	60	80	100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														

+³, ×³: Numbers refer to
Sensitivity

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(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MC13-07

1 OF 4

METRIC

GWP# 5169-10-00 LOCATION Mondor Creek N 5 431 446.9 E 302 579.6 ORIGINATED BY SLL
 HWY 11 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2013.10.17 - 2013.10.28 CHECKED BY SKP

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 (%)				GR	SA	SI	CL	
								20	40	60	80	100	W _P	W						W _L
263.8																				
0.0	Gravelly SAND Dense Brown Moist (FILL)		1	SS	49									○					31 57 12 (SI+CL)	
			2	SS	50/ 0.075										○					
	Occasional cobbles																			
			3	SS	38											○				
		4	SS	46											○					22 65 13 (SI+CL)
260.9								261												
2.9	Silty CLAY , some sand Very Stiff Brown Moist		5	SS	27															
260.1								260												
3.7	Firm		6	SS	7										○					
			7	SS	3		259							○						
							258													
	Becoming grey Wet		8	SS	1		257								○				0 10 65 25	
							256								○					
			9	SS	PH		255													
255.1																				
8.7	Soft																			
			1	TW	PH		254													

Continued Next Page

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

RECORD OF BOREHOLE No MC13-07

2 OF 4

METRIC

GWP# 5169-10-00 LOCATION Mondor Creek N 5 431 446.9 E 302 579.6 ORIGINATED BY SLL
 HWY 11 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2013.10.17 - 2013.10.28 CHECKED BY SKP

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			20 40 60 80 100	20 40 60 80 100	20 40 60 80 100	W _P W W _L					
	Continued From Previous Page															
	Silty CLAY , some sand Soft Grey Wet															
			10	SS	1		253								0 12 66 22	
			11	SS	1		252									
							251									
			12	SS	1		250									
249.0							249									
14.8	Firm to Stiff															
			13	SS	WH		248									
							247								0 0 49 51	
							246									
			15	SS	2		245								0 0 34 66	
							244									

Continued Next Page

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

RECORD OF BOREHOLE No MC13-07

3 OF 4

METRIC

GWP# 5169-10-00 LOCATION Mondor Creek N 5 431 446.9 E 302 579.6 ORIGINATED BY SLL
 HWY 11 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2013.10.17 - 2013.10.28 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT NATURAL MOISTURE LIQUID CONTENT LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL	
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa			WATER CONTENT (%)					
								20 40 60 80 100	○ UNCONFINED + FIELD VANE			w _p w w _L				
								20 40 60 80 100	● QUICK TRIAXIAL × LAB VANE							
	Continued From Previous Page		16	SS	2		243	3.0				○				
			17	SS	3		242					○				
	Wet						241	3.0								
240.5			18	SS	4									0 0 90 10		
23.3	SILT , trace sand, trace clay Loose to Compact Grey Wet						240					○				
			19	SS	13		239					○				
238.8							238									
25.0	End of sampling at 25.0m and start of DCPT						237									
							236									
							235									
							234									

Continued Next Page

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

RECORD OF BOREHOLE No MC13-07

4 OF 4

METRIC

GWP# 5169-10-00 LOCATION Mondor Creek N 5 431 446.9 E 302 579.6 ORIGINATED BY SLL
 HWY 11 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2013.10.17 - 2013.10.28 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES						
	Continued From Previous Page DCPT continued										
229.1											
34.7	END OF BOREHOLE AND DCPT AT 34.7m UPON REFUSAL. FREE WATER AT 2.8m UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG TO 0.1m, SAND AND GRAVEL TO SURFACE.										

RECORD OF BOREHOLE No MC13-08

1 OF 4

METRIC

GWP# 5169-10-00 LOCATION Mondor Creek N 5 431 415.2 E 302 579.6 ORIGINATED BY ES
 HWY 11 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2013.10.31 - 2013.10.31 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
263.8														
0.0	SAND, trace gravel Compact to Dense Brown Wet (FILL) Occasional cobbles		1	SS	28									
			2	SS	38									6 90 4 (SI+CL)
			3	SS	32									
	Some gravel to gravelly, cobbles		4	SS	24									
			5	SS	68									
260.0														
3.8	Silty CLAY, some sand, trace gravel, trace organics, occasional wood fibres, trace rootlets Very Stiff to Firm Grey		6	SS	24									0 10 38 52
			7	SS	9									
			8	SS	6									
			9	SS	6									
							3.0 +							
			1	TW	PH									12 9 38 41

Continued Next Page

+³, ×³: Numbers refer to
Sensitivity

20
15
10
(%) STRAIN AT FAILURE

RECORD OF BOREHOLE No MC13-08

2 OF 4

METRIC

GWP# 5169-10-00 LOCATION Mondor Creek N 5 431 415.2 E 302 579.6 ORIGINATED BY ES
HWY 11 BOREHOLE TYPE NW Casing COMPILED BY AN
DATUM Geodetic DATE 2013.10.31 - 2013.10.31 CHECKED BY SKP

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 (%)				GR	SA	SI	CL	
								20 40 60 80 100	○ UNCONFINED + FIELD VANE	● QUICK TRIAXIAL × LAB VANE	W _p W W _L									
	Continued From Previous Page																			
	Silty CLAY Very Soft to Soft Grey Wet																			
			10	SS	1		253	6.0 +								3	12	44	41	
			11	SS	3		252	8.0 +												
							251													
								5.0 +												
			2	TW	PH		250													
							249	5.0 +												
			12	SS	1		248													
								8.0 +												
							247													
			13	SS	1															
								6.0 +												
							246													
			14	SS	1		245													
244.9																				
18.9	End of sampling and start of DCPT at 18.9m																			
							244													

Continued Next Page

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

RECORD OF BOREHOLE No MC13-08

3 OF 4

METRIC

GWP# 5169-10-00 LOCATION Mondor Creek N 5 431 415.2 E 302 579.6 ORIGINATED BY ES
 HWY 11 BOREHOLE TYPE NW Casing COMPILED BY AN
 DATUM Geodetic DATE 2013.10.31 - 2013.10.31 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
	Continued From Previous Page DCPT continued							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	20 40 60					
234.6							243							
29.2	END OF BOREHOLE AT 29.2m UPON REFUSAL. FREE WATER AT 0.2m UPON COMPLETION. BOREHOLE BACKFILLED WITH						235							

Continued Next Page

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

METRIC

[illegible]

METRIC

[illegible]

+³, ×³: Numbers refer to Sensitivity

RECORD OF BOREHOLE No MC13-09

2 OF 3

METRIC

GWP# 5169-10-00 LOCATION Mondor Creek N 5 431 441.6 E 302 565.3 ORIGINATED BY KMY
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.10.12 - 2013.10.12 CHECKED BY SKP

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			20	40	60	80	100	W _P	W		W _L	GR	SA	SI	CL
SHEAR STRENGTH kPa																				
○ UNCONFINED + FIELD VANE																				
● QUICK TRIAXIAL × LAB VANE																				
WATER CONTENT (%)																				
20 40 60 80 100																				
20 40 60 80 100																				
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+³, ×³: Numbers refer to Sensitivity
 20
15
10
5
0 (%) STRAIN AT FAILURE

METRIC

[illegible]

RECORD OF BOREHOLE No MC13-10

1 OF 3

METRIC

GWP# 5169-10-00 LOCATION Mondor Creek N 5 431 434.0 E 302 560.3 ORIGINATED BY KMY
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.10.12 - 2013.10.12 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				WATER CONTENT (%)								
								○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE				w _p w w _L								
259.8								20	40	60	80	100								
0.0	TOPSOIL: (25mm) Light Brown		1	SS	6									○	○					
	Silty CLAY , trace sand Stiff to firm Brown Moist to Wet		2	SS	8									○						0 5 50 45
			3	SS	3									○	○					
	Becoming grey Wet		4	SS	2															0 10 68 22
			5	SS	1									○						
			6	SS	3									○						
252.2	End of sampling at 7.6m and start of DCPT																			
7.6																				

Continued Next Page

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

RECORD OF BOREHOLE No MC13-10

2 OF 3

METRIC

GWP# 5169-10-00 LOCATION Mondor Creek N 5 431 434.0 E 302 560.3 ORIGINATED BY KMY
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.10.12 - 2013.10.12 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
	Continued From Previous Page DCPT continued							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	20 40 60					
249														
248														
247														
246														
245														
244														
243														
242														
241														
240														

Continued Next Page

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

RECORD OF BOREHOLE No MC13-10

3 OF 3

METRIC

GWP# 5169-10-00 LOCATION Mondor Creek N 5 431 434.0 E 302 560.3 ORIGINATED BY KMY
HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
DATUM Geodetic DATE 2013.10.12 - 2013.10.12 CHECKED BY SKP

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								
	Continued From Previous Page DCPT continued							20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	W _p W W _L	20 40 60			
238.2							239						
21.6	END OF BOREHOLE AT 21.6m. BOREHOLE CAVED TO 0.6m, BACKFILLED WITH BENTONITE HOLEPLUG AND CUTTINGS TO SURFACE.												

RECORD OF BOREHOLE No MC13-11

1 OF 2

METRIC

GWP# 5169-10-00 LOCATION Mondor Creek N 5 431 419.9 E 302 560.0 ORIGINATED BY KMY
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.10.14 - 2013.10.15 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT		NATURAL MOISTURE CONTENT		LIQUID LIMIT		UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa		W P		W		W L			
258.7								20 40 60 80 100									
0.0	Silty CLAY , with rootlets Firm to Stiff Dark Brown Moist		1	SS	6												
	Light Brown to Grey		2	SS	5												
	Some organics		3	SS	6												
	Firm Grey Moist to Wet		4	SS	3												
			5	SS	2												
			6	SS	4												
251.7	End of sampling at 7.0m and start of DCPT																
7.0																	

Continued Next Page

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

RECORD OF BOREHOLE No MC13-11

2 OF 2

METRIC

GWP# 5169-10-00 LOCATION Mondor Creek N 5 431 419.9 E 302 560.0 ORIGINATED BY KMY
 HWY 11 BOREHOLE TYPE Hollow Stem Augers COMPILED BY AN
 DATUM Geodetic DATE 2013.10.14 - 2013.10.15 CHECKED BY SKP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa	WATER CONTENT (%)					
	Continued From Previous Page DCPT continued							20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	20 40 60					
248														
247														
246														
245														
244														
243														
242														
241														
240.1 18.6	END OF BOREHOLE AT 18.6m. Piezometer installation consists of 19 mm diameter Schedule 40 PVC pipe with a 1.52 m slotted screen. WATER LEVEL READINGS: DATE DEPTH (m) ELEV. (m) Nov. 1/13 3.5 255.2 Nov. 7/13 3.4 255.3													

ONTMT4S 4069.GPJ 2012TEMPLATE(MTO).GDT 3/20/14

Appendix B

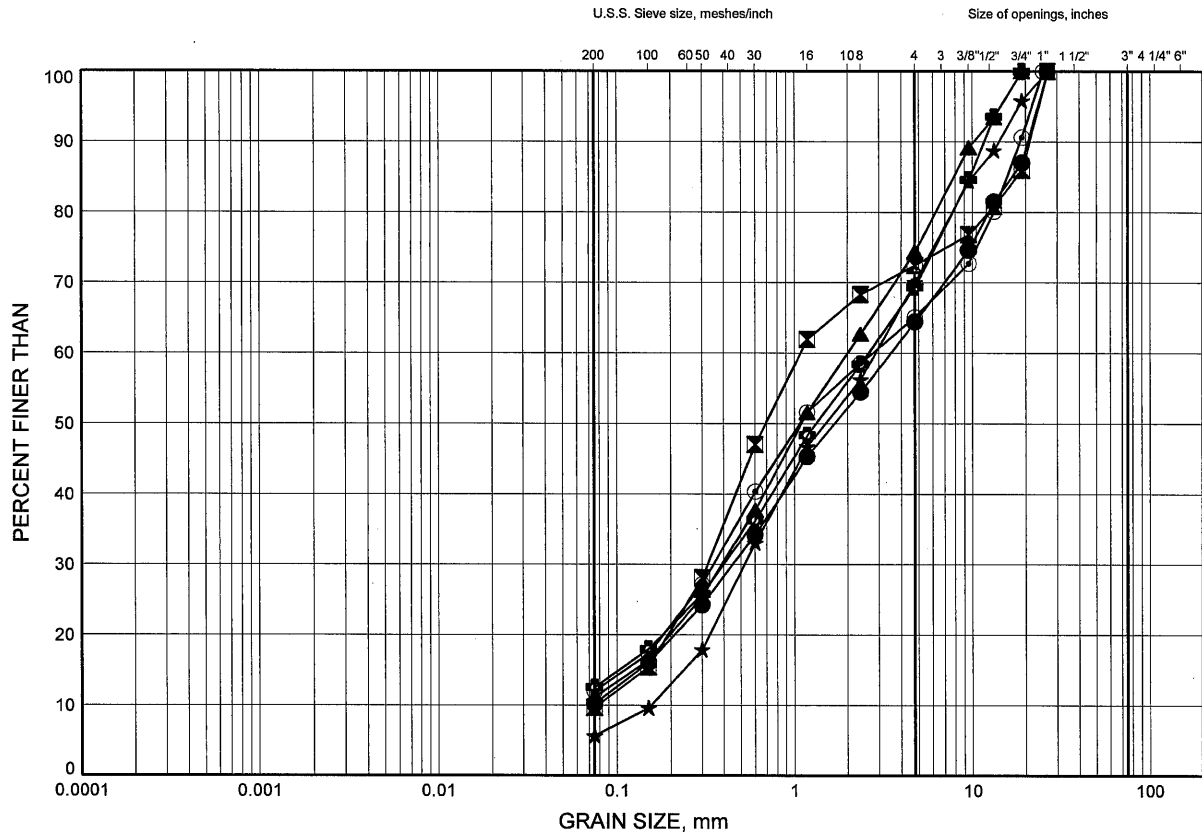
Laboratory Test Results

Hwys 11, 583, 652 Culverts - Foundations

GRAIN SIZE DISTRIBUTION

FIGURE B1

GRAVELLY SAND FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MC13-04	0.30	263.50
⊠	MC13-04	1.83	261.97
▲	MC13-05	0.30	263.50
★	MC13-05	2.59	261.21
⊙	MC13-06	1.07	262.93
⊕	MC13-07	0.30	263.50

Date November 2013
WP# 5169-10-00



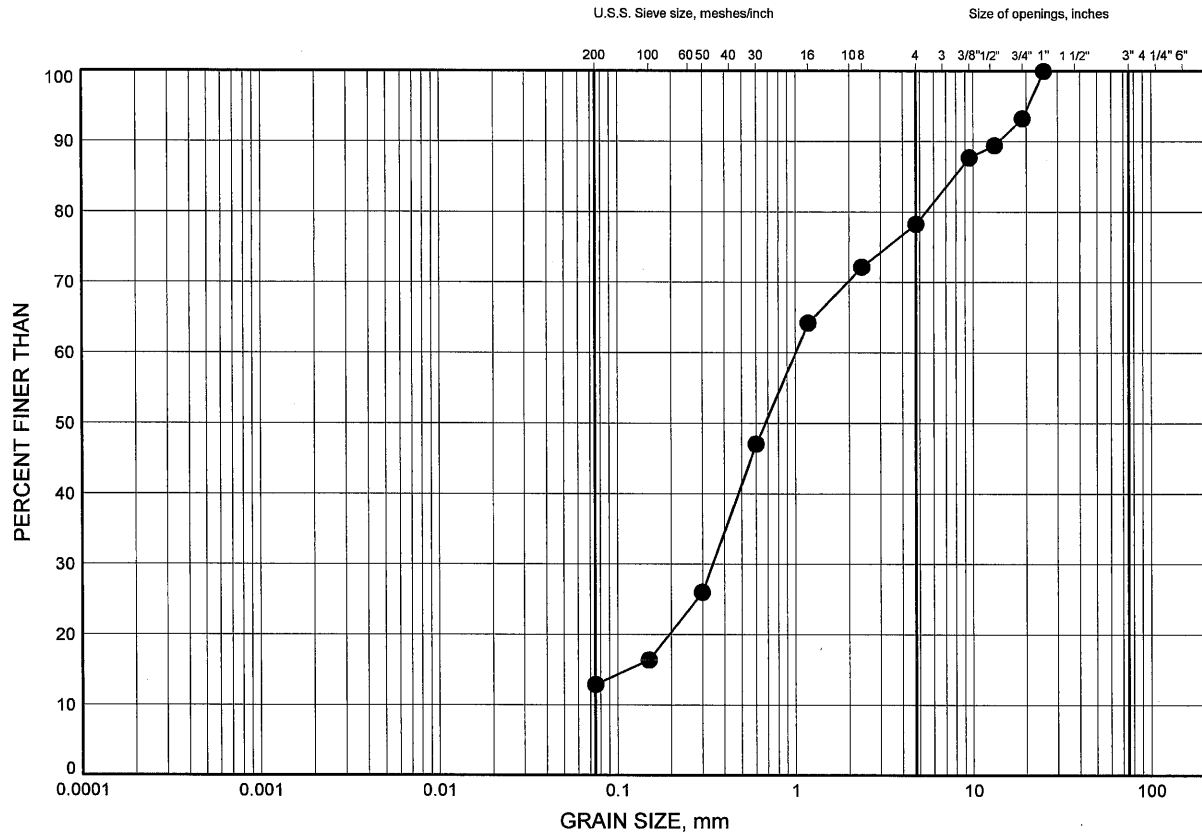
Prep'd AN
Chkd. SKP

Hwys 11, 583, 652 Culverts - Foundations

GRAIN SIZE DISTRIBUTION

FIGURE B2

GRAVELLY SAND FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MC13-07	2.59	261.21

GRAIN SIZE DISTRIBUTION - THURBER 4069.GPJ 11/29/13

Date November 2013
WP# 5169-10-00



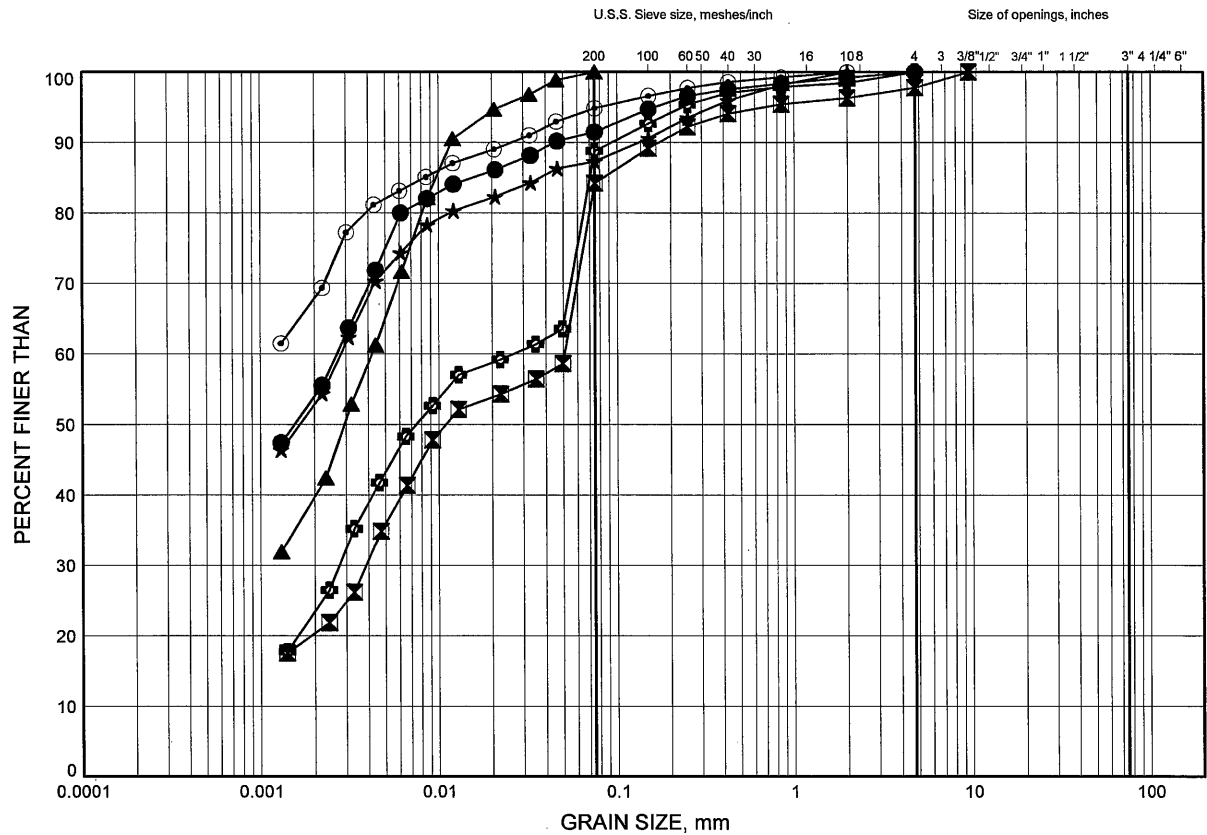
Prep'd AN
Chkd. SKP

Hwys 11, 583, 652 Culverts - Foundations

GRAIN SIZE DISTRIBUTION

FIGURE B3

SILTY CLAY



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MC13-02	1.07	258.03
⊠	MC13-02	6.40	252.70
▲	MC13-03	4.88	258.82
★	MC13-03	9.45	254.25
⊙	MC13-04	4.88	258.92
⊕	MC13-04	10.97	252.83

Date November 2013

WP# 5169-10-00



Prep'd AN

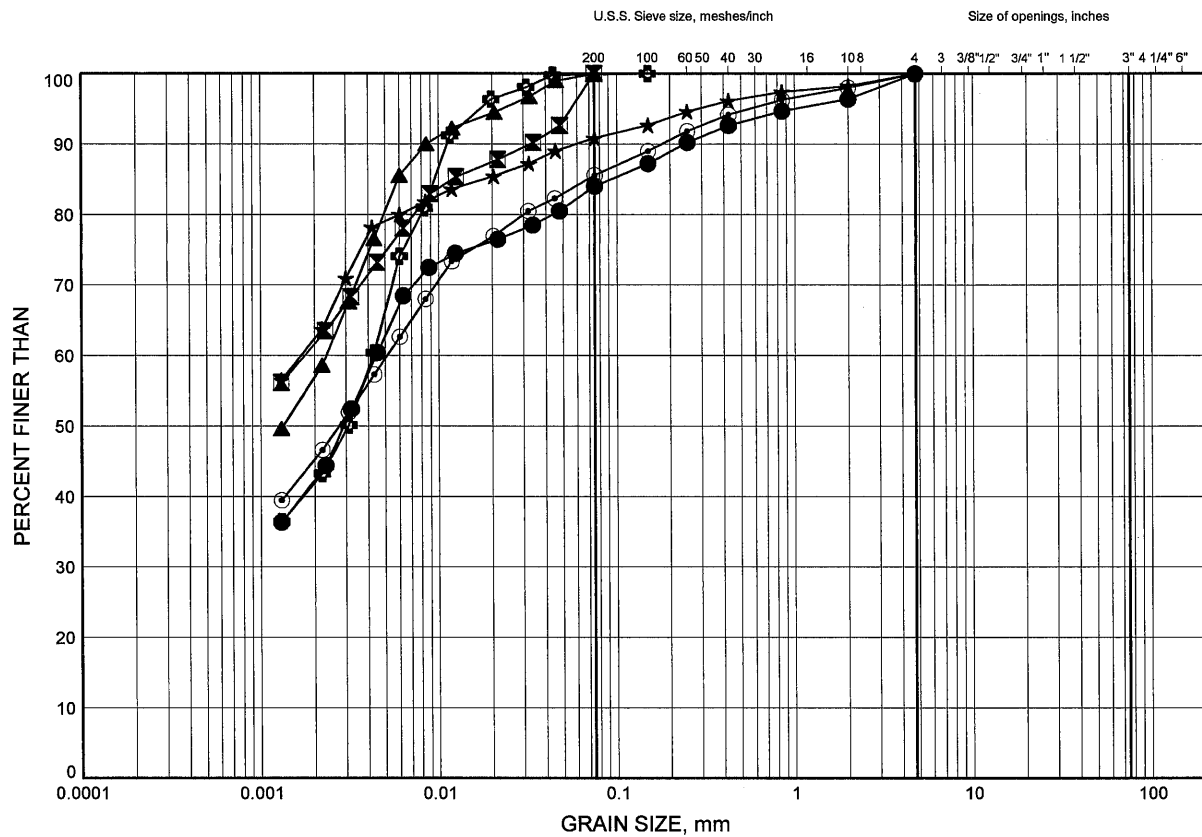
Chkd. SKP

Hwys 11, 583, 652 Culverts - Foundations

GRAIN SIZE DISTRIBUTION

FIGURE B4

SILTY CLAY



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MC13-04	12.40	251.40
⊠	MC13-04	15.54	248.26
▲	MC13-04	20.12	243.68
★	MC13-05	6.40	257.40
⊙	MC13-05	12.50	251.30
⊕	MC13-06	3.35	260.65

GRAIN SIZE DISTRIBUTION - THURBER 4069.GPJ 11/29/13

Date November 2013
 WP# 5169-10-00



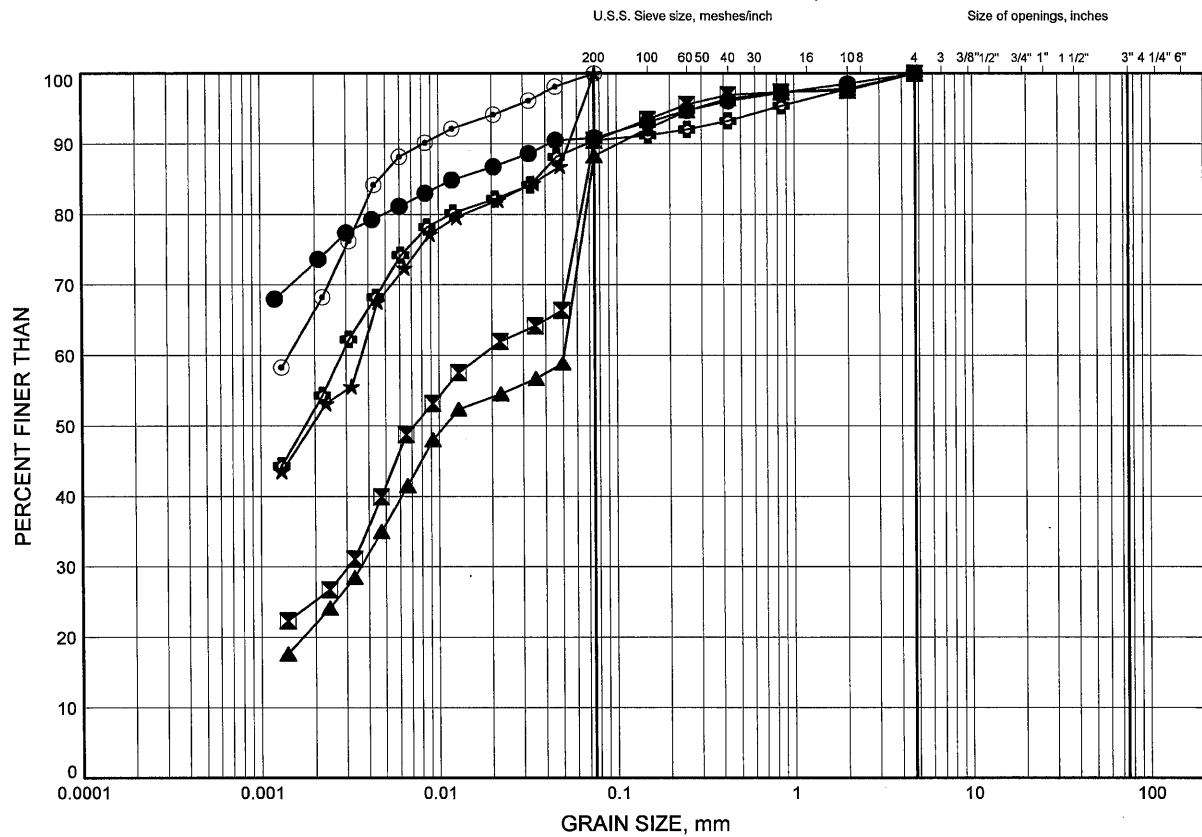
Prep'd AN
 Chkd. SKP

Hwys 11, 583, 652 Culverts - Foundations

GRAIN SIZE DISTRIBUTION

FIGURE B5

SILTY CLAY



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MC13-06	6.40	257.60
⊠	MC13-07	6.40	257.40
▲	MC13-07	10.97	252.83
★	MC13-07	17.07	246.73
⊙	MC13-07	18.59	245.21
⊕	MC13-08	4.11	259.69

Date December 2013
Project 5169-10-00



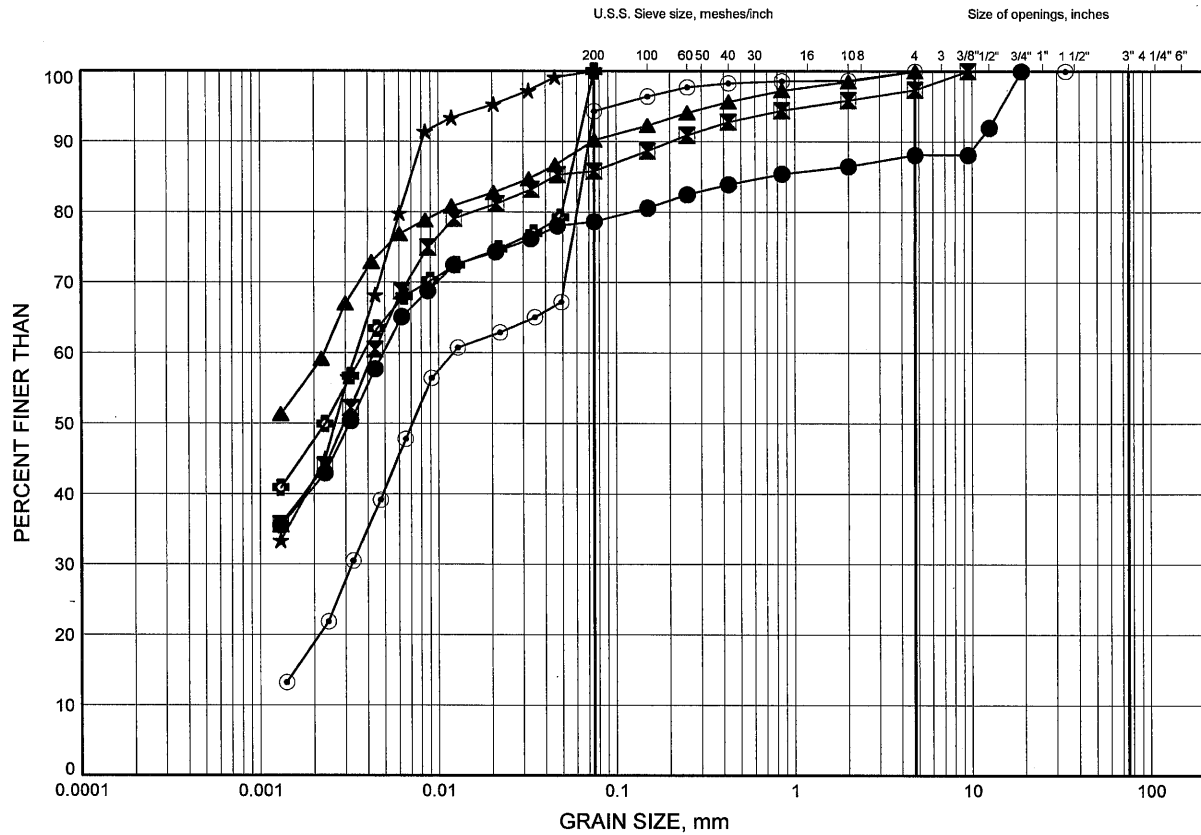
Prep'd AN
Chkd. SKP

Hwys 11, 583, 652 Culverts - Foundations

GRAIN SIZE DISTRIBUTION

FIGURE B6

SILTY CLAY



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MC13-08	9.45	254.35
⊠	MC13-08	10.97	252.83
▲	MC13-08	17.07	246.73
★	MC13-09	1.07	259.63
⊙	MC13-09	5.49	255.21
⊕	MC13-09	13.11	247.59

GRAIN SIZE DISTRIBUTION - THURBER 4069.GPJ 11/29/13

Date November 2013
WP# 5169-10-00



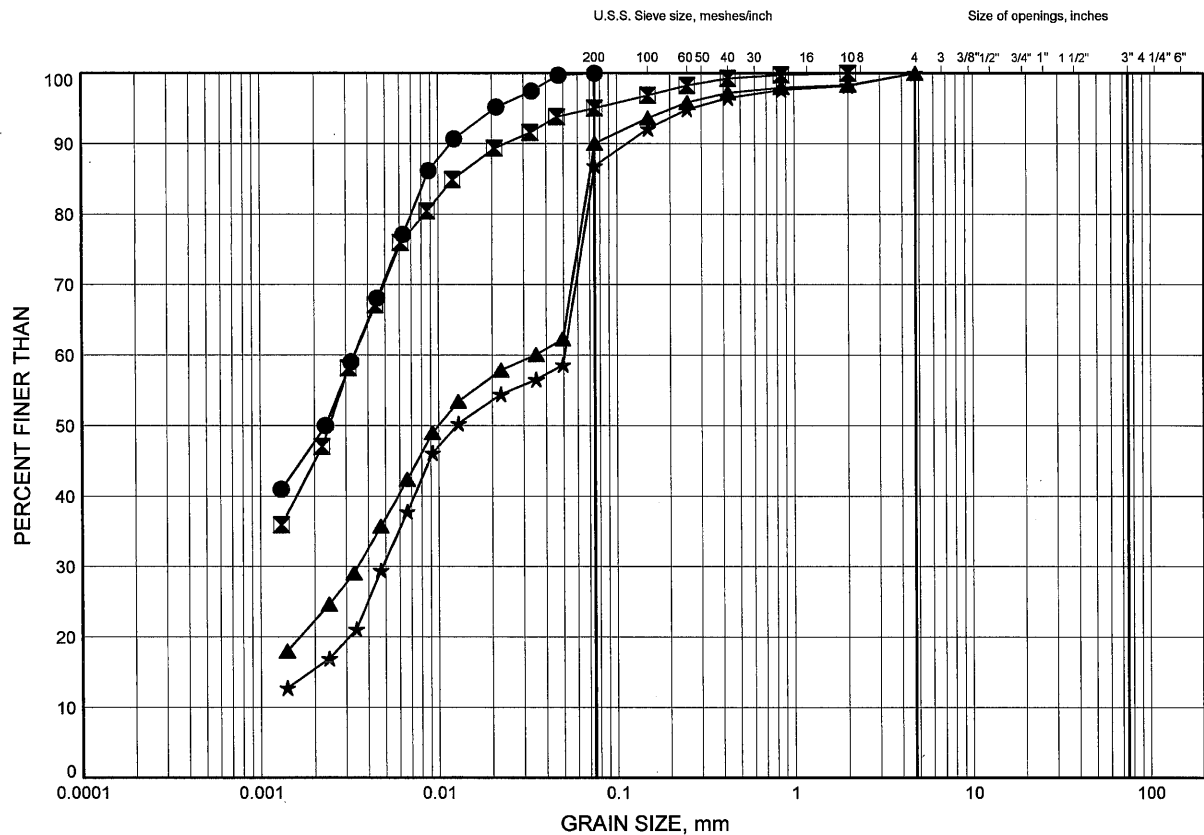
Prep'd AN
Chkd. SKP

Hwys 11, 583, 652 Culverts - Foundations

GRAIN SIZE DISTRIBUTION

FIGURE B7

SILTY CLAY



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MC13-09	18.59	242.11
⊠	MC13-10	1.07	258.73
▲	MC13-10	4.11	255.69
★	MC13-11	6.40	252.30

Date November 2013
 WP# 5169-10-00



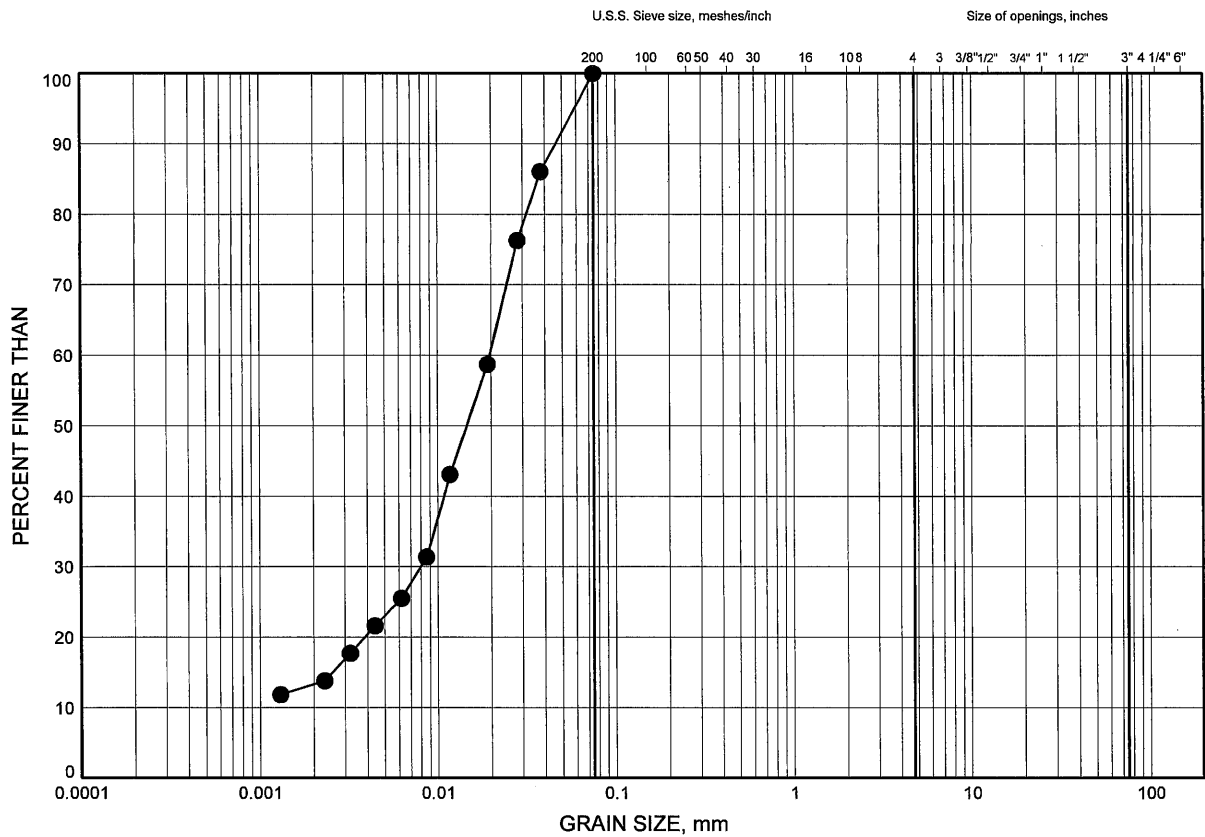
Prep'd AN
 Chkd. SKP

Hwys 11, 583, 652 Culverts - Foundations

GRAIN SIZE DISTRIBUTION

FIGURE B8

CLAYEY SILT



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MC13-05	24.69	239.11

Date November 2013
WP# 5169-10-00

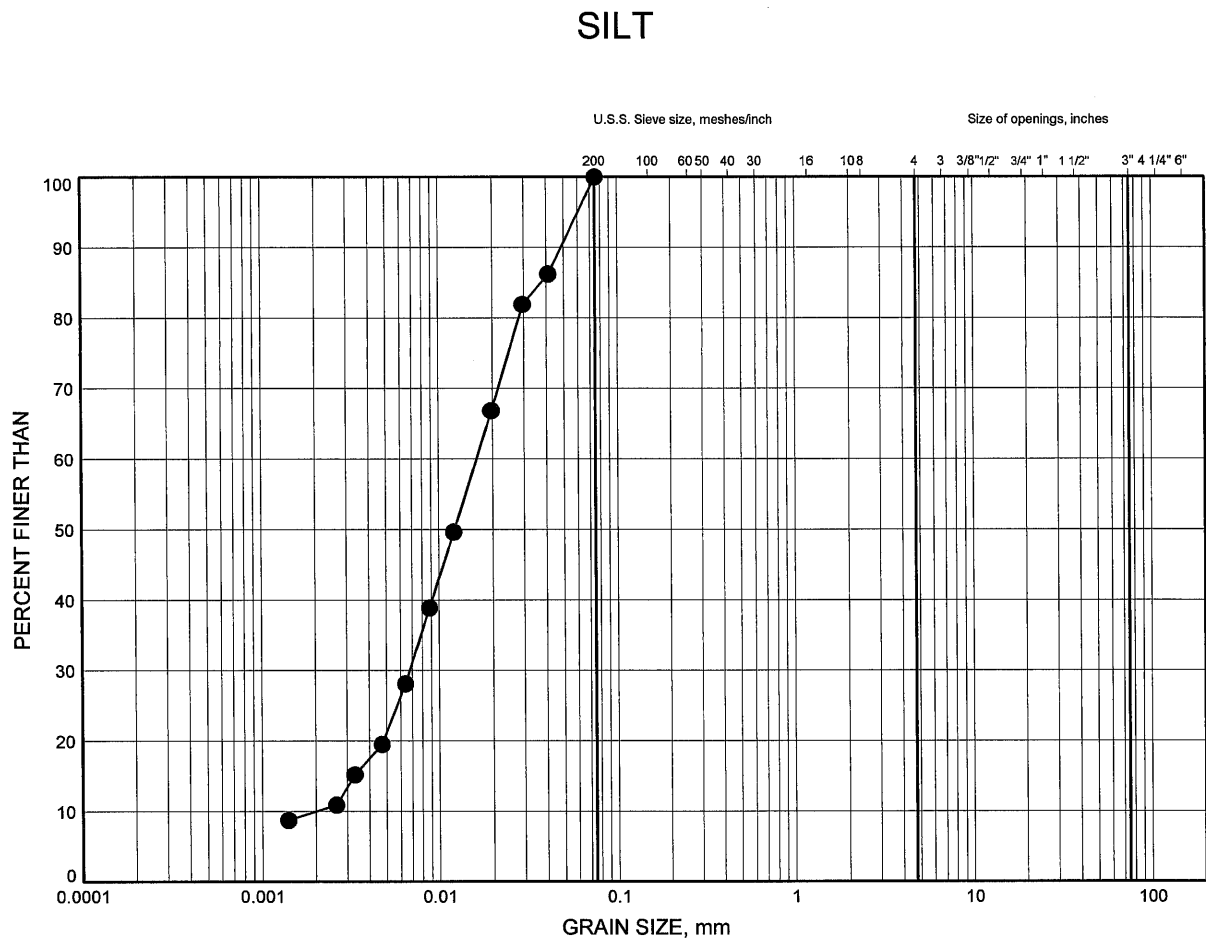


Prep'd AN
Chkd. SKP

Hwys 11, 583, 652 Culverts - Foundations

GRAIN SIZE DISTRIBUTION

FIGURE B9



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MC13-07	23.16	240.64

GRAIN SIZE DISTRIBUTION - THURBER 4069.GPJ 11/29/13

Date November 2013
 WP# 5169-10-00

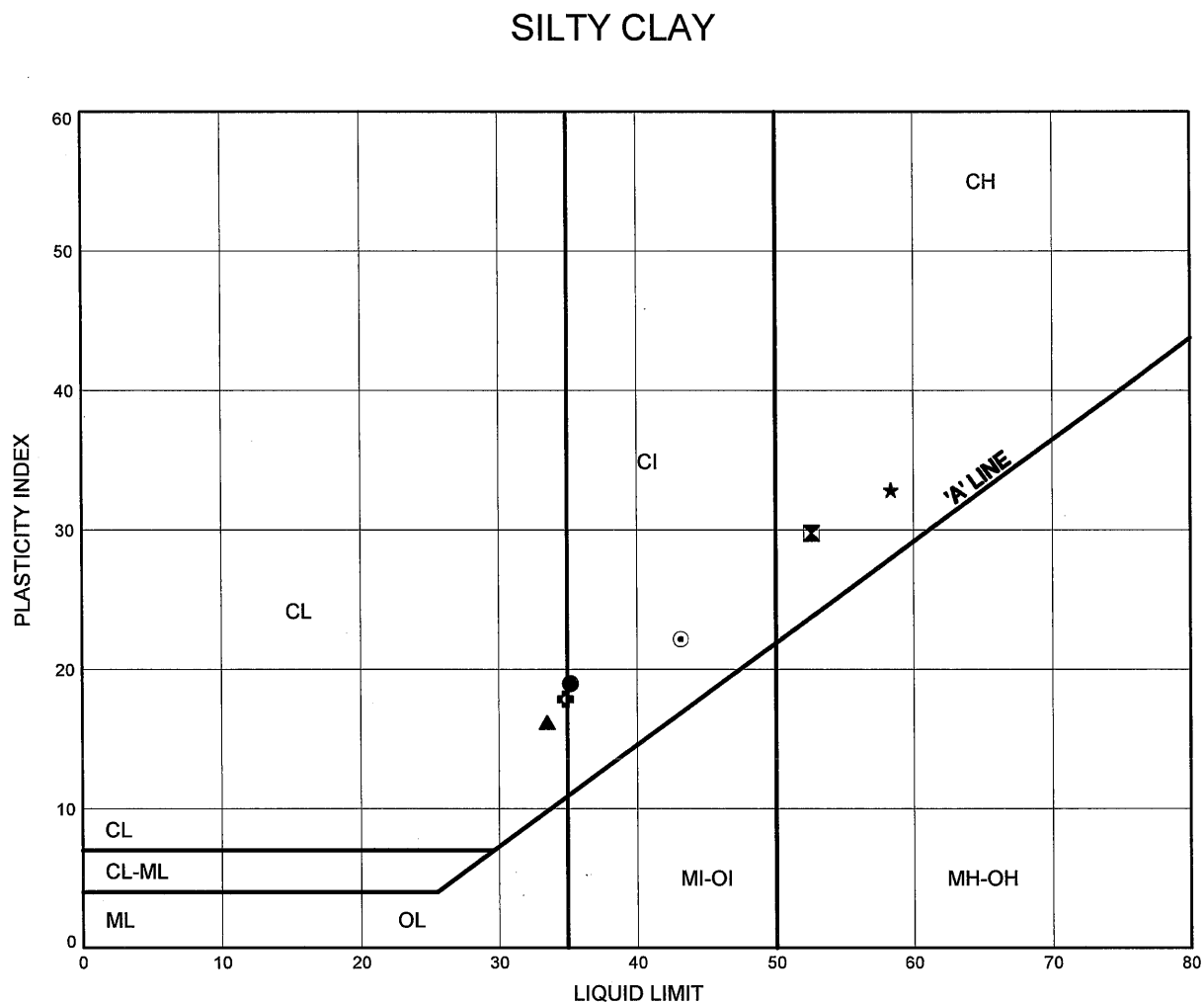


Prep'd AN
 Chkd. SKP

Hwys 11, 583, 652 Culverts - Foundations

ATTERBERG LIMITS TEST RESULTS

FIGURE B10



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MC13-02	6.40	252.70
⊠	MC13-04	4.88	258.92
▲	MC13-04	10.97	252.83
★	MC13-04	15.54	248.26
⊙	MC13-05	6.40	257.40
⊕	MC13-05	12.50	251.30

Date November 2013
 WP# 5169-10-00



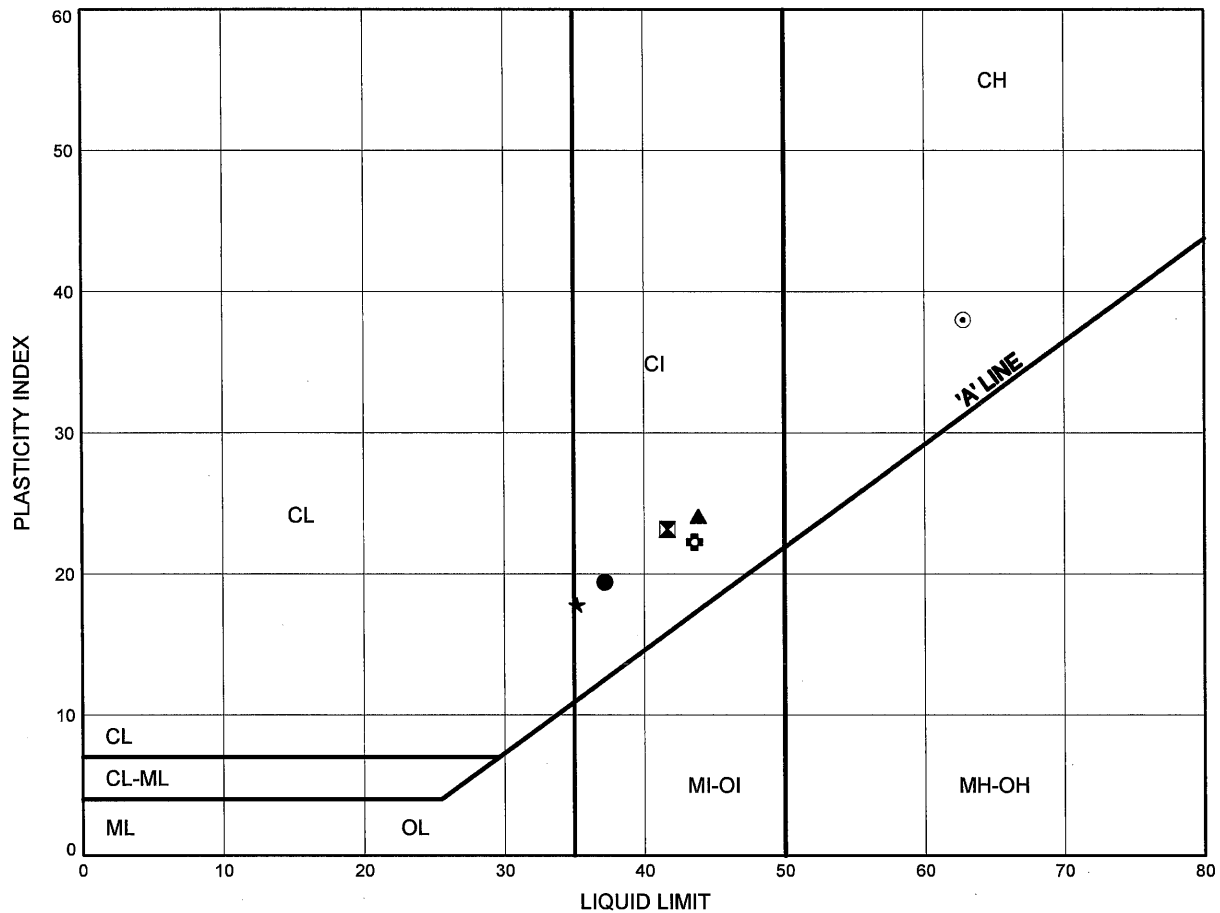
Prep'd AN
 Chkd. SKP

Hwys 11, 583, 652 Culverts - Foundations

ATTERBERG LIMITS TEST RESULTS

FIGURE B11

SILTY CLAY



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MC13-06	3.35	260.65
⊠	MC13-06	6.40	257.60
▲	MC13-07	6.40	257.40
★	MC13-07	10.97	252.83
⊙	MC13-07	17.07	246.73
⊕	MC13-07	18.59	245.21

Date November 2013

WP# 5169-10-00



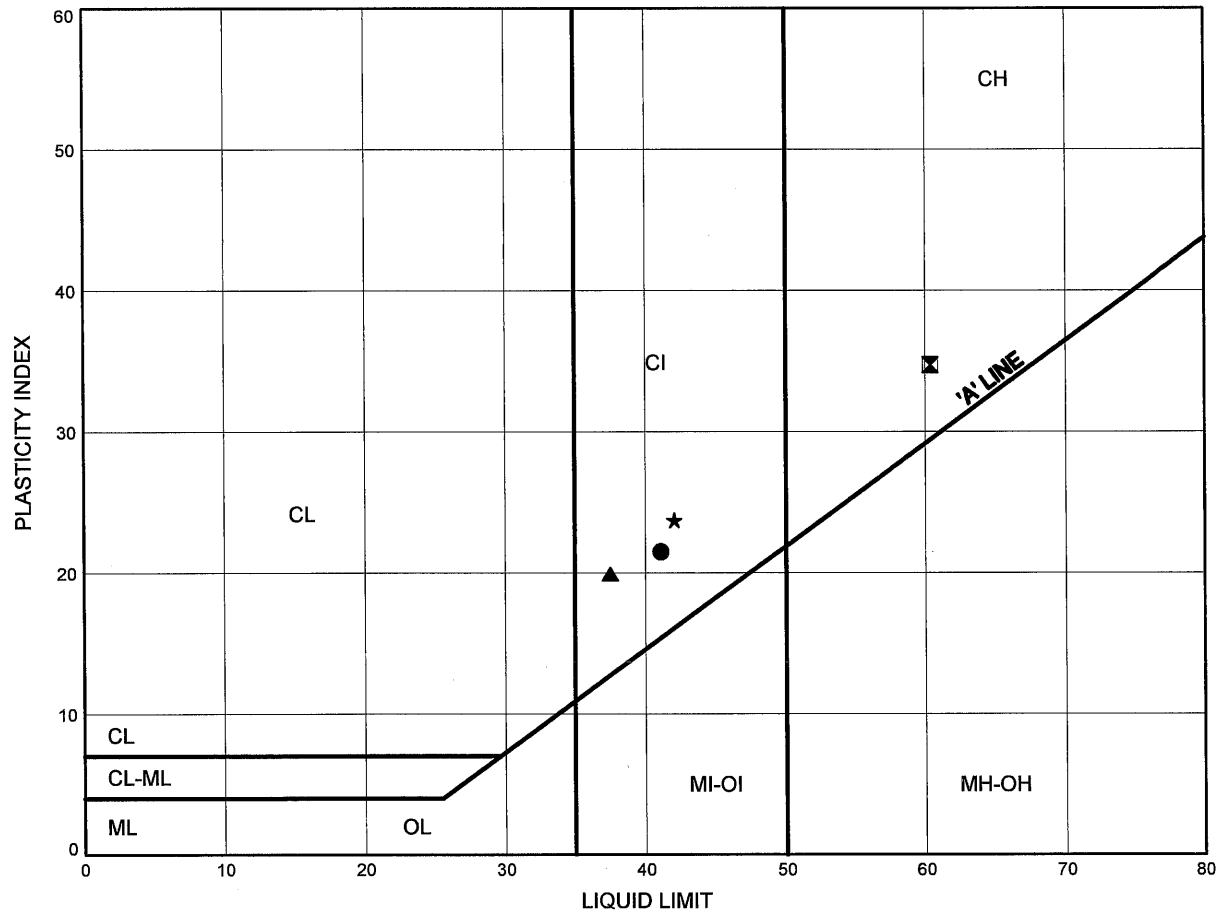
Prep'd AN

Chkd. SKP

Hwys 11, 583, 652 Culverts - Foundations
ATTERBERG LIMITS TEST RESULTS

FIGURE B12

SILTY CLAY



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MC13-09	5.49	255.21
⊠	MC13-09	13.11	247.59
▲	MC13-10	4.11	255.69
★	MC13-11	1.83	256.87

Date November 2013
 WP# 5169-10-00

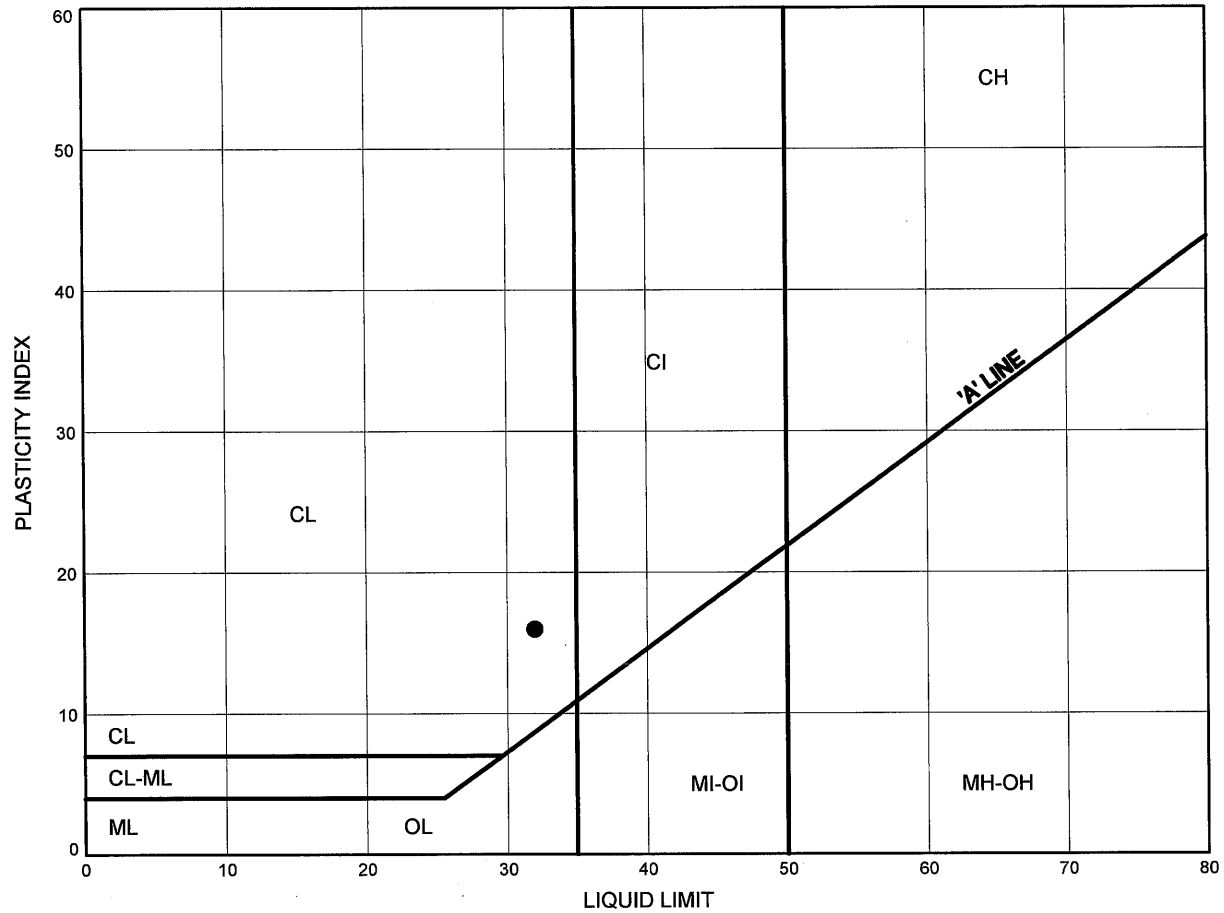


Prep'd AN
 Chkd. SKP

Hwys 11, 583, 652 Culverts - Foundations
ATTERBERG LIMITS TEST RESULTS

FIGURE B13

CLAYEY SILT



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	MC13-11	6.40	252.30

THURBALT 4089.GPJ 11/29/13

Date November 2013
 WP# 5169-10-00



Prep'd AN
 Chkd. SKP

Consolidation Test Report

CLIENT: URS Canada Inc.

FILE NUMBER: 19-4406-9

PROJECT: Mondor Creek

REPORT DATE: 7-Apr-14

TEST DATES: November 18, 2013 - November 29, 2013

SAMPLE: MC13-04-TW1 (40' - 41' 4")
Silty Clay, grey, contains 16% sand, 42% silt and 42% clay, PL=16%, LL=32%

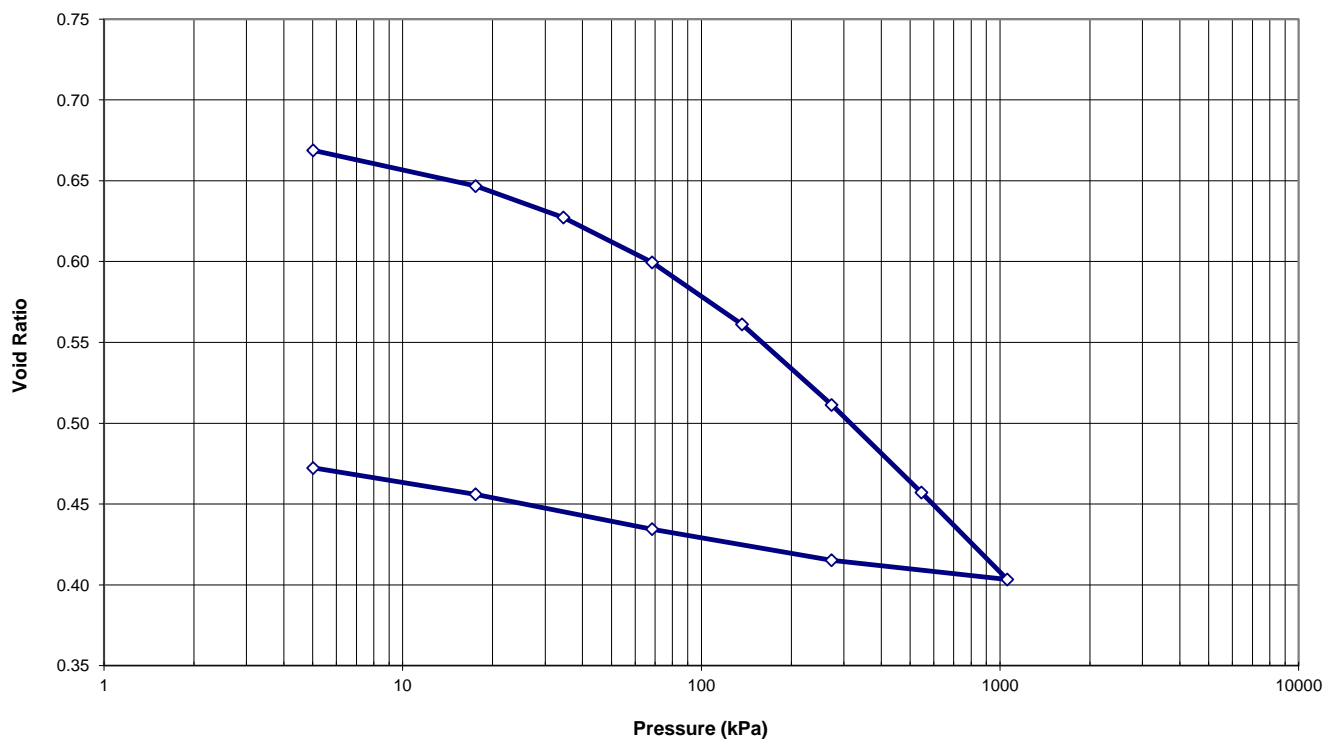
PROCEDURE: Test carried out in accordance with Standard Test Method for One-Dimensional Consolidation Properties of Soils, ASTM D 2435-04, method A (constant load increment duration of 24 hrs)

	<u>Start of Test</u>	<u>End of Test</u>
Wet Dens. (kg/m ³)	2063.8	2214.6
Dry Dens. (kg/m ³)	1636.8	1868.7
Moisture Cont. (%)	26.1	18.5
Void Ratio	0.681	0.473

Note: A Specific Gravity of 2.75 was measured for the void ratio and saturation calculations.

Void Ratio vs. Pressure

Project #: 19-4406-9
Client: URS Canada Inc.
Project Name: Mondor Creek
Sample: MC13-04-TW1 (40' - 41' 4")



Consolidation Test Report

Mondor Creek

19-4406-9

MC13-04-TW1 (40' - 41' 4")

TRIMMING: The Specimen was manually trimmed to the size of consolidation ring, then mounted in a fixed ring consolidometer.

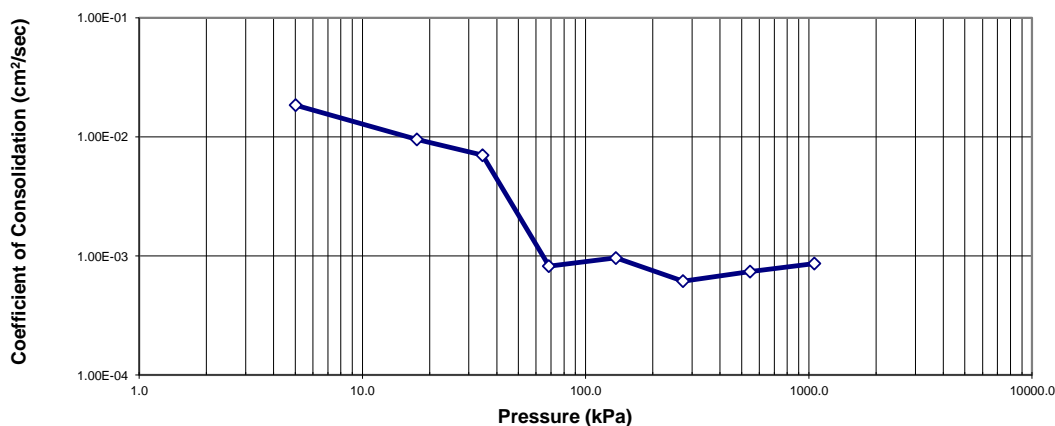
LOADING: A seating load of 5 kPa was applied and the consolidometer was flooded with distilled water. Sample was monitored to ensure no swelling effect occurred before the start of the test. Subsequent loads were applied after 100% primary consolidation was reached.

CALCULATIONS: Coefficients of Consolidation were calculated by the square root time method.

Pressure (kPa)	Corr. H. (mm)	Avg. H. (mm)	d_{90} (mm)	t_{90} (min)	C_v (cm ² /s)	Void Ratio	m_v (m ² /kN)	k (cm/s)
0.0	20.000					0.681		
5.0	19.854	19.927	-0.115	0.757	1.85E-02	0.669	1.45E-03	2.64E-06
17.6	19.593	19.724	-0.116	1.440	9.55E-03	0.647	1.05E-03	9.82E-07
34.5	19.360	19.477	-0.067	1.904	7.04E-03	0.627	7.01E-04	4.84E-07
68.5	19.030	19.195	-0.173	15.840	8.22E-04	0.599	5.02E-04	4.05E-08
136.9	18.574	18.802	-0.240	12.960	9.64E-04	0.561	3.51E-04	3.31E-08
273.2	17.982	18.278	-0.370	19.184	6.15E-04	0.511	2.34E-04	1.41E-08
545.5	17.336	17.659	-0.410	14.900	7.40E-04	0.457	1.32E-04	9.57E-09
1057.7	16.696	17.016	-0.397	11.834	8.65E-04	0.403	7.21E-05	6.11E-09
273.2	16.839	16.768				0.415		
68.5	17.067	16.953				0.434		
17.6	17.324	17.196				0.456		
5.0	17.518	17.421				0.472		

Coefficient of Consolidation vs. Pressure

Project #: 19-4406-9
Client: URS Canada Inc.
Project Name: Mondor Creek
Sample: MC13-04-TW1 (40' - 41' 4")



Notes: C_v and k calculated using t_{90} values

TEST DONE BY:
REVIEWED BY:



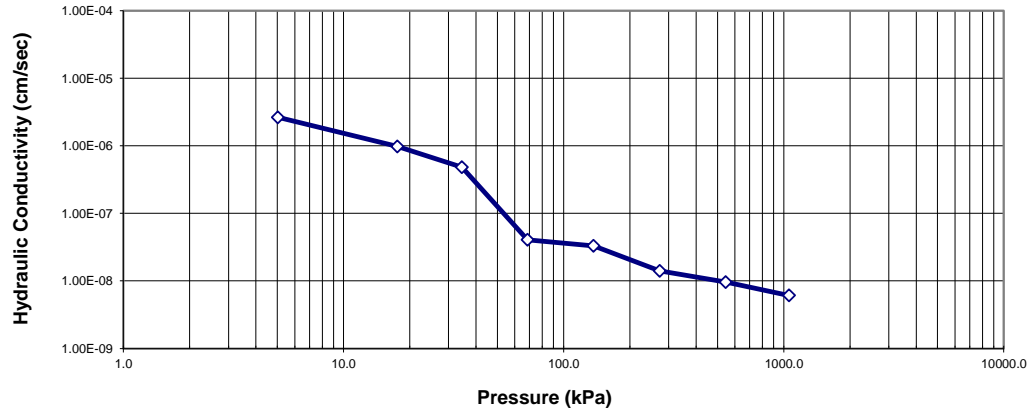
Consolidation Test Report

Mondor Creek
19-4406-9

MC13-04-TW1 (40' - 41' 4")

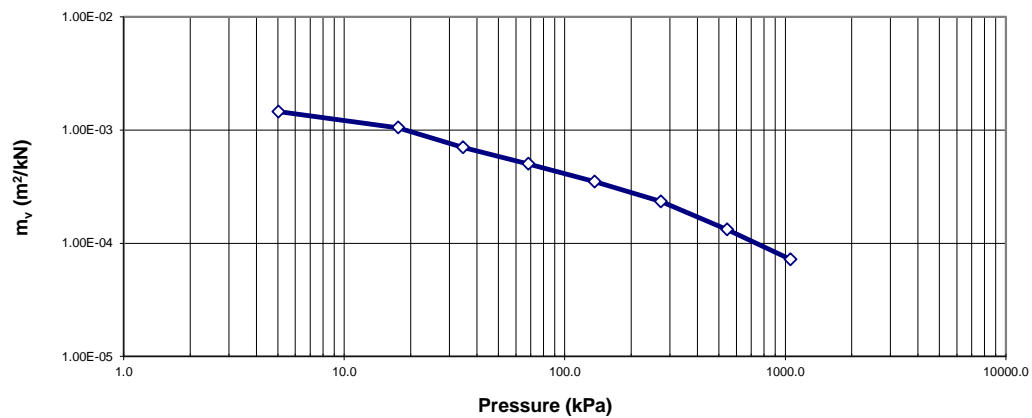
Hydraulic Conductivity vs. Pressure

Project #: 19-4406-9
Client: URS Canada Inc.
Project Name: Mondor Creek
Sample: MC13-04-TW1 (40' - 41' 4")



m_v vs. Pressure

Project #: 19-4406-9
Client: URS Canada Inc.
Project Name: Mondor Creek
Sample: MC13-04-TW1 (40' - 41' 4")



Consolidation Test Report

CLIENT: URS Canada Inc.

FILE NUMBER: 19-4406-9

PROJECT: Mondor Creek

REPORT DATE: 7-Apr-14

TEST DATES: November 18, 2013 - November 29, 2013

SAMPLE: MC13-08-TW1 (30' - 32')
Silty Clay, grey, contains 12% gravel, 9% sand, 38% silt and 41% clay, PL=18%, LL=36%

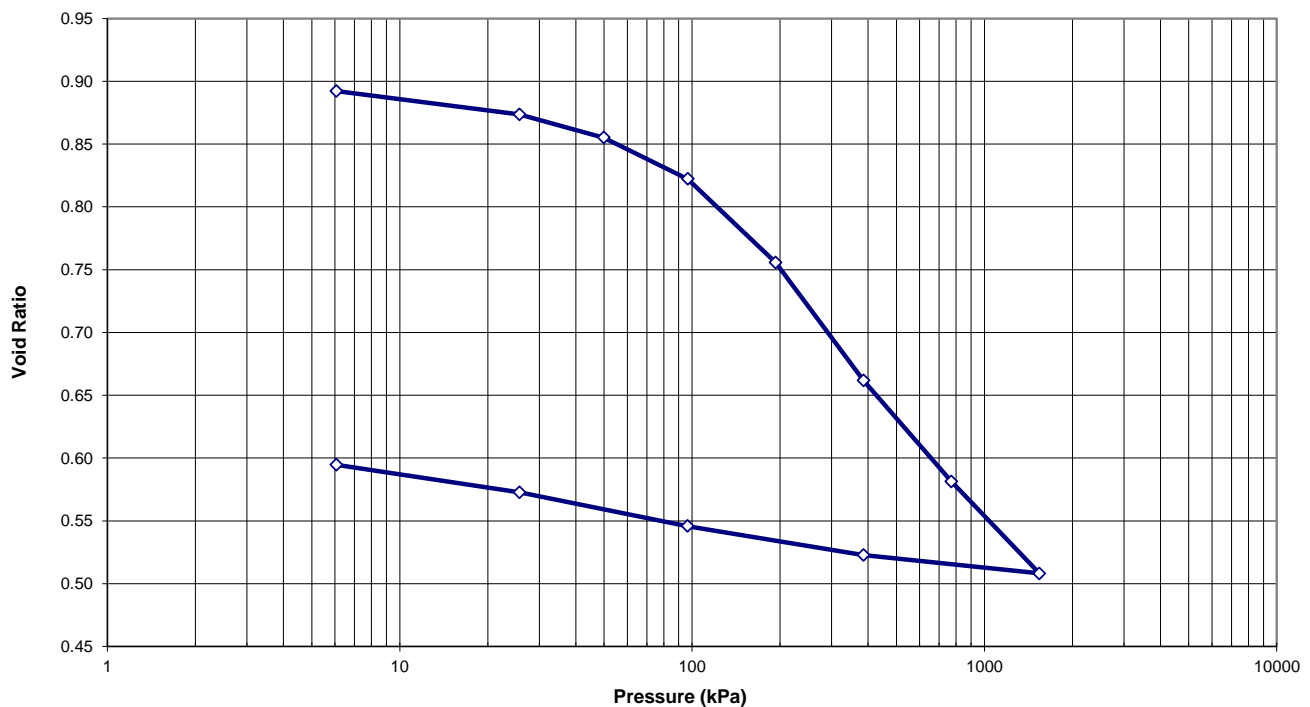
PROCEDURE: Test carried out in accordance with Standard Test Method for One-Dimensional Consolidation Properties of Soils, ASTM D 2435-04, method B

	<u>Start of Test</u>	<u>End of Test</u>
Wet Dens. (kg/m ³)	1923.4	2098.4
Dry Dens. (kg/m ³)	1439.3	1712.0
Moisture Cont. (%)	33.6	22.6
Void Ratio	0.897	0.595

Note: A Specific Gravity of 2.73 was measured for the void ratio and saturation calculations.

Void Ratio vs. Pressure

Project #: 19-4406-9
Client: URS Canada Inc.
Project Name: Mondor Creek
Sample: MC13-08-TW1 (30' - 32')



Consolidation Test Report

Mondor Creek
19-4406-9

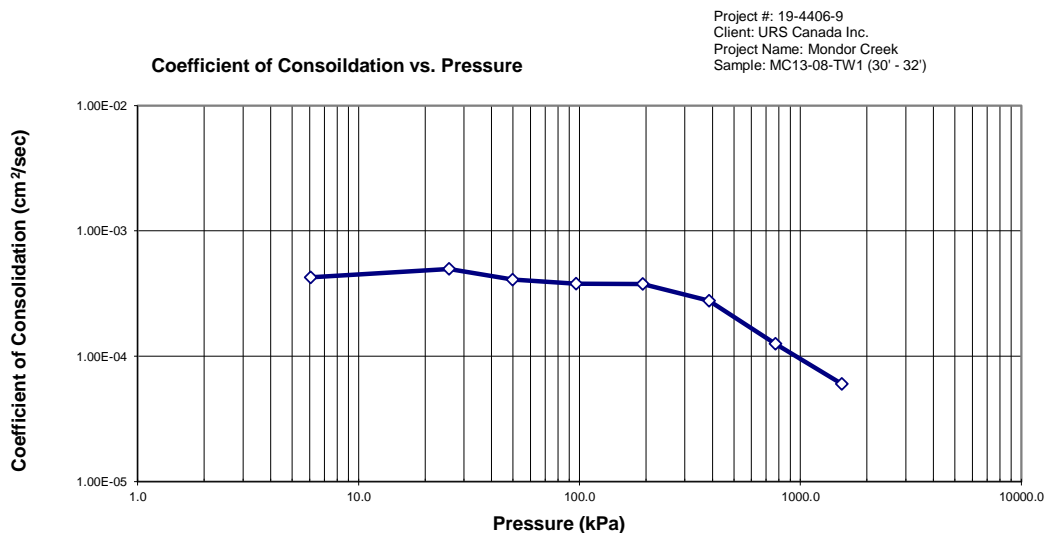
MC13-08-TW1 (30' - 32')

TRIMMING: The Specimen was manually trimmed to the size of consolidation ring, then mounted in a fixed ring consolidometer.

LOADING: A seating load of 6.1 kPa was applied and the consolidometer was flooded with distilled water. Sample was monitored to ensure no swelling effect occurred before the start of the test. Subsequent loads were applied after 100% primary consolidation was reached.

CALCULATIONS: Coefficients of Consolidation were calculated by the square root time method.

Pressure (kPa)	Corr. H. (mm)	Avg. H. (mm)	d_{90} (mm)	t_{90} (min)	c_v (cm ² /s)	Void Ratio	m_v (m ² /kN)	k (cm/s)
0.0	25.500					0.897		
6.1	25.434	25.467	-0.090	0.46	5.03E-02	0.892	4.26E-04	2.10E-06
25.7	25.186	25.310	-0.311	1.32	1.71E-02	0.874	4.98E-04	8.35E-07
49.9	24.937	25.062	-0.105	3.61	6.15E-03	0.855	4.09E-04	2.46E-07
96.6	24.495	24.716	-0.174	3.96	5.45E-03	0.822	3.79E-04	2.03E-07
193.2	23.601	24.048	-0.450	15.84	1.29E-03	0.756	3.78E-04	4.78E-08
385.7	22.339	22.970	-0.880	33.64	5.54E-04	0.662	2.78E-04	1.51E-08
770.7	21.258	21.799	-0.730	20.98	8.00E-04	0.581	1.26E-04	9.87E-09
1540.7	20.274	20.766	-0.620	13.18	1.16E-03	0.508	6.01E-05	6.82E-09
385.7	20.470	20.372				0.523		
96.6	20.780	20.625				0.546		
25.7	21.141	20.961				0.573		
6.1	21.438	21.290				0.595		

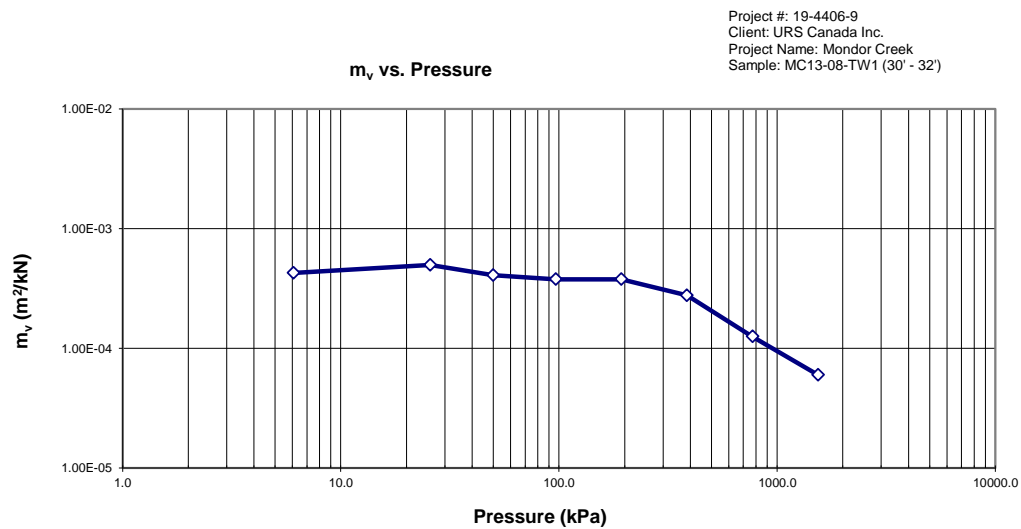
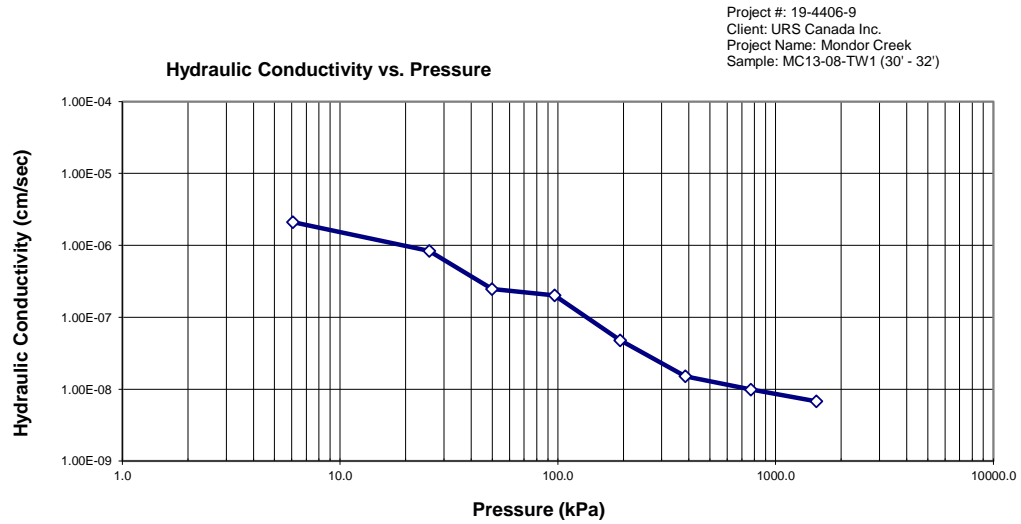


Notes: c_v and k calculated using t_{90} values

Consolidation Test Report

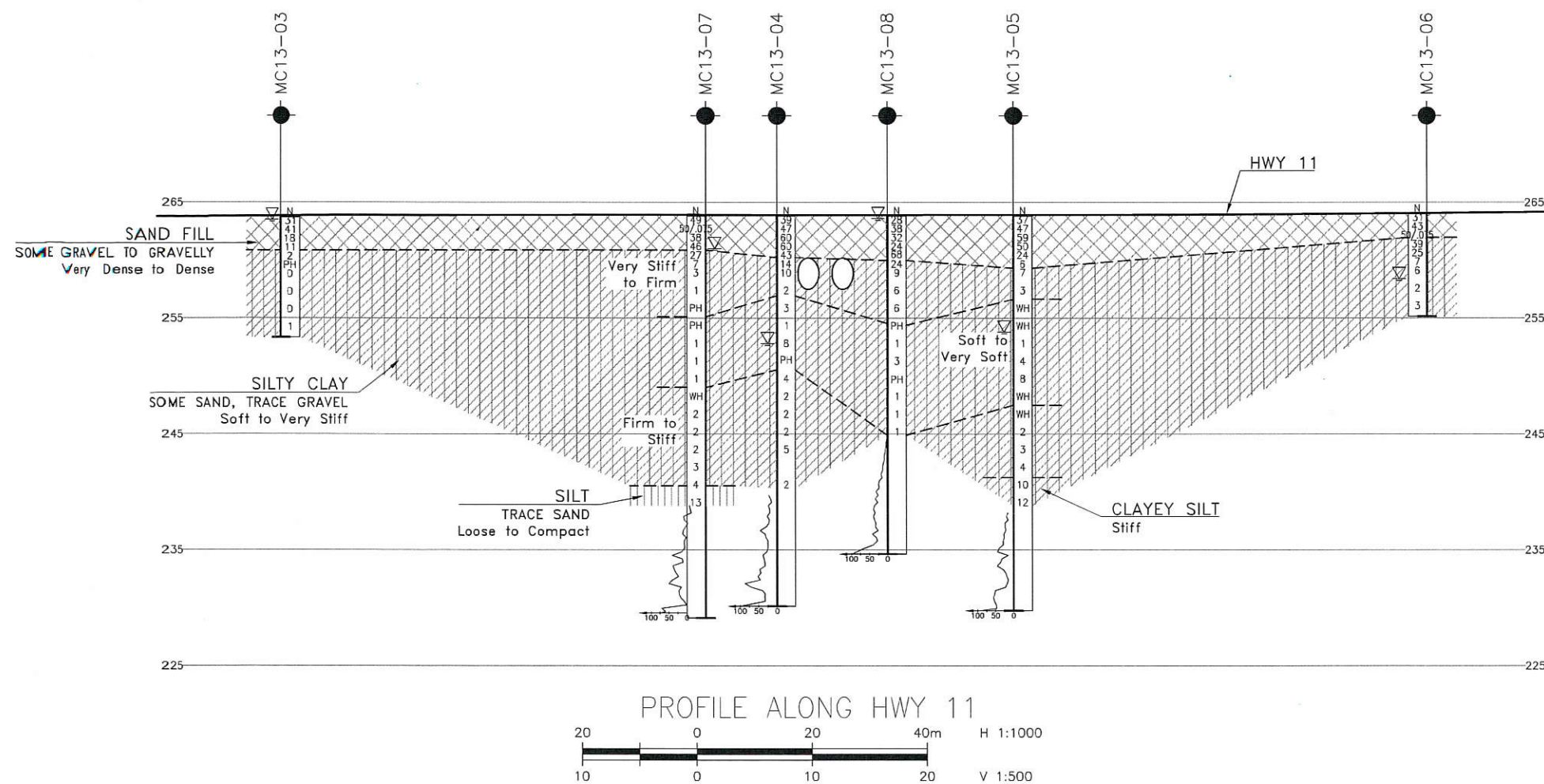
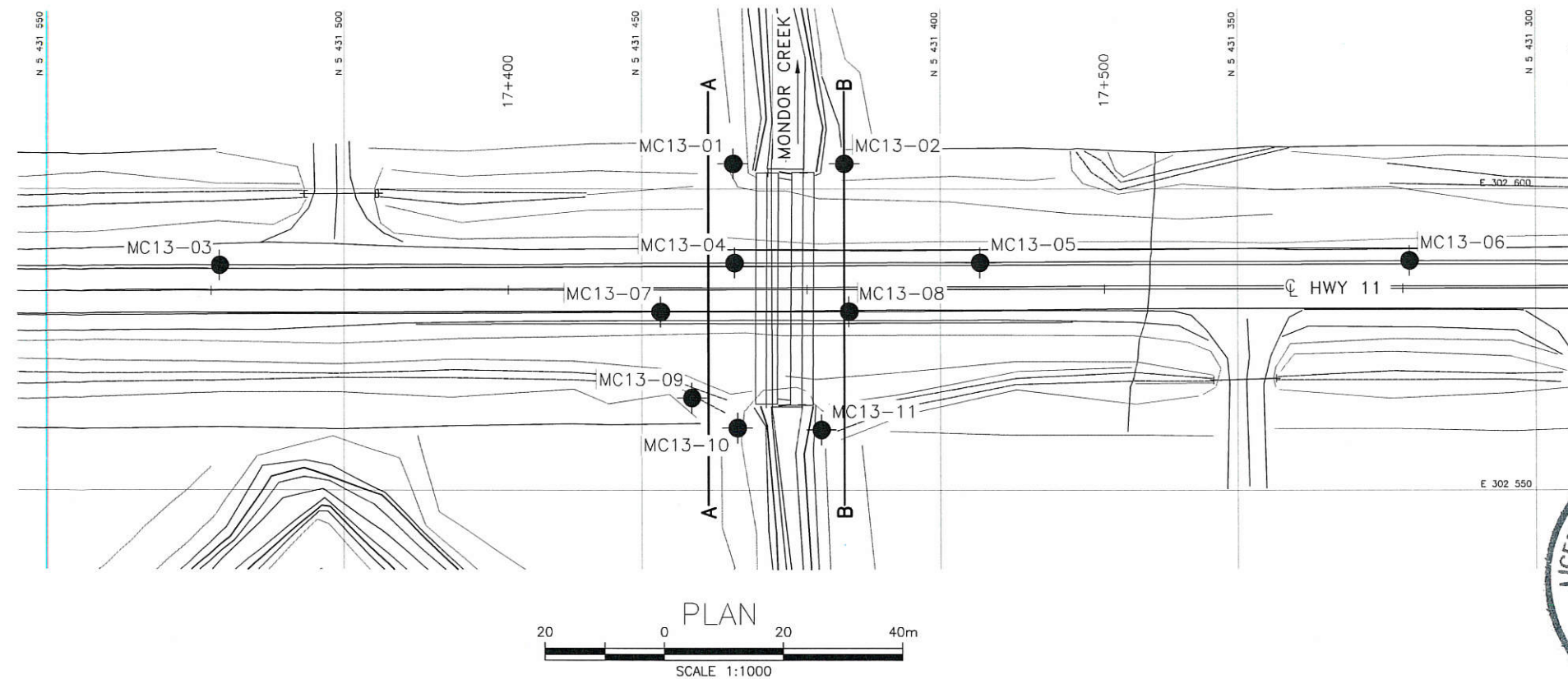
Mondor Creek
19-4406-9

MC13-08-TW1 (30' - 32')



Appendix C

Borehole Locations and Soil Strata Drawings



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

CONT No
GWP No 5169-10-00

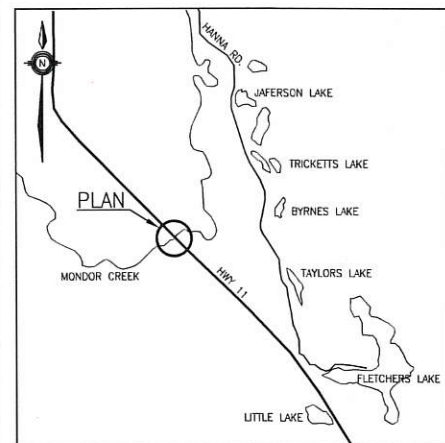
HIGHWAY 11
MONDOR CREEK
CULVERT REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET
S-02

URS




THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

- | | |
|---|---------------------------------------|
|  | Borehole |
|  | Borehole and Cone |
| N | Blows /0.3m (Std Pen Test, 475J/blow) |
| CONE | Blows /0.3m (60° Cone, 475J/blow) |
| WH | Weight, Hammer |
| PH | Pressure, Hydraulic |
|  | Water Level |
|  | Head Artesian Water |
|  | Piezometer |
| A/R | Auger Refusal |

NO	ELEVATION	NORTHING	EASTING
MC13-01	259.4	5 431 434.7	302 604.2
MC13-02	259.1	5 431 416.0	302 604.2
MC13-03	263.7	5 431 520.8	302 587.3
MC13-04	263.8	5 431 434.5	302 587.7
MC13-05	263.8	5 431 393.2	302 587.8
MC13-06	264.0	5 431 321.2	302 588.1
MC13-07	263.8	5 431 446.9	302 579.6
MC13-08	263.8	5 431 415.2	302 579.6
MC13-09	260.7	5 431 441.6	302 565.3
MC13-10	259.8	5 431 434.0	302 560.3
MC13-11	258.7	5 431 419.9	302 560.0

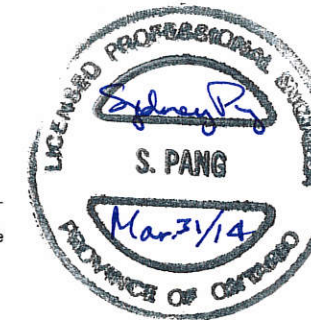
-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 42H-53

[illegible]

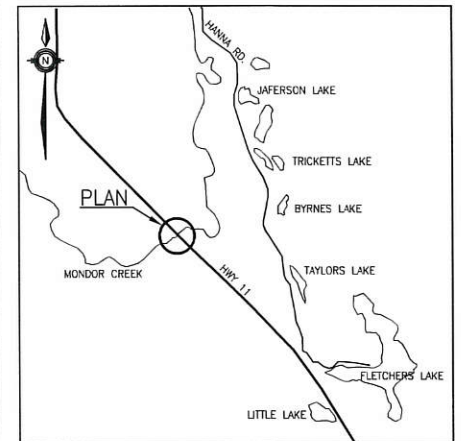
METRIC
DIMENSIONS ARE IN METRES
AND/OR MILLIMETRES
UNLESS OTHERWISE SHOWN



CONT No	
GWP No	5169-10-00






HIGHWAY 11
MONDOR CREEK
CULVERT REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET
S-03



KEYPLAN

LEGEND

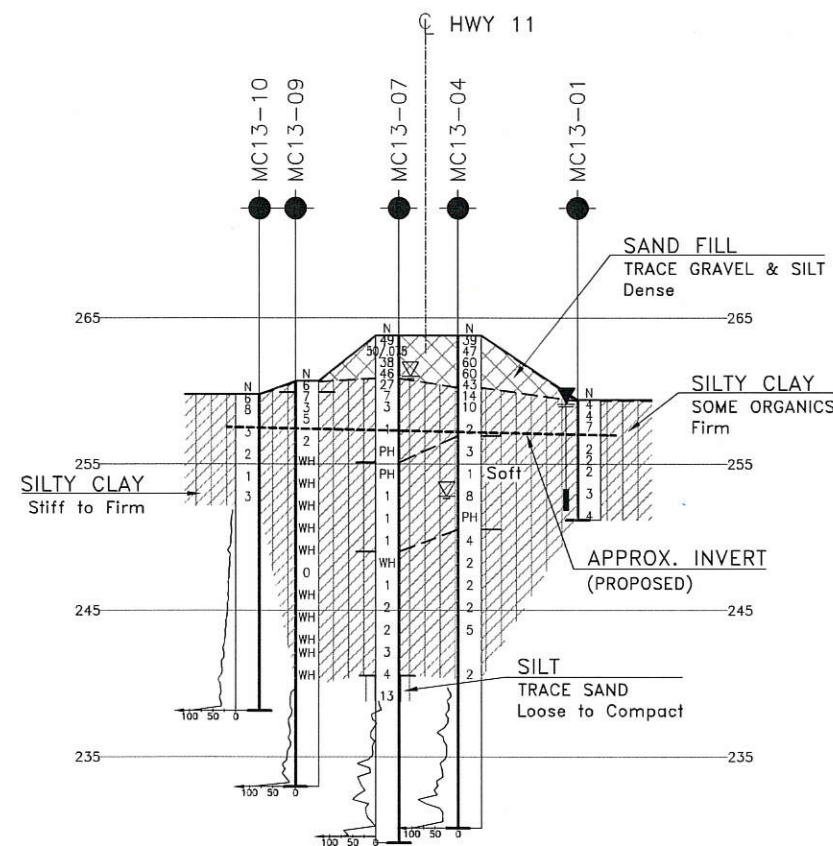
	Borehole
	Borehole and Cone
N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
WH	Weight, Hammer
PH	Pressure, Hydraulic
	Water Level
	Head Artesian Water
	Piezometer
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
MC13-01	259.4	5 431 434.7	302 604.2
MC13-02	259.1	5 431 416.0	302 604.2
MC13-03	263.7	5 431 520.8	302 587.3
MC13-04	263.8	5 431 434.5	302 587.7
MC13-05	263.8	5 431 393.2	302 587.8
MC13-06	264.0	5 431 321.2	302 588.1
MC13-07	263.8	5 431 446.9	302 579.6
MC13-08	263.8	5 431 415.2	302 579.6
MC13-09	260.7	5 431 441.6	302 565.3
MC13-10	259.8	5 431 434.0	302 560.3
MC13-11	258.7	5 431 419.9	302 560.0

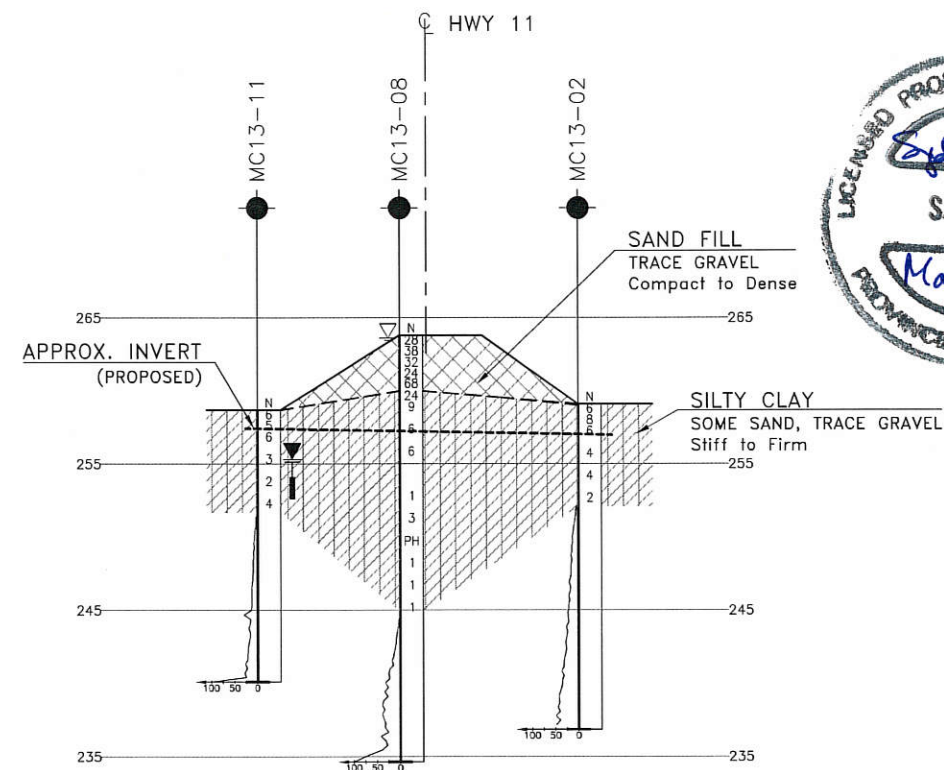
-NOTES-

- 1) The boundaries between soil strata have been established only at Borehole locations. Between Boreholes the boundaries are assumed from geological evidence.
- 2) This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

GEOCRES No. 42H-53



PROFILE ALONG A-A



PROFILE ALONG B-B



H 1:1000

V 1:500

[illegible]