THURBER ENGINEERING LTD.

FOUNDATION INVESTIGATION REPORT
CULVERT REPLACEMENT
HIGHWAY 112
NEW LISKEARD AREA
G.W.P. No. 5110-06-00

GEOCRES Number: 42A-98

Report to

MMM Group Limited

5012-E-0006, Assignment 10

February 26, 2014

File: 19-1351-248

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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 a culvert replacement site on Highway 112 near Kirkland Lake, 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 site and, based on the data obtained, provide a comprehensive model of the subsurface conditions using borehole location plans, stratigraphic profiles, records of boreholes, laboratory test results, and a written description of the subsurface conditions.

Thurber was retained by the MMM Group Limited to carry out this foundation investigation under the MTO Agreement Number 5012-E-0006, Assignment 10.

2 SITE DESCRIPTION

The culvert site is located on Highway 112, approximately 11 kilometres South of Highway 66 in the Township of Boston. Twin 760 mm corrugated steel pipes (CSPs) are present at the site and covered with 5.5 to 7.5 m of fill.

The culverts are located within a tangent section at Stations 18+360 and 18+362. The grade of the existing Highway 112 in the vicinity of the culverts is at 300 m geodetic. Several residential entrances and a horizontal curve are located a short distance south of the culverts.

The culverts are located within a fill section. The maximum embankment fill height is approximately 6.4 m on the west side and 8.3m on the east side. The invert elevations are 293.5 and 293.7 m on the west side and 291.6 and 291.8 m on the east side, indicating average gradients of approximately 5.3%.

The site is located in a rural area with brush, forested land and occasional residential properties. Bedrock outcrops are present within a few hundred metres in both directions along the highway. Local topography is generally flat with some low sloping hills.

The surficial geology of the area is typical of the Wisconsin glaciation. Soil cover is thin and consists primarily of glacial till and glaciolacustrine (clay, varved clay and silt) deposits with localized organic deposits.

3 SITE INVESTIGATION AND FIELD TESTING

This borehole investigation and field testing program was carried out between September 17, 2013 and September 21, 2013. The program consisted of drilling and sampling 7 boreholes (numbered 13-1, 13-2A, 13-2B, 13-3, 13-4, 13-5 and 13-6) to depths ranging from 1.7 m to 15.1 m (elevations 284.3 m to 291.5 m). Of the seven boreholes, one (13-1) was located near the culvert inlets, two (13-2A and 13-2B) were located near the culvert outlets, two (13-3 and 13-4) were located at the embankment crest (one within each shoulder), and two (13-5 and 13-6) were located on the road (one within each lane).

Prior to the start of drilling, the borehole locations were staked in the field and utility clearances were obtained. The staked borehole locations were subsequently surveyed by MMM Geomatics.

A truck-mounted drill rig was used to drill and sample the embankment crest and road boreholes. Hollow stem augers and NW casing were used to advance the boreholes through the overburden soil. Portable drilling equipment including an electric core drill with NW casing and a tripod with a pulley and 140 lb SPT hammer was used to advance the inlet and outlet boreholes. Soil samples were obtained at selected intervals using a 50 mm diameter split spoon sampler in conjunction with Standard Penetration Testing (SPT). In-situ shear vane testing was attempted with an MTO N-sized vane in borehole 13-5, however, the soil did not shear prior to reaching the capacity of the vane testing equipment. Boreholes were advanced into bedrock using NQ-size coring equipment.

Results of field drilling and sampling are presented on the Record of Borehole sheets in Appendix B.

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.

The boreholes were backfilled with a bentonite-grout mix. Boreholes through asphalt were capped with 150 mm of premium cold-mix asphalt.

4 LABORATORY TESTING

All recovered soil samples were subjected to Visual Identification and to natural moisture content determination. Selected soil samples were subjected to grain size distribution analyses (sieve and hydrometer) and Atterberg limit testing. The results of this laboratory testing program are shown on the Record of Borehole sheets in Appendix B and on the figures in Appendix C. It is noted that sample recovery was generally poor.

5 DESCRIPTION OF SUBSURFACE CONDITIONS

5.1 General

Reference is made to the Record of Borehole sheets in Appendix B for details of the soil stratigraphy encountered in the boreholes. A stratigraphic profile for the culvert replacement alignment is presented on the Borehole Locations and Soil Strata Drawing in Appendix A for illustrative purposes. An overall description of the stratigraphy is given in the following paragraphs; however, the factual data presented in the record of boreholes governs any interpretation of the site conditions.

In general, the subsurface conditions encountered in the boreholes located on the highway shoulder consist of asphalt and/or fill overlying thin silt and clay deposits underlain by glacial till over bedrock. Boreholes located at the culvert inlet and outlet encountered topsoil overlying thin layers of silt and clay and glacial till over shallow bedrock. More detailed descriptions of the individual strata are presented below.

5.2 Pavement Structure

Boreholes 13-5 and 13-6 were advanced through the driving lanes of Highway 112. The thickness of the asphalt surface was 190 mm and 240 mm in Boreholes 13-5 and 13-6, respectively. The asphalt was underlain by approximately 600 mm of gravelly sand, which was underlain by a buried asphalt layer (120 to 230 mm thick). The buried asphalt was underlain by gravelly sand fill extending to a total depth of at least 1.5 m below existing grades.

Boreholes 13-3 and 13-4 were advanced through the granular shoulders of Highway 112. Gravelly sand fill, likely placed as part of the pavement structure extended to depths of 1.4 to 1.5 m below surface (elevations 298.4 and 298.5 m). The gravelly sand fill was typically compact to dense with SPT N-values ranging from 14 to 31.

5.3 Fill

Embankment fill was encountered below the pavement structure in Boreholes 13-3, 13-4, 13-5 and 13-6. The thickness of the embankment fill (excluding the pavement structure) ranged from 4.8 to 5.4 m. The base of the embankment fill was encountered at elevations ranging from 293.2 to 293.8 m.

The fill included both cohesive and non-cohesive materials.

Cohesive Fill

The cohesive fill material was present directly beneath the pavement structure in Boreholes 13-3, 13-4 and 13-5 and extended to depths of 2.1 m, 2.1 m and 6.6 m below ground surface respectively. Within Borehole 13-6, the cohesive fill was identified between 5.2 and 6.9 m below ground surface.

SPT N-values ranged from 3 to 12 blows per 0.3 m penetration. The water contents of the recovered cohesive fill samples ranged between 18% and 48%. Grain size analyses conducted on three samples of the fill are presented on Figure 3 in Appendix C. These results are summarized in the following table.

Soil Particles	%
Gravel	0 to 9
Sand	0 to 27
Silt	23 to 44
Clay	28 to 56

Three samples of cohesive fill were tested to determine the Atterberg limits. The results are presented on Figure 1 in Appendix C and summarized in the table below.

Plastic Limit	20 to 22
Liquid Limit	36 to 45
Plasticity Index	17 to 22

All three samples can be classified as having intermediate plasticity (CI). Overall, the cohesive fill is best described as ranging from silty clay, trace to some sand, to silty sandy clay, trace gravel. Some organic matter was identified within the cohesive fill material in Boreholes 13-3, 13-4 and 13-6.

Non-Cohesive Fill

Non-cohesive fill was encountered beneath the cohesive fill in Boreholes 13-3 and 13-4, where it extended from 2.1 m below ground surface to depths of 6.4 m and 6.1 m below ground surface respectively, and above the cohesive fill in Borehole 13-6.

SPT N-values ranged from 5 to 26 blows per 0.3 m penetration. The water contents of the recovered fill samples ranged between 3% and 38%. Grain size analysis conducted on one sample of the non-cohesive fill is presented on Figure 4 in Appendix C. The results are summarized in the following table.

Soil Particles	%
Gravel	45
Sand	46
Silt and Clay	9

Cobbles and or boulders were inferred to be present within the non-cohesive fill in Boreholes 13-3 and 13-4 based on grinding noises and vibration during advancement of the augers. Coring techniques were used to advance through inferred cobbles and/or boulders in Borehole 13-4 between depths of 2.1 and 3.0 m below ground surface, however, sample recovery was negligible.

5.4 Rootmat

Rootmat ranging from 100 mm to 200 mm in thickness was encountered in Boreholes 13-1, 13-2A, and 13-2B. The thickness of the rootmat or surficial organic material may vary between and beyond the borehole locations, and the limited data is not suitable for estimating stripping quantities.

A buried layer of peat was encountered below the fill in Borehole 13-4 at 6.1 m depth. The thickness of the buried peat layer was approximately 100 mm and the moisture content of the sample tested was 203%.

5.5 Cobbles and Boulders

Cobbles and boulders were encountered below the rootmat in Borehole 13-1. The thickness of the cobbles and boulders was approximately 500 mm at this location. Cobbles and boulders were also observed at ground surface in the areas around the existing culvert inlets and outlets.

5.6 Clayey Silt to Silty Clay

The surficial materials and fill were underlain by a clayey silt to silty clay deposit in five of the boreholes (Boreholes 13-1, 13-2A, 13-2B, 13-3 and 13-4). The thickness of this deposit, where present, ranged from 0.3 to 1.4 m. The surface of the clay ranged from elevation 292.9 to 293.7 m.

SPT N-values measured within this deposit ranged from 3 to 28 blows per 0.3 m penetration, indicating a soft to very stiff consistency. The colour of the clayey silt to silty clay ranged from brown to grey and the layer frequently contained some woody organic matter.

The moisture content of the samples tested ranged from 19% to 52%. Two samples of this deposit were subjected to gradation analysis. The results are summarized in the table below and presented on Figure 5 in Appendix C.

Soil Particles	%
Gravel	0
Sand	15 to 19
Silt	38 to 53
Clay	32 to 43

One sample was tested to determine the Atterberg limits. The results which are presented on Figure 2 in Appendix C and summarized in the table below indicates a clay of intermediate plasticity.

Plastic Limit	20
Liquid Limit	39
Plasticity Index	19

5.7 Glacial Till

A glacial till deposit was identified underlying the fill and clayey soil deposits in five of the boreholes (Boreholes 13-2A, 13-3, 13-4, 13-5, and 13-6). Where encountered, the thickness of glacial till deposit ranged from 0.5 to 2.2 m. The surface of the till was encountered at elevations ranging from 291.9 m to 293.4 m.

The SPT N-values measured within this layer were 22 to greater than 100 blows per 0.3 m penetration, indicating a compact to very dense state. The measured water contents of samples recovered from this deposit ranged from 7% to 21%. Grain size analysis conducted on a

sample of the till is presented on Figure 6, in Appendix C. The results are summarized in the following table.

Soil Particles	%
Gravel	17
Sand	37
Silt and Clay	46

The glacial till was typically described as silty sand with gravel to gravelly sand. Occasional to frequent cobbles were inferred to be present within the glacial till deposit based on observations during the drilling operation. Glacial till inherently contains cobbles and boulders.

5.8 Bedrock

Six of the boreholes (13-1, 13-2B, 13-3, 13-4, 13-5 and 13-6) were advanced into bedrock using coring techniques. The seventh borehole (13-2A) was terminated upon auger refusal on inferred bedrock. The bedrock surface was encountered at elevations ranging from 290.3 to 293.3 m.

The bedrock generally consisted of fresh, medium grained granite. The granite was pink with some iron staining on fracture surfaces. The fracture surfaces were typically rough and planar, and frequently diagonal. The apparent quality of the rock in the boreholes drilled using portable equipment may have been affected by frequent short core runs. In the remaining boreholes, the rock quality designation (RQD) values were typically greater than 50% with the exception of localized highly fractured material near the bedrock surface in some boreholes.

5.9 Groundwater Conditions

Free water was not observed in the boreholes at the time of drilling. Water in the culvert was observed at approximately elevation 292.2 m at the time of drilling.

Where surface water is present, the groundwater level should be assumed to coincide with the local surface water level. Local high water levels and the effects of heavy rainfalls must also be taken into consideration.

6 MISCELLANEOUS

Thurber staked and/or marked the borehole locations in the field and obtained utility clearances prior to drilling. MMM Geomatics surveyed the borehole locations, and provided the northing and easting coordinates and ground surface elevations.

Landcore Drilling of Chelmsford, Ontario, supplied and operated a truck-mounted CME 75 drill rig to carry out the drilling, sampling and in-situ testing operations on the existing highway platform. Ohlmann Geotechnical Services (OGS) Inc. of Almonte, Ontario, supplied and operated the portable drill rig.

The drilling and sampling operations in the field were supervised on a full time basis by Mr. Nick Weil and Mr. Justin Gray of Thurber. Laboratory testing was carried out by Thurber in its MTO-approved laboratory.

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

Thurber Engineering Ltd.

Paul Carnaffan, P.Eng.
Associate/Senior Project Engineer

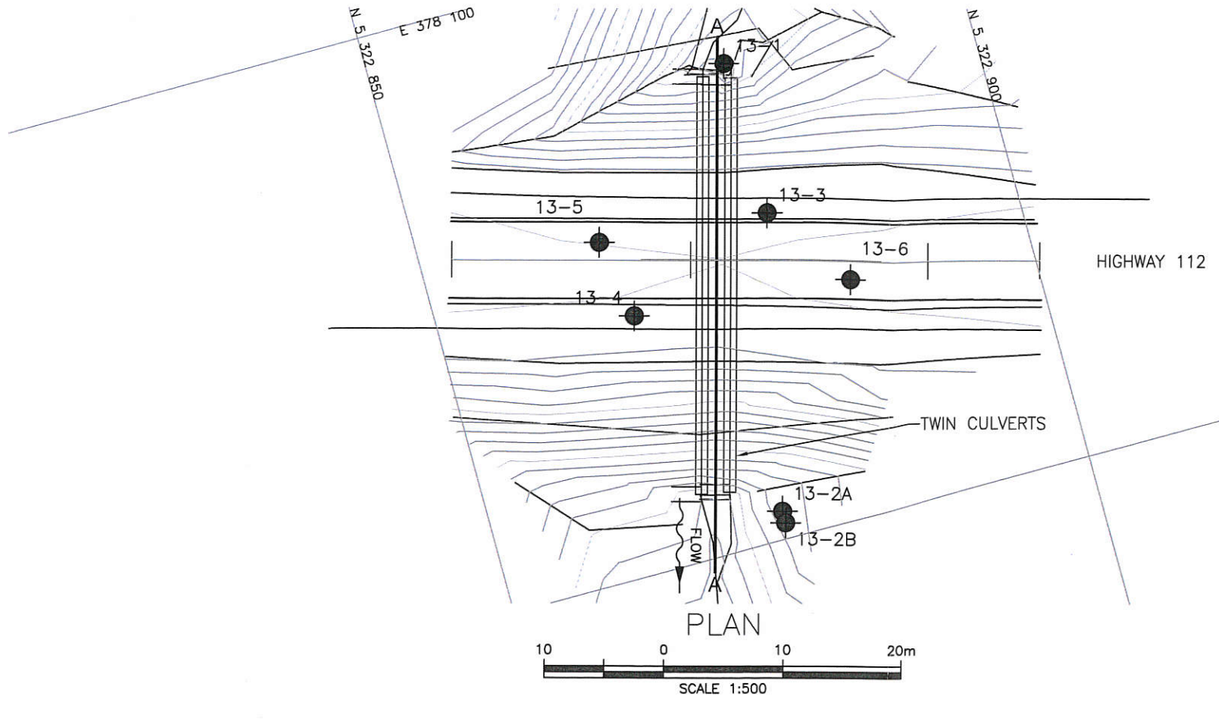
Fred J. Griffiths, P.Eng.
Associate/Senior Foundations Engineer

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

Appendix A

Borehole Locations and Soil Strata Drawings

MINISTRY OF TRANSPORTATION, ONTARIO



PLAN

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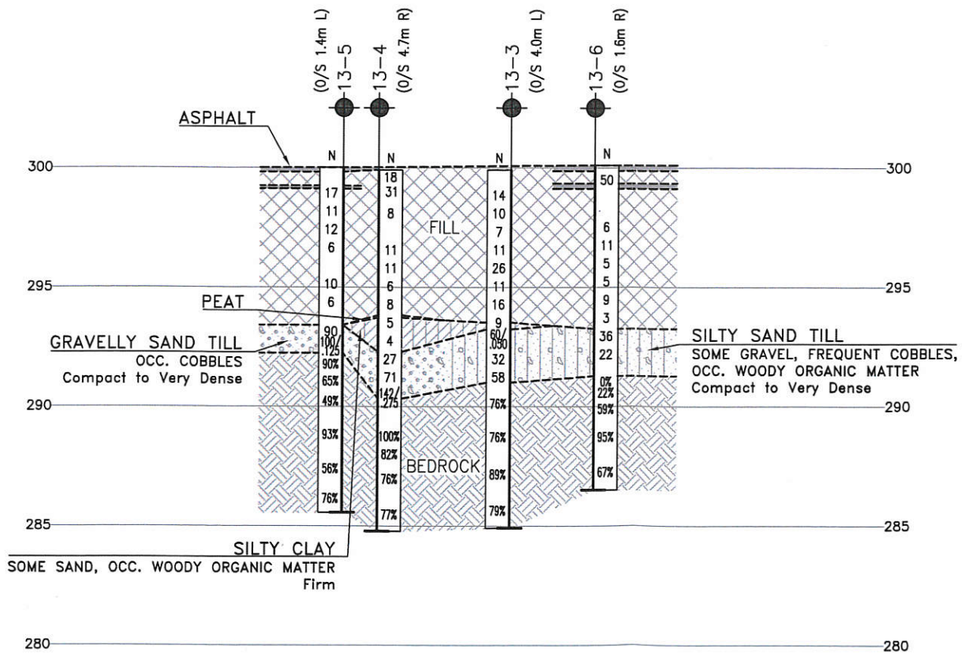

PROFILE ALONG ℄ HIGHWAY 112

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5 0 5 10m V 1:250

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

LICENSED PROFESSIONAL ENGINEER
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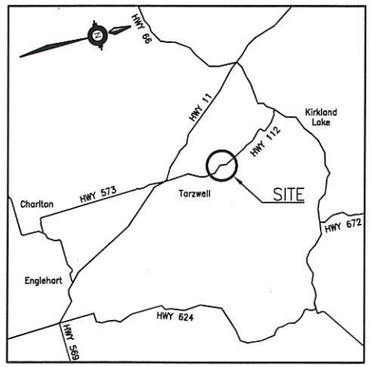
CONT No
GWP No 5110-06-00

HIGHWAY 112
CULVERT
REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

MMM GROUP

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)
PH	Pressure, Hydraulic
▽	Water Level
▽	Head Artesian Water
▯	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
13-1	294.4	5 322 879.0	378 110.1
13-2A	293.1	5 322 873.9	378 147.7
13-2B	293.1	5 322 873.9	378 148.7
13-3	299.9	5 322 879.2	378 123.2
13-4	299.9	5 322 866.2	378 128.6
13-5	300.0	5 322 865.0	378 121.9
13-6	300.1	5 322 884.5	378 130.4

-NOTES-

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

GEOCRES No. 42A-98

REVISIONS			
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DESIGN PC	CHK	CODE	LOAD
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		DATE FEB 2014	DWG 1

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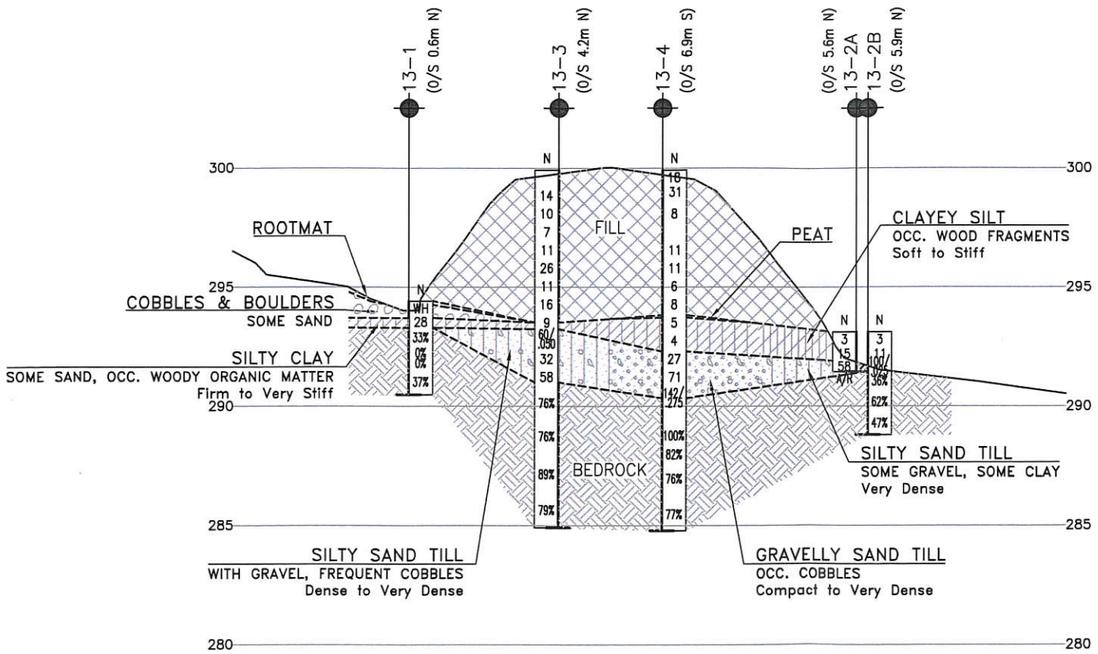

SECTION A–A

10 0 10 20m H 1:500

5 0 5 10m V 1:250

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

LICENSED PROFESSIONAL ENGINEER
P. K. CHATTERJI
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LICENSED PROFESSIONAL ENGINEER
PAUL CARMICHAEL
90416075
Feb 26/14
PROVINCE OF ONTARIO

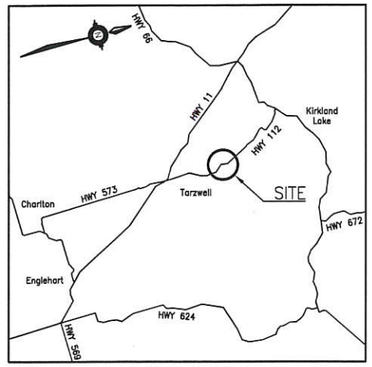
CONT No
GWP No 5110-06-00

HIGHWAY 112
CULVERT
REPLACEMENT
BOREHOLE LOCATIONS AND SOIL STRATA

SHEET

MMM GROUP

THURBER ENGINEERING LTD.



KEYPLAN

LEGEND

⊕	Borehole
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N	Blows /0.3m (Std Pen Test, 475J/blow)
CONE	Blows /0.3m (60° Cone, 475J/blow)
PH	Pressure, Hydraulic
▽	Water Level
▽	Head Artesian Water
	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
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GEOCRES No. 42A-98

REVISIONS		
DATE	BY	DESCRIPTION

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Appendix B

Record of Borehole Sheets

SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

1. TEXTURAL CLASSIFICATION OF SOILS

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

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

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

3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

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

NOTE: Hierarchy of Soil Strength Prediction

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

4. TERMS DESCRIBING DENSITY (COHESIONLESS SOILS ONLY)

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

5. LEGEND FOR RECORDS OF BOREHOLES

SYMBOLS AND ABBREVIATIONS FOR SAMPLE TYPE

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

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

$\blacktriangledown$ Water Level

C_{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

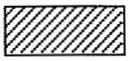
MAJOR DIVISIONS		GROUP SYMBOL	TYPICAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel-sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines.
		GM	Silty gravels, gravel-sand-silt mixtures.
		GC	Clayey gravels,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

EXPLANATION OF ROCK LOGGING TERMS

ROCK WEATHERING CLASSIFICATION

Fresh (FR)	No visible signs of weathering.
Fresh Jointed (FJ)	Weathering limited to the surface of major discontinuities.
Slightly Weathered (SW)	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.
Moderately Weathered (MW)	Weathering extends throughout the rock mass, but the rock material is not friable.
Highly Weathered (HW)	Weathering extends throughout the rock mass and the rock is partly friable.
Completely Weathered (CW)	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.

SYMBOLS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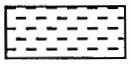
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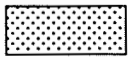
SANDSTONE


COAL


Bedrock (general)

DISCONTINUITY SPACING

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

TERMS

Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.
Rock Quality Designation: (RQD)	Total length of sound core recovered in pieces 0.1m in length or larger as a percentage of total core run length.
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.

STRENGTH CLASSIFICATION

Rock Strength	Approximate Uniaxial Compressive Strength (MPa)	(psi)	Field Estimation of Hardness*
Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail

THURBER

Ministry of Transportation
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RECORD OF BOREHOLE No 13-1 1 OF 1 METRIC

GWP# 5110-06-00 LOCATION N 5 322 879.0 E 378 110.1 ORIGINATED BY NW

HWY 112 BOREHOLE TYPE Casing COMPILED BY NW

DATUM Geodetic DATE 2013.09.18 - 2013.09.18 CHECKED BY PC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100) ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	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
294.4											
0.0	**ROOTMAT**, clayey Dark Brown Moist		1	SS	WH				○		
0.2							294				
293.7	**BOULDERS and COBBLES**, frequent voids, some sand		2	SS	28				○		
0.7											
293.3	**SILTY CLAY**, occasional wood fragments Very Stiff Grey Moist		3	RUN			293				RUN #3 TCR=100% SCR=37% RQD=33%
1.1	**BEDROCK**, granite, fresh Heavily fractured, diagonal, rough planar Pink with iron staining on fracture surfaces		4	RUN							RUN #4 TCR=100% SCR=25% RQD=0%
			5	RUN			292				RUN #5 TCR=100% SCR=0% RQD=0%
			6	RUN			291				RUN #6 TCR=100% SCR=37% RQD=37%
290.5											
3.9	End of Bolehole Water observed in adjacent culvert at approximately elevation 292.2 m										

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

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

ONTMT4S 19-1351-248 HWY 112 CULVERT - IMPERIAL.GPJ 2012TEMPLATE(MTO).GDT 21/2/14

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THURBER

RECORD OF BOREHOLE No 13-2A 1 OF 1 METRIC

GWP# 5110-06-00 LOCATION N 5 322 873.9 E 378 147.7 ORIGINATED BY NW
HWY 112 BOREHOLE TYPE Casing COMPILED BY NW
DATUM Geodetic DATE 2013.09.17 - 2013.09.17 CHECKED BY PC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100	SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
293.1												
0.0 / 0.1	**ROOTMAT**											
	CLAYEY SILT, occasional wood fragments Soft Brown Moist		1	SS	3		293			○		
292.5 / 0.6			2	SS	15					○		0 15 53 32
291.9 / 1.2	**CLAYEY SILT** Stiff Grey Dry		3	SS	58		292			○		17 37 27 19
291.4 / 1.7	**SILTY SAND**, some gravel , some clay Very Dense Brown Moist **(TILL)**											
	End of Borehole Refusal on Possible Boulder or Bedrock. Moved over 1 m and drilled 13-2B.											

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

20
15 ⊕ 5
10
(%) STRAIN AT FAILURE

ONTMT4S 19-1351-248 HWY 112 CULVERT - IMPERIAL.GPJ 2012TEMPLATE(MTO).GDT 21/2/14

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Ontario

THURBER

RECORD OF BOREHOLE No 13-2B

1 OF 1

METRIC

GWP# 5110-06-00 LOCATION N 5 322 873.9 E 378 148.7 ORIGINATED BY NW

HWY 112 BOREHOLE TYPE Casing COMPILED BY NW

DATUM Geodetic DATE 2013.09.17 - 2013.09.18 CHECKED BY PC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	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
293.1											
0.0	**ROOTMAT**										
0.2	**CLAYEY SILT** Soft to stiff Brown Moist		1	SS	3		293		○		
			2	SS	11				○		
291.9			3	SS	100/25mm		292				
1.2	**BEDROCK**, granite, fresh Heavily fractured, diagonal, rough, planar Pink with iron staining on joint surfaces		4	RUN							RUN #4 TCR=100% SCR=33% RQD=0%
			5	RUN			291				RUN #5 TCR=88% SCR=70% RQD=36%
	Clay seam 2.4-2.6 m		6	RUN			290				RUN #6 TCR=100% SCR=63% RQD=62%
			7	RUN							RUN #7 TCR=100% SCR=33% RQD=47%
288.8							289				
4.3	End of Borehole Water observed in adjacent culvert at approximately elevation 292.2 m										

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

20
15 ⊕ 5
10
(%) STRAIN AT FAILURE

ONTMT4S 19-1351-248 HWY 112 CULVERT - IMPERIAL.GPJ 2012TEMPLATE(MTO).GDT 21/2/14

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 13-3 1 OF 2 METRIC

GWP# 5110-06-00 LOCATION N 5 322 879.2 E 378 123.2 ORIGINATED BY JAG
HWY 112 BOREHOLE TYPE Hollow Stem Augers/Casing COMPILED BY NW
DATUM Geodetic DATE 2013.09.18 - 2013.09.19 CHECKED BY PC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
299.9											
0.0	**GRAVELLY SAND** Compact Brown Moist **(FILL)**		1	SS	14		299		○		
298.4											
1.5	**SILTY CLAY (CI)**, some sand, trace gravel Stiff Brown Moist **(FILL)**		2	SS	10		298		⊖		7 23 42 28
2.1	**SAND and GRAVEL**, trace to some silt Loose to compact Brown Moist **(FILL)** -Cobbles from 3.6 to 6.4 m		3	SS	7		297		○		
			4	SS	11				○		
			5	SS	26		296		○		
			6	SS	11		295		○		
			7	SS	16				○		45 46 9 (SI+CL)
293.5			8	SS	9		294		○		
6.4 293.2	**SILTY CLAY (CI)**, some sand, occasional woody organic matter Firm Grey Moist								⊖		0 19 38 43
6.7	**SILTY SAND**, some gravel, frequent cobbles Dense to Very Dense Grey Wet **(TILL)**		9	SS	60/50mm		293				
			10	SS	32		292		○		
			11	SS	58				○		
291.0											
8.9	**BEDROCK**, granite, fresh, medium grained Highly Fractured, diagonal, rough, planar Pink some iron staining on fracture surfaces		13	RUN			291				RUN #14 TCR=100% SCR=87% RQD=76%
			14	RUN			290				

Continued Next Page

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

$\frac{20}{15}\oplus\frac{5}{10}$ (%) STRAIN AT FAILURE

ONTMT4S 19-1351-248 HWY 112 CULVERT - IMPERIAL.GPJ 2012TEMPLATE(MTO).GDT 21/2/14

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 13-3 2 OF 2 METRIC

GWP# 5110-06-00 LOCATION N 5 322 879.2 E 378 123.2 ORIGINATED BY JAG
HWY 112 BOREHOLE TYPE Hollow Stem Augers/Casing COMPILED BY NW
DATUM Geodetic DATE 2013.09.18 - 2013.09.19 CHECKED BY PC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	BEDROCK, granite, fresh, medium grained Highly Fractured, diagonal, rough, planar Pink some iron staining on fracture surfaces						289				
			15	RUN							RUN #15 TCR=93% SCR=81% RQD=76%
							288				
			16	RUN							RUN #16 TCR=100% SCR=96% RQD=89%
							287				
			17	RUN			286				RUN #17 TCR=100% SCR=85% RQD=79%
284.9							285				
15.0	End of Borehole										

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

$15 \overset{20}{\underset{10}{\oplus}} 5$ (%) STRAIN AT FAILURE

ONTMT4S 19-1351-248 HWY 112 CULVERT - IMPERIAL.GPJ 2012TEMPLATE(MTO).GDT 21/2/14

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 13-4 1 OF 2 METRIC

GWP# 5110-06-00 LOCATION N 5 322 866.2 E 378 128.6 ORIGINATED BY JAG
HWY 112 BOREHOLE TYPE Hollow Stem Augers/Casing COMPILED BY NW
DATUM Geodetic DATE 2013.09.17 - 2013.09.17 CHECKED BY PC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
299.9											
0.0	**GRAVELLY SAND** Compact to Dense Brown Moist **(FILL)**		1	SS	18				○		
298.5			2	SS	31		299		○		
1.4	**SILTY CLAY**, some sand, occasional woody organic matter Firm Brown Moist		3	SS	8		298		○		
297.8											
2.1	**(FILL)** **SAND** some gravel, some silt Loose to Compact Brown Moist **(FILL)** Advanced by coring through cobbles and boluders from 2.1 to 3.0 m		4	SS	11		297		○		
			5	SS	11		296		○		
			6	SS	6		295		○		
			7	SS	8		294				
293.8											
293.7	**PEAT**, black, wet,										
6.2	**SILTY CLAY (CI)**, some sand, occasional wood fragments Firm Grey WET		8	SS	5				○ 203		
			9	SS	4		293				
292.3											
7.6	**GRAVELLY SAND**, occasional cobbles Compact to Very Dense Grey **(TILL)**		10	SS	27		292				
			11	SS	71				○		
			12	SS	142/275mm		291		○		
290.3											
9.6	**BEDROCK**, gneiss, medium grained Heavily fractured						290				

Continued Next Page

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

20
15 5 (%) STRAIN AT FAILURE
10

ONTMT4S 19-1351-248 HWY 112 CULVERT - IMPERIAL.GPJ 2012TEMPLATE(MTO).GDT 21/2/14

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 13-4 2 OF 2 METRIC

GWP# 5110-06-00 LOCATION N 5 322 866.2 E 378 128.6 ORIGINATED BY JAG
HWY 112 BOREHOLE TYPE Hollow Stem Augers/Casing COMPILED BY NW
DATUM Geodetic DATE 2013.09.17 - 2013.09.17 CHECKED BY PC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	Greenish-black		13	RUN							
289.2											
10.7	**BEDROCK**, granite, fresh Pink, some greyish brown staining at joints		14	RUN			289				RUN #14 TCR=100% SCR=100% RQD=100%
			15	RUN			288				RUN #15 TCR=82% SCR=82% RQD=82%
			16	RUN			287				RUN #16 TCR=100% SCR=95% RQD=76%
			17	RUN			286				RUN #17 TCR=97% SCR=94% RQD=77%
284.8							285				
15.1	End of Borehole										

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

$\oplus^{20}_{15\ 10\ 5}$ (%) STRAIN AT FAILURE

ONTMT4S 19-1351-248 HWY 112 CULVERT - IMPERIAL.GPJ 2012TEMPLATE(MTO).GDT 21/2/14

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 13-5 1 OF 2 METRIC

GWP# 5110-06-00 LOCATION N 5 322 865.0 E 378 121.9 ORIGINATED BY JAG
HWY 112 BOREHOLE TYPE Hollow Stem Augers/Casing COMPILED BY NW
DATUM Geodetic DATE 2013.09.21 - 2013.09.21 CHECKED BY PC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
300.0							
0.0	**ASPHALT:** 190 mm						300
0.2	**GRAVELLY SAND** Compact **(FILL)**						
299.3							
299.1 0.8	**ASPHALT:**120 mm						
0.9	**GRAVELLY SAND** Compact Moist **(FILL)**		1	SS	17		299
298.5							
1.5	**SILTY CLAY (CI)** trace to some sand Very Stiff to Stiff Grey Moist **(FILL)**		2	SS	11		298
			3	SS	12		
			4	SS	6		297
	- attempted vane test, Su >100 kPa						296
			5	SS	10		
			6	SS	6		295
293.4	- attempted vane test, Su >100 kPa						
6.6	**GRAVELLY SAND** Very Dense Brown Wet **(TILL)**		7	SS	90		294
292.3			8	SS	100/125mm		293
7.8	**BEDROCK**, granite, fresh Highly fractured, diagonal, rough planar Pink		9	RUN			292
			10	RUN			
			11	RUN			291

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
	0	0	44	56
RUN #9 TCR=100% SCR=90% RQD=90%				
RUN #10 TCR=100% SCR=85% RQD=65%				
RUN #11 TCR=100% SCR=54% RQD=49%				

Continued Next Page

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

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

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 13-5 2 OF 2 METRIC

GWP# 5110-06-00 LOCATION N 5 322 865.0 E 378 121.9 ORIGINATED BY JAG
HWY 112 BOREHOLE TYPE Hollow Stem Augers/Casing COMPILED BY NW
DATUM Geodetic DATE 2013.09.21 - 2013.09.21 CHECKED BY PC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	BEDROCK, granite, fresh Highly fractured, diagonal, rough planar Pink						290				
			12	RUN			289				RUN #12 TCR=157% SCR=96% RQD=93%
			13	RUN			288				RUN #13 TCR=100% SCR=92% RQD=56%
			14	RUN			287				RUN #14 TCR=100% SCR=84% RQD=76%
285.6							286				
14.5	End of Borehole										

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

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE
10

ONTMT4S 19-1351-248 HWY 112 CULVERT - IMPERIAL.GPJ 2012TEMPLATE(MTO).GDT 21/2/14

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 13-6 1 OF 2 METRIC

GWP# 5110-06-00 LOCATION N 5 322 884.5 E 378 130.4 ORIGINATED BY JAG
HWY 112 BOREHOLE TYPE Hollow Stem Augers/Casing COMPILED BY NW
DATUM Geodetic DATE 2013.09.18 - 2013.09.18 CHECKED BY PC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
300.1											
0.0	**ASPHALT**: 240 mm						300				
0.2	**GRAVELLY SAND** Compact Brown Moist (FILL)			AS							
299.3			1	SS	50						
0.8											
299.1											
1.0	**ASPHALT:** 230 mm										
	GRAVELLY SAND Loose to Compact Brown Moist (FILL)						299				
			2	SS	6		298				
			3	SS	11		297				
			4	SS	5		296				
			5	SS	5						
294.9							295				
5.2	**SILTY SANDY CLAY (CI)** trace gravel, occasional woody organic matter Firm Grey **(FILL)**		6	SS	9						9 27 23 41
294.1							294				
5.9	**SILTY CLAY** occasional black organic matter Soft to Firm Grey Wet **(FILL)**		7	SS	3						
293.2											
6.9	**SILTY SAND** some gravel, occasional woody organic matter Compact to Dense Grey Wet **(TILL)**		8	SS	36		293				
			9	SS	22						
	-Cobbles from 8.2 to 8.8 m						292				
291.2											
8.8	**BEDROCK**, granite, fresh Highly fractured, diagonal, rough planar Pink with greenish-grey discolouration on fracture surfaces		11	RUN			291				RUN #11 TCR=93% SCR=16% RQD=0%
			12	RUN							RUN #12 TCR=45% SCR=67% RQD=22%

Continued Next Page

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

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

Ministry of Transportation
Ontario

THURBER

RECORD OF BOREHOLE No 13-6 2 OF 2 METRIC

GWP# 5110-06-00 LOCATION N 5 322 884.5 E 378 130.4 ORIGINATED BY JAG
HWY 112 BOREHOLE TYPE Hollow Stem Augers/Casing COMPILED BY NW
DATUM Geodetic DATE 2013.09.18 - 2013.09.18 CHECKED BY PC

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	Continued From Previous Page										
	BEDROCK, granite, fresh Highly fractured, diagonal, rough planar Pink with greenish-grey discolouration on fracture surfaces		13	RUN			290				RUN #13 TCR=100% SCR=67% RQD=59%
			14	RUN			289				RUN #14 TCR=98% SCR=95% RQD=95%
			15	RUN			288				RUN #15 TCR=93% SCR=77% RQD=67%
286.4							287				
13.6	End of Borehole										

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

$\frac{20}{15 \oplus 5}$ (%) STRAIN AT FAILURE
10

ONTMT4S 19-1351-248 HWY 112 CULVERT - IMPERIAL.GPJ 2012TEMPLATE(MTO).GDT 21/2/14

Appendix C

Laboratory Test Results

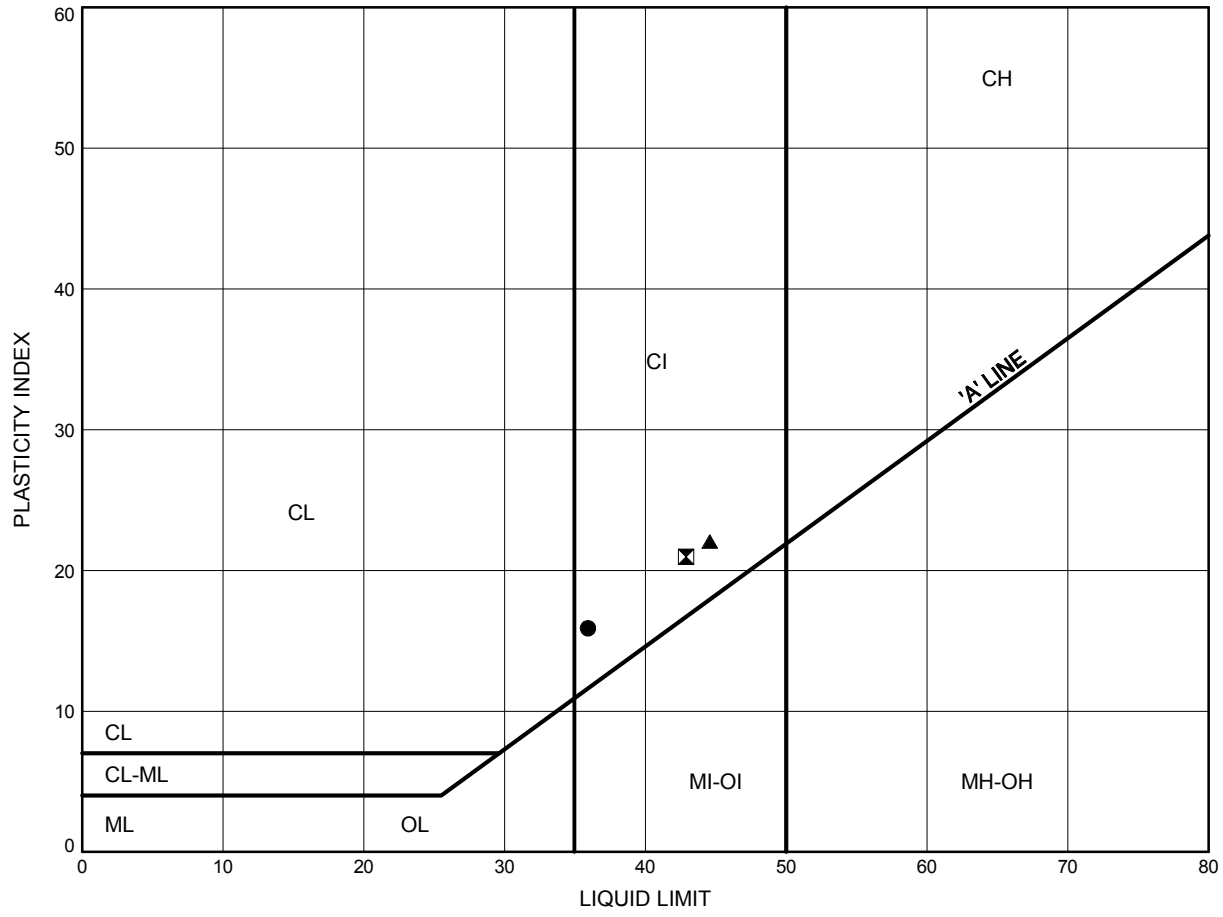
19-1351-248

NE Region Retainer: Assignment 10

ATTERBERG LIMITS TEST RESULTS

FIGURE 1

Cohesive FILL



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-3	1.83	298.07
⊠	13-5	5.68	294.35
▲	13-6	5.64	294.43

Date February 2014

GWP# 5110-06-00

THURBER

Prep'd CM

Chkd. PC

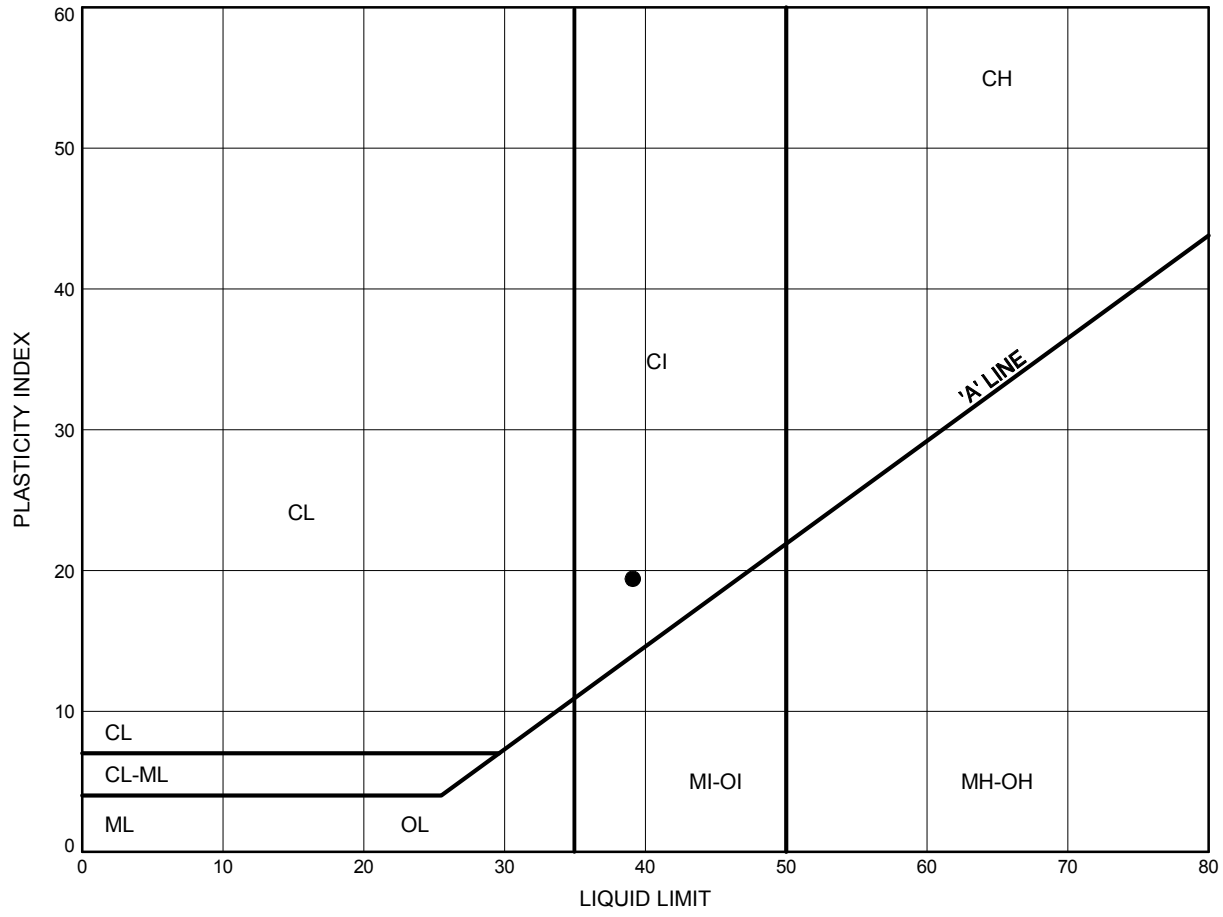
THURBALT 19-1351-248 HWY 112 CULVERT - IMPERIAL.GPJ 21/2/14

NE Region Retainer: Assignment 10

ATTERBERG LIMITS TEST RESULTS

FIGURE 2

Silty Clay



LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-3	6.50	293.40

Date February 2014

GWP# 5110-06-00

THURBER

Prep'd CM

Chkd. PC

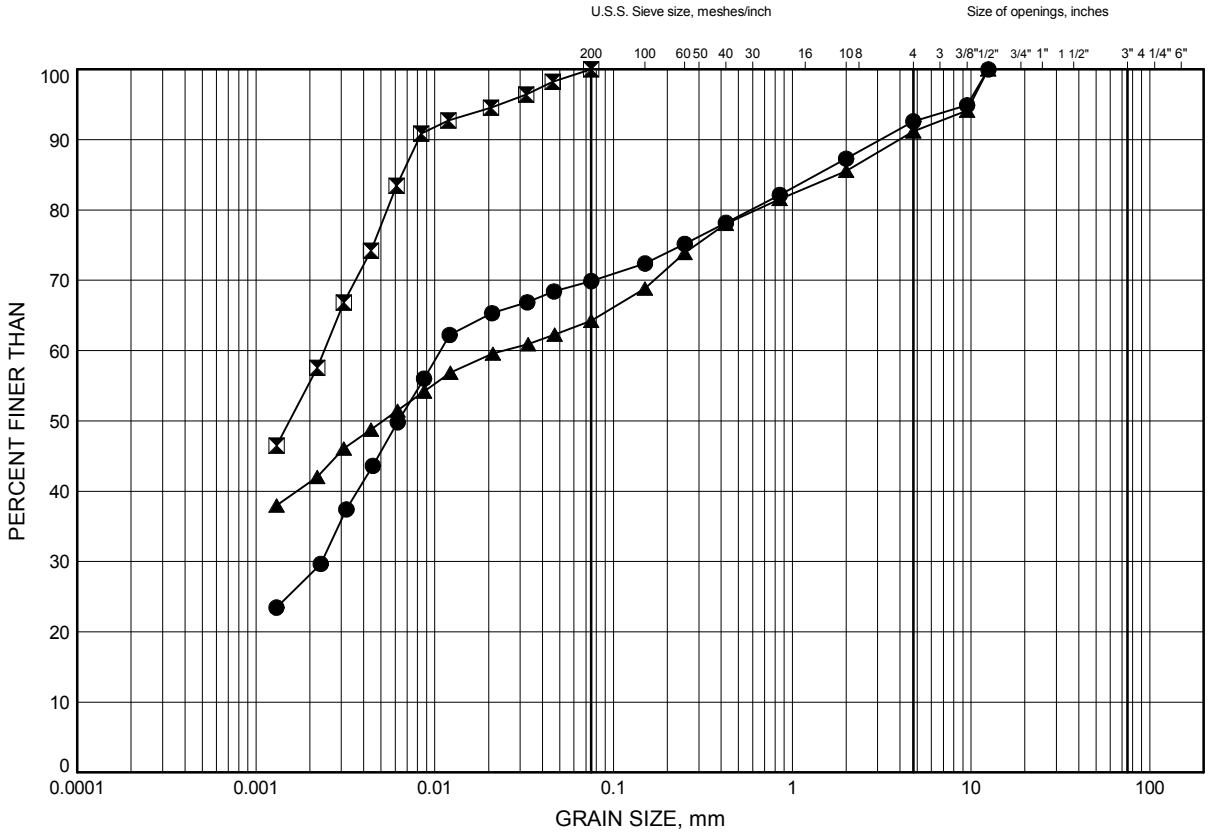
THURBALT 19-1351-248 HWY 112 CULVERT - IMPERIAL.GPJ 21/2/14

NE Region Retainer: Assignment 10

GRAIN SIZE DISTRIBUTION

FIGURE 3

Cohesive FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-3	1.83	298.07
⊠	13-5	5.68	294.35
▲	13-6	5.64	294.43

Date February 2014

GWP# 5110-06-00

THURBER

Prep'd CM

Chkd. PC

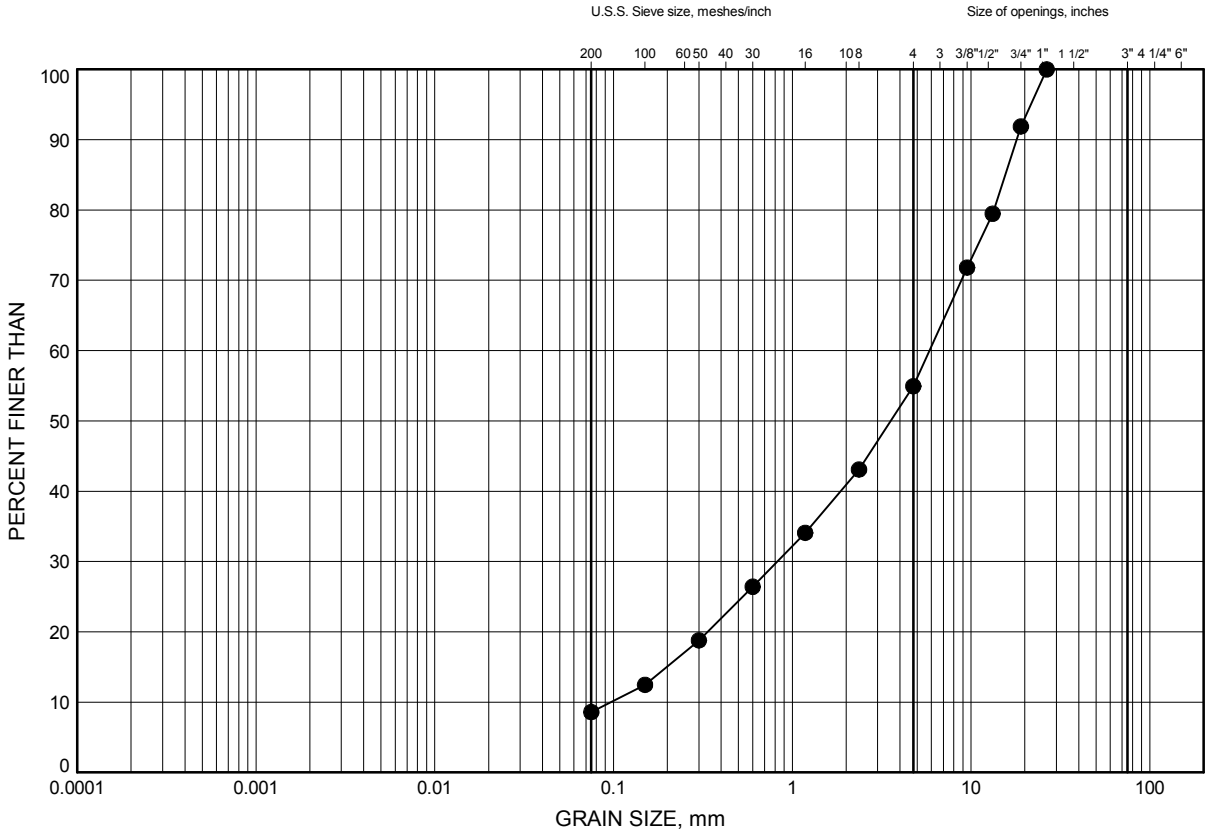
GRAIN SIZE DISTRIBUTION - THURBER 19-1351-248 HWY 112 CULVERT - IMPERIAL.GPJ 21/2/14

NE Region Retainer: Assignment 10

GRAIN SIZE DISTRIBUTION

FIGURE 4

Non-Cohesive FILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-3	5.64	294.26

Date February 2014

GWP# 5110-06-00

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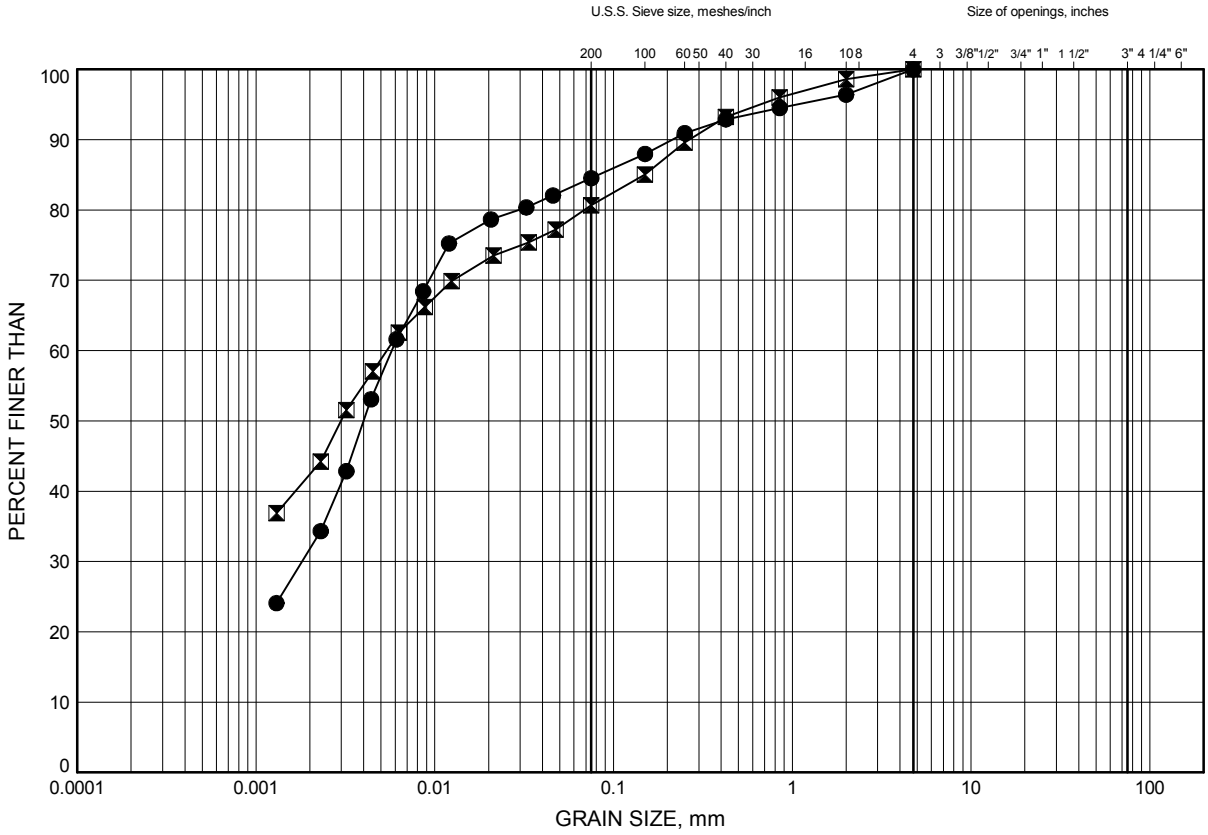
GRAIN SIZE DISTRIBUTION - THURBER 19-1351-248 HWY 112 CULVERT - IMPERIAL.GPJ 21/2/14

NE Region Retainer: Assignment 10

GRAIN SIZE DISTRIBUTION

FIGURE 5

Clayey Silt to Silty Clay



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-2A	0.91	292.19
⧓	13-3	6.50	293.40

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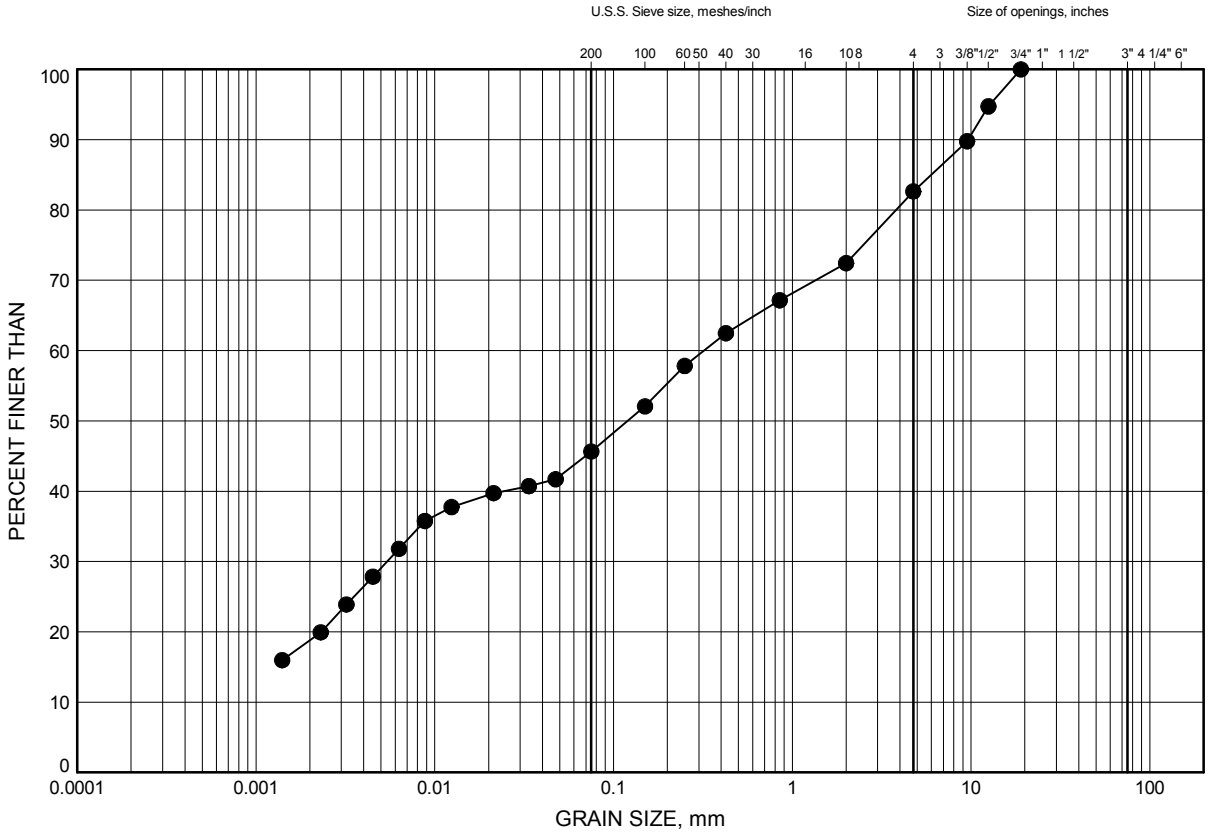
NE Region Retainer: Assignment 10

GRAIN SIZE DISTRIBUTION

FIGURE 6

Silty Sand TILL



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

LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	13-2A	1.45	291.65

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GRAIN SIZE DISTRIBUTION - THURBER 19-1351-248 HWY 112 CULVERT - IMPERIAL.GPJ 21/2/14

Appendix D

Selected Photographs of Culvert Locations

19-1351-248

Photo 1: **West side – end of first CSP**

Photo 2: **West side – end of second CSP**

Photo 3: East side – end of first CSP

Photo 4: East side – end of second CSP

Photo 5: **Looking north at culvert crossing.**

Photo 6: **Looking north at culvert crossing and east sideslope.**