



**THURBER** ENGINEERING LTD.

**FOUNDATION INVESTIGATION REPORT  
CULVERT C7 REPLACEMENT WITH  
PROPOSED TWIN CULVERTS (C5 & C6)  
HIGHWAY 404  
NORTH OF STOUFFVILLE ROAD  
NEAR GORMLEY, ONTARIO  
G.W.P. 2930-02-00**

**GEOCRES NO. 30M14-469**

**Report**

to

**WSP Canada Inc.**

Date: March 2, 2018  
File: 15786



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### APPENDICES

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**FOUNDATION INVESTIGATION REPORT  
CULVERT C7 REPLACEMENT WITH  
PROPOSED TWIN CULVERTS (C5 & C6)  
HIGHWAY 404  
NORTH OF STOUFFVILLE ROAD  
MARKHAM, ONTARIO  
G.W.P. 2930-02-00**

**GEOCRES NO. 30M14-469**

**PART 1: FACTUAL INFORMATION**

**1. INTRODUCTION**

This report presents the factual findings obtained from a foundation investigation conducted for the replacement of an existing culvert (designated as C7) with at that crosses under Highway 404 at Station 10+229, north of Stouffville Road near Gormley, Ontario.

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

Thurber was retained by WSP Canada Inc. (WSP) to carry out this foundation investigation under the MTO Assignment Number 2016-E-0014.

For preparation of this report, reference has been made to culvert design information provided by WSP.

**2. PROJECT AND SITE DESCRIPTION**

The culvert is located on Highway 404, near Station 10+229, approximately 350 m north of Stouffville Road near Gormley, Ontario. The general location of the proposed culvert replacement is shown on the key plan on the Borehole Locations and Soil Strata Drawing in Appendix D.

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The culvert allows water to flow beneath the highway from west to east. The existing culvert is a 750 mm diameter corrugated steel pipe. The Highway 404 grade at the existing culvert is at approximate Elevation 267 m. The culvert invert is at approximate Elevations 263.9 m at the inlet (west) and 262.4 m at the outlet (east). The existing culvert is reportedly in a fair to poor condition. The bottom of the culvert is rusted near the inlet and outlet, and dents were also noted at the inlet. Based on drainage analysis, the existing culvert is considered undersized for handling existing flow conditions.

The land use adjacent to this section of Highway 404 is largely rural and agricultural, although there is increasing residential and commercial development in recent years. The vegetation cover beyond the paved areas of the highway comprises grass, bushes and stands of trees. Photographs of the culvert and surrounding area are presented in Appendix C.

The culvert site is located within the physiographic region known as the Peel Plain. The topography is flat to gently undulating. The soil cover in the region typically comprises silty clay glacial tills with sand and silt layers. Shale bedrock of the Georgian Bay Formation is anticipated at an approximate depth of 50 m.

### **3. SITE INVESTIGATION AND FIELD TESTING**

The borehole investigation and field testing program for this site was carried out from September 5 to 7, 2017, and consisted of drilling and sampling four (4) boreholes, designated as Boreholes C7-01 to C7-04, north of the existing culvert alignment. The boreholes were terminated at depths ranging from 10.9 m to 11.1 m (Elevations 255.9 to 255.5).

Lane closures and traffic control were carefully planned for drilling each borehole. Prior to commencement of drilling, utility clearances were obtained for all borehole locations.

The approximate locations of the boreholes are shown on the Borehole Locations and Soil Strata Drawing included in Appendix D. The coordinates and elevations of the boreholes are given on this drawing and on the individual Record of Borehole Sheets in Appendix A. Northing and easting co-ordinates at the borehole locations were obtained by Thurber using a Trimble GPS Pathfinder ProXRT, and the corresponding ground surface elevations were provided by WSP based on the project DTM survey.



The boreholes were advanced using a truck-mounted D-90 drill rig. Hollow stem augers were used to advance the boreholes, and soil samples were obtained at selected intervals using a 50-mm diameter split spoon sampler in conjunction with the Standard Penetration Test (SPT).

A member of Thurber's engineering staff supervised the drilling and sampling operations on a full-time basis. The supervisors logged the boreholes, visually examined the recovered soil samples, and transported them to Thurber's laboratory for further examination and testing.

Groundwater conditions in the open boreholes were observed throughout the drilling operations. Standpipe piezometers were installed in boreholes near the inlet and outlet to permit monitoring of groundwater levels. The standpipe piezometers consisted of 50 mm diameter PVC pipes with slotted screens. Upon completion, the boreholes were abandoned in general accordance with Ontario Regulation 903 amended by Ontario Reg. 372 (O.Reg. 903). Once the final readings are taken, the piezometers will be decommissioned in general accordance with O.Reg. 903. The details of borehole completion are summarized in Table 3.1.

**Table 3.1 – Borehole Completion Details**

<b>Borehole No.</b>	<b>Borehole Depth / Base Elevation (m)</b>	<b>Piezometer Tip Depth/ Elevation (m)</b>	<b>Completion Details</b>
C7-01	10.9/255.7	10.4/256.2	Borehole backfilled with a sand filter from 10.4 m to 6.6 m, bentonite holeplug from 6.6 m to 0.3 m, then cement to surface.
C7-02	11.1/255.9	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.3 m, cement to 0.1 m, then asphalt to surface.
C7-03	11.1/255.8	None installed	Borehole backfilled with bentonite holeplug and auger cuttings to 0.3 m, cement to 0.1 m, then asphalt to surface.
C7-04	11.1/255.5	10.4/256.2	Borehole backfilled with a sand filter from 10.4 m to 6.6 m, bentonite holeplug from 6.6 m to 0.3 m, then cement to surface.



#### **4. LABORATORY TESTING**

The recovered soil samples were subjected to Visual Identification (VI) and to natural moisture content determination. Selected samples were also subjected to grain size analysis and Atterberg Limits testing. All the laboratory tests were carried out in accordance with MTO and/or ASTM Standards, as appropriate. The results of the laboratory testing are summarized on the Record of Borehole sheets and on the accompanying figures in Appendix B.

#### **5. DESCRIPTION OF SUBSURFACE CONDITIONS**

Reference is made to the Record of Borehole sheets in Appendix A for details of the encountered soil stratigraphy. A soil profile near the culvert alignment is presented on the "Borehole Locations and Soil Strata" drawing in Appendix D. An overall description of the stratigraphy is given in the following paragraphs. However, the factual data presented in the Record of Borehole sheets governs any interpretation of the site conditions. It must be recognized that soil conditions may vary between and beyond borehole locations.

In general, the subsurface conditions encountered in the boreholes consist of pavement structure and sand to silty sand embankment fill overlying silty clay till which contained sand and silt lenses or interlayers. The silty clay till grades into a sandy silt till near the inlet area.

More detailed descriptions of the individual stratum are presented below.

##### **5.1 Pavement Structure**

A layer of asphalt ranging in thickness from 125 mm to 150 mm was encountered at all four borehole locations.

In Boreholes C7-01 and C7-04, granular fill consisting of sand, trace gravel, ranging from 0.6m to 0.7 m in thickness, was encountered. The base of the fill was at Elevation 265.8.

##### **5.2 Embankment Fill**

Embankment fill was contacted below the pavement in all four boreholes. The embankment fill generally consists of layers of cohesionless and cohesive soils. The cohesionless fill consists of brown sand to silty sand containing trace gravel, trace to some silt, trace clay and



occasional cobbles. Where encountered in Boreholes C7-02 and C7-03, the granular fill ranged from 3.0 m to 4.2 m in thickness. This fill layer extended to 3.2 m to 4.4 m depths (Elevations 263.8 to 262.5).

A layer of brown silty clay fill containing some to with sand and trace gravel, was contacted below the pavement granular at 0.8 m depth in Boreholes C7-01 and C7-04. The thickness of the cohesive fill was 0.7 m and 1.5 m. The depth to the base of the silty clay fill was 1.5 m and 2.3 m (Elevations 265.1 and 264.3) in Boreholes C7-01 and C7-04, respectively.

SPT 'N' values for the sand/silty sand fill layer ranged from 11 to 44 blows per 0.3 m penetration indicating a compact to dense state. Measured moisture contents of sand/silty sand fill samples ranged from 1 percent to 18 percent.

SPT 'N' values for the silty clay fill ranged from 7 to 19 blows per 0.3 m penetration, indicating a firm to very stiff consistency. Moisture contents measured in the silty clay fill ranged from 9 percent to 17 percent.

The results of grain size distribution analyses carried out on selected samples of the sand/silty sand fill and silty clay fill are presented on the Record of Borehole sheets included in Appendix A and on Figures B1 and B2 of Appendix B. The results of the grain size distribution analyses are summarized below:

<b>Soil Particle</b>	<b>Sand Fill (percent)</b>	<b>Silty Clay Fill (percent)</b>
Gravel	5 to 8	3
Sand	63 to 79	28
Silt	10 to 23	36
Clay	3 to 9	33

The results of Atterberg Limits tests conducted on one sample of the silty clay fill are provided on the Record of Borehole sheets in Appendix A and illustrated in Figure B6 of Appendix B. The results are summarized as follows:



Index Property	Percentage (%)
Plastic Limit	14
Liquid Limit	30
Plasticity Index	16

The results of the Atterberg Limits testing indicate the silty clay fill to be of low plasticity with a group symbol CL.

### 5.3 Silty Clay Till

Brown to grey silty clay till with sand, trace gravel and occasional cobbles was encountered below the embankment fill in all four boreholes at depths ranging from 1.5 m to 4.4 m. The thickness of the silty clay till was 7.8 m where fully penetrated in Borehole C7-01. Where interrupted by sand and silt interlayers or lenses, Boreholes C7-02 and C7-04 were terminated in this till at a depth of 11.1 m (Elevation 255.5 to 255.9), respectively.

SPT 'N' values in the silty clay till typically ranged from 15 to 61 blows per 0.3 m penetration, indicating a very stiff to hard consistency. An SPT 'N' value of 50 blows for less than 0.3 m of penetration indicated the potential presence of cobbles near Elevation 258.8 in Borehole C7-01. Near the top of the till deposit, 'N' values ranged from 8 to 11 blows were measured indicating stiff zones. Moisture contents measured in the silty clay till ranged from 8 percent to 29 percent.

The results of grain size distribution analyses testing carried out on selected samples of the silty clay till are presented on the Record of Borehole sheets included in Appendix A and on Figure B3 of Appendix B. The results of the grain size distribution analyses are summarized below:

Soil Particle	Percentage (%)
Gravel	0 to 2
Sand	13 to 28
Silt	42 to 61
Clay	20 to 38





The results of Atterberg Limits tests conducted on samples of the silty clay till are presented on the Record of Borehole sheets in Appendix A and illustrated in Figure B7 of Appendix B. The results are summarized as follows:

Index Property	Percentage (%)
Plastic Limit	11 to 17
Liquid Limit	20 to 43
Plasticity Index	7 to 26

The results of the Atterberg Limits testing indicate that the silty clay till is of low to medium plasticity with group symbols CL and CI.

Glacial tills inherently contain cobbles and boulders.

#### 5.4 Silty Sand

A layer of brown to grey silty sand was found embedded within the silty clay till in Boreholes C7-01 and C7-02, and was encountered at depths of 9.3 m and 5.6 m, respectively. The silty sand layer ranged in thickness from 1.1 m to 3.1 m, and extended to 8.7 m to 10.4 m depths (Elevations 258.3 to 256.2).

SPT 'N' values for the silty sand layer ranged from 36 to 58 blows per 0.3 m penetration, indicating a dense to very dense state. Moisture contents measured in the silty sand ranged from 8 percent to 16 percent.

The results of grain size distribution analyses carried out on selected samples of the silty sand are presented on the Record of Borehole sheets included in Appendix A and on Figure B4 of Appendix B. The results of the grain size distribution analyses are summarized below:

Soil Particle	Percentage (%)
Gravel	0 to 7
Sand	44 to 65
Silt	30 to 31
Clay	4 to 19

## 5.5 Silt

A brown to grey silt deposit containing some sand, some clay and trace gravel was encountered in Borehole C7-04 at 5.6 m depth. This layer was 4.6 m thick and extended to a depth of 10.2 m (Elevation 256.4).

SPT 'N' values for the silt layer ranged from 27 to 72 blows per 0.3 m penetration, indicating a compact to very dense state. Moisture contents measured in the silt ranged from 10 percent to 22 percent.

The results of grain size distribution analyses carried out on a selected sample of the silt are presented on the Record of Borehole sheets included in Appendix A and on Figure B5 of Appendix B. The results of the grain size distribution analysis is summarized below:

Soil Particle	Percentage (%)
Gravel	3
Sand	11
Silt	72
Clay	14

## 5.6 Sandy Silt Till

A layer of sandy silt till was encountered in Borehole C7-01 below the silty sand deposit at a depth of 10.4 m. Borehole C7-01 was terminated within the sandy silt till at a depth of 10.9 m (Elevation 255.7).

An SPT 'N' value for the sandy silt till deposit was over 100 blows for less than 0.3 m penetration indicating a very dense state. A moisture content of 10 percent was measured for a sample of the sandy silt till.

Cohesionless tills inherently contain cobbles and boulders.

## 5.7 Groundwater Conditions

Groundwater levels in the boreholes were observed during the drilling operations and measured upon completion of drilling. Standpipe piezometers were installed in Boreholes C7-



01 and C7-04 to permit monitoring of groundwater levels. Water levels measured in the two installed standpipes and open boreholes are presented in Table 5.1 below.

**Table 5-1. Groundwater Level Measurements**

Borehole	Date	Groundwater Level		Comments
		Depth (m)	Elevation (m)	
C7-01	September 5, 2017	7.5	259.1	Open borehole
	September 24, 2017	Above ground surface *		Piezometer
	October 23, 2017	1.0 above ground surface *		
	February 16, 2018	frozen	-	
C7-02	September 6, 2017	4.1	262.9	Open borehole
C7-03	September 7, 2017	4.0	262.9	Open borehole
C7-04	September 5, 2017	4.3	262.3	Open borehole
	September 24, 2017	3.9	262.7	Piezometer
	October 23, 2017	3.4	263.2	
	February 16, 2018	3.3	263.3	

\* Artesian conditions at depth.

Artesian groundwater condition associated with the underlying sands and silts was noted in the piezometer installed in Borehole C7-01.

The values shown in Table 5.1 are short-term readings, and seasonal fluctuations of the groundwater level are to be expected. In particular, the groundwater level may be at a higher elevation after periods of significant or prolonged precipitation.

## 6. CORROSIVITY TEST RESULTS

A sample of the silty sand fill from Borehole C7-02 and a sample of the native silty clay till from Borehole C7-04 were submitted for analytical testing of corrosivity parameters and sulphate. The results of the analytical tests are shown in Table 6.1 below. The laboratory certificates of analysis are presented in Appendix B.

**Table 6.1- Analytical Test Results**

Parameter	Units (Soil)	Test Results	
		C7-02 SS 2 Depth 1.7 m	C7-04 SS 4 Depth 3.3 m
		(Soil Sample)	(Soil Sample)
Sulphide	%	0.02	0.02
Chloride	µg/g	320	890
Sulphate	µg/g	240	180
pH	-	9.38	9.30
Electrical Conductivity	µS/cm	640	1150
Resistivity	Ohm.cm	1560	872
Redox Potential	mV	292	271

## 7. MISCELLANEOUS

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

Walker Drilling of Utopia, Ontario, supplied and operated a track-mounted D-90 drill rig to carry out the drilling, sampling and in-situ testing operations for the boreholes.

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

Overall project management was provided by Dr. Sydney Pang, P.Eng. Interpretation of the field data and preparation of this report was completed by Dr. Nancy Berg, EIT. The report was reviewed by Dr. Sydney Pang, P.Eng. and Dr. P.K. Chatterji, P.Eng., a Designated Principal Contact for MTO Foundations Projects.



THURBER ENGINEERING LTD.

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March 2, 2018

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## **Appendix A**

### **Record of Borehole Sheets**

## SYMBOLS, ABBREVIATIONS AND TERMS USED ON RECORDS OF BOREHOLES

### 1. TEXTURAL CLASSIFICATION OF SOILS

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

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

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

### 3. TERMS DESCRIBING CONSISTENCY (COHESIVE SOILS ONLY)

DESCRIPTIVE TERM	UNDRAINED SHEAR STRENGTH (kPa)	APPROXIMATE SPT <sup>(1)</sup> '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.

# 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 <sub>L</sub> < 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 <sub>L</sub> < 30%).
		CI	Inorganic clays of medium plasticity, silty clays. (30% < W <sub>L</sub> < 50%).
		OL	Organic silts and organic silty-clays of low plasticity.
	SILTS AND CLAYS W <sub>L</sub> > 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

<u>ROCK WEATHERING CLASSIFICATION</u>		<u>SYMBOLS</u>	
<b>Fresh (FR)</b>	No visible signs of weathering.		
<b>Fresh Jointed (FJ)</b>	Weathering limited to the surface of major discontinuities.		CLAYSTONE
<b>Slightly Weathered (SW)</b>	Penetrative weathering developed on open discontinuity surfaces, but only slight weathering of rock material.		SILTSTONE
<b>Moderately Weathered (MW)</b>	Weathering extends throughout the rock mass, but the rock material is not friable.		SANDSTONE
<b>Highly Weathered (HW)</b>	Weathering extends throughout the rock mass and the rock is partly friable.		COAL
<b>Completely Weathered (CW)</b>	Rock is wholly decomposed and in a friable condition, but the rock texture and structure are preserved.		Bedrock (general)

<u>DISCONTINUITY SPACING</u>		<u>STRENGTH CLASSIFICATION</u>			
Bedding	Bedding Plane Spacing	Rock Strength	Approximate Uniaxial Compressive Strength		Field Estimation of Hardness*
			(MPa)	(psi)	
Very thickly bedded	Greater than 2m	Extremely Strong	Greater than 250	Greater than 36,000	Specimen can only be chipped with a geological hammer
Thickly bedded	0.6 to 2m				
Medium bedded	0.2 to 0.6m	Very Strong	100-250	15,000 to 36,000	Requires many blows of geological hammer to break
Thinly bedded	60mm to 0.2m	Strong	50-100	7,500 to 15,000	Requires more than one blow of geological hammer to break
Very thinly bedded	20 to 60mm				
Laminated	6 to 20mm	Medium Strong	25.0 to 50.0	3,500 to 7,500	Breaks under single blow of geological hammer.
Thinly Laminated	Less than 6mm				

<u>TERMS</u>					
Total Core Recovery: (TCR)	Core recovered as a percentage of total core run length.	Weak	5.0 to 25.0	750 to 3,500	Can be peeled by a pocket knife with difficulty
Solid Core Recovery: (SCR)	Percent Ratio of solid core of full cylindrical shape recovered. Expressed with respect to the total length of core run.	Very Weak	1.0 to 5.0	150 to 750	Can be peeled by a pocket knife, crumbles under firm blows of geological pick.
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.	Extremely Weak (Rock)	0.25 to 1.0	35 to 150	Indented by thumbnail
Uniaxial Compressive Strength (UCS)	Axial stress required to break the specimen				
Fracture Index: (FI)	Frequency of natural fractures per 0.3m of core run.				

# RECORD OF BOREHOLE No C7-01

1 OF 2

METRIC

W.P. 2930-02-00 LOCATION SB N 4 867 008.7 E 313 550.7 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2017.09.05 - 2017.09.05 CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					UNIT WEIGHT  γ  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)				
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa										
266.6	GROUND SURFACE							20	40	60	80	100						
0.0	ASPHALT: (125mm)																	
0.1	SAND, trace gravel Brown Moist (FILL)		1	GS			266											
265.8																		
0.8	Silty CLAY with sand, trace gravel Firm Brown Moist (FILL)		1	SS	7													3 28 36 33
265.1																		
1.5	Silty CLAY with sand, trace gravel Stiff Brown Moist (TILL)		2	SS	9		265											
			3	SS	8		264											
	Brown to Grey		4	SS	9		263											
262.5																		
4.1	Hard						262											
			5	SS	56													
							261											
			6	SS	58		260											
							259											
			7	SS	50/ .050													
							258											
257.3																		
9.3	Silty SAND, trace clay Very Dense Brown Wet		8	SS	58		257											0 65 31 4

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No C7-01

2 OF 2

METRIC

W.P. 2930-02-00 LOCATION SB N 4 867 008.7 E 313 550.7 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2017.09.05 - 2017.09.05 CHECKED BY PP


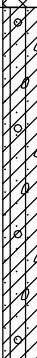
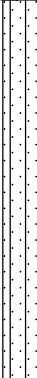
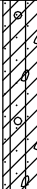
SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
	Continued From Previous Page													
256.2	Silty <b>SAND</b> , trace clay Very Dense Brown Wet						256							
255.7	Sandy <b>SILT</b> , trace gravel Very Dense Grey Wet (TILL)		9	SS	100/ 275					o				
10.9	END OF BOREHOLE AT 10.9m. BOREHOLE OPEN TO 10.4m AND WATER LEVEL AT 7.5m DEPTH UPON COMPLETION. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.  WATER LEVEL READINGS DATE DEPTH(m) ELEV.(m) 2017.09.24 Above ground surface - 2017.10.23 -1.0 267.6 2018.02.16 Frozen -  '-' Above ground surface													

# RECORD OF BOREHOLE No C7-02

1 OF 2

METRIC

W.P. 2930-02-00 LOCATION SB N 4 867 022.1 E 313 583.0 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2017.09.06 - 2017.09.06 CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT			UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)			
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa				W P      W      W L				GR   SA   SI   CL			
								20   40   60   80   100	○ UNCONFINED      + FIELD VANE			WATER CONTENT (%)							
						20   40   60   80   100	● QUICK TRIAXIAL      × LAB VANE												
267.0	GROUND SURFACE																		
0.0	ASPHALT: (150mm)																		
0.2	Silty <b>SAND</b> , trace gravel, trace clay Compact to Dense Brown Moist (FILL)		1	GS															
			1	SS	11														
			2	SS	44														
			3	SS	29														
263.8																			
3.2	Silty <b>CLAY</b> , with sand, trace gravel Very Stiff Brown Moist (TILL)		4	SS	15														
			5	SS	20														
261.4																			
5.6	Silty <b>SAND</b> , some clay, trace gravel Very Dense to Dense Brown to Grey Wet																		
			6	SS	53														
			7	SS	36														
258.3																			
8.7	Silty <b>CLAY</b> with sand, trace gravel Hard Grey Moist (TILL)																		
			8	SS	35														

Continued Next Page

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

RECORD OF BOREHOLE No C7-02

2 OF 2

METRIC

W.P. 2930-02-00 LOCATION SB N 4 867 022.1 E 313 583.0 ORIGINATED BY ES  
HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
DATUM Geodetic DATE 2017.09.06 - 2017.09.06 CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa						
	Continued From Previous Page													
255.9	Silty <b>CLAY</b> with sand, trace gravel Hard Grey Moist (TILL)		9	SS	57		256							
11.1	END OF BOREHOLE AT 11.1m. BOREHOLE OPEN AND WATER LEVEL AT 4.1m DEPTH UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO 0.3m, CEMENT TO 0.1m, THEN ASPHALT TO SURFACE.													

# RECORD OF BOREHOLE No C7-03

1 OF 2

METRIC

W.P. 2930-02-00 LOCATION NB N 4 867 019.7 E 313 603.0 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2017.09.07 - 2017.09.07 CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT				UNIT WEIGHT  <b>γ</b>  kN/m <sup>3</sup>	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 <sub>P</sub> W      W <sub>L</sub>									
266.9	GROUND SURFACE																					
0.0	ASPHALT: (150mm)																					
0.2	SAND, trace to some silt, trace clay, trace gravel Compact to Dense Brown Moist (FILL)		1	GS													8	79	10	3		
			1	SS	13																	
			2	SS	14																	
	Occasional cobbles		3	SS	42																	
			4	SS	33																	
262.5																						
4.4	Silty <b>CLAY</b> with sand, trace gravel Stiff to Very Stiff Grey Moist (TILL)		5	SS	11													2	28	49	21	
			6	SS	19																	
			7	SS	17																	
			8	SS	20														2	26	43	29

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE

# RECORD OF BOREHOLE No C7-03

2 OF 2

METRIC

W.P. 2930-02-00 LOCATION NB N 4 867 019.7 E 313 603.0 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2017.09.07 - 2017.09.07 CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	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 <sub>p</sub>	W	W <sub>L</sub>			
	Continued From Previous Page																
255.8	Silty <b>CLAY</b> with sand, trace gravel Very Stiff Grey Moist (TILL)		9	SS	23		256										
11.1	END OF BOREHOLE AT 11.1m. BOREHOLE OPEN AND WATER LEVEL AT 4.0m DEPTH UPON COMPLETION. BOREHOLE BACKFILLED WITH BENTONITE HOLEPLUG AND AUGER CUTTINGS TO 0.3m, CEMENT TO 0.1m, THEN ASPHALT TO SURFACE.																

# RECORD OF BOREHOLE No C7-04

1 OF 2

METRIC

W.P. 2930-02-00 LOCATION NB N 4 867 030.2 E 313 635.2 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2017.09.05 - 2017.09.05 CHECKED BY PP

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT				UNIT WEIGHT $\gamma$ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES			SHEAR STRENGTH kPa					
266.6	GROUND SURFACE							20 40 60 80 100					
0.0	ASPHALT: (150mm)							20 40 60 80 100					
0.2	SAND, trace gravel Brown Moist (FILL)		1	GS			266						
265.8													
0.8	Silty CLAY, some sand, trace gravel Very Stiff to Stiff Brown Moist (FILL)		1	SS	19		265						
			2	SS	8								
264.3													
2.3	Silty CLAY, some sand, trace gravel Very Stiff Grey Moist (TILL)		3	SS	24		264						0 19 61 20
			4	SS	20		263						
	Occasional cobbles Brown		5	SS	17		262						
261.0							261						
5.6	SILT, some sand, some clay, trace gravel Compact to Very dense Brown Wet		6	SS	27		260						3 11 72 14
	Grey Moist		7	SS	57		259						
			8	SS	72		258						
							257						

Continued Next Page

+<sup>3</sup>, ×<sup>3</sup>: Numbers refer to  
Sensitivity

20  
15  
10  
(%) STRAIN AT FAILURE



# RECORD OF BOREHOLE No C7-04

2 OF 2

METRIC

W.P. 2930-02-00 LOCATION NB N 4 867 030.2 E 313 635.2 ORIGINATED BY ES  
 HWY 404 BOREHOLE TYPE Hollow Stem Augers COMPILED BY MP  
 DATUM Geodetic DATE 2017.09.05 - 2017.09.05 CHECKED BY PP

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 <sup>3</sup>	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									
						20   40   60   80   100									
						20   40   60   80   100									
Continued From Previous Page															
256.4	<b>SILT</b> , some sand, some clay, trace gravel Very Dense Grey Moist						256								
10.2															
255.5	Silty <b>CLAY</b> , some sand Hard Grey Moist (TILL)		9	SS	61										0   13   57   30
11.1	END OF BOREHOLE AT 11.1m. BOREHOLE OPEN TO 10.4m DEPTH AND WATER LEVEL AT 4.3m UPON COMPLETION. Well installation consists of 50mm diameter Schedule 40 PVC pipe with a 3.05m slotted screen.														
WATER LEVEL READINGS															
DATE                  DEPTH(m)    ELEV.(m)															
2017.09.24                  3.9                  262.7															
2017.10.23                  3.4                  263.2															
2018.02.16                  3.3                  263.3															



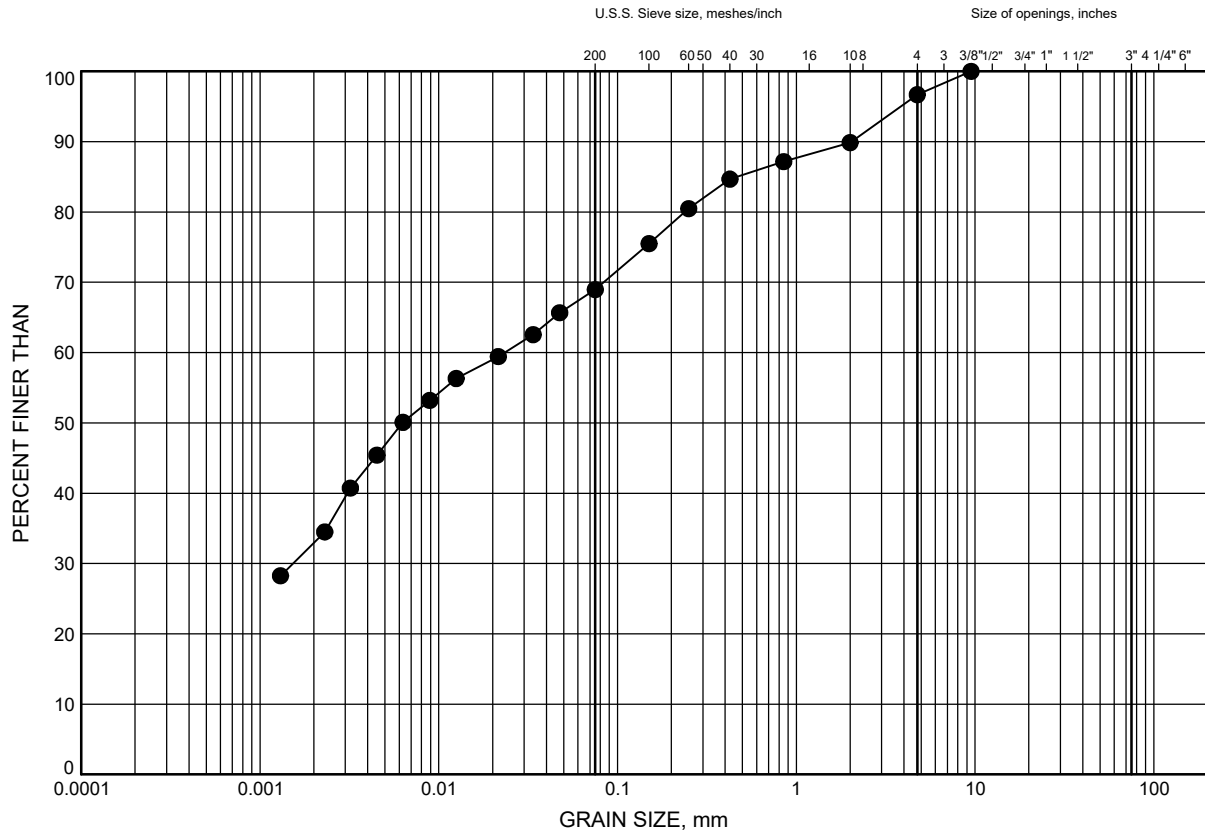
## **Appendix B**

### **Geotechnical and Analytical Laboratory Test Results**

# HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE B1

## Silty CLAY FILL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C7-01	1.1	265.5

Date December 2017  
W.P. 2930-02-00

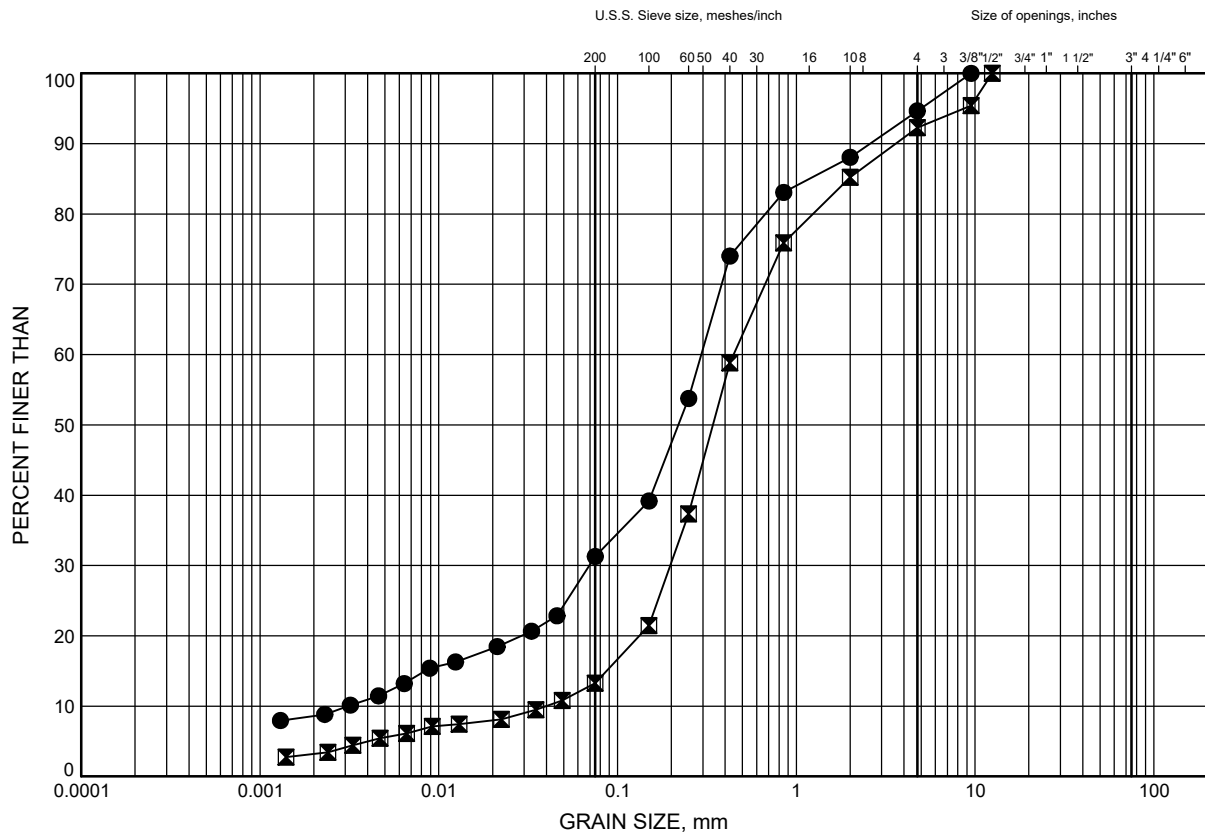


Prep'd AN  
Chkd. RPR

# HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE B2

## Silty SAND to SAND FILL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C7-02	1.1	265.9
⊠	C7-03	1.0	265.9

Date December 2017  
W.P. 2930-02-00

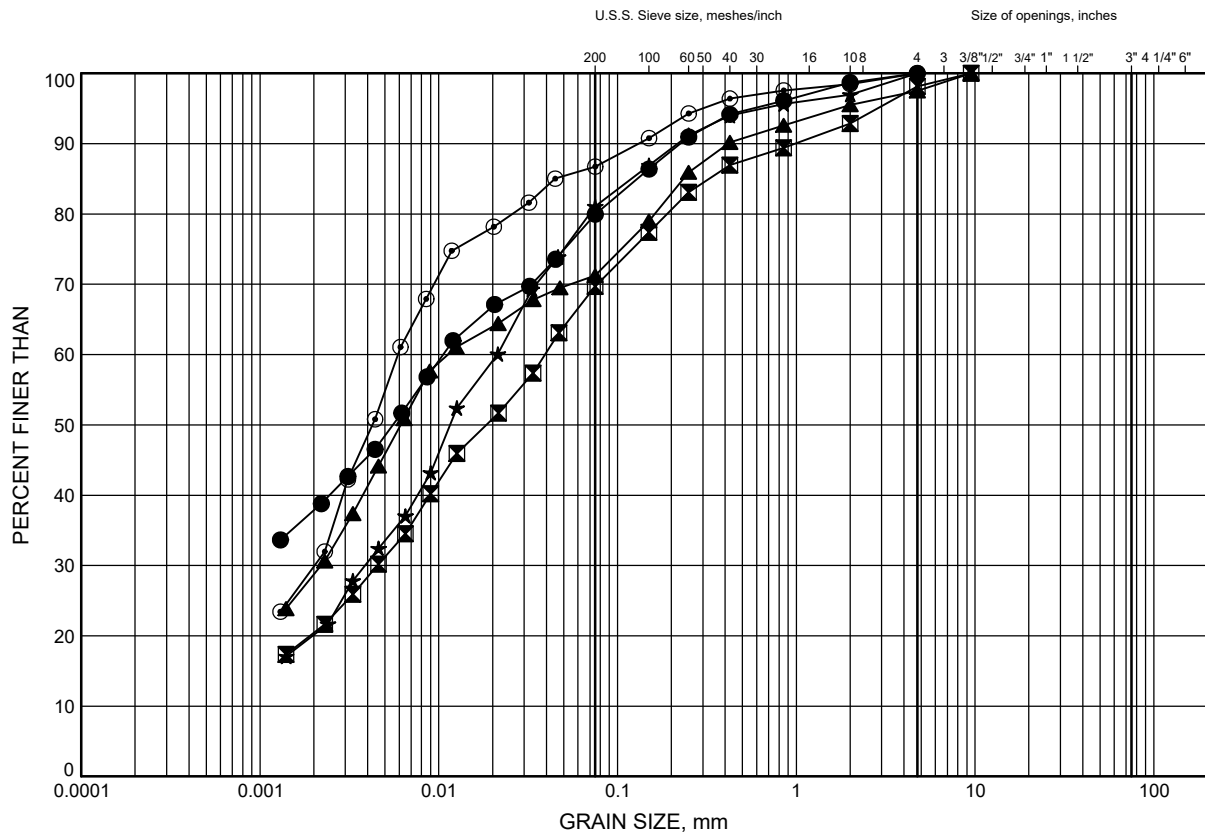


Prep'd AN  
Chkd. RPR

# HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE B3

## Silty CLAY TILL



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C7-02	3.3	263.7
⊠	C7-03	4.8	262.1
▲	C7-03	9.4	257.5
★	C7-04	2.6	264.0
⊙	C7-04	10.9	255.7

Date December 2017  
W.P. 2930-02-00

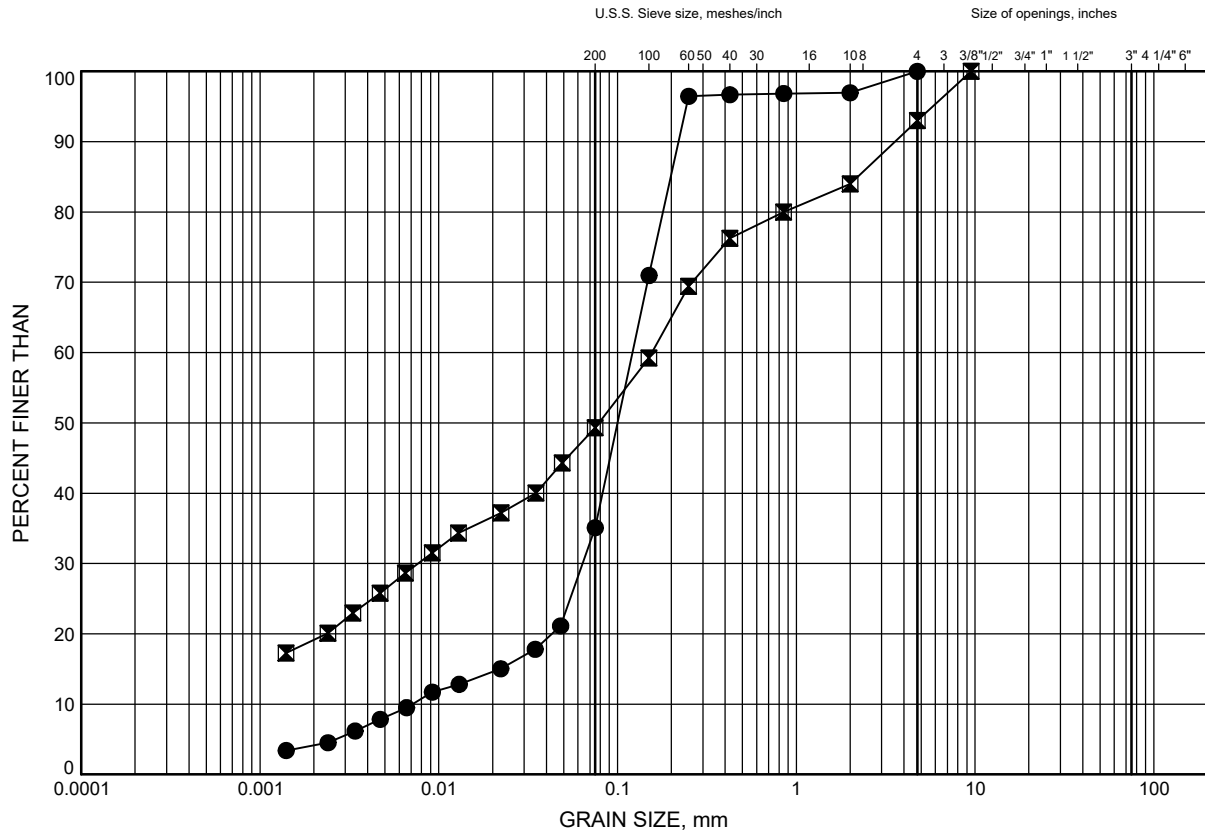


Prep'd AN  
Chkd. RPR

# HWY 404 Widening GRAIN SIZE DISTRIBUTION

FIGURE B4

## Silty SAND



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C7-01	9.4	257.2
⊠	C7-02	7.8	259.2

Date October 2017  
W.P. 2930-02-00

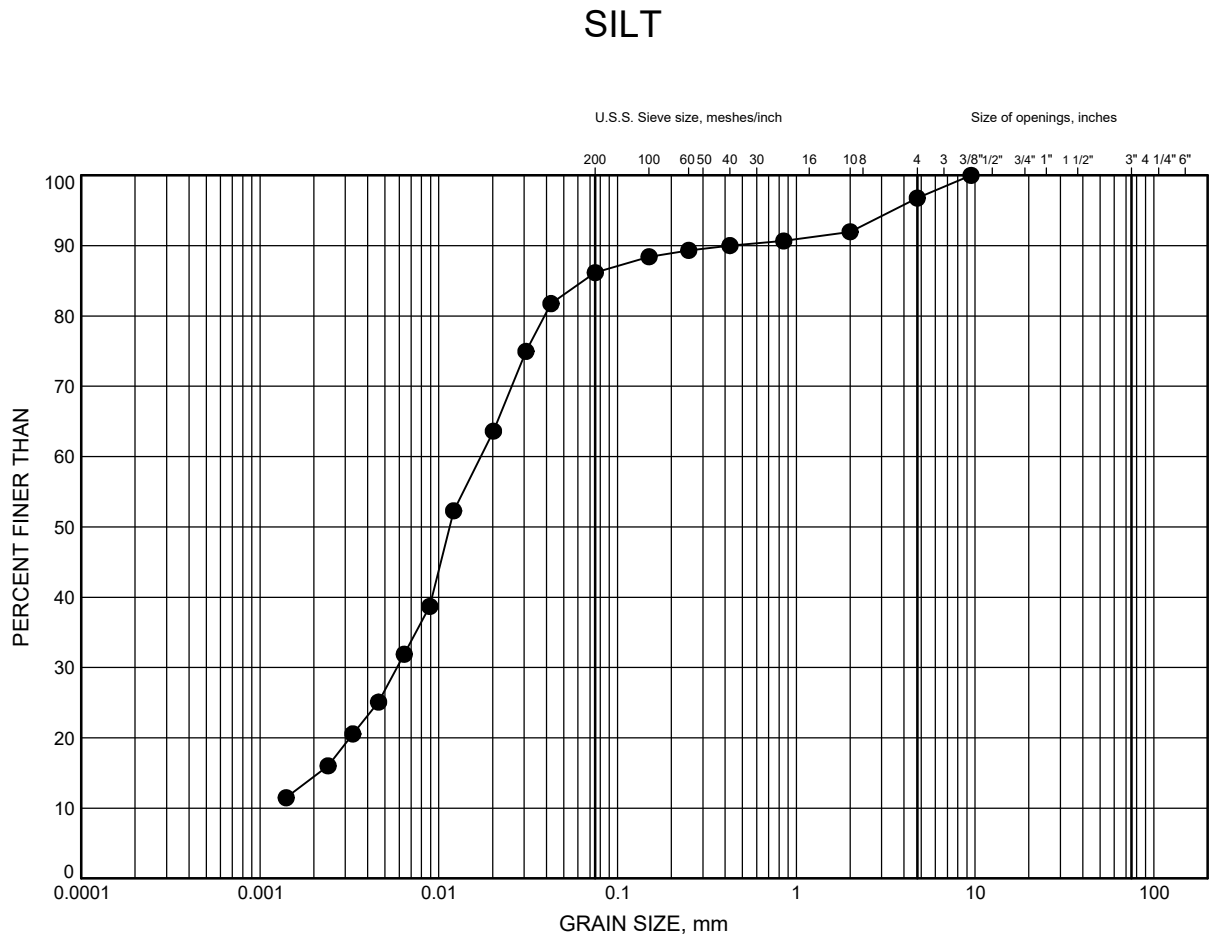


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Chkd. RPR

# HWY 404 Widening

## GRAIN SIZE DISTRIBUTION

FIGURE B5



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

### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C7-04	6.4	260.2

Date October 2017  
W.P. 2930-02-00

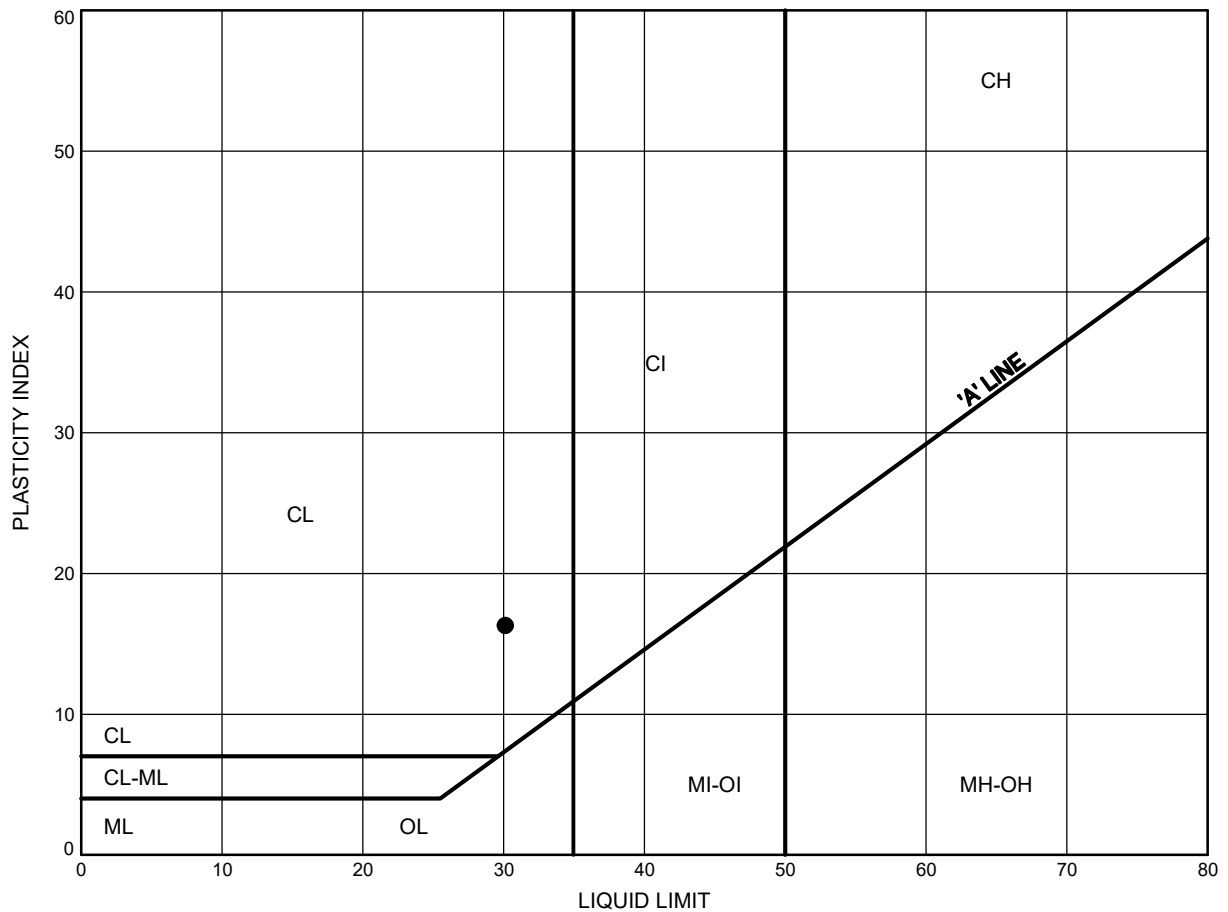


Prep'd AN  
Chkd. RPR

# HWY 404 Widening ATTERBERG LIMITS TEST RESULTS

FIGURE B6

Silty CLAY FILL



### LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C7-01	1.1	265.5

Date December 2017  
W.P. 2930-02-00



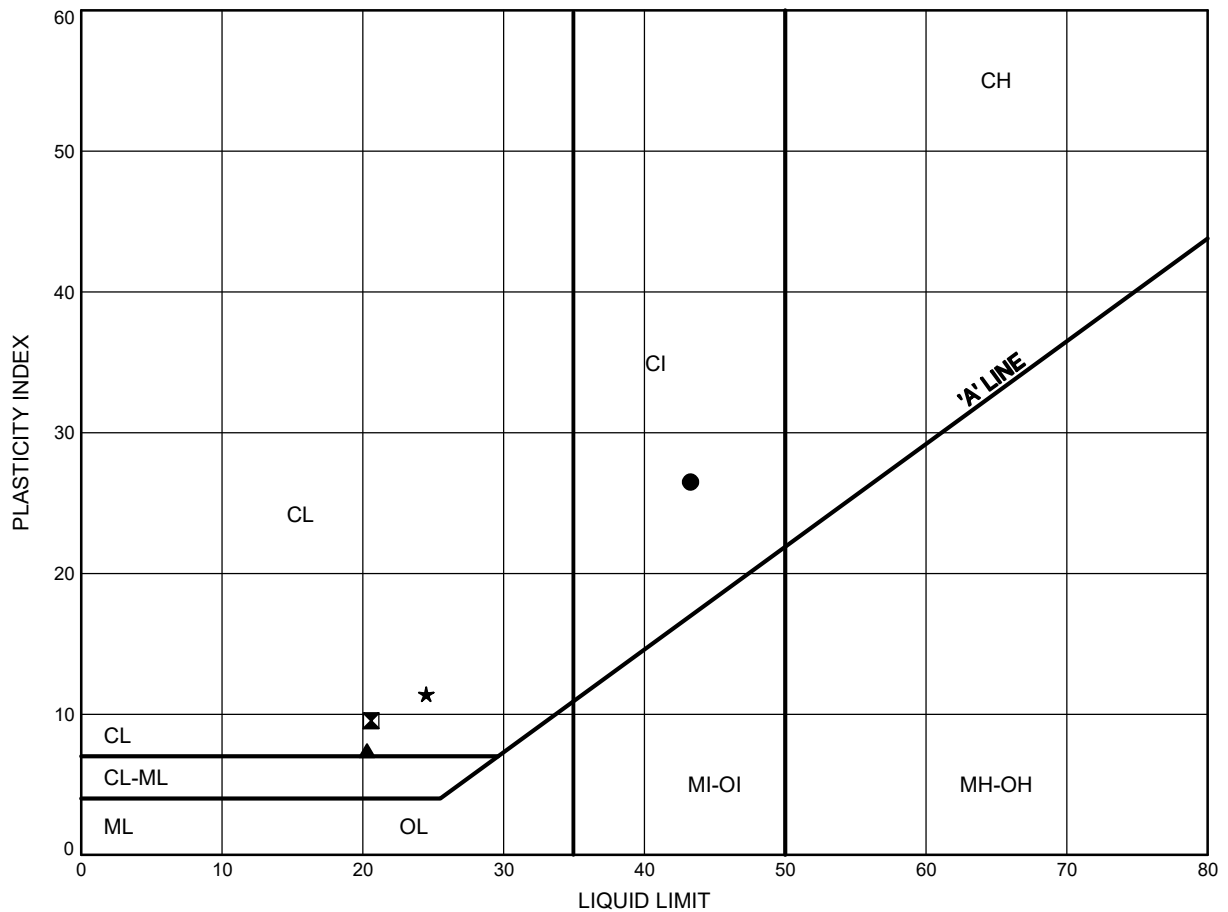
Prep'd AN  
Chkd. RPR



# HWY 404 Widening ATTERBERG LIMITS TEST RESULTS

FIGURE B7

Silty CLAY TILL



## LEGEND

SYMBOL	BOREHOLE	DEPTH (m)	ELEV. (m)
●	C7-02	3.3	263.7
⊠	C7-03	9.4	257.5
▲	C7-04	2.6	264.0
★	C7-04	10.9	255.7

Date December 2017  
W.P. 2930-02-00



Prep'd AN  
Chkd. RPR



## FINAL REPORT

CA15233-OCT17 R1

15786

Prepared for

**Thurber Engineering Ltd.**

## First Page

### CLIENT DETAILS

Client Thurber Engineering Ltd.

Address 103, 2010 Winston Park Drive  
Oakville, ON  
L6H 5R7.

Contact Rocio Palomeque

Telephone 905-829-8666 x 263

Facsimile

Email rreyna@thurber.ca

Project 15786

Order Number

Samples Soil (4)

### LABORATORY DETAILS

Project Specialist Deanna Edwards, B.Sc, C.Chem

Laboratory SGS Canada Inc.

Address 185 Concession St., Lakefield ON, K0L 2H0

Telephone 705-652-2000

Facsimile 705-652-6365

Email deanna.edwards@sgs.com

SGS Reference CA15233-OCT17

Received 10/12/2017

Approved 10/18/2017

Report Number CA15233-OCT17 R1

Date Reported 10/18/2017

### COMMENTS

Temperature of Sample upon Receipt: 17 degrees C

Cooling Agent Present: No

Custody Seal Present: No

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

### SIGNATORIES

Deanna Edwards, B.Sc, C.Chem





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FINAL REPORT

CA15233-OCT17 R1

Client: Thurber Engineering Ltd.

Project: 15786

Project Manager: Rocio Palomeque

Samplers: ,

PACKAGE: REG153 - 1.3 Other (ORP) (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 2 - Agricultural/Other - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

				Sample Number	5	6	7	8
				Sample Name	C7-02-SS2	C7-04-SS4	C4-01-SS2	C4-03-SS3
				Sample Matrix	Soil	Soil	Soil	Soil
				Sample Date	06/09/2017	05/09/2017	09/09/2017	08/09/2017

Parameter	Units	RL	L1	L2	Result	Result	Result	Result
1.3 Other (ORP)								
Chloride	µg/g	0.4			320	890	930	360



FINAL REPORT

CA15233-OCT17 R1

Client: Thurber Engineering Ltd.

Project: 15786

Project Manager: Rocio Palomeque

Samplers: ,

PACKAGE: REG153 - Corrosivity Index (SOIL)

L1 = REG153 / SOIL / COARSE - TABLE 2 - Agricultural/Other - UNDEFINED

L2 = REG153 / SOIL / COARSE - TABLE 2 - Industrial/Commercial - UNDEFINED

	Sample Number	5	6	7	8
	Sample Name	C7-02-SS2	C7-04-SS4	C4-01-SS2	C4-03-SS3
	Sample Matrix	Soil	Soil	Soil	Soil
	Sample Date	06/09/2017	05/09/2017	09/09/2017	08/09/2017

Parameter	Units	RL	L1	L2	Result	Result	Result	Result
Corrosivity Index								
Corrosivity Index	none	1			15.5	17.5	14.0	3.0
Soil Redox Potential	mV	-			292	271	231	285
Sulphide	%	0.02			0.02	0.02	< 0.02	< 0.02
pH	no unit	0.05			9.38	9.30	9.09	8.22
Resistivity (calculated)	ohms.cm	-9999			1560	872	1130	2520



FINAL REPORT

CA15233-OCT17 R1

QC SUMMARY

Anions by IC  
Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-IENVIIC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO0265-OCT17	µg/g	0.4	<0.4	0	20	99	80	120	109	75	125
Sulphate	DIO0265-OCT17	µg/g	0.4	<0.4	2	20	98	80	120	99	75	125

Carbon/Sulphur  
Method: ASTM E1915-07A | Internal ref.: ME-CA-IENVIARD-LAK-AN-020

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide	ECS0027-OCT17	%	0.02	<0.02	ND	20	109	80	120			

Conductivity  
Method: SM 2510 | Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0213-OCT17	uS/cm	2	< 0.002	0	10	103	90	110	NA		



FINAL REPORT

CA15233-OCT17 R1

QC SUMMARY

pH  
Method: SM 4500 | Internal ref.: ME-CA-|ENVIEWL-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0213-OCT17	no unit	0.05	NA	0		100			NA		

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate laboratory accuracy with sample matrix effects.

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

**Multielement Scan Qualifier:** as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

**Duplicate Qualifier:** for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

**Matrix Spike Qualifier:** for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.



## LEGEND

## FOOTNOTES

**NSS** Insufficient sample for analysis.

**RL** Reporting Limit.

↑ Reporting limit raised.

↓ Reporting limit lowered.

**NA** The sample was not analysed for this analyte

**ND** Non Detect

Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at [http://www.sgs.com/terms\\_and\\_conditions.htm](http://www.sgs.com/terms_and_conditions.htm). The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

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# Request for Laboratory Services and CHAIN OF CUSTODY

Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Toll Free: 877-747-7658 Fax: 705-652-6365  
London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361 Web: www.ca.sgs.com

No:

Page 1 of 1

## Laboratory Information Section - Lab use only

Received By: Tammy Macleod

Received Date (mm/dd/yyyy): 09/12/17 (mm/dd/yy)

Received Time: 00:55

Received By (signature): [Signature]  
Custody Seal Intact: ☐

Cooling Agent Present: ☐

Temperature Upon Receipt (°C): 20.17, 17.18, 18.4

No cooler

LAB LIMS #: 0415233

## REPORT INFORMATION

Company: Thurber Env.

Contact: Rocio Palomere

Address: 103-2015 Winston Park Dr.

Phone: 905-829-8666

Fax: \_\_\_\_\_

Email: Yregina@thurber.ca

## INVOICE INFORMATION

☒ (same as Report Information)

Company: \_\_\_\_\_

Contact: \_\_\_\_\_

Address: \_\_\_\_\_

Phone: \_\_\_\_\_

Email: \_\_\_\_\_

## PROJECT INFORMATION

Quotation #: 15786

Project #: 15786

Site Location/ID: \_\_\_\_\_

P.O. #: \_\_\_\_\_

## TURNAROUND TIME (TAT) REQUIRED

☒ Regular TAT (5-7 days)

☐ Rush TAT (Additional Charges May Apply)

☐ 1 Day ☐ 2 Days ☐ 3-4 Days

PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date: \_\_\_\_\_

Rush Confirmation ID: \_\_\_\_\_

DRINKING WATER SAMPLES (POTABLE WATER FOR HUMAN CONSUMPTION) MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

## ANALYSIS REQUESTED

COMMENTS:  
Field Filtered (F)  
Preserved (P)

<b>Regulation 153 (2011):</b>		<b>Other Regulations:</b>		<b>Sewer By-Law:</b>	
<input type="checkbox"/> Table 1	<input type="checkbox"/> Res/Park	<input type="checkbox"/> Soil Texture:	<input type="checkbox"/> Reg 347/558 (3 Day min TAT)	<input type="checkbox"/> Sanitary	
<input type="checkbox"/> Table 2	<input type="checkbox"/> Ind/Com	<input type="checkbox"/> Coarse	<input type="checkbox"/> PW/OO	<input type="checkbox"/> MMR	
<input type="checkbox"/> Table 3	<input type="checkbox"/> Agri/Other	<input type="checkbox"/> Medium	<input type="checkbox"/> CCME	<input type="checkbox"/> Other:	
<input type="checkbox"/> Table	<input type="checkbox"/> Fine	<input type="checkbox"/> MISA		Municipality:	

## RECORD OF SITE CONDITION (RSC)

☐ YES ☐ NO

## SAMPLE IDENTIFICATION

	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX
1	C2-02-552	See 16/17		
2	C2-04-554	See 16/17		
3				
4	C4-01-552	See 19/17		
5	C4-03-553	See 18/17		
6				
7				
8				
9				
10				

Observations/Comments/Special Instructions

Sampled By (NAME):

Signature: [Signature]

Relinquished by (NAME): Rocio Palomere

Signature: [Signature]

Date: 04/13/2017 (mm/dd/yy)

Date: 04/13/2017 (mm/dd/yy)

Pink Copy - Client

Yellow & White Copy - SGS



## **Appendix C**

### **Selected Site Photographs**



**Photo 1: Culvert (C7) outlet looking east**



**Photo 2: Culvert (C7) outlet looking west**





**Photo 3: East embankment looking north**



**Photo 4: East Embankment looking south**



**Photo 5: Culvert (C7) inlet looking west**



**Photo 6: Culvert (C7) inlet looking east**



**Photo 7: West embankment looking south**



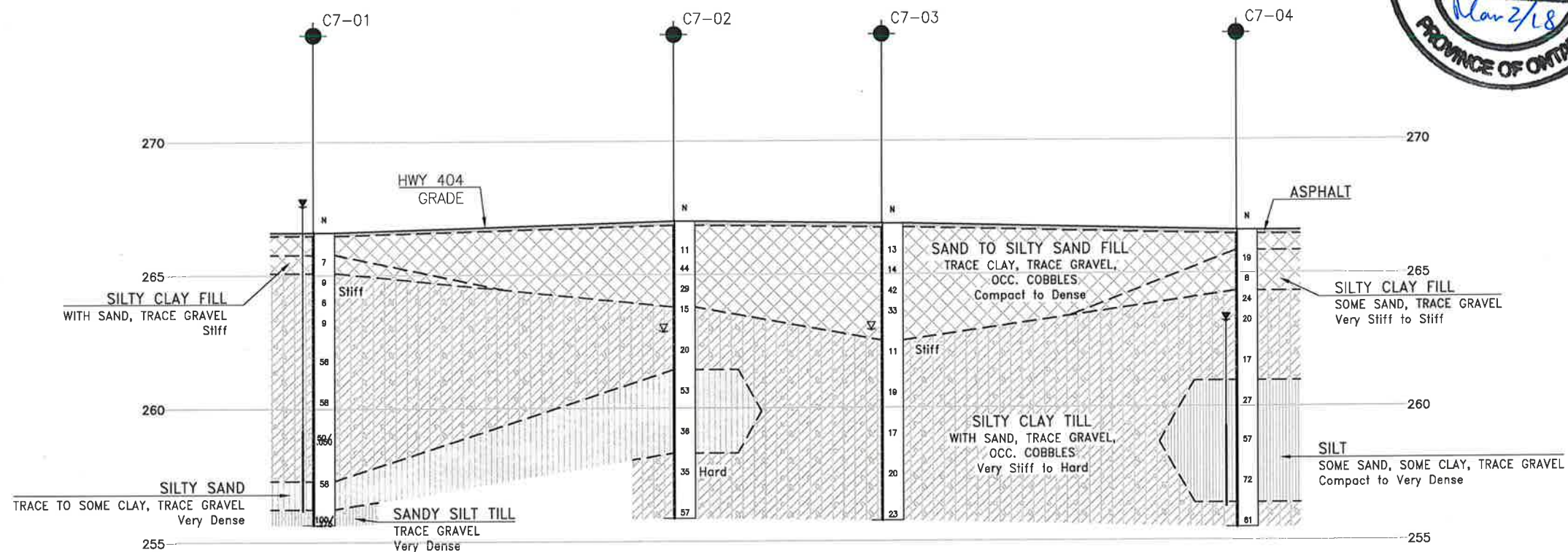
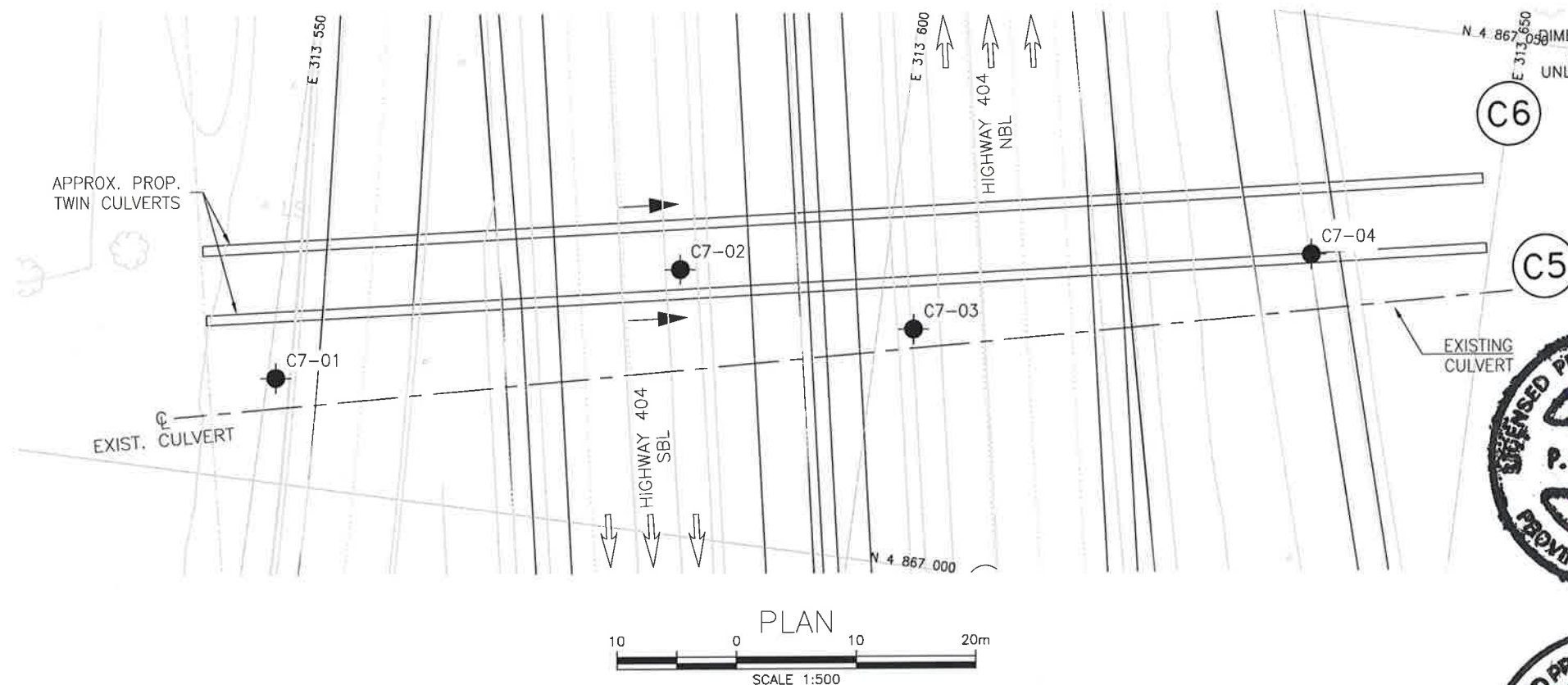
**Photo 8: West embankment looking north**



## **Appendix D**

### **Borehole Locations and Soil Strata Drawing**





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

C6

C5

EXISTING  
CULVERT



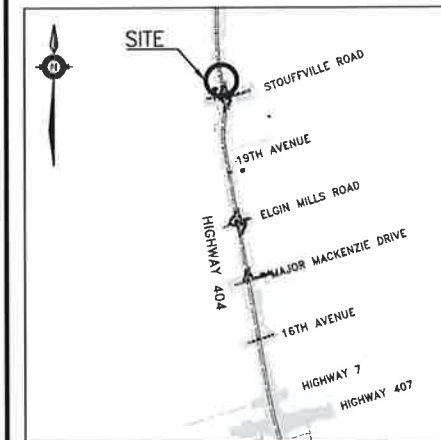
CONT No 2017-2045  
WP No 2930-02-00

HIGHWAY 404 WIDENING  
CULVERT C7  
STATION 10+229  
BOREHOLE LOCATIONS AND SOIL STRATA

wsp



THURBER ENGINEERING LTD.



# 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
W	Water Level
↑	Head Artesian Water
—	Piezometer
90%	Rock Quality Designation (RQD)
A/R	Auger Refusal

NO	ELEVATION	NORTHING	EASTING
C7-01	266.6	4 867 008.7	313 550.7
C7-02	267.0	4 867 022.1	313 583.0
C7-03	266.9	4 867 019.7	313 603.0
C7-04	266.6	4 867 030.2	313 635.2

## NOTES

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

GEOCREs No. 30M14-469

REVISIONS	DATE	BY	DESCRIPTION
DESIGN	RPR	CHK	SKP
DRAWN	AN	CHK	RPR
DATE	FEB 2018		
DWG	1		