FOUNDATION INVESTIGATION REPORT
CULVERT REPLACEMENT
WASHBURN DRAIN
HIGHWAY 23

AGREEMENT # 3010-E-0033
MTO WEST REGION
SITE # 25-331-C

MTO GEOCRES No. 40P6-22

Submitted to:

Ministry of Transportation
West Region
Geotechnical Section
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Submitted by:

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AUGUST 2011
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TABLE OF CONTENTS

DRAWINGS

APPENDICES

1.0 INTRODUCTION

AMEC Earth & Environmental, a division of AMEC Americas Limited (AMEC), Consulting Geotechnical, Construction Quality Control and Environmental Engineers, was retained by the Ministry of Transportation (West Region) to conduct a foundation investigation for the replacement of a structural culvert. The existing culvert is located where Washburn Drain crosses Hwy 23 (Perth Road 164). The project site is located at the border of the Township of Blandshard, Perth County, Ontario and the Township of Usborne, Huron County, Ontario. The overall site location is shown on Drawing 1.

Available subsurface information from previous projects was reviewed prior to carrying out the fieldwork for this project. The following information was reviewed at the MTO Foundation Library (GEOCRES), in Downsview, and used in preparing this report, wherever applicable.

- "***Foundation Investigation, Fish Creek (North) Bridge Replacement, Highway 23, Site 25-224, GWP 313-94-00, Agreement Number 3005-A-000078"***, Prepared by Golder Associates Ltd, Dated September 2001. (GEOCRES NO. 40P6-18).
- "***Foundation Investigation, Fish Creek (Centre) Bridge Replacement, Highway 23, Site 25-225, GWP 313-94-00, Agreement Number 3005-A-000078"***, Prepared by Golder Associates Ltd, Dated September 2001. (GEOCRES NO. 40P6-19).
- "***Foundation Investigation, Fish Creek (South) Bridge Replacement, Highway 23, Site 25-226, GWP 313-94-00, Agreement Number 3005-A-000078"***, Prepared by Golder Associates Ltd, Dated September 2001. (GEOCRES NO. 40P6-20).

Based on a review of these documents, the soils generally consist of variable thicknesses of topsoil and fill materials underlain by silt, silty clay and sand and gravel. These soils were underlain by sandy silt till and/or clayey silt till.

This investigation was carried out by means of a limited number of boreholes, in-situ tests and laboratory tests on selected samples. The results of the soil conditions encountered in the boreholes and laboratory tests are presented in this report.

2.0 SITE DESCRIPTION

Culvert 25-331-C is located on Hwy 23 (Perth Road 164) at Station ±16+510 between Line 6 Road and Kirkton Road. At the project site location, Hwy 23 marks the division between two townships. West of Hwy 23 is the Township of Usborne, Huron County and east of Hwy 23 is Township of Blandshard, Perth County.

Table 1 lists the designation, stationing, dimensions and the type of culvert.

Table 1 – Details of Culvert 25-331-C

NAME	SITE #	STATION	DIMENSIONS WxHxL (m)	TYPE
Washburn Drain	25-331-C	±16+510	3.65 x 1.83 x 21.0	Concrete Open

The road at this location is a two lane paved road and runs on top of an embankment built up above the surrounding grade with an approximate fill height above the culvert of 0.9 to 1.0 m. The top of the culvert lies at elevation 299.62 m and 299.59 m, at the inlet and outlet, respectively. Rebars were exposed due to the deterioration of the concrete at the inlet and outlet of the culvert.

The road embankment at the culvert location is approximately 1.6 to 1.7 m above the surrounding grades. The embankment slopes were covered with low vegetation and granular material at the time of the fieldwork. Based on field measurements, the embankment slopes adjacent to the culvert have a maximum slope of 2.5H:1V from the edge of the shoulder to the toe of the embankment.

At the time of the fieldwork, the water flow in the drain was low. The flow runs from west to east. Photographs taken at an earlier date (April 19, 2011) indicate significantly more water flowing through the culvert.

Typical site photographs of the culvert locations can be found in Appendix C.

3.0 GEOLOGY

Ontario Road Network, National Topographic Database (Canvec) basemap shapefiles, Tile 30M12, indicates that the native soils at the culvert locations consist of Silty Clay Rannoch Till. Map 2254, Paleozoic Geology of Southern Ontario, indicates the region is underlain by limestone of the Dundee formation. The rock surface is typically found at depths of about 12 to 27 m below the ground surface.

4.0 INVESTIGATION PROCEDURES

4.1 Field Investigation

In accordance with the Terms of Reference for this investigation, three (3) borehole locations were staked and cleared for presence of underground utility. Borehole 1 was drilled to a depth 10.8 m below ground surface at mid shoulder of Hwy 23, south of the culvert. Boreholes 2 and 3 were drilled close to the culvert inlet and outlet, respectively. Borehole 2 was drilled to a depth of 7.5 m and Borehole 3 was terminated at 5.0 m due to auger refusal on a possible boulder.

Borehole locations were adjusted based on the proximity of underground and overhead utilities, as well as limited drill rig access due to steep slopes. The borehole locations are presented in Drawing 2.

The fieldwork was performed on May 13th, 2011 under the full-time supervision of experienced geotechnical personnel from AMEC. Prior to drilling, utility locates were carried out. Drilling operations were performed using a track-mounted drilling rig, outfitted with hollow stem augers.

Ground surface elevations at the borehole locations were surveyed by AMEC personnel. The elevations at the project site were related to the geodetic benchmarks (BM) listed on Engineering Transportation References (ETR's) for Site # 25-331-C. The benchmark is located on top of the culvert outlet with geodetic elevation of 299.585 m.

Soil samples were taken at 0.75m intervals for the top 3 m and subsequently at 1.5 m intervals during the performance of Standard Penetration Test (SPT) in accordance with ASTM D1586. This consisted of freely dropping a 63.5 kg hammer for a vertical distance of 0.76 m to drive a 51 mm diameter O.D. split-barrel (split spoon) sampler into the ground. The number of blows of the hammer required to drive the sampler into the relatively undisturbed ground by a vertical distance of 300 mm was recorded as SPT 'N' value of the soil, which indicated the consistency of cohesive soils or the compactness of non-cohesive soils.

Combustible soil headspace vapour readings were measured for each soil sample recovered from the boreholes, using a portable vapour meter (GasTechtor ™ 1238ME).

The groundwater levels were monitored during, and upon completion of the drilling operations. Upon completion of drilling, Boreholes 1 and 2 were backfilled with bentonite in accordance with the general requirements of Ont. Regulation 903. In accordance with the Terms of Reference, a standpipe piezometer was installed in Borehole 3 to monitor the groundwater level. The standpipe was decommissioned at the end of the day.

The results of the in-situ and laboratory tests are presented in the corresponding Records of Boreholes (Appendix A) and Laboratory Test Results (Appendix B).

AMEC will retain the soil samples for a period of one year after completion of the Project, unless otherwise advised in writing by the Ministry.

4.2 Laboratory Tests

In accordance with the Terms of Reference for this investigation, the following tests were conducted:

- In-situ water content determination (24);
- Grain size distribution analysis (3);
- Atterberg Limits (2);
- Soil Corrosivity (1).

The results of the laboratory tests are included in the Record of Boreholes in Appendix A. The grain size distribution curves, Plasticity Chart and results of soil corrosivity testing are shown in Appendix B.

4.3 Miscellaneous

The boreholes were drilled by Determination Drilling and Soil Investigations, who are licensed well drillers. The drilling operations were supervised by Shailendrasinh Jadeja, P.Eng. of AMEC.

Upon completion of drilling, the soil samples were transported to AMEC's Laboratory in Hamilton for further examination and laboratory testing. Testing to determine the corrosivity of the soils was subcontracted to Maxxam Analytics, an accredited CAEL laboratory. The laboratory test results are included in Appendix B.

5.0 SUB-SURFACE CONDITIONS

The general soil profile through the road embankment consisted of gravelly sand fill over buried topsoil. Native soil below the fill was mainly silty clay to silty clay till/sandy silt till deposits.

The stratigraphic units and groundwater conditions at the borehole locations are discussed in the following sections. Detailed information is provided in the Record of Boreholes (Appendix A), and the interpolated stratigraphical sections are shown on Drawing 2. However, soil and groundwater conditions may vary between the borehole locations.

5.1 Stratigraphy

Topsoil

Topsoil was encountered at all three (3) borehole locations; at surface, in Boreholes 2 and 3 and buried at Boreholes 1 and 3. The thickness of the surface topsoil was approximately 200 mm. Buried topsoil was encountered in Borehole 1 at elevation 298.9 m and was approximately 1.2 m thick. Buried topsoil was encountered in Borehole 3 at elevation 298.2 m and was approximately 300 mm thick.

Fill

Through the shoulder embankment, brown gravelly sand fill of thickness 1.4 m was encountered in Borehole 1, overlying 1.2 m of buried topsoil. The fill also contained some clayey silt. The granular fill was compact to loose, with SPT 'N' value of 16 and 8 blows per 300 mm. Two moisture contents measured within the granular fill were 17 % and 7%.

At Borehole 3, silty clay fill was encountered between surface topsoil and buried topsoil. The silty clay fill was 400 mm thick. The topsoil and the fill extended to 0.9 m below ground surface (Elev. 297.9 m). The fill at Borehole 3 was firm with 'N' value of 6 blows per 300 mm.

The results of laboratory testing carried out on a sample are summarized in Table 2.

Table 2 – Summary of Index Testing - Site 25-331-C - Fill

	%			Atterberg Limits	Soil Classification	Moisture Content, % (Lab Sample)
	Gravel	Sand	Fines			
BH1-SS1	31.6	54.9	13.5		Gravelly sand, some silt	17

Silty Clay/Silt and Clay

Brown, mottled silty clay/silt and clay deposit was encountered below buried and/or surface topsoil at all three borehole locations. At Borehole 1 location, the deposit also contained traces of shells. The deposit was soft to stiff, with 'N' values varying from 3 to 13 blows per 300 mm.

The results of laboratory testing carried out on one selected sample are summarized in Table 3.

Table 3 – Summary of Index Testing - Site 25-331-C – Silt and Clay

	%				Atterberg Limits	Soil Classification	Moisture Content, % (Lab sample)
	Gravel	Sand	Silt	Clay			
BH3-SS3	0	11.0	58.0	41.0	LL=23, PL=17, PI=6	Silt and clay, trace sand	13.5

Silty Clay Till / Sandy Silt Till

Native silty clay till deposit was encountered at geodetic elevations 294.6 m, 297.6 m and 296.2 m in Boreholes 1, 2 and 3, respectively. The silty clay till deposit extended to at least the maximum depths investigated. The deposit also contained trace to some sand and gravel and trace cobbles. The color of deposit varied from brown to grey.

A discrete deposit of sandy silt till with some clay was encountered in Borehole 1 at a depth of 4.0 m to 5.6 m below grade. The deposit was compact, with a 'N' value of 16 blows per 300 mm.

SPT values indicated that the silty clay till was stiff to hard, with 'N' values ranging from 13 blows per 300 mm to 50 blows for 80 mm.

The results of laboratory testing carried out on one selected sample are summarized in Table 4.

Table 4 – Summary of Index Testing - Site 25-331-C – Sandy Silt Till

	%				Atterberg Limits	Soil Classification	Moisture Content, % (Lab sample)
	Gravel	Sand	Silt	Clay			
BH1-SS6	6.7	27.7	41.6	24.0	LL=18, PL=12, PI=6	Sandy silt , some clay, trace gravel	12.3

One sample was submitted for analytical testing to determine the soil aggressiveness towards corrosion. The laboratory test certificates can be found in Appendix B. The test results are summarized in Table 5.

Table 5 – Summary of Analytical Testing

Soil Characteristic	Units	BH2-SS6
Resistivity	ohm-cm	4700
Soluble (20:1) Chloride (Cl)	ug/g	<20
Conductivity	umho/cm	213
Available (CaCl2) pH	pH	7.84
Soluble (20:1) Sulphate (SO4)	ug/g	52

5.2 Groundwater

At completion of drilling, groundwater depths were recorded at 9.8 m and 4.6 m below ground surface in Boreholes 1 and 3, respectively. Borehole 2 dry was at completion of drilling.

A standpipe piezometer was installed in Borehole 3, and the water level was measured at the end of the day following the installation. The groundwater level was recorded at 0.95 m below ground surface. The piezometer was decommissioned at the end of the day as per Ministry of Environmental Regulation 903.

The noted groundwater levels are not considered to represent long-term stabilized groundwater conditions and the groundwater levels are expected to fluctuate due to climatic and seasonal fluctuations.

5.3 Organic Vapour Measurements

Combustible soil headspace vapour readings were measured using a portable vapour meter GasTechtor^{TM} 1238E. Combustible soil vapour headspace measurements for all of the soil samples recovered from the Boreholes 1, 2 and 3 ranged from non-detectable to 30 parts per million (ppm).

6.0 CLOSURE

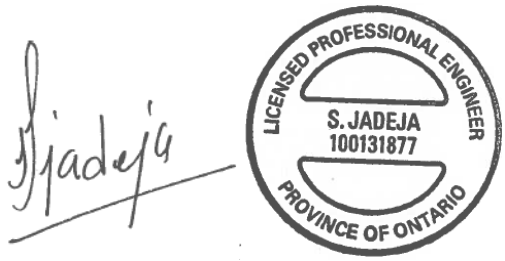
The Limitations of Report, as quoted on the following page, is an integral part of this report.

The sub-soil information contained in this report should be used solely for the purpose of foundation assessment of this site.

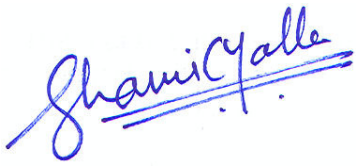
The information presented in this report is complete within AMEC's terms of reference. If there are any further questions concerning this report, please do not hesitate to contact the undersigned.

Sincerely,

AMEC Earth & Environmental,
A division of AMEC Americas Limited



Shailendrasinh Jadeja, M.A.Sc., P.Eng.
Project Engineer



Shami Malla, M.Civ.Eng., P.Eng.
Geotechnical Engineer

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Consulting Engineer
Associate Geotechnical Engineer

Prapote Boonsinsuk, Ph.D., P.Eng.
Designated Principal Contact

LIMITATIONS OF REPORT

The conclusions and recommendations given in this report are based on information determined at the testhole locations. The information contained herein in no way reflects on the environmental aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. It is recommended practice that the Geotechnical Engineer be retained during the construction to confirm that the subsurface conditions across the site do not deviate materially from those encountered in the testholes.

The design recommendations given in this report are applicable only to the project described in the text, and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known, we recommend that we be retained during the final design stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.

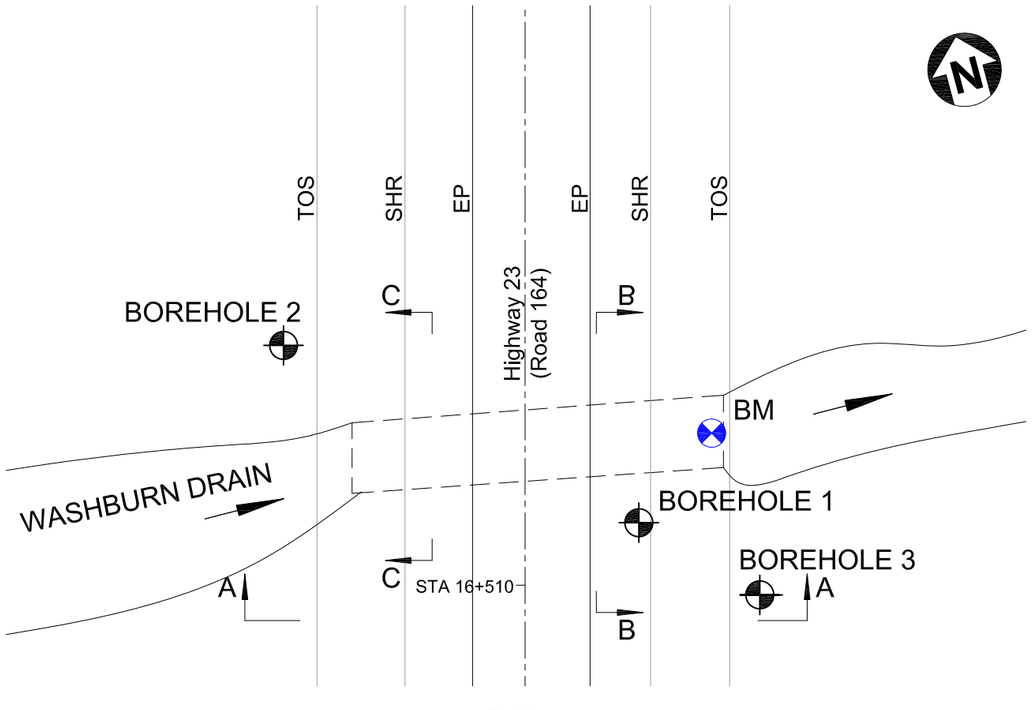
The comments made in this report relating to potential construction problems and possible methods of construction are intended only for the guidance of the designer. The number of testholes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work. This work has been undertaken in accordance with normally accepted geotechnical engineering practices. No other warranty is expressed or implied.

The benchmark and elevations mentioned in this report were obtained strictly for use by this office in the geotechnical design of the project. They should not be used by any other party for any other purpose.

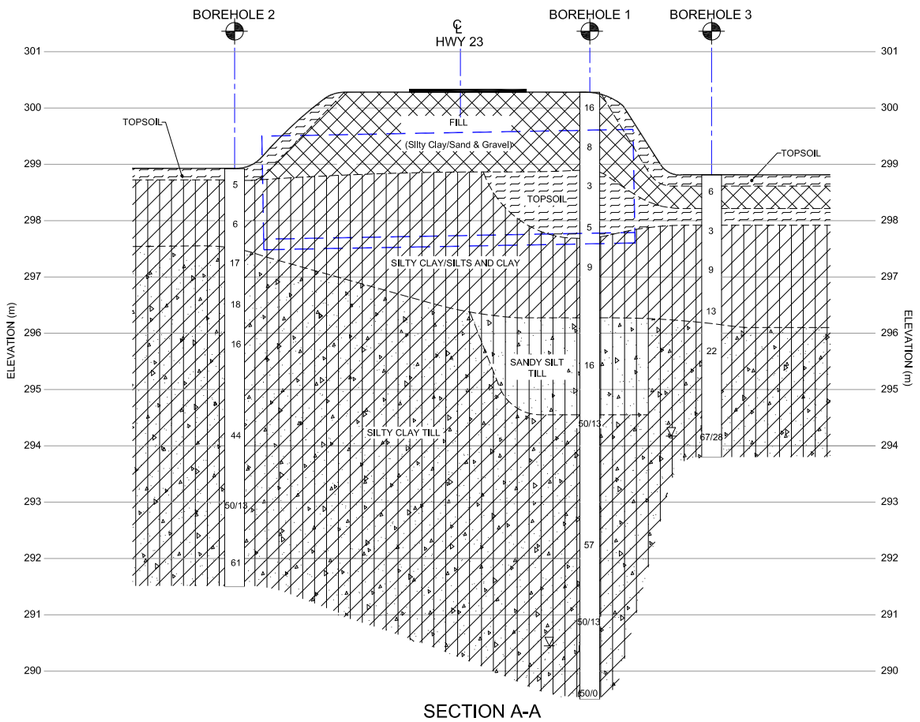
Approximate Scale

5km 0 5 10 15 20km

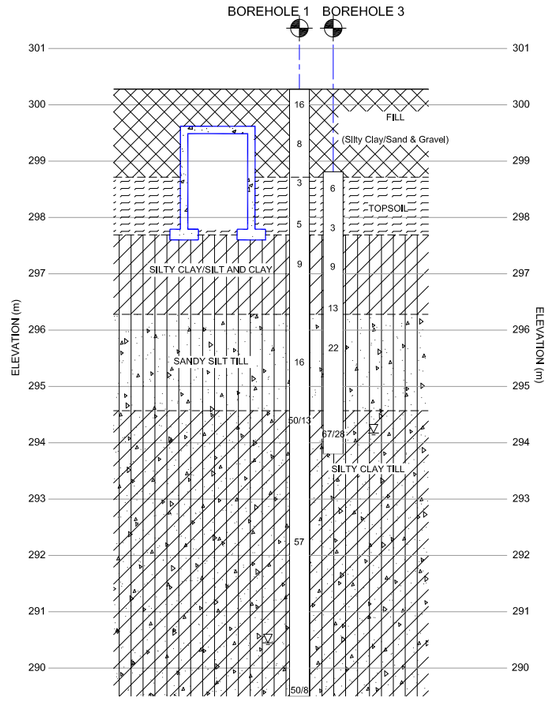
AMEC Earth & Environmental, a Division of AMEC Americas Limited	amec	CLIENT LOGO: Ontario	CLIENT: MINISTRY OF TRANSPORTATION ONTARIO	
TITLE: SITE MAP		DWN BY: KW	DATUM: -	DATE: AUGUST 2011
PROJECT: CULVERT REPLACEMENT HIGHWAY 23 NORTH OF WOODHAM RD - WASHBURN DRAIN AGREEMENT NUMBER 3010-E-0033, Site 25-331C - STATION 16+510		CHK'D BY: PB	REV. NO.: A	PROJECT NO: TB112041
		PROJECTION: -	SCALE: AS SHOWN	DRAWING No. 1



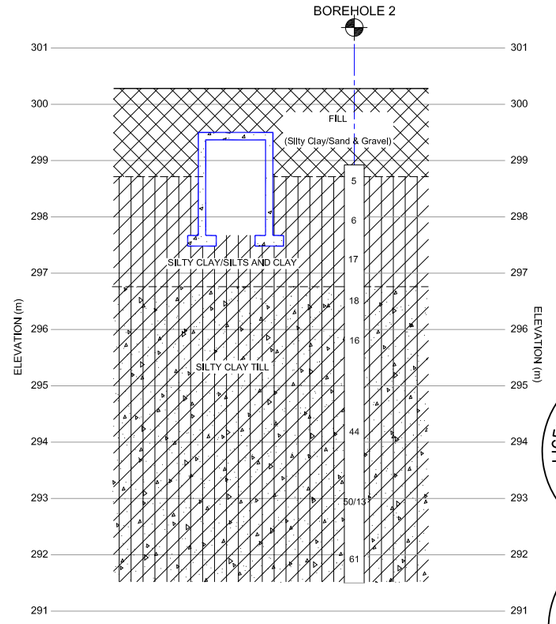
PLAN



SECTION A-A



SECTION B-B



SECTION C-C

NOTES:
1. The boundaries between soil strata have been established only at borehole locations. Between boreholes, the boundaries are assumed from geological evidence and may be subject to considerable error.
2. Foundation elevation not confirmed.
3. This drawing is for subsurface information only. Surface details and features are for conceptual illustration.

METRIC

DIMENSIONS ARE IN METRES AND/OR MILLIMETRES UNLESS OTHERWISE SHOWN

AGREEMENT No.
3010-E-0033

G.W.P. No.
-

CULVERT REPLACEMENT
HIGHWAY 23 NORTH OF WOODHAM RD
WASHBURN DRAIN
SITE 25-331C - STA 16+510

SHEET 1 of 1

AMEC Earth & Environmental,
a Division of AMEC Americas Limited

KEY PLAN

5km 0 5 10 15 20km
Approximate Scale

LEGEND

- BOREHOLE LOCATION
- GROUND WATER LEVEL AT TIME OF INVESTIGATION
- GEODETIC BENCHMARK
- EOP EDGE OF PAVEMENT
- SHR SHOULDER ROUND

BOREHOLE	STATION / OFFSET	ELEVATION (m)
1	STA. 16+505 / 5.8m RT	300.28
2	STA. 16+517 / 14.2m LT	298.92
3	STA. 16+503 / 16.5m RT	298.81

SOIL STRATIGRAPHY

- Silty Clay / Sand & Gravel FILL
- Topsoil
- Silty Clay / Silts and Clays
- Silty Clay TILL
- Sandy Silt TILL

LICENSED PROFESSIONAL ENGINEER
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100131877
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
P. BOONSINSUK
PROVINCE OF ONTARIO

0 4 8 12m
SCALE

REVISIONS

DESIGN PB	CHK PB	CODE CHBDC-06	CL 625-ONT	DATE AUG. 2011
DRAWN KW	CHK HS	SITE 25-331C		DWG 2

P:\GEO\Projects\2011\TB112041\Drawings\TB112041 - Washburn Drain.DWG

APPENDIX A

RECORD OF BOREHOLES

EXPLANATION OF BOREHOLE LOG

This form describes some of the information provided on the borehole logs, which is based primarily on examination of the recovered samples, and the results of the field and laboratory tests. Additional description of the soil/rock encountered is given in the accompanying geotechnical report.

GENERAL INFORMATION

Project details, borehole number, location coordinates and type of drilling equipment used are given at the top of the borehole log.

SOIL LITHOLOGY

Elevation and Depth

This column gives the elevation and depth of inferred geologic layers. The elevation is referred to the datum shown in the Description column.

Lithology Plot

This column presents a graphic depiction of the soil and rock stratigraphy encountered within the borehole.

Description

This column gives a description of the soil stratums, based on visual and tactile examination of the samples augmented with field and laboratory test results. Each stratum is described according to the *MTC Soil Classification Manual*.

The compactness condition of cohesionless soils (SPT) and the consistency of cohesive soils (undrained shear strength) are defined as follows *(Ref. MTC Soil Classification Manual)*:

Compactness of Cohesionless Soils	SPT N-Value*
Very loose	0 to 5
Loose	5 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	> 50

Consistency of Cohesive Soils	Undrained Shear Strength kPa
Very soft	0 to 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very stiff	100 to 200
Hard	Over 200

* For penetration of less than 0.3 m, N-values are indicated as the number of blows for the penetration achieved (e.g. 50/25: 50 blows for 25 centimeter penetration).

Soil Sampling

Sample types are abbreviated as follows:

SS Split Spoon	TW Thin Wall Open (Pushed)	RC Rock Core	GS Grab Sample
AS Auger Sample	TP Thin Wall Piston (Pushed)	WS Washed Sample	AR Air Return Sample

Additional information provided in this section includes sample numbering, sample recovery and numerical testing results.

Field and Laboratory Testing

Results of field testing (e.g., SPT, pocket penetrometer, and vane testing) and laboratory testing (e.g., natural moisture content, and limits) executed on the recovered samples are plotted in this section.

Instrumentation Installation

Instrumentation installations (monitoring wells, piezometers, inclinometers, etc.) are plotted in this section. Water levels, if measured during fieldwork, are also plotted. These water levels may or may not be representative of the static groundwater level depending on the nature of soil stratum where the piezometer tips are located, the time elapsed from installation to reading and other applicable factors.

Comments

This column is used to describe non-standard situations or notes of interest.

MTC SOIL CLASSIFICATION
Based on MTC Soil Classification Manual

Ontario

MAJOR DIVISION					GROUP SYMBOL	TYPICAL DESCRIPTION	INFORMATION REQUIRED FOR DESCRIBING SOILS	LABORATORY CLASSIFICATION CRITERIA
COARSE GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN 75µm)	GRAVELS MORE THAN HALF THE COARSE FRACTION LARGER THAN 4.75mm	CLEAN GRAVELS (LITTLE OR NO FINES)	WIDE RANGE IN GRAIN SIZE & SUBSTANTIAL AMOUNTS OF ALL INTERMEDIATE PARTICAL SIZE		GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	GIVE TYPE, NAME, IF NECESSARY, INDICATE APPROX % OF SAND & GRAVEL ; MAX SIZE; ANGULARITY, SURFACE CONDITION, & HARDNESSOF THE COARSE GRAINS, LOCAL OR GEOLOGICAL NAME & OTHER PERTINENT DESCRICTIVE INFORMATION, & SYMBOL IN PARENTHESIS.	$C_u = \frac{D_{60}}{D_{10}}$ GREATER THAN 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ BETWEEN 1 AND 3
			PREDOMINANTLY ONE SIZE OF A RANGE OF SIZES WITH STONE INTERMEDIATE SIZES MISSING		GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES		
		GRAVEL WITH FINES (APPLICABLE AMOUNT OF FINES)	NON PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE ML BELOW)		GM	SILTY GRAVELS, POORLY GRADED GRAVEL-SAND- SILT MIXTURES		
			PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE CL BELOW)		GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES		
	SANDS MORE THAN HALF THE COARSE FRACTION SMALLER THAN 4.75mm	CLEAN SANDS (LITTLE OR NO FINES)	WIDE RANGE IN GRAIN SIZE & SUBSTANTIAL AMOUNT OF ALL INTERMEDIATE PARTICLE SIZES		SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	FOR UNDISTURBED SOILS ADD INFORMATION ON STRATIFICATION, DEGREE OF COMPACTNESS, CEMENTATION, MOISTURE CONDITION & DRAINAGE CHARACTERISTICS	NOT MEETING ALL GRADATION REQUIREMENTS FOR GW
			PREDOMINANTLY ONE SIZE OR A RANGE OF SIZES WITH SOME INTERMEDIATE SIZE MISSING		SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES		
		SANDS WITH FINES (APPLICABLE AMOUNT OF FINES)	NON PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE ML BELOW)		SM	SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES		ATTERBERG LIMITS BELOW A-LINE OR Ip LESS THAN 4
			PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE CL BELOW)		SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES		ATTERBERG LIMITS ABOVE A- LINE WITH Ip GREATER THAN 7
								ABOVE A-LINE WITH Ip BETWEEN 4 AND 7 ARE BORDERLINE CASES REQUIRING USE OF DUAL SYMBOLS
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT SMALLER THAN 75µm)	IDENTIFICATION PROCEDURE ON FRACTION SMALLER THAN 425µm							
	SILT AND CLAYS	LIQUID LIMIT LESS THAN 35	DRY STRENGTH (CRUSHING CHARACTERISTICS)	DILATANCY (REACTION TO SHAKING)	TOUGHNESS (CONSISTENCY NEAR PLASTIC LIMIT)			
			NONE	QUICK	NONE	ML	INORGANIC SILTS & SANDY SILTS OR SLIGHTLY PLASTICITY, ROCK FLOUR	GIVE TYPE, NAME, IF NECESSARY, INDICATE DEGREE AND CHARACTER OF PLASTICITY, AMOUNT AND MAXIMUM SIZE OF COURSE GRAINS, COLOUR IN WET CONDITION, ODOUR, IF ANY, LOCAL OR GEOLOGIC NAME & OTHER PERTINENT DESCRICTIVE INFORMATION & SYMBOL IN PARENTHESIS. FOR UNDISTURBED SOILS AND INFORMATION ON STRUCTURE, STRATIFICATION, CONSISTANCY IN UNDISTURBED AND REMOLDED STATES, MOISTURE & DRAINAGE CONDITION.
			MEDIUM TO HIGH	NONE TO VERY SLOW	MEDIUM	CL	SILTY CLAYS (INORGANIC), GRAVELLY CLAYS, SANDY CLAYS, LEAN CLAYS	
			SLIGHT TO MEDIUM	SLOW	SLIGHT	OL	ORGANIC SILT OF LOW PLASTICITY, ORGANIC SANDY SILTS	
		LIQUID LIMIT BETWEEN 35 AND 50	NONE TO SLIGHT	SLOW TO QUICK	SLIGHT	MI	INORGANIC COMPRESSIBLE FINE SANDY SILT WITH CLAY OF MEDIUM PLASTICIT, CLAYEY SILTS	
			HIGH	NONE	MEDIUM TO HIGH	CI	SILTY CLAYS (INORGANIC) OF MEDIUM PLASTICITY	
			SLIGHT TO MEDIUM	VERY SLOW	SLIGHT	OI	ORGANIC SILTY CLAYS OF MEDIUM PLASTICITY	
		LIQUID LIMIT GREATER THAN 50	SLIGHT TO MEDIUM	SLOW TO NONE	MEDIUM	MH	INORGANIC SILTS, HIGHLY COMPRESSIBLE MICACEOUS OR DIATOMECACOUS FINE SANDY SILTS, ELASTIC SILTS	
			HIGH TO VERY HIGH	NONE	HIGH	CH	CLAYS (INORGANIC) OF HIGH PLASTICITY, FAT CLAYS	
			MEDIUM TO HIGH	NONE TO VERY SLOW	SLIGHT TO MEDIUM	OH	ORGANIC CLAYS OF HIGH PLASTICITY	
								ATTERBERG LIMITS BELOW A- LINE OR Ip LESS THAN 4
								ATTERBERG LIMITS ABOVE A- LINE WITH Ip GREATER THAN 7
								ABOVE A-LINE WITH Ip BETWEEN 4 AND 7 ARE BORDERLINE CASES REQUIRING USE OF DUAL SYMBOLS
HIGH ORGANIC SOILS	READILY IDENTIFIED BY COLOUR, ODOUR, SPONGY FEEL & FREQUENTLY BY FIBROUS TEXTURE				Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS		

USE GRAIN SIZE CURVE IN IDENTIFYING THE FACTORS AS GIVEN UNDER FIELD IDENTIFICATION

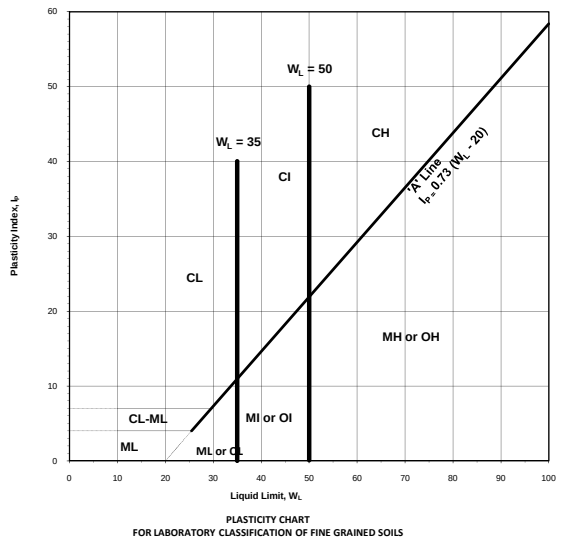
DETERMINE PERCENTAGE OF GRAVEL & SAND FROM GRAIN SIZE CURVE. DEPENDING ON PERCENTAGE OF FINES (FRACTION SMALLER THAN 75 µm) COARSE GRAINED SOILS ARE CLASSIFIED AS FOLLOWS:

LESS THAN 5%	GW, GP, SW, SP
MORE THAN 12%	GM, GC, SM, SC
5% TO 12%	BORDER LINE CASES REQUIRE USE OF DUAL SYMBOL.

FRACTION	U.S STANDARD SIEVE SIZE		DEFINING RANGES OF PERCENTAGE BY WEIGHT OF MINOR COMPONENTS		
		PASSING	RETAINED	PERCENT	DESCRIPTOR
GRAVEL	COARSE	75 mm	26.5 mm	40-50	AND
	FINE	26.5 mm	4.75 mm	30-40	Y/EY
SAND	COARSE	4.75 mm	2.00 mm	20-30	WITH
	MEDIUM	2.00 mm	425 µm	10-20	SOME
	FINE	425 µm	75 µm	1-10	TRACE
FINES (SILT OR CLAY BASED ON PLASTICITY)		75 µm			

OVERSIZED MATERIAL

ROUNDED OR SUBROUNDED: COBBLES 75 mm TO 200 mm BOULDERS > 200 mm	NOT ROUNDED: ROCK FRAGMENTS > 75 mm ROCKS > 0.76 CUBIC METRE IN VOLUME



PLASTICITY CHART
FOR LABORATORY CLASSIFICATION OF FINE GRAINED SOILS

BOUNDARY CLASSIFICATION: BOUNDARY CLASSIFICATION: SOILS POSSESSING CHARACTERISTICS OF TWO GROUPS ARE DESIGNATED BY COMBINATIONS OF GROUP SYMBOLS FOE EXAMPLE GW-GC
WELL GRADED GRAVEL-SAND MIXTURE WITH CLAY BINDER

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AMEC Earth & Environmental,
a Division of AMEC American

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ENGINEERING PROPERTIES OF SOIL

Ontario

TYPICAL NAMES OF SOIL GROUPS	GROUP SYMBOLS	PERMEABILITY WHEN COMPACTED	STRENGTH WHEN COMPACTED	COMPRESSIBILITY WHEN COMPACTED	WORKABILITY AS A CONSTRUCTION MATERIAL	SCOUR RESISTANCE	SUSCEPTIBI LIIY TO SURFICIAL EROSION	SUSCEPTIBILI TY TO FROST ACTION	DRAINAGE CHARACTERISTICS
WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	GW	PERVIOUS	EXCELLENT	NEGLIGIBLE	EXCELLENT	MEDIUM	NEGLIGIBLE	NEGLIGIBLE	EXCELLENT
POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES	GP	VERY PERVI0US	GOOD	NEGLIGIBLE	GOOD	MEDIUM	NEGLIGIBLE	NEGLIGIBLE	EXCELLENT
SILTY GRAVELS, POORLY GRADED GRAVEL- SAND-SILT MIXTURES	GM	SEMI-PERVIOUS TO IMPERVIOUS	GOOD	NEGLIGIBLE	GOOD	LOW TO MEDIUM	SLIGHT	SLIGHT	FAIR TO SEMI IMPERVIOUS
CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES	GC	IMPERVIOUS	GOOD TO FAIR	VERY LOW	GOOD	MEDIUM	SLIGHT	NEGLIGIBLE TO SLIGHT	PRACTICALLY IMPERVIOUS
WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	SW	PERVIOUS	EXCELLENT	NEGLIGIBLE	EXCELLENT	LOW TO MEDIUM	SLIGHT	NEGLIGIBLE	EXCELLENT
POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES	SP	PERVIOUS	GOOD	VERY LOW	FAIR TO GOOD	LOW TO MEDIUM	MODERATE	NEGLIGIBLE TO SLIGHT	EXCELLENT
SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES	SM	SEMI-PERVIOUS TO IMPERVIOUS	GOOD	LOW	FAIR	LOW	MODERATE	SLIGHT TO MODERATE	FAIR TO SEMI IMPERVIOUS IMPERVIOUS
CLAYEY SANDS, POORLY GRADED SAND WITH SOME CLAY MIXTURES	SC	IMPERVIOUS	GOOD TO FAIR	LOW	GOOD	VERY LOW TO LOW	MODERATE TO SLIGHT	NEGLIGIBLE	PRACTICALLY IMPERVIOUS
INORGANIC SILTS AND SANDY SILTS OF SLIGHT PLASTICITY, ROCK FLOUR	ML	SEMI-PERVIOUS TO IMPERVIOUS	FAIR	MEDIUM	FAIR	VERY LOW	SEVERE	SEVERE	FAIR TO POOR
INORGANIC CLAYEY SILTS OF LOW PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, LEAN CLAYS	CL	IMPERVIOUS	FAIR	MEDIUM	GOOD TO FAIR	LOW TO MEDIUM	SLIGHT TO MODERATE	MODERATE TO SEVERE	PRACTICALLY IMPERVIOUS
ORGANIC SILTS OF LOW PLASTICITY	OL	SEMI-PERVIOUS TO IMPERVIOUS	POOR	MEDIUM	FAIR TO POOR	VERY LOW TO LOW	SEVERE	SEVERE	POOR
INORGANIC COMPRESSIBLE SILTS OF MEDIUM PLASTICITY	MI	SEMI-PERVIOUS TO IMPERVIOUS	FAIR	MEDIUM TO HIGH	FAIR TO POOR	LOW	MODERATE	MODERATE TO SEVERE	FAIR TO POOR
INORGANIC SILTY CLAYS OF MEDIUM PLASTICITY	CI	IMPERVIOUS	FAIR TO POOR	HIGH	FAIR	LOW TO MEDIUM	SLIGHT	MODERATE TO SEVERE	SEMI IMPERVIOUS TO PRACTICALL Y
ORGANIC SILTY CLAY OF MEDIUM PLASTICITY	OI	SEMI-PERVI0US TO IMPERVIOUS	POOR	HIGH	POOR	VERY LOW TO LOW	SEVERE	MODERATE TO SEVERE	POOR TO PRACTICALLY IMPERVIOUS
INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS	MH	SEMI-PERVIOUS TO IMPERVIOUS	FAIR TO POOR	HIGH	POOR	VERY LOW	MEDIUM	SEVERE	POOR
INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	CH	IMPERVIOUS	POOR	HIGH	FAIR TO POOR	LOW TO MEDIUM	SLIGHT TO NEGLIGIBLE	NEGLIGIBLE	PRACT I.CALL Y IMPERVIOUS
ORGANIC CLAYS OF HIGH PLASTICITY	OH	IMPERVIOUS	POOR	HIGH	POOR	LOW	MODERATE	NEGLIGIBLE TO SLIGHT	PRACTICALLY IMPERVIOUS
PEAT AND OTHER HIGHLY ORGANIC SOILS	Pt	-	-	-	-	LOW	SEVERE	-	FAIR TO GOOD

RECORD OF BOREHOLE No 1

1 OF 2

PROJECT Agreement # 3010-E-0033 Hwy 23 LOCATION Washburn Drain - Site # 25-331-C ORIGINATED BY SJ

CLIENT MTO West Region Hwy 23, Sta(16+510) COMPILED BY SJ

JOB NO. TB112041 DATE 13 May 2011 Mid Shoulder, NBL, 5.8 m Rt of CL. CHECKED BY WK

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	OBSERVATIONS & REMARKS
300.3 / 0.0	Brown **Gravelly Sand FILL** , some clayey silt, dry to moist, compact to loose.		1	SS	16		0	SS#1 Vapour: 20 ppm Gravel: 31.6% Sand: 54.9% Fines: 13.5%
			2	SS	8		1	Vapour: 20 ppm
298.9 / 1.4	Black to dark Brown **Buried TOPSOIL**, soft.		3	SS	3		2	Vapour: 30 ppm
297.7 / 2.6	Brown, mottled **SILTY CLAY**, traces of sea shells, firm to stiff.		4	SS	5			Vapour: 20 ppm
			5	SS	9		3	Vapour: 25 ppm
296.3 / 4.0	Grey **Sandy Silt TILL**, some clay, trace gravel, wet, compact.		6	SS	16		4	SS#6 Vapour: 5 ppm Gravel: 6.7% Sand: 27.7% Silt: 41.6% Clay: 24% LL=18,PL=12,PI=6
294.6 / 5.6	Grey **Silty Clay TILL**, some gravel, trace sand, trace cobbles, hard.						5	

STANDARD PENETRATION TEST □
DYNAMIC PENETRATION TEST ■
10 20 30 40 50
SHEAR STRENGTH (kPa)
○ UNCONFINED ▲ FIELD VANE
● QUICK TRIAXIAL ✣ LAB VANE
100 200 300

PLASTIC LIMIT W_P NATURAL MOISTURE CONTENT W LIQUID LIMIT W_L
WATER CONTENT (%)
20 40 60

Continued Next Page

RECORD OF BOREHOLE No 1

2 OF 2

PROJECT Agreement # 3010-E-0033 Hwy 23 LOCATION Washburn Drain - Site # 25-331-C ORIGINATED BY SJ

CLIENT MTO West Region Hwy 23, Sta(16+510) COMPILED BY SJ

JOB NO. TB112041 DATE 13 May 2011 Mid Shoulder, NBL, 5.8 m Rt of CL. CHECKED BY WK

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	OBSERVATIONS & REMARKS
			7	SS	50/13 cm			Vapour: 5 ppm
			8	SS	57		7 8	Vapour: 25 ppm
			9	SS	50/13 cm	▽	9	Vapour: 15 ppm
289.5			10	SS	50/8 cm		10	Vapour: 5 ppm
10.8	**End of Borehole** Due to split spoon refusal.							Upon Completion: Borehole open to 10.1 m & GWL at 9.8 m.

STANDARD PENETRATION TEST □
DYNAMIC PENETRATION TEST ■
10 20 30 40 50
SHEAR STRENGTH (kPa)
○ UNCONFINED ▲ FIELD VANE
● QUICK TRIAXIAL ✥ LAB VANE
100 200 300

PLASTIC LIMIT W_P NATURAL MOISTURE CONTENT W LIQUID LIMIT W_L
WATER CONTENT (%)
20 40 60

RECORD OF BOREHOLE No 2

PROJECT Agreement # 3010-E-0033 Hwy 23 | LOCATION Washburn Drain - Site # 25-331-C | ORIGINATED BY SJ

CLIENT MTO West Region | Hwy 23, Sta(16+510) | COMPILED BY SJ

JOB NO. TB112041 | DATE 13 May 2011 | 5.9 m N-W of Culvert Inlet, W of Hwy 23 | CHECKED BY WK

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	DEPTH (m)	OBSERVATIONS & REMARKS
298.9 0.0	**TOPSOIL: 200 mm**							
298.7 0.2	Brown mottled with grey and red **SILTY CLAY**, trace rootlets, firm.		1	SS	5			Vapour: 20 ppm
			2	SS	6		1	Vapour: 20 ppm
297.6 1.4	Brown to grey **Silty Clay TILL**, trace sand, trace gravel, trace cobbles, very stiff to hard.		3	SS	17		2	Vapour: 15 ppm
			4	SS	18		3	Vapour: 5 ppm
			5	SS	16		4	Vapour: 5 ppm
			6	SS	44		5	Vapour: 15 ppm

STANDARD PENETRATION TEST □
DYNAMIC PENETRATION TEST ■
10 20 30 40 50
SHEAR STRENGTH (kPa)
○ UNCONFINED ▲ FIELD VANE
● QUICK TRIAXIAL ✤ LAB VANE
100 200 300

PLASTIC LIMIT W_P | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W_L
WATER CONTENT (%)
20 40 60

Continued Next Page

RECORD OF BOREHOLE No 2

2 OF 2

PROJECT Agreement # 3010-E-0033 Hwy 23 | LOCATION Washburn Drain - Site # 25-331-C | ORIGINATED BY SJ

CLIENT MTO West Region | Hwy 23, Sta(16+510) | COMPILED BY SJ

JOB NO. TB112041 | DATE 13 May 2011 | 5.9 m N-W of Culvert Inlet, W of Hwy 23 | CHECKED BY WK

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DEPTH (m)	STANDARD PENETRATION TEST □ / DYNAMIC PENETRATION TEST ■ (10 20 30 40 50) SHEAR STRENGTH (kPa) ○ UNCONFINED ▲ FIELD VANE ● QUICK TRIAXIAL ✤ LAB VANE (100 200 300)	PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L WATER CONTENT (%) (20 40 60)	OBSERVATIONS & REMARKS
ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES					
			7	SS	50/13 cm					Vapour: 5 ppm
							7			
			8	SS	61					Vapour: 15 ppm
291.5 / 7.5	**End of Borehole**									Upon Completion: Borehole open to 6.4 m and dry.

RECORD OF BOREHOLE No 3

1 OF 1

PROJECT Agreement # 3010-E-0033 Hwy 23 | LOCATION Washburn Drain - Site # 25-331-C | ORIGINATED BY SJ

CLIENT MTO West Region | Hwy 23, Sta(16+510) | COMPILED BY SJ

JOB NO. TB112041 | DATE 13 May 2011 | 6.44 m S-E of Culvert Outlet, E of Hwy 23 | CHECKED BY WK

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	GROUND WATER CONDITIONS	OBSERVATIONS & REMARKS
298.8 0.0	**TOPSOIL: 200 mm**						
298.6 0.2	Brown, mottled **Silty Clay FILL**, trace sand, trace rootlets, firm.		1	SS	6		Vapour: 20 ppm
298.2 0.6	**Buried TOPSOIL**						
297.9 0.9	Brown, mottled **SILT and CLAY**, trace sand, trace rootlets, soft to stiff.		2	SS	3		Vapour: 5 ppm
			3	SS	9		SS#3 Vapour: 5 ppm Gravel: 0% Sand: 1% Silt: 58% Clay: 41% LL=23,PL=17,PI=6
296.2 2.6	Brown to grey **Silty Clay TILL**, trace to some sand and gravel, trace cobbles, stiff to hard.		4	SS	13		Vapour: N/D
			5	SS	22		
293.8 5.0	**Borehole Terminated** Auger refusal due to boulders.		6	SS	67/28 cm		Vapour: 5 ppm Upon Completion: Borehole open and GWL at 4.57 m. Piezometer was installed. End of the day, GWL at 0.95 m.

DEPTH (m): 0, 1, 2, 3, 4, 5

STANDARD PENETRATION TEST □
DYNAMIC PENETRATION TEST ■

SHEAR STRENGTH (kPa)
10 20 30 40 50
100 200 300
○ UNCONFINED ▲ FIELD VANE
● QUICK TRIAXIAL ✜ LAB VANE

PLASTIC LIMIT W_P | NATURAL MOISTURE CONTENT W | LIQUID LIMIT W_L

WATER CONTENT (%)
20 40 60

APPENDIX B

LABORTORY TEST RESULTS

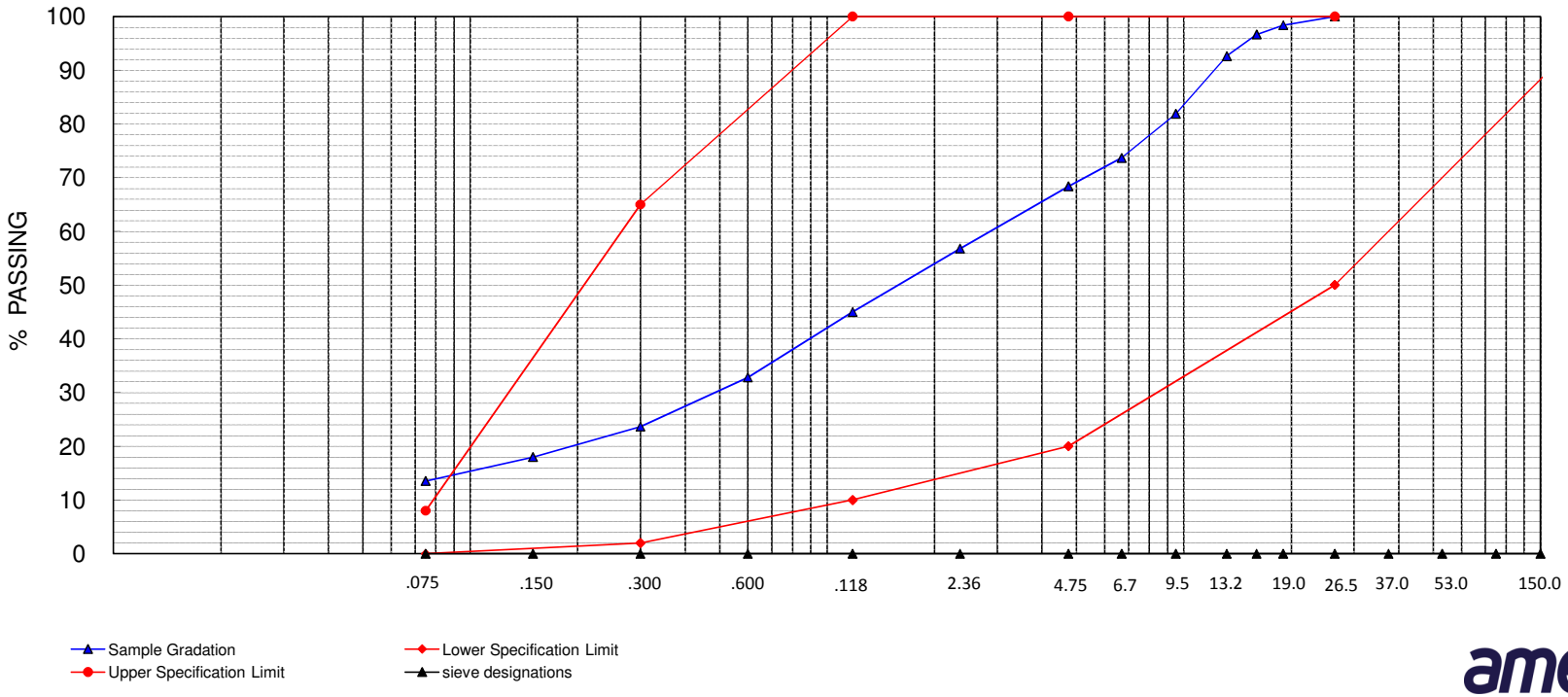
MATERIAL FINER THAN 75µm BY WASHING AND SIEVE ANALYSIS OF AGGREGATES
MTO LS-601 & LS-602

Enclosure: 1
Date: 31 May 2011
Project: TB112041

Client: MTO West Region
MTO Assignment # 3010-E-0033
Sample Source: BH1 - SS1
Culvert Name: Washburn Drain (25-331-C)
Sample Type: Bore Hole
Specification: Granular B, Type I

Lab No: S315-11
Date Sampled: May 2011
Sampled by: AMEC
Date Received: 20 May 2011
Date Tested: 30 May 2011

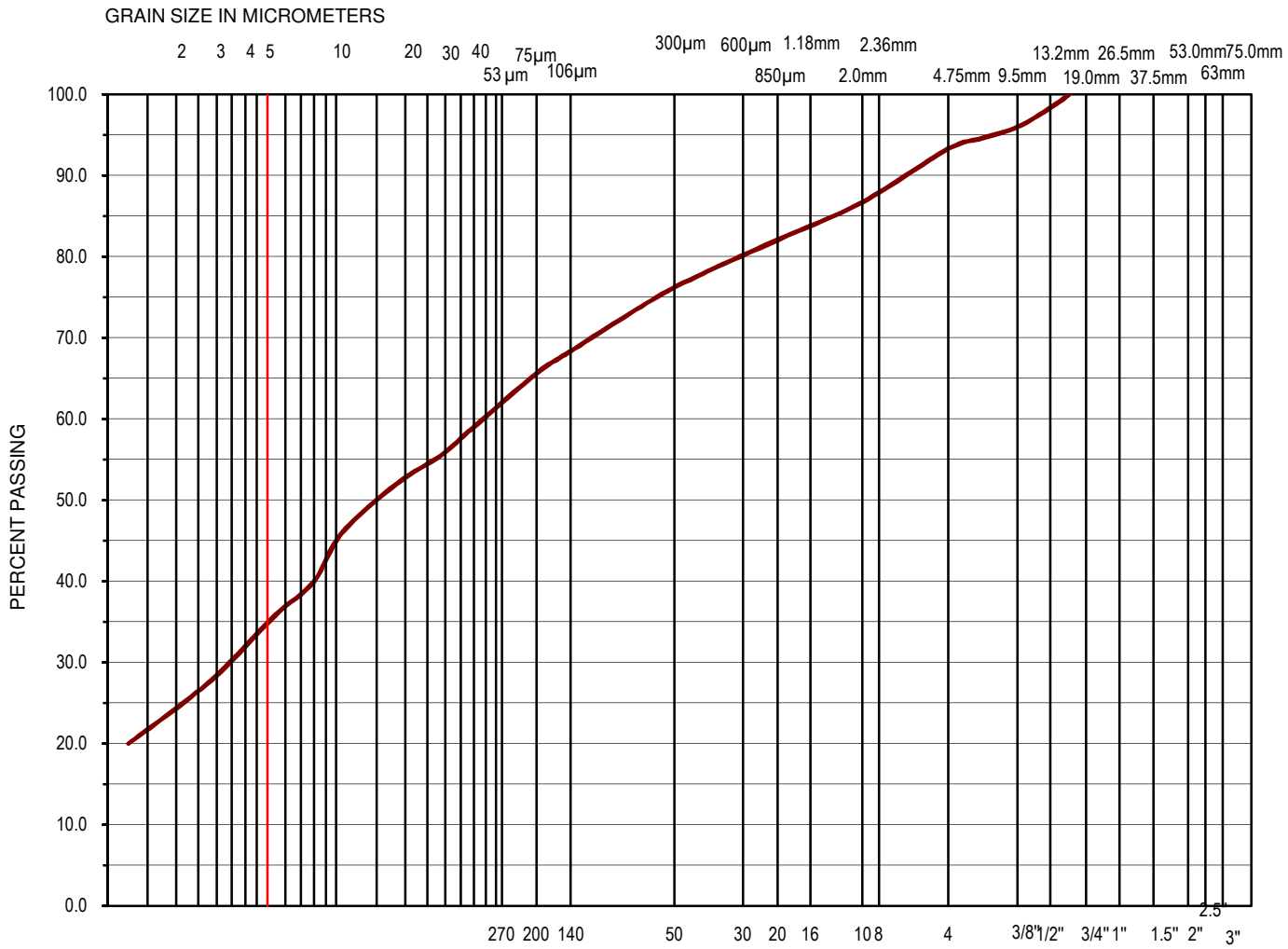
SIEVE SIZES (mm)	150	75.0	53.0	37.5	26.5	19.0	16.0	13.2	9.5	6.7	4.75	2.36	1.18	0.600	0.300	0.150	0.075
SPECIFICATIONS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
% PASSING	-	-	-	-	100.0	98.4	96.7	92.6	81.9	73.7	68.4	56.8	45.0	32.8	23.6	18.0	13.5



UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY	SILT	SAND			GRAVEL	
		Fine	Medium	Coarse	Fine	Coarse

MINISTRY SIEVE DESIGNATION (Metric)



Particle Size	Percent Passing
75	100.0
63	100.0
37.5	100.0
26.5	100.0
19	100.0
16	100.0
13.2	98.3
9.5	96.0
6.7	94.6
4.75	93.3
2	86.7
0.85	82.05
0.425	78.24
0.25	74.94
0.106	68.35
0.075	65.57
0.0400	58.98
0.0288	55.51
0.0185	52.04
0.0106	45.97
0.0080	39.90
0.0053	35.56
0.0028	27.75
0.0012	19.95

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GRAIN SIZE DISTRIBUTION

Sandy Silt,Some Clay, Trace Gravel

BH1 - SS6

Lab No. S315-11 **TB112041**

Date Sampled: May 2011

Date Received: 20 May 2011

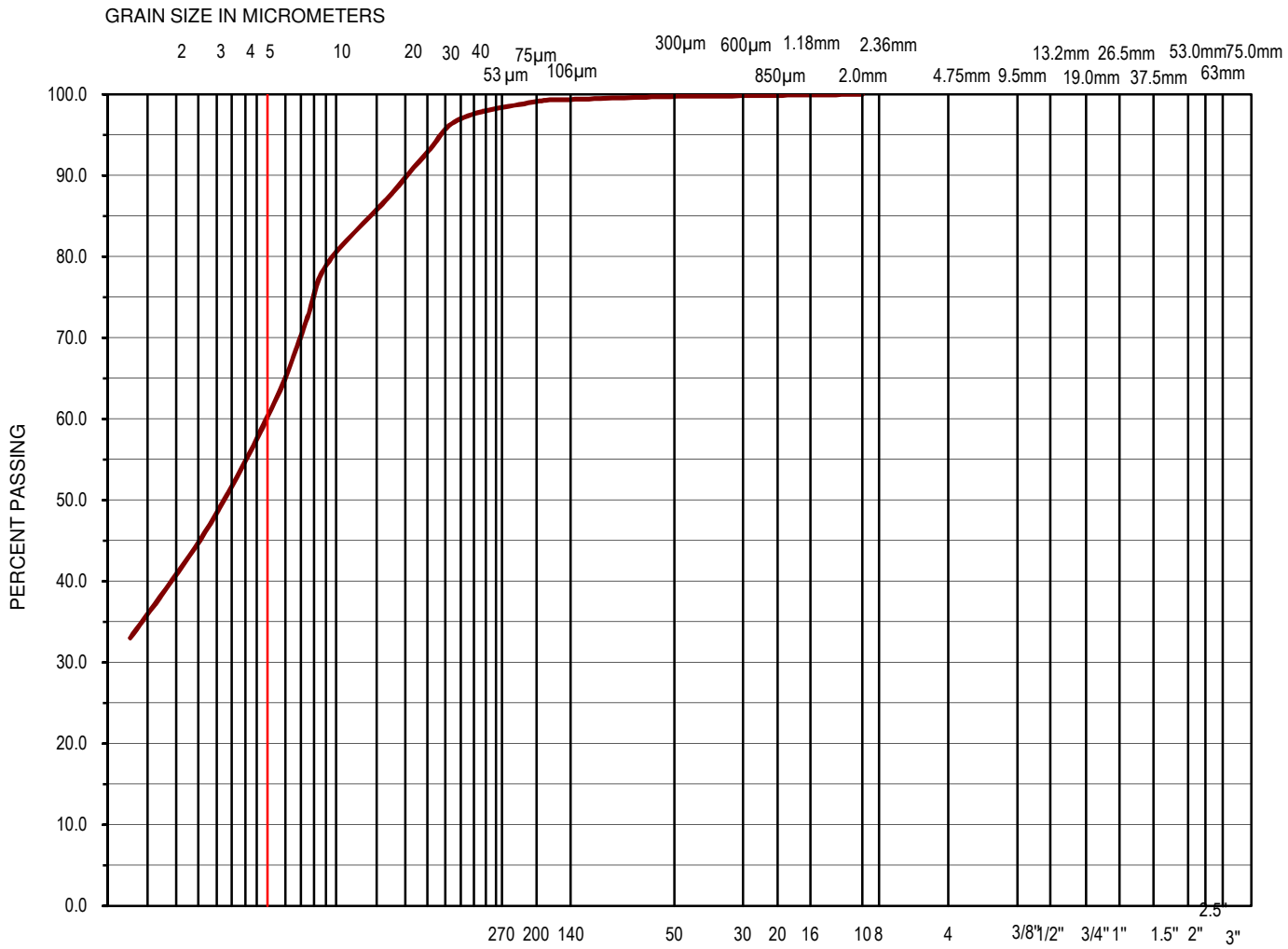
June 2, 2011

Enclosure: 1

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY	SILT	SAND			GRAVEL	
		Fine	Medium	Coarse	Fine	Coarse

MINISTRY SIEVE DESIGNATION (Metric)



Particle Size	Percent Passing
75	100.0
63	100.0
37.5	100.0
26.5	100.0
19	100.0
16	100.0
13.2	100.0
9.5	100.0
6.7	100.0
4.75	100.0
2	100.0
0.85	99.88
0.425	99.78
0.25	99.70
0.106	99.36
0.075	99.10
0.0349	96.99
0.0252	92.99
0.0165	86.99
0.0091	78.99
0.0074	72.00
0.0054	62.00
0.0028	47.00
0.0013	33.00

amec

GRAIN SIZE DISTRIBUTION

Silt And Clay, Trace Sand

BH3 - SS3

Lab No. S315-11 **TB112041**

Date Sampled: May 2011

Date Received: 20 May 2011

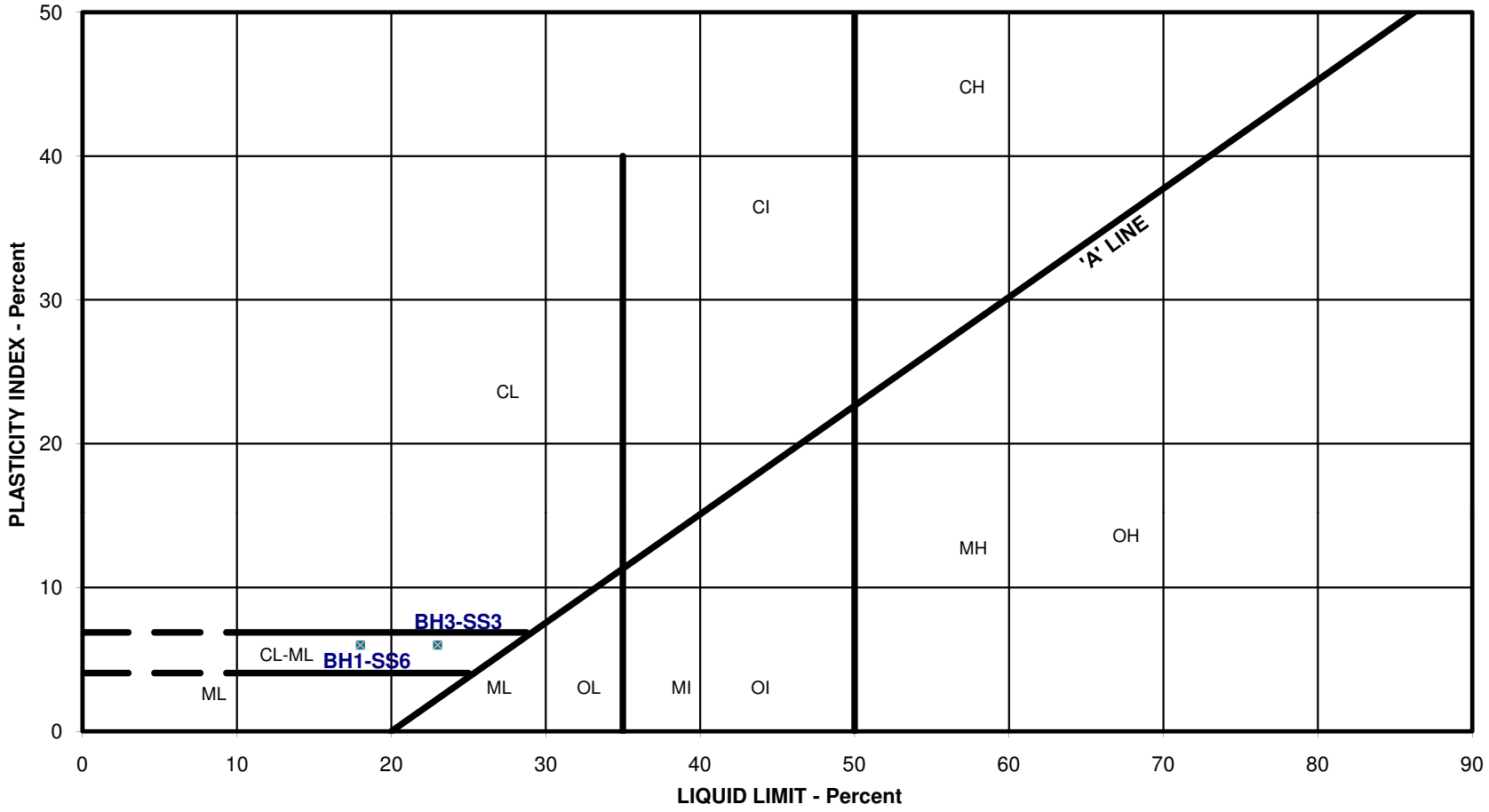
May 31, 2011

Enclosure: 1

Enclosure: 1

PLASTICITY CHART

BH1-SS6: LL = 18, PL = 12, PI = 6
BH3-SS3: LL = 23, PL = 17, PI = 6



Project Number: TB112041
Date: 2 June 2011

Success Through Science®

Your Project #: TB112041
Site: HWY 23 AGREEMENT#3010-E-0033
Your C.O.C. #: 19912

Attention: Shail Jadeja
AMEC Earth & Environmental Ltd
Hamilton - Standing Offer
505 Woodward Ave
Unit 1
Hamilton, ON
L8H 6N6

Report Date: 2011/05/27

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B172126
Received: 2011/05/20, 14:20

Sample Matrix: Soil
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Chloride (20:1 extract)	2	N/A	2011/05/27	CAM SOP-00463	
Conductivity	2	N/A	2011/05/27	CAM SOP-00414	APHA 2510
pH CaCl2 EXTRACT	2	2011/05/26	2011/05/26	CAM SOP-00413	SM 4500 H
Resistivity of Soil	2	2011/05/21	2011/05/27	CAM SOP-00414	APHA 2510
Sulphate (20:1 Extract)	2	N/A	2011/05/27	CAM SOP-00464	EPA 375.4

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
* Results relate only to the items tested.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

MARIJANE CRUZ, Project Manager
Email: MCruz@maxxam.ca
Phone# (905) 817-5756

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 1

Maxxam Job #: B172126
Report Date: 2011/05/27

AMEC Earth & Environmental Ltd
Client Project #: TB112041
Project name: HWY 23 AGREEMENT#3010-E-0033

RESULTS OF ANALYSES OF SOIL

Maxxam ID		JO7086	JO7087		
Sampling Date		2011/05/12 13:00	2011/05/13 13:00		
	Units	**BH2-SS6 WALLIS DRAIN**	**BH2-SS6 WASHBURN**	**RDL**	**QC Batch**
Calculated Parameters					
Resistivity	ohm-cm	4100	4700		2495498
Inorganics					
Soluble (20:1) Chloride (Cl)	ug/g	<20	<20	20	2500532
Conductivity	umho/cm	244	213	2	2500541
Available (CaCl2) pH	pH	7.76	7.84		2499078
Soluble (20:1) Sulphate (SO4)	ug/g	70	52	20	2500535

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Maxxam Job #: B172126
Report Date: 2011/05/27

AMEC Earth & Environmental Ltd
Client Project #: TB112041
Project name: HWY 23 AGREEMENT#3010-E-0033

Package 1	23.7°C

Each temperature is the average of up to three cooler temperatures taken at receipt

GENERAL COMMENTS

Maxxam Job #: B172126
Report Date: 2011/05/27

AMEC Earth & Environmental Ltd
Client Project #: TB112041
Project name: HWY 23 AGREEMENT#3010-E-0033

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
2500532	Soluble (20:1) Chloride (Cl)	2011/05/27	108	75 - 125	102	85 - 115	<20	ug/g	NC	35		
2500535	Soluble (20:1) Sulphate (SO4)	2011/05/27	101	75 - 125	103	85 - 115	<20	ug/g	NC	35		
2500541	Conductivity	2011/05/27					<2	umho/cm	1.9	35	103	75 - 125

N/A = Not Applicable
RPD = Relative Percent Difference
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
QC Standard: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.

Validation Signature Page

Maxxam Job #: B172126

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

BRAD NEWMAN, Scientific Specialist

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Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam 6740 Campobello Road, Mississauga, ON L5N 2L8
Phone: 905-817-5700 Fax: 905-817-5778 Toll Free: (800) 56

20-May-11 14:20
MARIJANE CRUZ
B172126
MHO ENV-034

CHAIN OF CUSTODY RECORD

19912 Page 1 of 1

INVOICE INFORMATION	REPORT INFORMATIO	OJECT INFORMATION	MAXXAM JOB NUMBER
Company Name: AMEC Earth & Environmental	Company Name:		
Contact Name: Shail Jadeja	Contact Name:		
Address: 505 Woodward Avenue, Unit Hamilton L8H 6N6	Address:	Project #: TB11204	CHAIN OF CUSTODY#
Phone: 905-312-0700 Fax: 905-312-0771	Phone: Fax:	Project Name: Agreement # 3010-E-0033	00
Email: Shail.jadeja@amec.com	Email:	Location: Hwy 23	
		Sampled By: Shail Jadeja	

REGULATORY CRITERIA

Note: For regulated drinking water samples - please use the Drinking Water Chain of Custody Form.

- ☐ MISA
- ☐ PWQO
- ☐ Reg. 558
- Reg. 153: ☐ Table 1 ☐ Table 2 ☐ Table 3 ☐ Table 6
- ☐ Residential / Parkland ☐ Industrial / Commercial ☐ Medium / Fine ☐ Coarse
- Sewer Use: ☐ Sanitary ☐ Storm Municipality:

Other (specify): Report Criteria on C of A? ☐

SAMPLES MUST BE KEPT COOL (<10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM.

ANALYSIS REQUESTED (Please be specific)

	Sample Identification	Date Sampled	Time Sampled	Matrix (GW, SW, Soil, etc.)	Regulated Drinking Water? (Y / N)	Metals Field Filtered? (Y / N)	Chloride	Sulphate	pH	Resistivity	Cosmositivity Package
1	BH2 – SS6 Wallis Drain	May12	1:00PM	Soil	N	N	✓	✓	✓	✓	
2	BH2 - SS6 Washburn	May13	1:00PM	Soil	N	N	✓	✓	✓	✓	
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											

TURNAROUND TIME (TAT) REQUIRED

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS.

Regular (Standard) TAT:
☐ 5 to 7 Working Days

Rush TAT: Rush Confirmation #: (call Lab for #)
☐ 1 day ☐ 2 days ☐ 3 days

DATE Required:

TIME Required:

Please note that TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

# of Cont.	COMMENTS / TAT COMMENTS

RELINQUISHED BY (Signature/Print)	RECEIVED BY (Signature/Print)	Date	Time
Shail Jadeja		May20	11:00 AM
	Lina Stigsson	2011-05-20	14:20

JARS USED AND NOT SUBMITTED

Laboratory Use Only
Temperature (°C) on Receipt: 24/24/23

*MANDATORY SECTIONS IN GREY MUST BE FILLED OUT. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

COC-1004 (03/10) - ENV. ENG. Maxxam Analytics International Corporation o/a Maxxam Analytics White: Maxxam Yellow: Mail Pink: Client

APPENDIX C

SITE PHOTOGRAPHS

APPENDIX C - PHOTOGRAPHIC RECORD

PROJECT NO. TB112041

PROJECT MTO West Region - Agreement # 3010-E-0033

LOCATION Washburn Drain, Highway 23

ENCLOSURE 1

PHOTOGRAPH	1

Description

Culvert # 25-331-C

Inlet

PHOTOGRAPH	2

Description

Culvert # 25-331-C

Upstream - Washburn Drain

APPENDIX C - PHOTOGRAPHIC RECORD

PROJECT NO. TB112041

PROJECT MTO West Region - Agreement # 3010-E-0033

LOCATION Washburn Drain, Highway 23 **ENCLOSURE** 2

PHOTOGRAPH	3

Description
Culvert # 25-331-C Outlet

PHOTOGRAPH	4

Description
Culvert # 25-331-C Downstream - Washburn Drain