



FOUNDATION INVESTIGATION REPORT
RETAINED SOIL SYSTEM (RSS) WALL AND GABION RETAINING WALL
CAMPBELL DRAIN CULVERT (STATION 11+488)
HWY 40 & BOUNDARY LINE/CREEK RD,
TWP OF HARWICH, ONTARIO

ASSIGNMENT #11 – PART A
MTO WEST REGION CONTRACT #3006-E-0083
GWP 52-00-00

GEOCRES No. 40J8-48

Submitted to:

Ministry of Transportation
West Region
3rd Floor Geotechnical Section
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TB7210011-A

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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 (Western Region) to conduct a foundation investigation for the design of a Retained Soil System (RSS) and a Gabion Retaining Wall at Highway 40 and Boundary Line/Creek Road, Harwich Township, Ontario. The project site is located approximately 5 km southeast of Chatham. The site location is shown on Figure 1 in Appendix A.

Authorization to proceed with this investigation was given by Mr. Robert Mount, Project Soils Engineer for the West Region, MTO, dated February 3, 2009. The work was carried out by AMEC according to the MTO Western Region Terms of Reference Agreement #3006-E-0083 Assignment #11; Hwy 40 at Creek Road/Boundary Line, RSS Wall and Gabion Retaining Wall, Foundation Engineering. Three (3) boreholes were specified by the MTO in the vicinity of the existing culvert.

Subsurface information from previous projects that were available 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.

- ***“Soil Site Investigation – Proposed Underpass, County Road, Chatham to Charing Crossing, Hwy 401, W.P. 56-59, District #1 - Harwich & Raleigh”***, Prepared by E.M. Peto Associates Limited, Dated December 1959.
(GEOCRES Report #59-F-201C)
- ***“Soil Investigation – English Sideroad Bridge, McGregor’s Creek, Lot 5, Con 3 & 4”***
Prepared by E.M. Peto Associates Limited, Dated March 1964.
(GEOCRES Report #64-F-251M)

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

2.0 SITE DESCRIPTION

The area surrounding the project site can best be described as agricultural. The adjacent lands consist of fields used for animal grazing and farming, with some farm houses nearby. The land in the northwest corner of Hwy 40 and Creek Rd appears to be swamp with dense trees and vegetation. Typical site photographs of the culvert location can be found in Appendix B.



The project site is located adjacent to the existing concrete culvert at Campbell Drain (Station 11+488) which is located approximately 5 km southeast of Chatham, in Harwich Township. The project work includes rehabilitation and extensions to the inlet and outlet of Campbell Drain.

Based on the field investigation and drawings provided by the MTO, the structure crosses under Hwy 40 and is a concrete box culvert with approximate dimensions for width, height and length of 2.9 x 3.0 x 29.1m. The road at this location is a two lane asphalt paved road and runs on top of an embankment built up above the surrounding grade. The culvert lies below Hwy 40 near the base of the embankment. The embankment slopes were covered with snow overlying tall grasses and other low vegetation at the time of the fieldwork. The existing and proposed embankment heights and side slopes were provided by the MTO in the following table.

Side	Existing Height (m)	Existing Slope	Proposed Height (m)	Proposed Slope
East	± 3.6	~ 2.6:1	4.1	3:1
West	± 4	~ 2.2:1	4.9	3:1

During field investigations, the direction of flow was observed to be east to west. The water level appears to be approximately 0.1m above the base of the drain adjacent to the inlet/outlet.

3.0 GEOLOGY

The Physiography of Southern Ontario by Chapman and Putnam (1984) indicates that the project site in Harwich Township lies within the St. Clair Clay Plains. Covered by glacial Lake Whittlesey and Lake Warren, much of the area around Chatham is covered by deep stratified beds of sediment underlain by clay till which is further underlain by black shale. More specifically, the project site is located within the Chatham Flats, where beds of silt appear immediately south and east of the City of Chatham.

A previous foundation investigation (GEOCRETS Report #59-F-201C) for a site slightly southeast of the intersection of Hwy 40 and Creek Road, indicate the following subsurface soils: very stiff grey clayey till to approximately 11.0m, overlying very dense grey sandy till.

4.0 INVESTIGATION PROCEDURES

4.1 Field Investigation

In accordance with the Terms of Reference for this investigation, three borehole locations (BH 1 to BH 3) were staked and cleared.

Borehole 1 was put down on the shoulder of Boundary Line through the existing road embankment adjacent to the north east corner of the culvert. Boreholes 2 and 3 were drilled at

the road shoulder on Creek Road through the existing road embankment adjacent to the south west corner of the culvert. The boreholes were completed in order to verify embankment fill material and soil conditions below the existing culvert, and to obtain sufficient foundation information for culvert rehabilitation and extension. Boreholes 1, 2 and 3 extended to depths of 11.1, 11.7 and 11.1 metres below ground surface, respectively.

Borehole locations were adjusted as required based on the proximity of overhead utilities, as well as limited drill rig access to steep slopes, ditches and swampy areas. The borehole locations are presented in Drawing 1 in Appendix A.

Borehole 1 was relocated to the road shoulder due to the following issues with the original borehole locations; close proximity to underground gas pipeline, saturated conditions of ground surface in areas for loading/unloading of drill rig, and the access route was located on private property.

Boreholes 2 and 3 were also relocated due to the following; embankment slopes too steep for drill rig access, restricted access from fenced areas along Hwy 40, close proximity to overhead hydro wires and flooded conditions around culvert and surrounding area.

The fieldwork was performed on February 23rd and 24th, 2009 under the full-time supervision of experienced geotechnical personnel from AMEC. Prior to drilling, utility locates were carried out. Drilling operations were performed using both a track-mounted and trailer-mounted drilling rig, outfitted with hollow-stem augers.

Ground surface elevations at the borehole locations were also surveyed by AMEC personnel. The elevations were related to a geodetic benchmark (BM) which is "the top of culvert at Campbell Drain, at the east end". The BM has an elevation of 182.058m, which was provided by the MTO.

Soil samples were taken at 0.75m intervals during the performance of Standard Penetration Test (SPT) in accordance with ASTM D1586. This consisted of freely dropping a 63.5kg hammer for a vertical distance of 0.76m to drive a 51mm 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 0.30m was recorded as SPT 'N' value of the soil which indicated the consistency of cohesive soils or the relative density of non-cohesive soils.

If appropriate, in-situ shear vane testing (MTO vane) was carried out through the soft, 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 BH 1 and BH 3 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 BH 2. The piezometer was constructed to a depth of 10.6m by placing 3.0m of screen with sandpack, then riser with bentonite up to ground surface, as indicated on the borehole log. The standpipe piezometer construction was intended to detect any groundwater levels within the borehole. The conditions at the time the fieldwork was carried out were dry and the standpipe was decommissioned two days following installation.

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

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 (22);
- Grain size distribution analysis (6)
- Atterberg Limits (3)
- Soil Corrosivity Testing; pH, sulphate, chloride, electrical conductivity, resistivity and Redox potential (2)
- Groundwater testing; sulphide, sulphate, chloride and pH (1).

The results of the routine laboratory tests are included in the Record of Boreholes in Appendix A. The grain size distribution curves and Plasticity Chart are shown in Appendix C.

4.3 Miscellaneous

The boreholes were drilled by Determination Drilling and Soil Investigation Holdings Ltd, who are licensed well drillers. They were also responsible for decommissioning the standpipe piezometer. The drilling operations were supervised by Laura Wiebe, E.I.T. of AMEC.

Upon completion of drilling, the soil samples were transported to AMEC's Laboratory in Hamilton for further examination and routine laboratory testing. All soil and ground water samples were submitted for chemical analysis to AGAT Laboratories located in Mississauga, Ontario, to determine the corrosivity of the soils and groundwater to various materials. AGAT is accredited by the CALA (Canadian Association for Laboratory Accreditation).

5.0 SUB-SURFACE CONDITIONS

The general soil profile through the road embankment consisted of granular road base over silty clay/clayey silt fill, which was underlain by silty clay till.

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).

The following summary is to assist the designers of the project with an understanding of the anticipated soil conditions across the site. However, it should be noted that the soil and groundwater conditions may vary between the borehole locations.

5.1 Stratigraphy

Fill

Through the shoulder embankment in each of the boreholes, granular road base was encountered overlying grey to brown silty clay/clayey silt fill, to depths of between 3.6 and 4.4m below ground surface. The silty clay/clayey silt fill contained traces of rootlets, gravel and organics, and was slightly drier than plastic limit, to about the plastic limit.

The silty clay to clayey silt fill was soft to firm, with Standard Penetration testing giving N values of between 3 and 8 blows for 30cm, and moisture contents of 20 to 33%.

Silty Clay Till

Underlying the fill, silty clay till was encountered, extending to at least the maximum depths investigated. The silty clay till deposit was brown, turning grey with depth, and contained traces of gravel.

Based on Atterberg Limits, grain size/hydrometer analyses carried out and the MTO Classification system, the material categorized as fine-grained soils with 50% or more passing the 0.075 mm (No.200) sieve with CL - 'Clay of Low Plasticity' as illustrated in the Table below.

Summary of Index Testing

	%				Atterberg Limits	Classification
	>4.75mm	75µm to 4.75mm	2µm to 75µm	<2µm		
BH1-SS2	3.6	28.4	41.0	27.0	-	Silt, with Sand & Clay, Trace of Gravel
BH1-SS6	2.4	15.0	39.6	43.0	LL=31, PL=19, PI=12	CL Clay of Low Plasticity
BH2-SS5	2.0	17.4	39.6	41.0	LL=30, PL=17, PI=13	CL Clay of Low Plasticity
BH2-SS8	2.1	21.1	39.8	37.0	-	Silt & Clay with Sand Trace of Gravel
BH3-SS4	3.7	17.6	40.2	39.5	-	Clay & Silt, Some Sand, Trace of Gravel

	%				Atterberg Limits	Classification
	>4.75mm	75µm to 4.75mm	2µm to 75µm	<2µm		
BH3-SS6	2.3	16.3	40.5	41.0	LL=30, PL=18, PI=12	CL Clay of Low Plasticity

The SPT 'N' values of the till varied from 10 to 30 blows for 30cm, indicating a stiff to very stiff consistency. Natural moisture contents ranged from 13 to 22%.

Split spoon sample #3 (4.6 to 5.0m) from Borehole BH 1 and split spoon sample #1 (3.0 to 3.4m) from Borehole BH 2 were submitted for testing to determine the corrosivity of the soils to various materials. The laboratory test certificates can be found in Appendix C, and are summarized below.

Soil Characteristic	Test Results of Soil	
	BH1-SS3	BH2-SS1
Sulphide	0.31 %	0.03 %
Sulphate	194 µg/g	41.6 µg/g
Chloride	93.5 µg/g	694 µg/g
pH	7.91	7.67
Electrical Conductivity	0.498 mS/cm	1.29 mS/cm
Resistivity	2010 ohms-cm	775 ohms-cm
Redox potential	285 mV	252 mV

5.2 Groundwater

Groundwater conditions in the boreholes were observed during drilling and upon completion of drilling. Borehole 1 remained open and dry upon completion, whereas a water level of 4 mbgs was recorded in Borehole 3 upon completion.

A standpipe piezometer was installed in Borehole BH 2, and the water level was measured two days following the installation. A water level at 3.1m (elev. 180.2m) was recorded. The piezometer was decommissioned two days after installation (Feb 25th, 2009) as per Ministry of Environment Regulation 903.

Groundwater samples from Borehole BH 2 were submitted for testing to determine the corrosivity of the groundwater to various materials. The laboratory test certificates can be found in Appendix C, and are summarized below.

Groundwater Characteristic	Test Results of Water	
	BH2A	BH2B
Sulphide (mg/L)	-	<0.1
Sulphate (mg/L)	75.9	-
Chloride (mg/L)	2010	-
pH	7.67	-

5.3 Organic Vapour Measurements

No staining or petroleum odours were noted in the boreholes. Combustible soil headspace vapour readings were measured using a portable vapour meter (GasTechtor™ 1238ME), calibrated to hexane and operated in methane exclusion mode. Combustible soil vapour headspace measurements for all of the soil samples recovered from the Boreholes BH 1, BH 2 and BH 3 ranged from non-detectable to 500 parts per million (“ppm”).

6.0 CLOSURE

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

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

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

Sincerely,

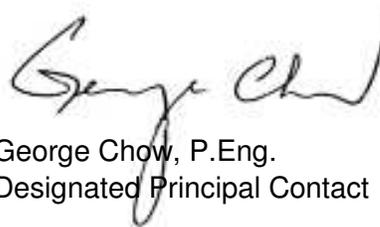
AMEC Earth & Environmental,
A division of AMEC Americas Limited



Laura Wiebe, B.Eng.
Geotechnical EIT



Jane Doucette, P.Eng.
Associate Geotechnical Engineer



George Chow, 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.

APPENDIX FIGURES

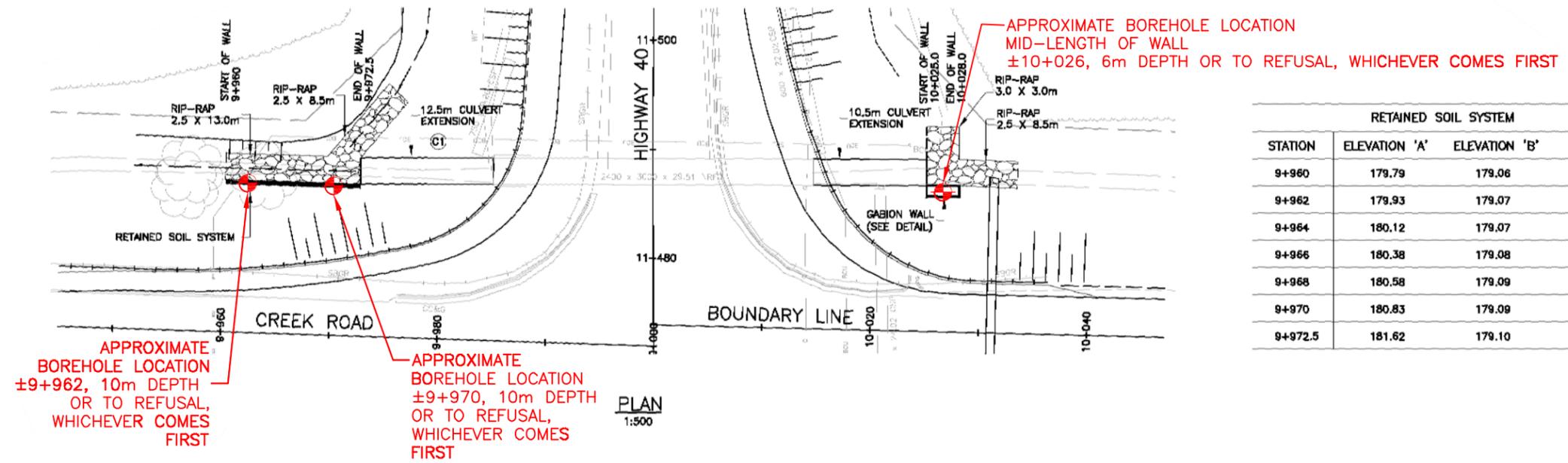
METRIC
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 AND OR MILLIMETRES
 UNLESS OTHERWISE SHOWN

CONT
 WP WP 52-00-00



BOREHOLE LOCATIONS
 CAMBELL DRAIN (BOUNDARY LINE)

SHEET
 1



RETAINED SOIL SYSTEM			
STATION	ELEVATION 'A'	ELEVATION 'B'	DIST. 'X'
9+960	179.79	179.06	14.0m
9+962	179.93	179.07	14.0m
9+964	180.12	179.07	13.9m
9+966	180.38	179.08	13.8m
9+968	180.58	179.09	13.7m
9+970	180.83	179.09	13.7m
9+972.5	181.62	179.10	13.5m



CONT

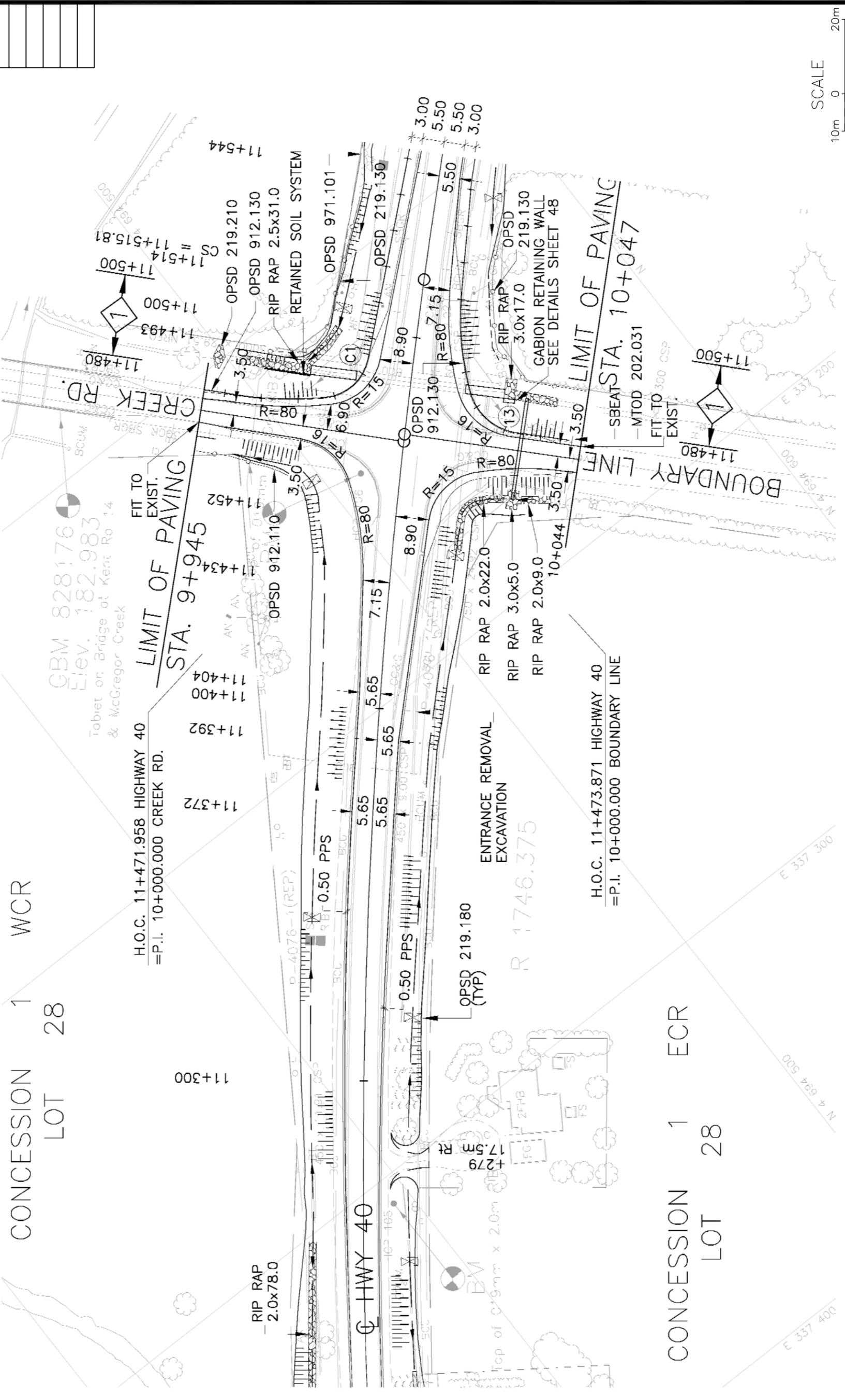
WP WP 52-00-00

SITE PLAN
CAMBELL DRAIN (BOUNDARY LINE)

SHEET
2

METRIC

DIMENSIONS ARE IN METRES
AND OR MILLIMETRES
UNLESS OTHERWISE SHOWN



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

AGREEMENT No. **3006-E-0083**
GWP No. **52-00-00**

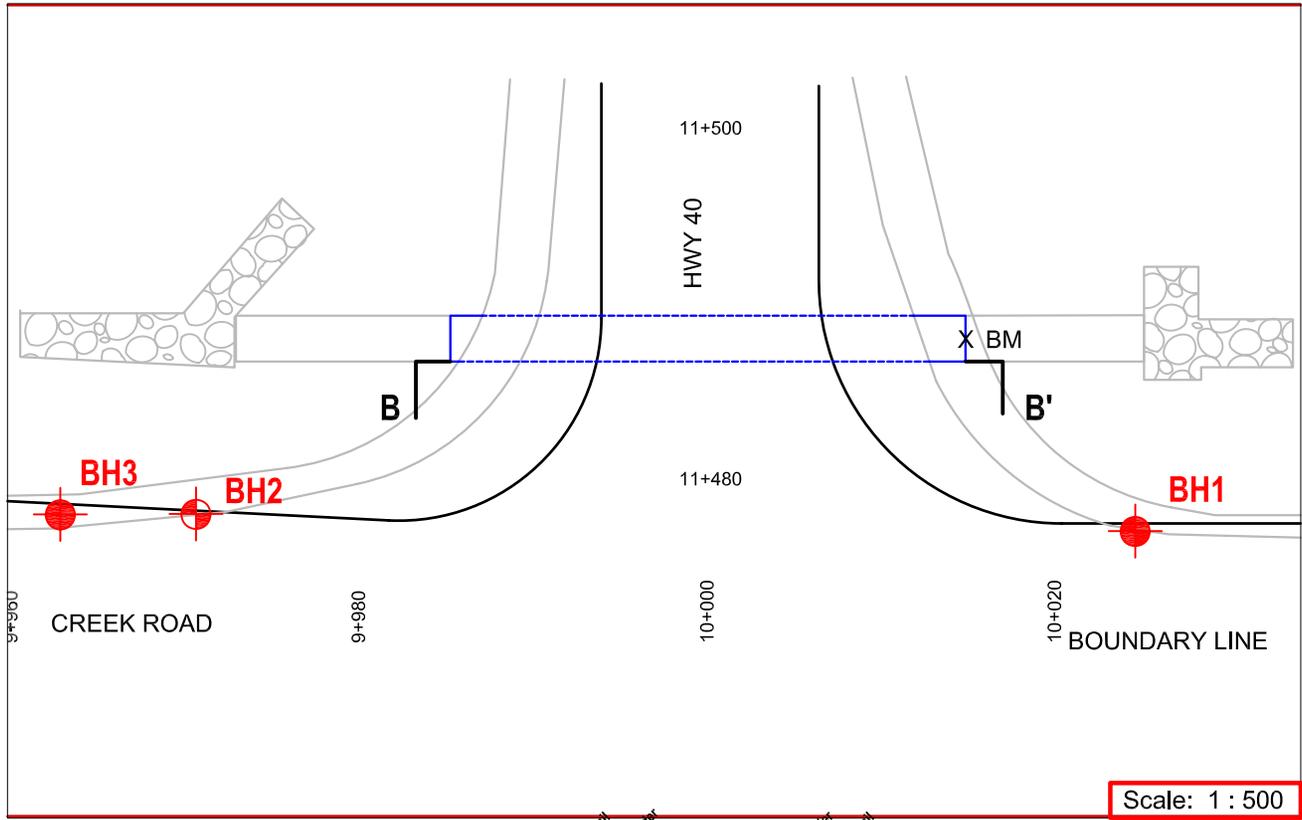


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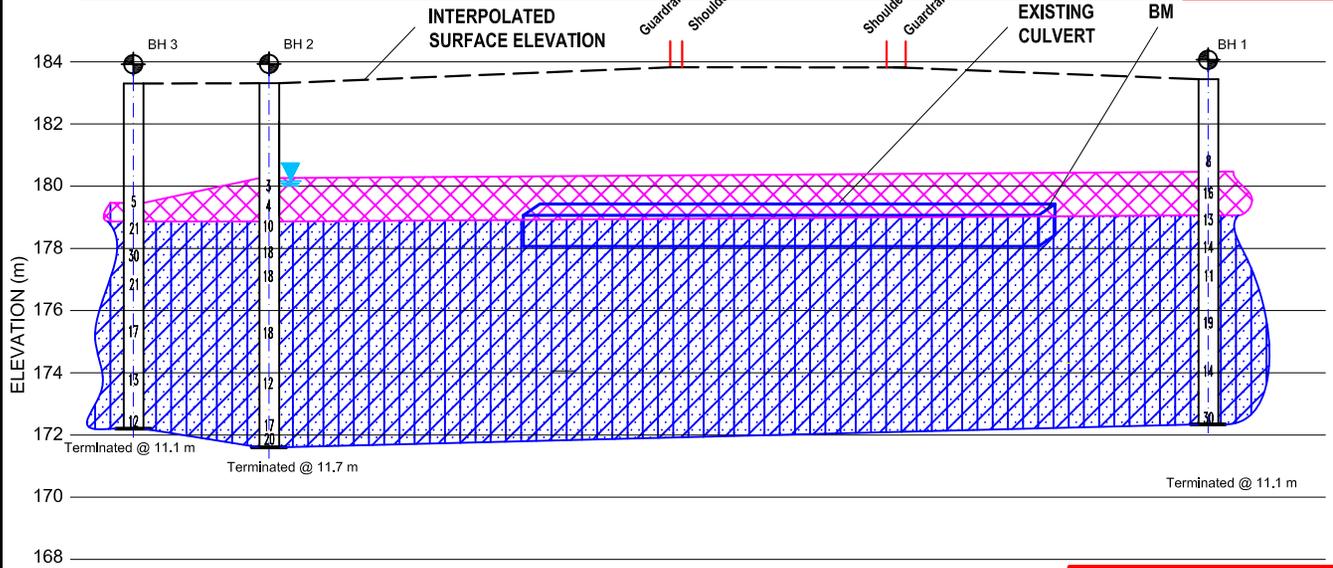
FOUNDATION INVESTIGATION
PROPOSED RETAINING WALL STRUCTURE
CAMPBELL DRAIN
CHATHAM, ONTARIO
ASSIGNMENT 11

TB7210011
FIGURE
1

Dwg. Title:
Borehole Location Plan / Cross Section B-B'



Scale: 1 : 500



PROFILE

Scale: Horizontal 1 : 500
Vertical 1 : 250

LEGEND

- BOREHOLE
- BOREHOLE (Equipped with Piezometer)
- WATER LEVEL
- Existing Culvert
- Existing Roadway
- Proposed Culvert/Retaining Structure
- SPT 'N'

BOREHOLE	LOCATION		COORDINATE (NAD 83)		ELEVATION (m)
	STATION	OFFSET	NORTHING	EASTING	
BH1	11 + 477.1	25.0m RT of CL	4694544.9	337161.5	183.406
BH2	11 + 477.4	23.8m LT of CL	4694510.4	337127.0	183.276
BH3	11 + 477.6	30.8m LT of CL	4694505.6	337121.9	183.266

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. All elevations shown are referred to a geodetic benchmark of 182,058 m, which was provided to AMEC by the MTO. (TBM - top of culvert on east side of Hwy 40)
Coordinates shown have also been provided by the MTO and are reference to the NAD83 MTM Zone 11 coordinate system.
3. This drawing is for subsurface information only. Surface details and features are for conceptual illustration. The proposed structure location is shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contract Documents.

SOIL STRATIGRAPHY

- Silty Clay/Clayey Silt Fill
- Silty Clay Till
- Unknown



APPENDIX A

RECORD OF BOREHOLE No 1

1 OF 1

PROJECT Hwy 40 - RSS Wall & Retaining Wall LOCATION Campbell Drain, Boundary Line, East of ORIGINATED BY LW
 CLIENT MTO Western Region Hwy 40. COMPILED BY LW/JW
 JOB NO. TB7210011 DATE 23 February 2009 Sta(11+477.1); 25.0m Rt of Hwy 40 CL CHECKED BY JD

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	DEPTH (m)	STANDARD PENETRATION TEST <input type="checkbox"/> DYNAMIC PENETRATION TEST <input type="checkbox"/>	WATER CONTENT (%)			OBSERVATIONS & REMARKS		
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH (kPa)					
							10 20 30 40 50						
							○ UNCONFINED ▲ FIELD VANE ● QUICK TRIAXIAL ◆ LAB VANE						
							100 200 300	20 40 60					
183.4 0.0	Augered to 3 mbgs. Granular Base fill overlying Silty Clay fill observed in auger cuttings.					1							
180.4 3.0	Greyish Brown Silty Clay FILL , trace rootlets and gravel, firm, sdtpl. Brown to Grey Silty Clay TILL , trace to some gravel, stiff to very stiff, sdtpl.	[Hatched]	1	SS	8	3	□				SS#2 >4.75 mm -4% 75 µm to 4.75 mm - 28% 2 µm to 75 µm - 41% <2 µm - 27% SS#6 >4.75 mm -2% 75 µm to 4.75 mm - 15% 2 µm to 75 µm - 40% <2 µm - 43% SS#6 LL - 31% PL - 19% PI - 12%		
179.8 3.6		[Hatched]	2	SS	16	4	□						
		[Hatched]	3	SS	13	5	□						
		[Hatched]	4	SS	14	6	□						
		[Hatched]	5	SS	11	7	□						
		[Hatched]	6	SS	19	8	□	PI ●	PL ●	LL ●			
		[Hatched]	7	SS	14	9	□						
172.7 10.7 172.3 11.1	BOREHOLE TERMINATED Organic Vapour Measurement (OVM) SS#1 = 90 ppm SS#2 = 50 ppm SS#3 = 70 ppm SS#4 = 80 ppm SS#5 = 190 ppm SS#6 = ND SS#7 = ND SS#8 = ND ppm = parts per million ND = non-detect		8	SS	30	11	□				Borehole open and dry upon completion.		

RECORD OF BOREHOLE No 2

1 OF 1

PROJECT Hwy 40 - RSS Wall & Retaining Wall LOCATION Campbell Drain, Creek Road, West of Hwy 40 ORIGINATED BY LW
 CLIENT MTO Western Region 40. COMPILED BY LW/JW
 JOB NO. TB7210011 DATE 24 February 2009 Sta(11+477.4); 23.8m Lt of Hwy 40 CL CHECKED BY JD

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	STANDARD PENETRATION TEST DYNAMIC PENETRATION TEST		WATER CONTENT (%)			OBSERVATIONS & REMARKS	
ELEV. DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE		"N" VALUES	DEPTH (m)	SHEAR STRENGTH (kPa)		(%)		
							<input type="checkbox"/> UNCONFINED <input type="checkbox"/> FIELD VANE <input type="checkbox"/> QUICK TRIAXIAL <input type="checkbox"/> LAB VANE	10 20 30 40 50 100 200 300	20	40	60	
183.3 0.0	Augered to 3 mbgs. Granular Base fill overlying Silty Clay fill observed in auger cuttings.					0						
180.3 3.0	Grey to Brown Silty Clay FILL, trace gravel and rootlets, soft to firm, apl to wtpl.	[Cross-hatch pattern]	1	SS	3	3						Water Level taken on Feb. 25 = 3.1mbgs
			2	SS	4	4						
178.9 4.4	Brown to Grey Silty Clay TILL, some fine gravel, very stiff to stiff, sdtpl to apl.	[Vertical line pattern]	3	SS	10	5						SS#5 >4.75 mm -2% 75 µm to 4.75 mm - 17% 2 µm to 75 µm - 40% <2 µm - 41%
			4	SS	18	6			PI	PL	LL	
			5	SS	18	7						SS#5 LL - 30% PL - 17% PI - 13%
			6	SS	18	8						
			7	SS	12	9						SS#8 >4.75 mm -2% 75 µm to 4.75 mm - 21% 2 µm to 75 µm - 39% <2 µm - 38%
			8	SS	17	10						
171.6 11.7	BOREHOLE TERMINATED Organic Vapour Measurement (OVM) SS#1 = 80 ppm SS#2 = 500 ppm SS#3 = 45 ppm SS#4 = 70 ppm SS#5 = 95 ppm SS#6 = 25 ppm SS#7 = 25 ppm SS#8 = 10 ppm SS#9 = 10 ppm ppm = parts per million ND = non-detect		9	SS	20	11					Well details: 50mm diameter slotted PVC pipe (7.6-10.6m) with sandpack (7.0-10.6m), bentonite plug above sandpack, with pipe riser and slip cap.	

RECORD OF BOREHOLE No 3

1 OF 1

PROJECT Hwy 40 - RSS Wall & Retaining Wall LOCATION Campbell Drain, Creek Road, West of Hwy 40 ORIGINATED BY LW
 CLIENT MTO Western Region 40. COMPILED BY LW/JW
 JOB NO. TB7210011 DATE 24 February 2009 Sta(11+477.6); 30.8m Lt of Hwy 40 CL CHECKED BY JD

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	DEPTH (m)	STANDARD PENETRATION TEST <input type="checkbox"/>	DYNAMIC PENETRATION TEST <input type="checkbox"/>	WATER CONTENT (%)			OBSERVATIONS & REMARKS
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH (kPa)			20	
183.3 0.0	Augered to 3.8 mbgs. Granular Base fill overlying Silty Clay fill observed in auger cuttings.											
179.5 3.8	Grey Clayey Silt FILL , trace gravel, rootlets and organics, firm, apl. Brown to Grey Silty Clay TILL , some gravel, very stiff to stiff, dtpl.	▨	1	SS	5	▽	□					
178.9 4.4		2	SS	21			□					
		3	SS	30			□					
		4	SS	21			□					
		5	SS	17			□					
		6	SS	13			□					
		7	SS	12			□					
172.2 11.1	BOREHOLE TERMINATED Organic Vapour Measurement (OVM) SS#1 = 50 ppm SS#2 = 40 ppm SS#3 = 40 ppm SS#4 = 20 ppm SS#6 = 5 ppm ppm = parts per million ND = non-detect											SS#4 >4.75 mm -3% 75 µm to 4.75 mm - 18% 2 µm to 75 µm - 40% <2 µm - 39% SS#6 >4.75 mm -2% 75 µm to 4.75 mm - 16% 2 µm to 75 µm - 40% <2 µm - 42% SS#6 LL - 30% PL - 18% PI - 12%
												Borehole open and water to 4.0mbgs upon completion.



APPENDIX B

APPENDIX B - PHOTOGRAPHIC RECORD

PROJECT NO. TB7210011

PROJECT Retaining Wall Construction at Campbell Drain Culvert

LOCATION Hwy 40 & Boundary Line/Creek Rd, Chatham

ENCLOSURE 1

	<table border="1"> <tr> <td>PHOTOGRAPH</td> <td>1</td> </tr> </table>	PHOTOGRAPH	1
PHOTOGRAPH	1		
<table border="1"> <tr> <td>Campbell Drain</td> </tr> </table>		Campbell Drain	
Campbell Drain			
<p>Culvert Inlet, looking north from Boundary Line (Jan 19/09)</p>			

	<table border="1"> <tr> <td>PHOTOGRAPH</td> <td>2</td> </tr> </table>	PHOTOGRAPH	2
PHOTOGRAPH	2		
<table border="1"> <tr> <td>Campbell Drain</td> </tr> </table>		Campbell Drain	
Campbell Drain			
<p>Culvert Inlet, looking west from Boundary Line towards BH 1 location. (Feb 24/09)</p>			

APPENDIX B - PHOTOGRAPHIC RECORD

PROJECT NO. TB7210011

PROJECT Retaining Wall Construction at Campbell Drain Culvert

LOCATION Hwy 40 & Boundary Line/Creek Rd, Chatham

ENCLOSURE 1

	<table border="1"> <tr> <td>PHOTOGRAPH</td> <td>3</td> </tr> </table>	PHOTOGRAPH	3	
	PHOTOGRAPH	3		
	<table border="1"> <tr> <td colspan="2">Campbell Drain</td> </tr> <tr> <td colspan="2">Culvert Outlet, looking east from Creek Road (Feb 11/09)</td> </tr> </table>	Campbell Drain		Culvert Outlet, looking east from Creek Road (Feb 11/09)
Campbell Drain				
Culvert Outlet, looking east from Creek Road (Feb 11/09)				
<table border="1"> <tr> <td colspan="2"> </td> </tr> </table>				

	<table border="1"> <tr> <td>PHOTOGRAPH</td> <td>4</td> </tr> </table>	PHOTOGRAPH	4	
	PHOTOGRAPH	4		
	<table border="1"> <tr> <td colspan="2">Campbell Drain</td> </tr> <tr> <td colspan="2">Culvert Outlet, looking north from Creek Road (Jan 19/09)</td> </tr> </table>	Campbell Drain		Culvert Outlet, looking north from Creek Road (Jan 19/09)
Campbell Drain				
Culvert Outlet, looking north from Creek Road (Jan 19/09)				
<table border="1"> <tr> <td colspan="2"> </td> </tr> </table>				



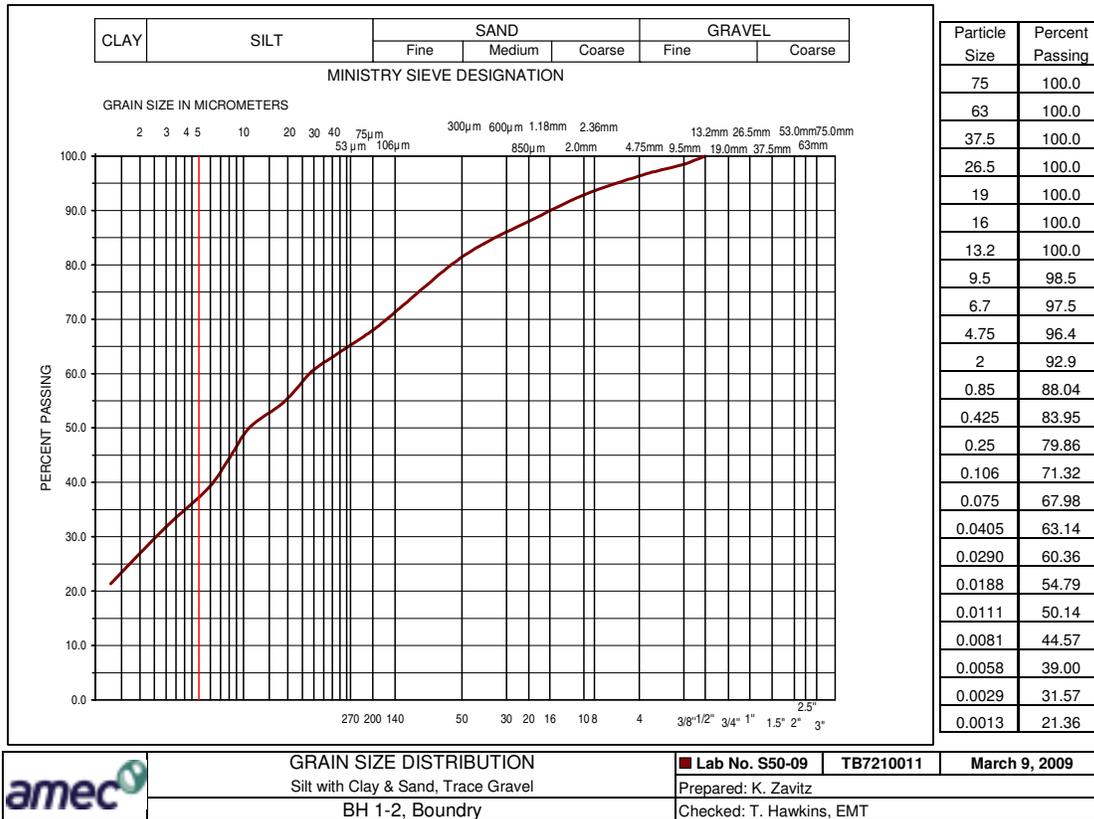
APPENDIX C

Laboratory Results



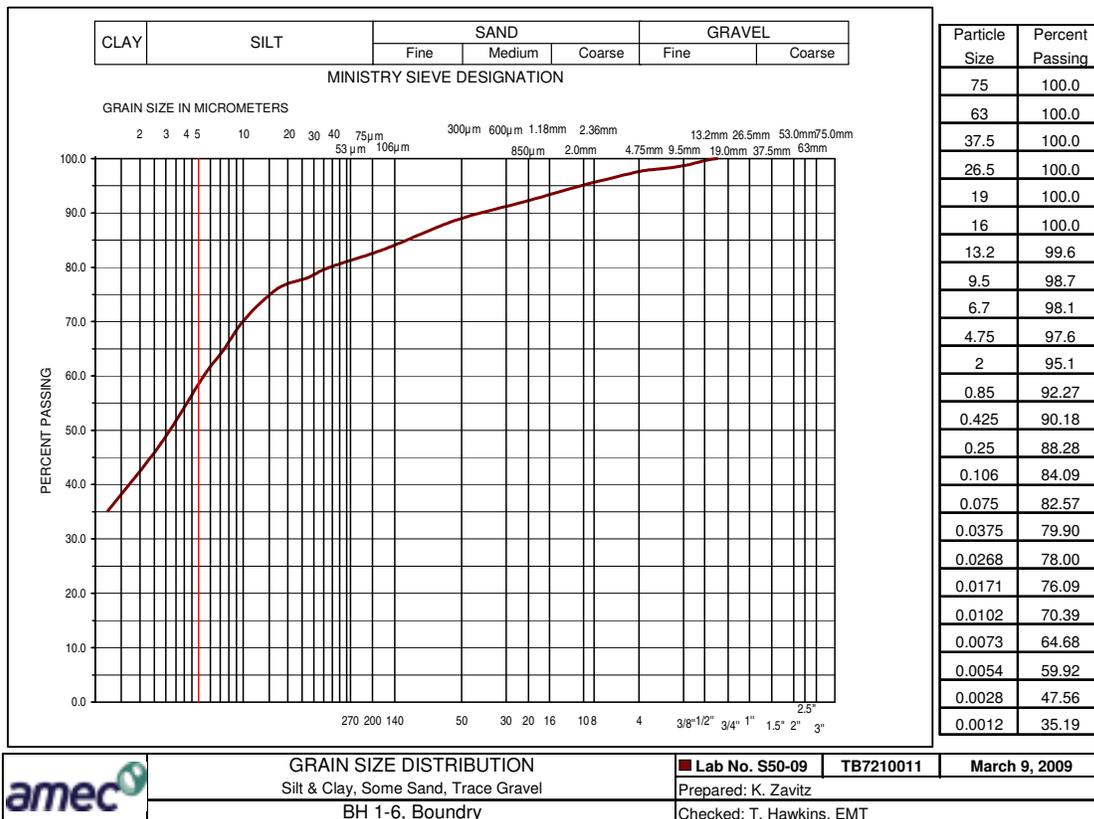
UNIFIED SOIL CLASSIFICATION SYSTEM

Enclosure: 1



UNIFIED SOIL CLASSIFICATION SYSTEM

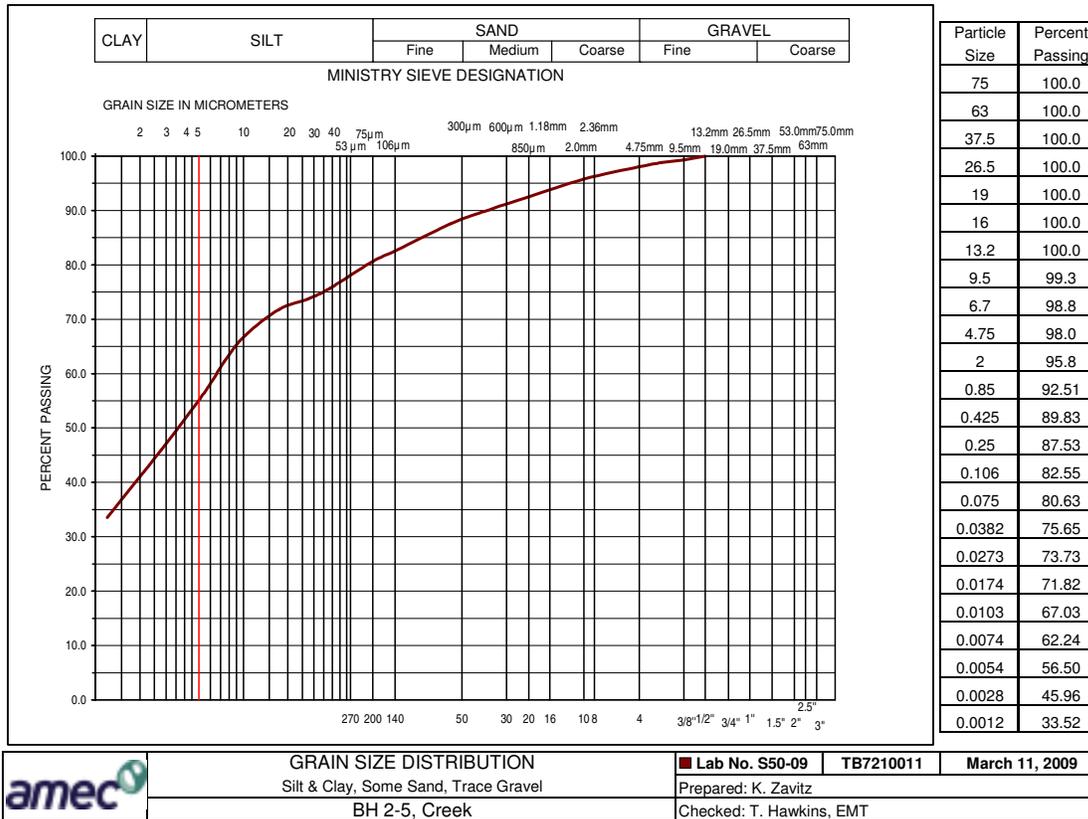
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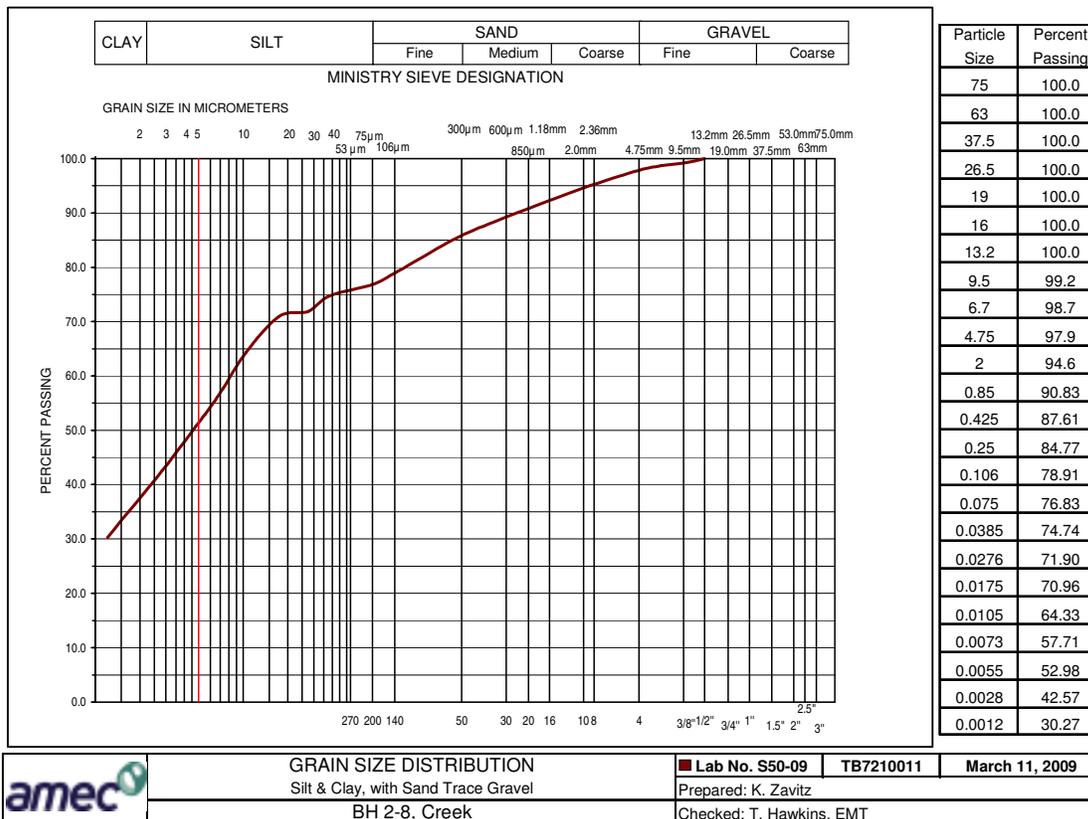
UNIFIED SOIL CLASSIFICATION SYSTEM

Enclosure: 3



UNIFIED SOIL CLASSIFICATION SYSTEM

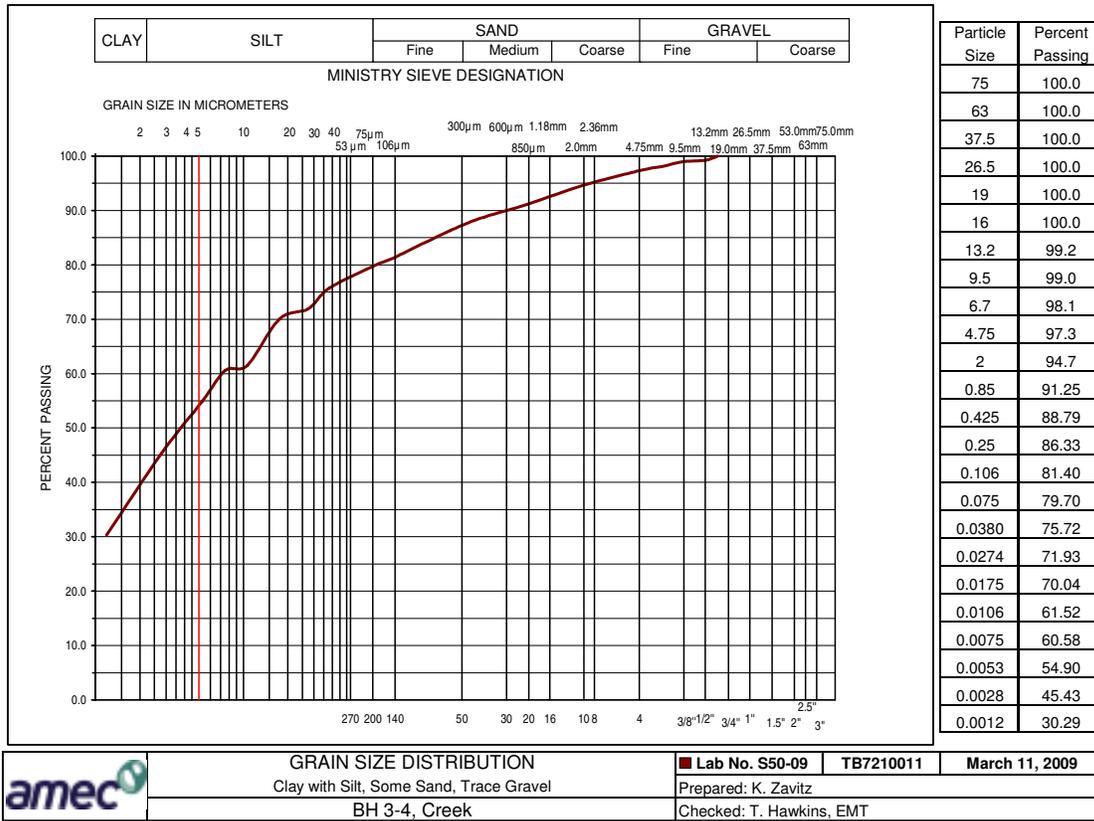
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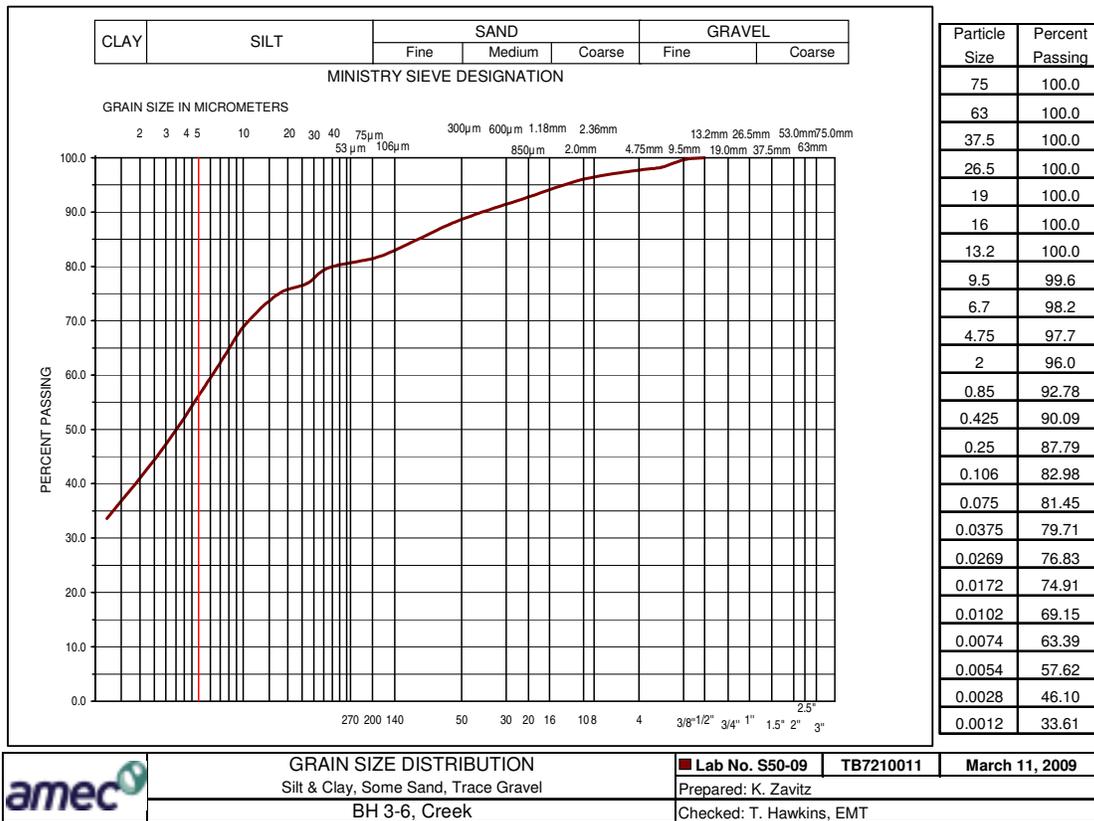
UNIFIED SOIL CLASSIFICATION SYSTEM

Enclosure: 5



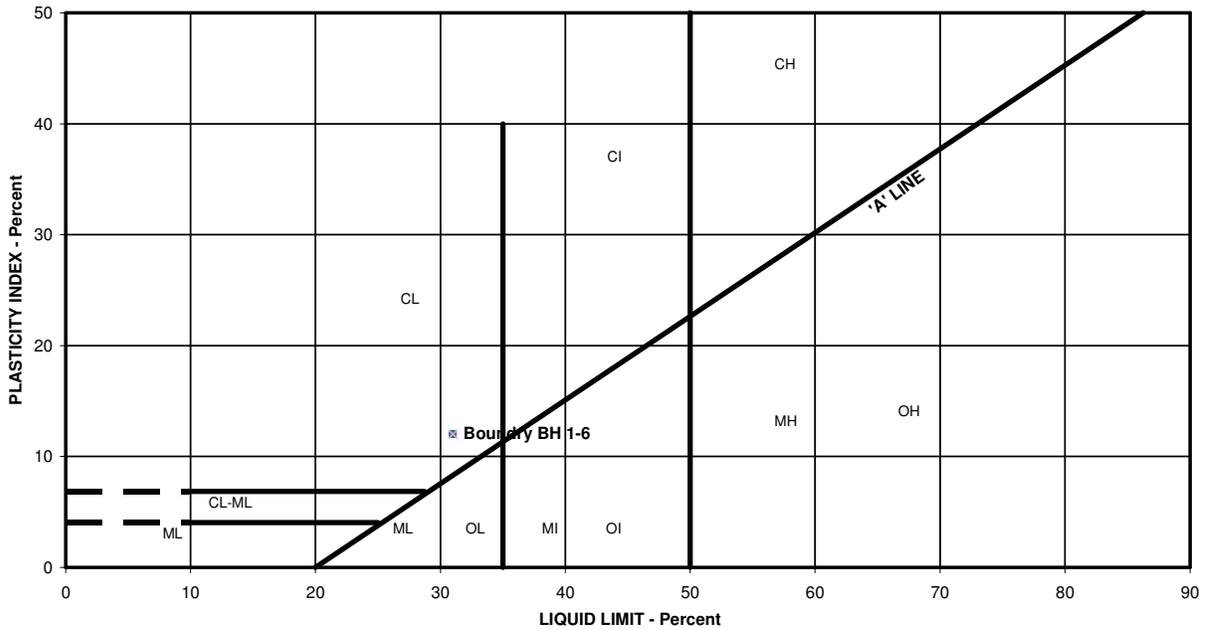
UNIFIED SOIL CLASSIFICATION SYSTEM

Enclosure: 6





PLASTICITY CHART
 BOUNDARY, BH 1-6: LL = 31, PL = 19, PI = 12



PLASTICITY CHART
 CREEK, BH 2-5: LL=30, PL=17, PI=13 ~ BH 3-6: LL=30, PL=18, PI=12

