



MERLEX ENGINEERING LTD.

CONSULTING GEOTECHNICAL ENGINEERS

**FINAL
FOUNDATION INVESTIGATION REPORT
CULVERT STATION 15+675 – TWP. of Eby
GWP 162-98-00
MEL SITE A**

**Highway 11, From 0.3 km South of the Highway 11/66 Intersection
Northerly 11.7 km to 3.5 km South of Highway 570**

MEL Ref. No.: 09/10/09181A

November 12, 2010

Submitted to:

AECOM Canada Ltd.
189 Wyld Street
North Bay, Ontario
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Geocres No. 42A-80



TABLE OF CONTENTS

	PAGE
1.0 INTRODUCTION.....	1
2.0 SITE DESCRIPTION.....	1
2.1 Site Physiography and Surficial Geology	2
3.0 INVESTIGATION PROCEDURES.....	2
4.0 SUBSURFACE CONDITIONS.....	5
4.1 Culvert, Station 15+675, Twp of Eby – MEL SITE A	5
4.1.1 Peat	6
4.1.2 Silt.....	6
4.1.3 Silty Clay.....	6
4.1.4 Sand	7
4.1.5 Embankment Fill.....	7
4.2 Groundwater Conditions.....	9



1.0 INTRODUCTION

Merlex Engineering Ltd. (MEL) has been retained by AECOM Canada Ltd., on behalf of the Ministry of Transportation of Ontario (MTO), to carry out a foundation investigation at a culvert located at Station 15+675, Township of Eby. GWP 162-98-00 on Highway 11 passes through parts of the Townships of Eby and Grenfell and the location is described as: from 0.3 km South of the Highway 11/66 intersection Northerly 11.7 km to 3.5 km South of Highway 570. This project involves the replacement of a single 610 mm diameter CSP culvert in an embankment that is some 4.1 m above the culvert invert at centerline.

The foundation investigation location was specified by the MTO in the RFP/TPM documentation Agreement No. 5008-E-0067. The terms of reference for the scope of work are outlined in MEL's proposal P-09-037, dated May 2009. The purpose of the investigation was to determine the subsurface conditions in the area of the culvert. MEL investigated the foundation area by the drilling of boreholes, carrying out in-situ tests, and performing laboratory testing on select samples.

2.0 SITE DESCRIPTION

The CSP culvert is located on Highway 11, at Station 15+675, Township of Eby (defined internally as MEL Site A). The topography at the site is generally of moderate relief and the direction of flow through the culvert is from east (inlet) to west (outlet). The existing highway embankment, at the culvert location, supports two undivided lanes of highway, running in a north south direction, and a right turn taper for Highway 568. The embankment platform is some 22 m wide at the culvert location. The existing highway embankment at the culvert location is some 4.1 m higher than the culvert invert at the highway centerline, with the paved surface at centerline at elevation 311.0 m and the culvert invert below centerline at 306.9 m.



The elevation of the culvert invert at the inlet and outlet is approximately 307.4 and 306.5 m, respectively. The embankment slopes at the culvert location are currently 2.6H:1.0V left of centerline and 2.1H:1.0V right of centerline. At the culvert location, a visual review indicated no signs of embankment instability, and there were no obvious signs of settlement of the pavement structure at the culvert location. The culvert is reported to be rusty at the right end, with the culvert sides heavily perforated.

2.1 Site Physiography and Surficial Geology

This project is located in the Geomorphic Sub-provinces known as the Eastern Sandy Uplands. The topography on this section of Highway 11 is generally rolling. At many locations, significant layers of earth overlay the bedrock. Organic terrain was also observed. Within this foundation project area, overburden consists generally of a thin deposit of peat beyond the culvert ends, overlying a deposit of silt, overlying a deposit of stiff silty clay, overlying a sand stratum, overlying bedrock at an average elevation of 301.0 m. There are exposed bedrock cuts a short distance both up and down chainage from the culvert site.

Bedrock in the area, as indicated on OGS Map 2440, is of the Early Precambrian Era. At the culvert site the bedrock comprises of Metasediments including conglomerate, sandstone, mudstone, marble, chert, iron formation, and related migmatites. The exposed bedrock located some 0.1 km north of the culvert site consists of conglomerate.

3.0 INVESTIGATION PROCEDURES

The field work for this investigation consisted of three sampled boreholes and was carried out on January 19 and 20, 2010, during which frozen ground conditions allowed access to the culvert ends. One borehole was advanced at each of the culvert ends to the east and west of



the embankment, and a third borehole was attempted to be advanced through the frozen embankment. An additional field investigation was carried out following thaw of the embankment material, to profile the pavement structure interface with the top and bottom of the material used to construct the embankment and the underlying native soils.

The initial field investigation was carried out using a Bombardier mounted CME drilling rig equipped with hollow stem augers, standard augers, and routine geotechnical sampling equipment. Soil samples were obtained at regular intervals of depth using the standard 50 mm O.D. split spoon sampler advanced in accordance with the Standard Penetration Test (SPT) procedures (ASTM D-1586) at the borehole locations. The SPT method involves advancing a 50 mm diameter split spoon sampler with the force of a 63.5 kg hammer freely dropping 760 mm mounted in a trip (automatic) hammer. The number of blows per 300 mm penetration was recorded as the “N” value. At the boreholes, a Dynamic Cone Penetration Test (DCPT) was carried out to give a continuous plot of the soil resistance with depth. When cohesive deposits were encountered, the in-situ strength was measured using an “N” size vane, vane collar, and calibrated torque meter. All samples taken during this investigation were stored in labeled airtight containers for transport to our North Bay laboratory for visual examination and select laboratory testing.

Since shallow auger refusal was met at auger holes advanced from the top of the embankment, during the initial phase of this investigation a dual drill system procedure was undertaken. This system consisted of augering, with a conventional (CME) drilling rig to practical auger refusal followed by further advancing the boring with a hydrotrack rock drill was initiated to define the vertical limits of the embankment material. Initially, a conventionally sampled borehole was advanced to auger refusal which was met at shallow depth, generally around a depth of 1.5 m.



Following this a hydrotrack rock drill was brought over the boring and percussion drilling was carried out through the embankment material until it had penetrated through the embankment material and a minimum of 1 m into the native subgrade. Nine of these borings were carried out on a 2 m interval across the location of the culvert to produce a soil profile perpendicular to the culvert orientation. This data is summarized on Enclosure No. 5, Appendix B, and the profile is shown on Enclosure No. 6, Appendix D.

Groundwater conditions in the open boreholes were observed during the advancement of and immediately following completion of the individual boreholes. All open boreholes were backfilled upon completion with compacted auger cuttings, in the general order they were removed and, where necessary, bentonite pellet backfill was added to the boreholes to bring them up to grade.

The field work for this investigation was under the full time direction of a senior member of our engineering staff, who was responsible for locating the boreholes, clearing the borehole locations of underground services, in-situ sampling and testing operations, logging of the boreholes, labeling and preparation of samples for transport to our North Bay laboratory, plus overall drill supervision. All samples received a visual confirmatory inspection in our laboratory. Laboratory testing of select samples included routine testing for natural moisture content determination and particle size analysis. The results of the laboratory testing are presented on the individual Record of Borehole Sheets (Appendix B), with a summary of results presented on the laboratory sheets Figures Nos. L-1 to L-4, Appendix C.

The location of the individual boreholes were determined in the field using highway chainage (established by others) and offset relative to highway centerline. The MTO co-ordinates,



northing and easting, were then established for the borehole locations. Elevations contained in this report are referenced to a geodetic datum.

4.0 SUBSURFACE CONDITIONS

Details of the subsurface conditions revealed by the investigation program are presented on the enclosed Record of Borehole Logs (Appendix B) and on Figure No. A-1 (Appendix C). Please note that stratigraphic delineation presented on the borehole logs and soil strata plot are the results of non-continuous sampling, response to drilling progress, the results of SPT and/or Dynamic Cone Penetration Test (DCPT), plus field observations. Typically such boundaries represent transitions from one zone to another and are not an exact demarcation of a specific geological unit. Additional consideration should be given to the fact that subsurface conditions may vary markedly between adjacent boreholes and beyond any specific boring location, and are shown on the drawings for design purposes only. At the time of the subsurface investigation, the ground surface elevations at Boreholes Nos. A-1 to A-3 were recorded at 308.0, 310.7, and 307.4 m, respectively.

4.1 Culvert, Station 15+675, Township of Eby – MEL SITE A

A plan, profile and cross section showing the boring locations and stratigraphic sequences is shown on Figure No. A-1, Appendix C. During the course of the exploration program, three (3) sampled boreholes were put down at this site, with Borehole Nos. A-1 and A-3, advanced at the east and west ends of the existing culvert, respectively, while Borehole No. A-2 was advanced through the embankment, right shoulder. In addition combined augered/rock drilled borings were advanced resulting in the data presented along the profile as shown on Enclosure No. 6, Appendix D.



4.1.1 Peat

At the culvert inlet and outlet, Borehole Nos. A-1 and A-3 respectively, a deposit of black fine fibrous peat trace fine sand trace gravel, some 0.3 to 0.8 m in thickness, was penetrated at surface. Natural moisture contents from samples of this deposit were in the order of 36 to 39%. A single In-situ field vane test at Borehole No. A-3 returned a value of 10 kPa.

4.1.2 Silt

Underlying the peat at Boreholes Nos. A-1 and A-3, a deposit of light brown silt containing some to with clay, 2.3 to 3.5 m in thickness, was penetrated and extended to elevations 304.2 and 304.4 m, respectively. Natural moisture contents from samples of this deposit were in the order of 26 to 38%. Hydrometer analyses were carried out on three (3) samples of this deposit which were retained in the spilt spoon sampler, the results of which indicated 0% gravel size particles, 0% sand size particles, 79 to 83% silt size particles, and 17 to 21% clay size particles (Figure No. L-1, Appendix C). Atterberg Limits testing was carried out on the three (3) samples of this deposit, the results of which indicated a plastic limit of 22% and a liquid limit of 27 to 29%, resulting in a USCS classification of ML-CL (Figure L-4, Appendix C). Based on SPT values of 6 to 44 blows per 300 mm penetration, the compactness of this deposit was described as loose to dense, generally compact. This deposit was encountered to depths of 3.8 and 3.1 m below ground surface (elevations 304.2 and 304.4 m) at Boreholes Nos. A-1 and A-3, respectively.

4.1.3 Silty Clay

Underlying the silt, a deposit of silty clay some 1.2 to 2.4 m in thickness was penetrated. Natural moisture contents from samples of this deposit were in the order of 30 to 36%. Hydrometer analyses were carried out on two (2) samples of this deposit, the results of which indicated 0% gravel size particles, 0 to 1% sand size particles, 61 to 64% silt size particles, and 36 to 38%



clay size particles (Figure No. L-2, Appendix C). Atterberg Limits testing was carried out on two (2) samples of this deposit, the results of which indicated a plastic limit of 10 to 19% and a liquid limit of 30 to 37%, resulting in a USCS classification of CL to CI (lean to plastic clay) (Figure L-4, Appendix C). Based on in-situ field vane tests which returned shear strengths of 50 kPa, the consistency of this deposit is described as stiff. This deposit was encountered to depths of 6.2 and 4.3 m below ground surface (elevations 301.8 and 303.1 m) at Borehole Nos. A-1 and A-3, respectively.

4.1.4 Sand

Underlying the silty clay, a deposit of brown fine to medium sand containing trace to some gravel, trace to some silt, varying from 1.3 to 1.9 m in thickness, was penetrated at Borehole Nos. A-1 and A-3. The natural moisture content from samples of this deposit was in the order of 11 to 12%. Gradation analyses were carried out on two (2) samples of this deposit, which were retained in the spilt spoon sampler, the results of which indicated 5 to 16% gravel size particles, 65 to 85% sand size particles, and 10 to 19% silt and clay size particles (Figure No. L-3, Appendix C). Based on the SPT values of 62 blows per 300 mm penetration to 88 blows per 250 mm penetration (hammer bouncing), the compactness of this deposit was described as very dense. Auger refusal was encountered in this deposit at Boreholes Nos. A-1 and A-3 at depths of 7.5 and 5.9 m below ground surface (elevations 300.5 and 301.5 m), respectively.

4.1.5 Embankment Fill

Borehole No. A-2 was advanced through the embankment at the culvert location. At this borehole, a deposit of brown medium sand containing trace silt, trace gravel and frequent cobble and boulder sizes/rock fill was penetrated. The natural moisture content of samples of



this granular fill deposit was measured to be in the order of 4 to 10%. Auger refusal was encountered on boulder/rock fill, at a depth of 1.8 m (elevation 308.9 m) at Borehole No. A-2.

At the location of Borings No. 1 to 9 inclusive (see Profile, Enclosure No. 6, Appendix D), the ground surface elevation was 310.7 m. Auger refusal on rock fill was met at the borings at depths ranging between 0.9 to 2.3 m (elevations 309.8 to 308.4 m). This rock fill was percussion drilled and the size of rock penetrated varied from 0.15 to 1.2 m in vertical dimension (orientation of the drill steel). Based on drill response, the rock fill extended to a depth varying between 2.4 to 5.2 m (elevation 308.3 to 305.5 m) along the profile line. The rock fill was underlain by a soil stratum which offered negligible resistance to the drill steel advance and has been interpreted as the silt stratum, as encountered at sampled Borehole Nos. A-1 and A-3 based on proximity and similar elevations. The hydro track probing was terminated at a 6.1 m depth (elevation 304.6 m).



4.2 Groundwater Conditions

Groundwater and cave-in levels in the open boreholes were measured during the advance of the individual borings and upon completion. These levels were recorded on the individual Record of Borehole Log Sheets (Appendix B). The water level was measured at a depth of 1.6 and 1.1 m at Boreholes No. A-1 and A-3, respectively (elevations 306.4 and 306.3 m). These groundwater levels will fluctuate seasonally.

MERLEX ENGINEERING LTD.

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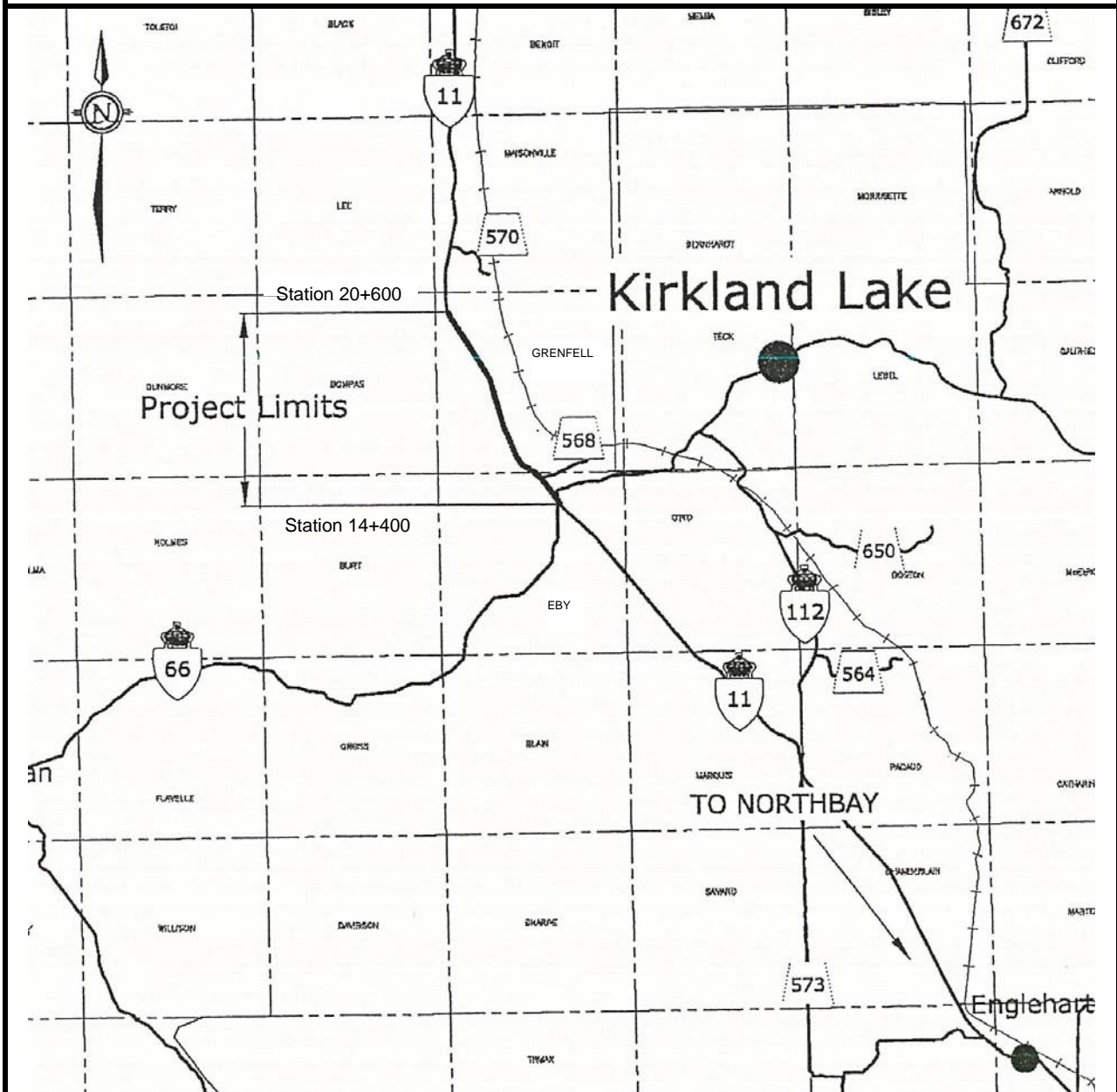
Z:\PROJECT FILES\2009\09181 - PAVE & FDN, Hwy 11 Kenogami 162-98-00 (AECOM)\FOUNDATION\REPORTS\FINAL\Site A - 15+675 Eby Twp\09181A- FINAL FIR, Hwy 11 GWP 162-98-00 - SITE A, Culvert 15+675.doc

APPENDIX A

Figure No. 1: Key Plan

KEY PLAN

NOT TO SCALE



FINAL FOUNDATION INVESTIGATION REPORT GWP 162-98-00

Highway 11, From 0.3 km South
of Highway 66, Northerly 11.7 km to
3.5 km South of Highway 570

MEL Ref. No.: 09/10/09181A

November 2010



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APPENDIX B

Enclosure No. 1: List of Abbreviations and Symbols

Enclosure Nos. 2 to 4: Record of Borehole Sheets

Enclosure No. 5: Probe Boring Data with Abbreviations



LIST OF ABBREVIATIONS & DESCRIPTION OF TERMS

The abbreviations and terms, used to describe retrieved samples and commonly employed on the borehole logs, on the figures and in the report are as follows:

1. ABBREVIATIONS

AS	Auger Sample
CS	Chunk Sample
DS	Denison type sample
FS	Foil Sample
HB	Hammer Bouncing
NFP	No Further Progress
PH	Sampler advanced by hydraulic pressure
PM	Sampler advanced by manual pressure
RC	Rock core with size & percentage of recovery
SS	Split Spoon
ST	Slotted Tube
TO	Thin-walled, open
TP	Thin-walled, piston
WH	Sampler Advanced by static weight (weight of hammer and/or rods)
WS	Wash Sample

2. PENETRATION RESISTANCE/"N"

Dynamic Cone Penetration Test (DCPT):

A continuous profile showing the number of blows for each 300 mm of penetration of a 50 mm diameter 90° point cone driven by a 63 kg hammer falling 760 mm.

Plotted as —●—●—●—●—

Standard Penetration Test (SPT) or "N" Values

The number of blows of a 63 kg hammer falling 760 mm required to advance a 50 mm O.D. drive open sampler 300 mm.

3. SOIL DESCRIPTION

a) *Cohesionless Soils:*

"N" (blows/0.3 m)	Relative Density
0 to 4	very loose
4 to 10	loose
10 to 30	compact
30 to 50	dense
over 50	very dense

3. SOIL DESCRIPTION (Cont'd)

b) *Cohesive Soils:*

Undrained Shear Strength (kPa)	Consistency
Less than 12	very soft
12 to 25	soft
25 to 50	firm
50 to 100	stiff
100 to 200	very stiff
over 200	hard

c) *Method of Determination of Undrained Shear Strength of Cohesive Soils:*

+ 3.2 - Field Vane test in borehole.
The number denotes the sensitivity to remoulding.

D - Laboratory Vane Test

" - Compression test in laboratory

For a saturated cohesive soil the undrained shear strength is taken as one-half of the undrained compressive strength.

4. TERMINOLOGY

Terminology used for describing soil strata is based on the proportion of individual particle sizes present in the samples (please note that, with the exception of those samples subject to a grain-size analysis, all samples were classified visually and the accuracy of visual examination is not sufficient to determine exact grain sizing):

Trace, or occasional	Less than 10%
Some	10 to 20%
With	20 to 30%
Adjective (i.e. silty or sandy)	30 to 40%
And (i.e. sand and gravel)	40 to 60%

5. LABORATORY TESTS

P	Standard Proctor Test
A	Atterberg Limit Test
GS	Grain Size Analysis
H	Hydrometer Analysis
C	Consolidation



SAMPLE DESCRIPTION NOTES:

1. **FILL:** The term fill is used to designate all man-made deposits of natural soil and/or waste materials. The reader is cautioned that fill materials can be very heterogeneous in nature and variable in depth, density and degree of compaction. Fill materials can be expected to contain organics, waste materials, construction materials, shot rock, rip-rap, and/or larger obstructions such as boulders, concrete foundations, slabs, abandoned tanks, etc.; none of which may have been encountered in the borehole. The description of the material penetrated in the borehole therefore may not be applicable as a general description of the fill material on the site as boreholes cannot accurately define the nature of fill material. During the boring and sampling process, retrieved samples may have certain characteristics that identify them as 'fill'. Fill materials (or possible fill materials) will be designated on the Borehole Logs. If fill material is identified on the site, it is highly recommended that testpits be put down to delineate the nature of the fill material. However, even through the use of testpits defining the true nature and composition of the fill material cannot be guaranteed. Fill deposits often contain pockets or seams of organics, organically contaminated soils or other deleterious material that can cause settlement or result in the production of methane gas. It should be noted that the origins and history of fill material is frequently very vague or non-existent. Often fill material may be contaminated beyond environmental guidelines and the material will have to be disposed of at a designated site (i.e. registered landfill). Unless requested or stated otherwise in this report, fill material on this site has not been tested for contaminants however, environmental testing of the fill material can be carried out at your request. Detection of underground storage tanks cannot be determined with conventional geotechnical procedures.
2. **TILL:** The term till indicates a material that is an unstratified, glacial deposit, heterogeneous in nature and, as such, may consist of mixtures and pockets of clay, silt, sand, gravel, cobbles and/or boulders. These heterogeneous deposits originate from a geological process associated with glaciation. It must be noted that due to the highly heterogeneous nature of till deposits, the description of the deposit on the borehole log may only be applicable to a very limited area and therefore, caution must be exercised when dealing with a till deposit. When excavating in till, contractors may encounter cobbles/boulders or possibly bedrock even if they are not indicated on the borehole logs. It must be appreciated that conventional geotechnical sampling equipment does not identify the nature or size of any obstruction.
3. **BEDROCK:** Auger refusal may be due to the presence of bedrock, but possibly could also be due to the presence of very dense underlying deposits, boulders or other large obstructions. Auger refusal is defined as the point at which an auger can no longer be practically advanced. It must be appreciated that conventional geotechnical sampling equipment does not differentiate between nature and size of obstructions that prevent further penetration of the boring below grade. Bedrock indicated on the borehole logs will be labeled 'possibly' or 'probable' etc. based on the response of the boring and sampling equipment, surrounding topography, etc. Bedrock can be proven at individual borehole locations, at your request, by diamond core drilling operations or, possibly, by testpits. It must also be appreciated that bedrock surfaces can be, and most times are, very erratic in nature (i.e. sheer drops, isolated rock knobs, etc.) and caution must be used when interpreting subsurface conditions between boreholes. A bedrock profile can be more accurately estimated, at the clients' request, through a series of closely positioned unsampled auger probes combined with core drilling.
4. **GROUNDWATER:** Although the groundwater table may have been encountered during this investigation and the elevation noted in the report and/or on the record of boreholes, it must be appreciated that the elevation of the groundwater table will fluctuate based upon seasonal conditions, localized changes, erratic changes in the underlying soil profile between boreholes, underlying soil layers with highly variable permeabilities, etc. These conditions may affect the design and type and nature of dewatering procedures. Cave-in levels recorded in borings give a general indication of the groundwater level in cohesionless soils however, it must be noted that cave-in levels may also be due to the relative density of the deposit, drilling operations etc.



METRIC

RECORD OF BOREHOLE NO. A-1

REFERENCE 09/10/09181A DATUM Geodetic LOCATION N 5329407.96 E 364663.52 - Eby Township ORIGINATED BY JL
 PROJECT GWP 162-98-00, Highway 11 - MEL Site A BOREHOLE TYPE CME 45B - Hollow Stem Augers COMPILED BY RG
 CLIENT AECOM Inc. DATE (Started/Completed) 10/1/19 - 10/1/19 TIME 1:10:00 PM CHECKED BY MAM

SOIL PROFILE			SAMPLES		GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE								
308.0	Ground Surface											
0.0	±150 mm Ice and Snow											
307.7	PEAT - black fine fibrous peat trace											
0.3	fine sand trace gravel		1	AS	N/A							
	SILT - light brown silt some to with clay		2	SS	18							
	(compact/dense)		3	SS	41							0 0 83 17
			4	SS	30							
			5	SS	44							0 0 79 21
304.2	SILTY CLAY- grey silty clay, silt content varies with depth		6	SS	7							
3.8	(stiff)		7	SS	WH							0 0 64 36
301.8	SAND - brown fine to medium sand trace gravel trace silt		8	SS	88/250 mm							5 85 (10)
6.2	DCPT Refusal											
301.2												
6.8												
300.5	Auger Refusal End of Borehole											
7.5												

COMMENTS		WATER LEVEL RECORDS	
Frozen ground to 0.3 m.		Date (dd/mm/yy)/Time	Water Depth (m)
+ ³ , × ³ : Numbers on right refer to Sensitivity Numbers on left refer to values greater than 120 kPa		1) 10/1/19 1:10:00 PM	1.6
○ 3% STRAIN AT FAILURE		2)	-
		3)	-

The stratification lines represent approximate boundaries. The transition may be gradual.

MEL-GEO 09181 - SITE A - BOREHOLE LOGS.GPJ MEL-GEO.GDT 10/11/15



METRIC

RECORD OF BOREHOLE NO. A-2

REFERENCE 09/10/09181A DATUM Geodetic LOCATION N 5329398.77 E 364652.91 - Eby Township ORIGINATED BY JL
 PROJECT GWP 162-98-00, Highway 11 - MEL Site A BOREHOLE TYPE CME 45B - Hollow Stem Augers COMPILED BY RG
 CLIENT AECOM Inc. DATE (Started/Completed) 10/1/19 - 10/1/19 TIME 3:00:00 PM CHECKED BY MAM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES								
310.7	Ground Surface												
0.0	FILL - brown fine to medium sand some gravel trace silt Frequent cobble and boulder sizes/rock fill		1	AS	N/A								
309.7	DCPT Refusal on Rock Fill		2	AS	N/A								
1.0					55/300 mm 30/0 mm								
308.9	Auger Refusal on Rock Fill End of Borehole		3	SS									
1.8													
COMMENTS								+ 3, X 3 : Numbers on right refer to Sensitivity Numbers on left refer to values greater than 120 kPa ○ 3% STRAIN AT FAILURE					
Advanced auger probe at sta. 15+677.5 (1.5 m N of borehole), auger refusal at 2.0 m. Changed to standard augers, advanced probe to 2.1m - refusal.								WATER LEVEL RECORDS Date (dd/mm/yy)/Time Water Depth (m) Cave In (m) 1) - ▽ - <input checked="" type="checkbox"/> 2) - ▽ - <input type="checkbox"/> 3) - ▽ - <input type="checkbox"/>					
The stratification lines represent approximate boundaries. The transition may be gradual.													

MEL-GEO 09181 - SITE A - BOREHOLE LOGS.GPJ MEL-GEO.GDT 10/11/15



METRIC

RECORD OF BOREHOLE NO. A-3

REFERENCE 09/10/09181A DATUM Geodetic LOCATION N 5329380.04 E 364634.17 - Eby Township ORIGINATED BY JL
 PROJECT GWP 162-98-00, Highway 11 - MEL Site A BOREHOLE TYPE CME 45B - Hollow Stem Augers COMPILED BY RG
 CLIENT AECOM Inc. DATE (Started/Completed) 10/1/20 - 10/1/20 TIME 10:40:00 AM CHECKED BY MAM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W _P	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES								
307.4	Ground Surface												
0.0	PEAT - black fine fibrous peat trace fine sand trace gravel		1	AS	N/A		307						
306.6													
0.8	SILT - light brown silt with clay (loose/compact)		2	SS	9		306						0 0 79 21
			3	SS	11								
			4	SS	6		305						
304.4													
3.1	SILTY CLAY - grey silty clay, silt content varies with depth (stiff)		5	SS	WH		304						0 1 61 38
303.4													
4.0	SAND - brown fine to medium sand some gravel some silt (very dense)		6	SS	83		303						
			7	SS	62								16 65 (19)
301.5							302						
5.9	DCPT Refusal Auger Refusal End of Borehole												

WATER LEVEL RECORDS	
Date (dd/mm/yy)/Time	Water Depth (m)
1) 10/1/20 10:40:00 AM	1.1
2)	-
3)	-

COMMENTS

The stratification lines represent approximate boundaries. The transition may be gradual.

+ 3, X 3 : Numbers on right refer to Sensitivity
 Numbers on left refer to values greater than 120 kPa
 ○ 3% STRAIN AT FAILURE

MERLEX ENGINEERING LTD.

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MEL-GEO 09181 - SITE A - BOREHOLE LOGS.GPJ MEL-GEO.GDT 10/11/15



ABBREVIATIONS FOR BOREHOLE SURVEY DATA SHEETS

Accep	Acceptable	Gry	Grey	Psty	Polystyrene
Agg	Aggregate	H	Heavy	Poss	Possible
Amor	Amorphous	Hi	Highly	PST	Prime & Surface Treated
Asph	Asphalt	HP	High Plasticity	Quant	Quantity
AP	Auger Probe	HM	Hot Mix	Reinf	Reinforced
BR	Bedrock	Lt	Light	RSS	Remoulded Shear Strength
Blk	Black	Liq	Liquid	RF	Rock Fill
Bl	Blue	W_L	Liquid Limit	Sa	Sand
BH	Borehole	Lo	Loam	Sat	Saturated
Bld (y)	Boulder (y)	L	Loose	SH	Shale
Blds	Boulders	Mrl	Marl	St	Sensitivity
BU	Break Up	Matl	Material	SSM	Select Subgrade Material
Br	Brown	Max	Maximum	Sh Rk	Shot Rock
CF	Channel Face	MDD	Maximum Dry Density	Si (y)	Silt (y)
Cl	Clay	MWD	Maximum Wet Density	Sl (y)	Slight (ly)
Co	Coarse	Med	Medium	SP	Slight Plasticity
Cob	Cobbles	MP	Medium Plasticity	Stn (y)	Stoney
Comp	Compact	Mod	Moderate	D_R	Relative Density
Conc	Concrete	Mott	Mottled	Stks	Streaks
Contam	Contaminated	Mul	Mulch	Surf	Surface
Cord	Corduroy	NFP	No Further Progress	Temp	Temperature
Cr	Crushed	NFP (Blds)	No Further Progress (Boulders)	TH	Test Hole
Dk	Dark	Num	Numerous	TP	Test Pit
Decomp	Decomposed	Occ	Occasional	Tps	Topsoil
D	Datum	Wopt	Optimum Moisture Content	Tr	Trace
E	Earth	Ora	Orange	USS	Undisturbed Shear Strength
Fib	Fibrous	Org	Organic	Unreinf	Unreinforced
w	Field Moisture Content	Org M	Organic Matter	Varv	Varved
F	Fine	Ob	Overburden	VF	Very Fine
Fr Wat	Free Water	Pavt	Pavement	WT	Water Table
FB	Frost Boil	Pedo	Pedological	Weath	Weathered
FH	Frost Heave	Pen Mac	Penetration Macadam	W	With
Gran	Granular	Wp	Plastic Limit	Wd (y)	Wood (y)
Gr	Gravel (ly)	Ip	Plasticity Index	Yel	Yellow
Grn	Green				

Boring No. 1

15+667 7 Rt C/L

0 - 1.7 Med Sa Tr Gr Tr Si Occ Cob
1.7 - 3.0 RF
3.0 - 6.1 Si

Boring No. 2

15+669 7 Rt C/L

0 - 1.1 Med Sa Tr Gr Tr Si Occ Cob
1.1 - 3.7 RF
3.7 - 6.1 Si

Boring No. 3

15+671 7 Rt C/L

0 - 1.4 Med Sa Tr Gr Tr Si Occ Cob
1.4 - 3.7 RF
3.7 - 6.1 Si

Boring No. 4

15+673 7 Rt C/L

0 - 2.3 Med Sa Tr Gr Tr Si Occ Cob
2.3 - 5.2 RF
5.2 - 6.1 Si

Boring No. 5 (Directly over culvert)

15+675 7 Rt C/L

0 - 1.4 Med Sa Tr Gr Tr Si Occ Cob
1.4 NFP RF

Boring No. 6

15+677 7 Rt C/L

0 - 1.4 Med Sa Tr Gr Tr Si Occ Cob
1.4 - 4.9 RF
4.9 - 6.1 Si

Boring No. 7

15+679 7 Rt C/L

0 - 1.2 Med Sa Tr Gr Tr Si Occ Cob
1.2 - 4.9 RF
4.9 - 6.1 Si

Boring No. 8

15+681 7 Rt C/L

0 - 900 Med Sa Tr Gr Tr Si Occ Cob
900 - 2.4 RF
2.4 - 6.1 Si

Boring No. 9

15+683 4.5 Rt C/L

0 - 1.2 Med Sa Tr Gr Tr Si Occ Cob
1.2 - 2.4 RF
2.4 - 6.1 Si

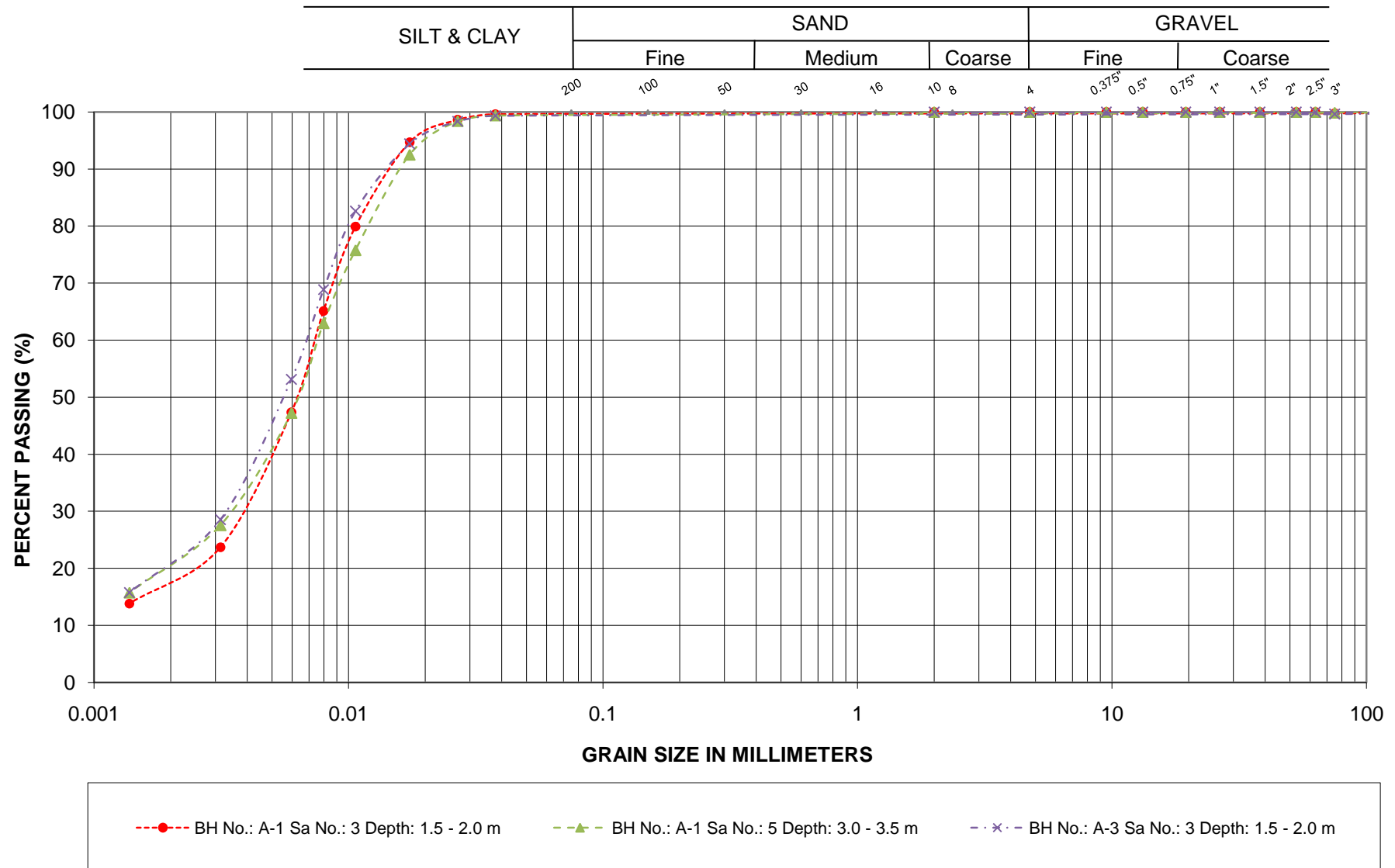
Note: Ground surface elevation 310.7 m at 7 m
Rt of C/L

APPENDIX C

Figure No. A-1:	Borehole Locations & Soil Strata
Figure Nos. L-1 to L-3:	Summary Grain Size Analysis Graph
Figure No. L-4:	Plasticity Chart



GRAIN SIZE ANALYSIS

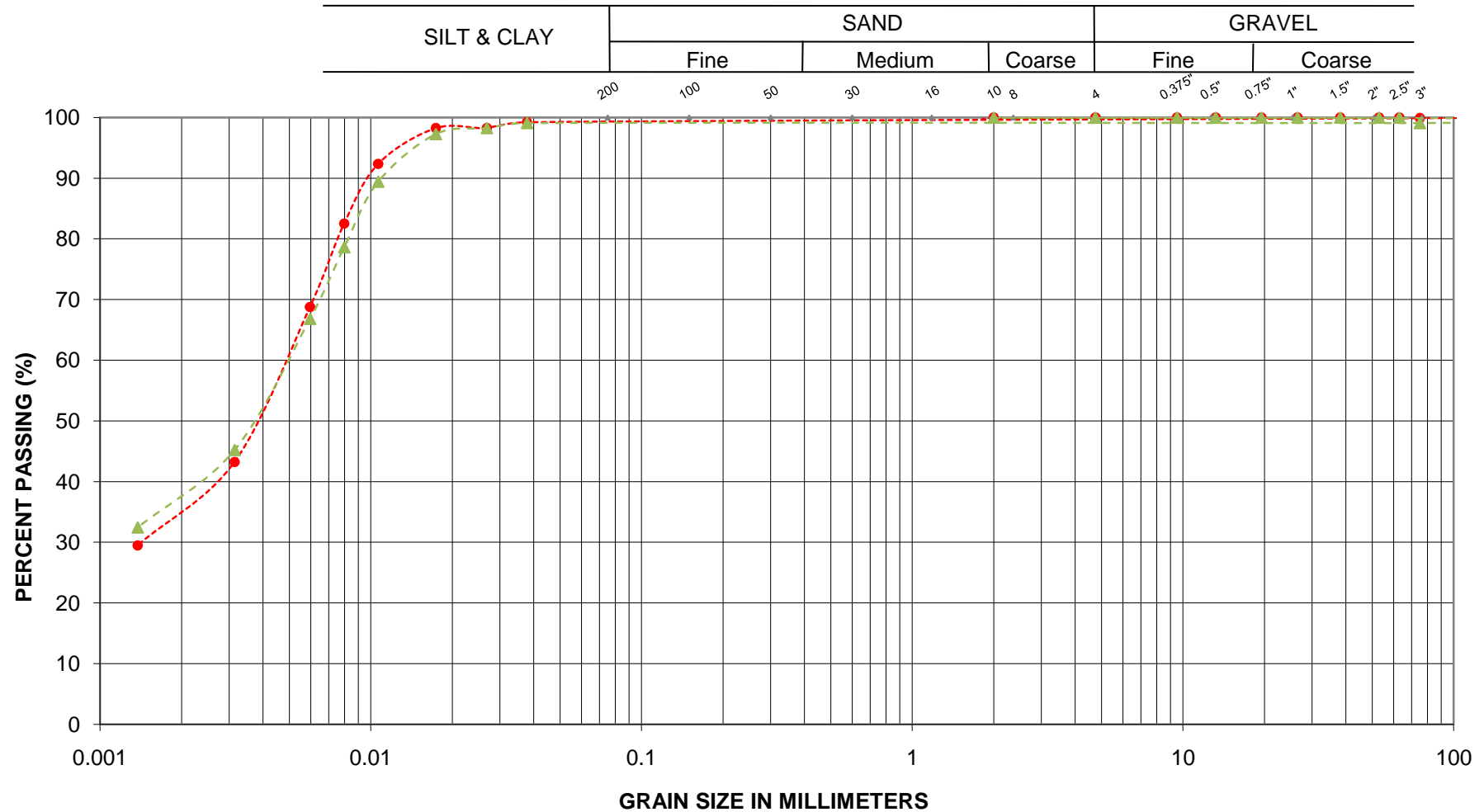


PROJECT: G.W.P. 162-98-00
LOCATION: Hwy 11 MEL Site A

SILTS - Silt, Some to With Clay

MERLEX ENGINEERING LTD.

FIGURE L-1

**GRAIN SIZE ANALYSIS**

---●--- BH No.: A-1 Sa No.: 7 Depth: 4.6 - 5.0 m

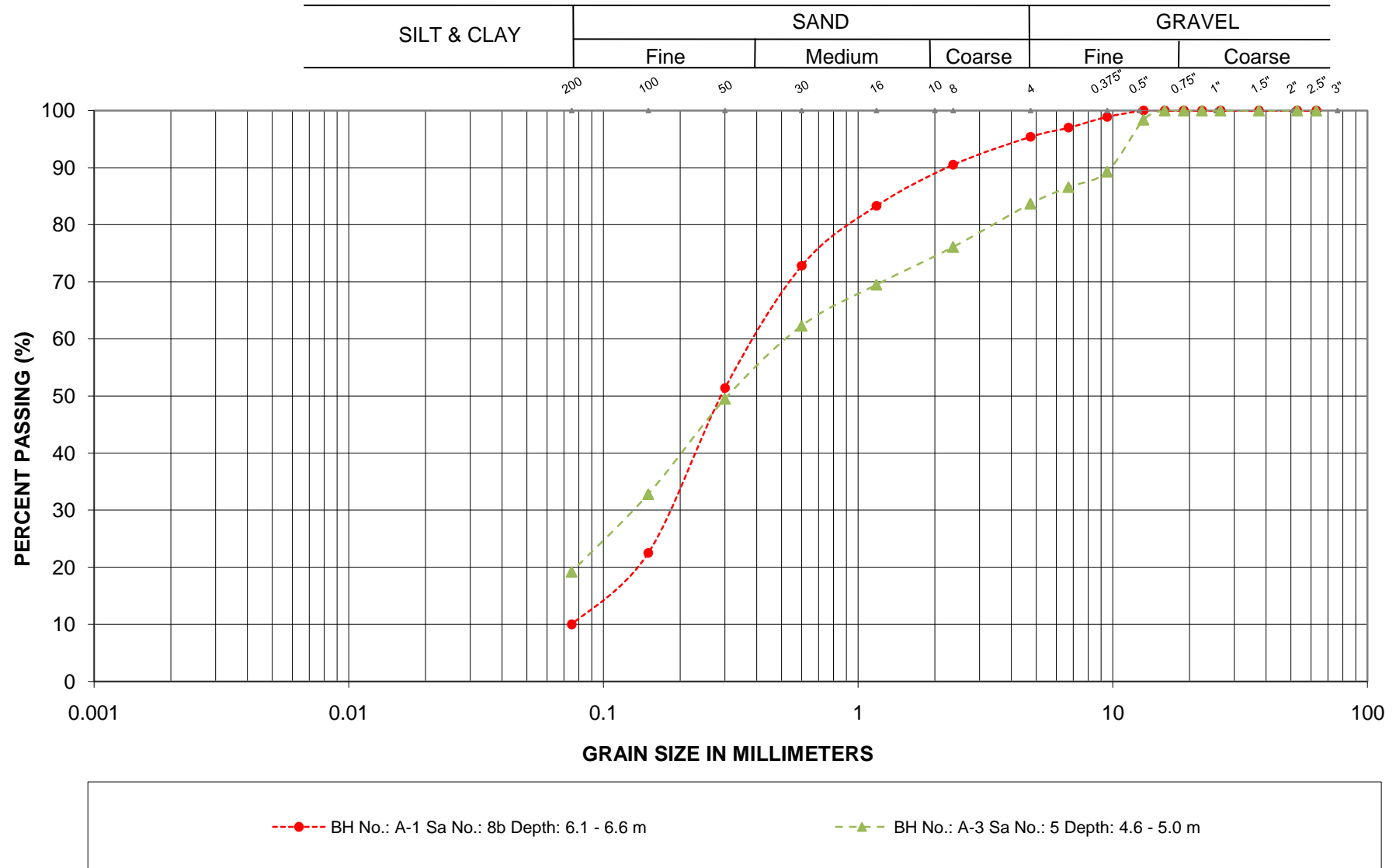
---▲--- BH No.: A-3 Sa No.: 5 Depth: 3.0 - 3.5 m

PROJECT: G.W.P. 162-98-00
LOCATION: Hwy 11 MEL Site A

SILTY CLAY - Silty Clay

MERLEX ENGINEERING LTD.

FIGURE L-2

**GRAIN SIZE ANALYSIS**

PROJECT: G.W.P. 162-98-00
 LOCATION: Hwy 11 MEL Site A

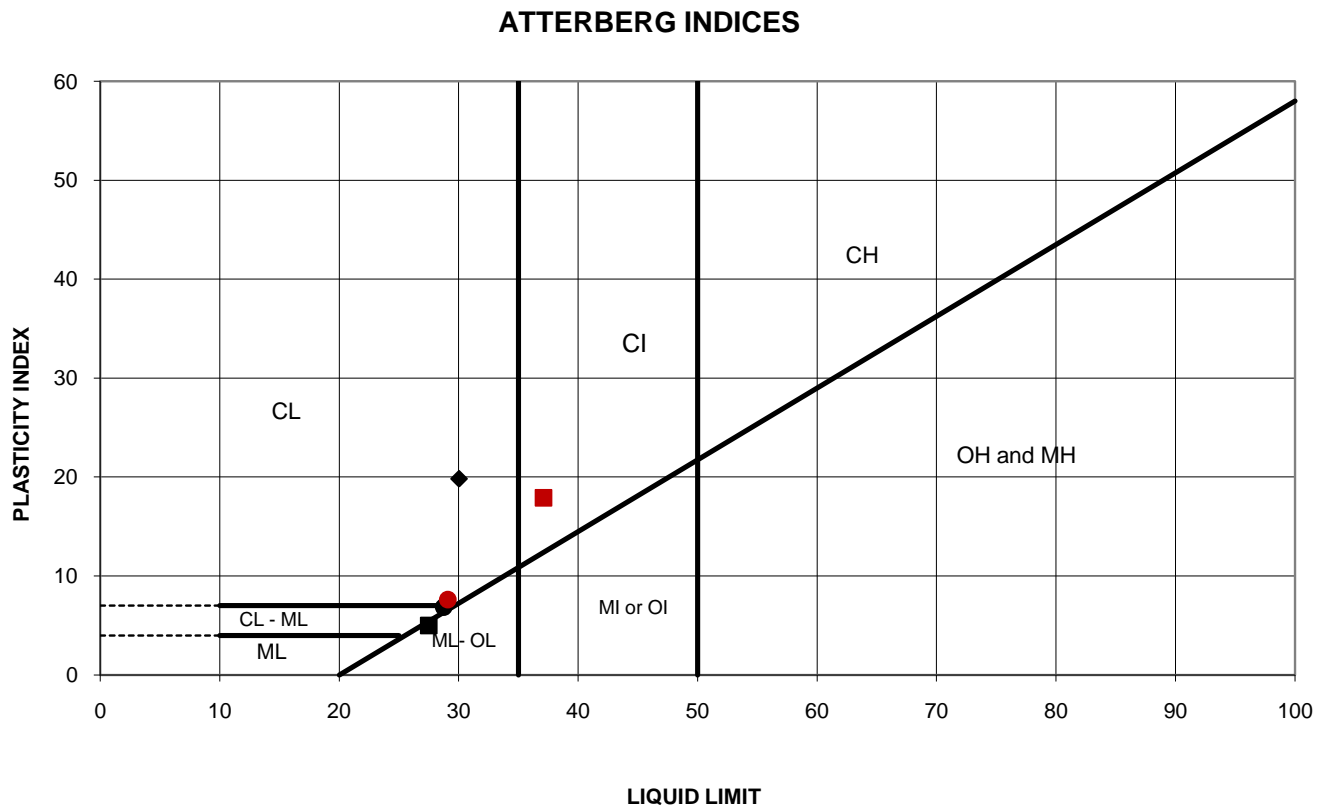
SANDS - Fine to Medium Sand Trace to Some Gravel, Trace to Some Silt

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FIGURE L-3

ATTERBERG LIMITS TEST RESULTS

FIGURE L- 4



SYMBOL	BH	Sa. No.	Depth(m)	Elev.(m)	Plasticity Index	Plastic Limit	Liquid Limit	NMC %
●	A-1	3	1.5	306.5	6.8	21.9	28.7	27.8
■	A-1	5	3.1	305.0	5.0	22.5	27.5	30.0
●	A-3	3	1.5	305.9	7.6	21.5	29.1	27.6
◆	A-1	7	4.6	303.4	19.8	10.2	30.0	35.8
■	A-3	5	3.1	304.4	17.9	19.2	37.1	32.6

Date: Nov-10
 Project: Hwy 11, Eby Twp - MEL Site A

Prep'd: AT
 Chkd: MAM
 Ref. No.: 09/10/09181A

APPENDIX D

Photos Nos. 1 to 3:

Culvert Photos

Enclosure No. 6:

Probe Boring Profile



Location of Culvert Inlet – East Embankment - Site A

Photo: 1



Culvert Outlet – Site A

Photo: 2




Reference No.: 09/10/09181A

Project: Hwy 11 – Township of Eby, Culvert Replacement Station 15+675, MEL Site A

Originated By: JL

Date: September 14, 2010



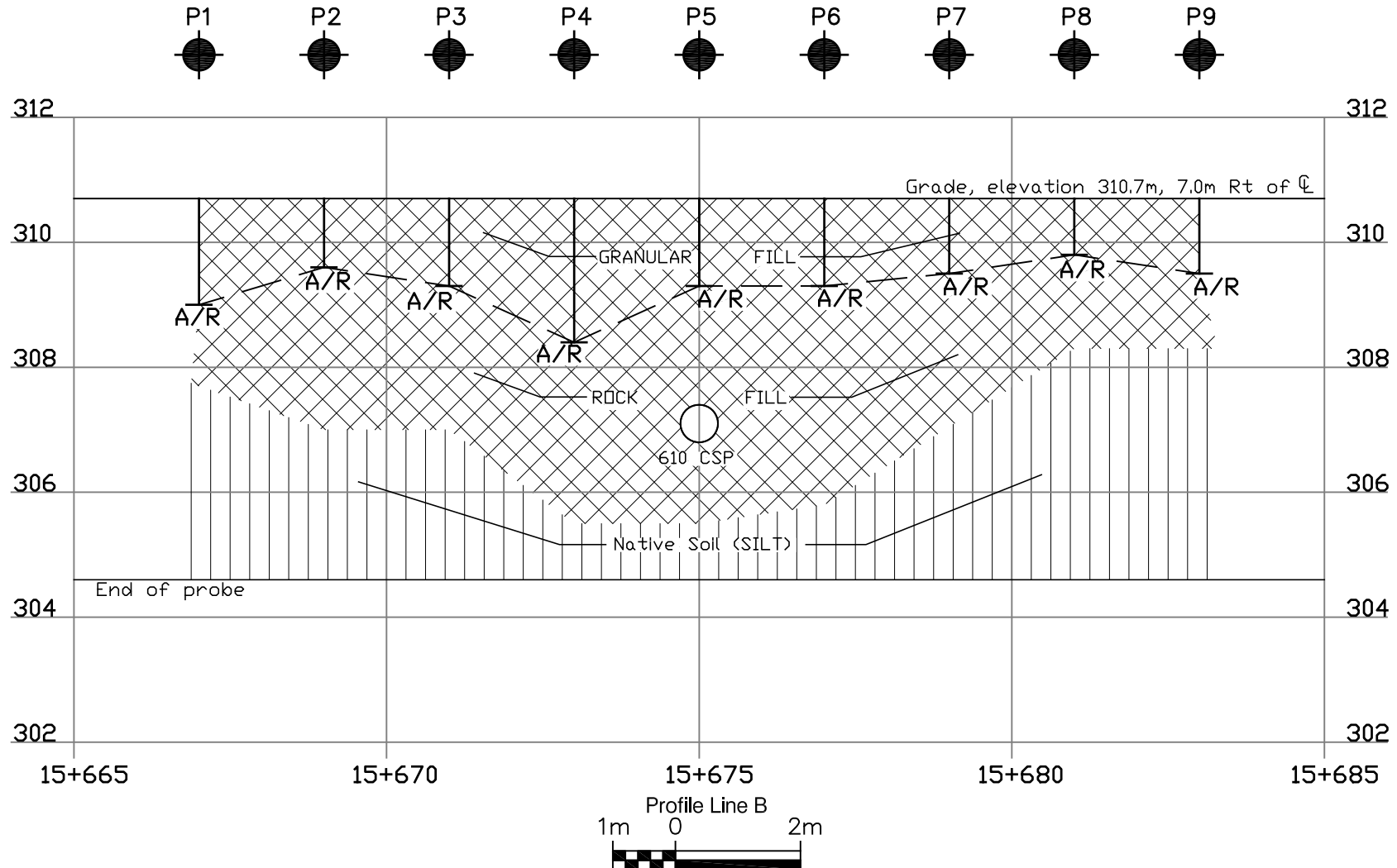
Location of Culvert Outlet – West Embankment, Site A	Photo: 3
	
Reference No.: 09/10/09181A Project: Hwy 11 – Township of Eby, Culvert Replacement Station 15+675, MEL Site A	Originated By: JL Date: September 14, 2010

METRIC

Dimensions are in meters
and/or millimeters unless
otherwise shown. Stations are
in kilometers + meters.



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Consulting Geotechnical Engineers



Note: Probe holes advanced by auger to
auger refusal (A/R). Further advanced
through rock fill into native silt with
percussion rock drill.