

**Submitted To AECOM Canada Ltd.
189 Wyld Street Suite 103, North Bay, Ontario P1B 1Z2
On Behalf of the Ontario Ministry of Transportation**

**Unnamed Creek Culvert Replacement
Site No. 47-413C
Stations 17+380 - Township of Boston
GWP 5105-12-00
Highway 112
4.7 km north of Blanche River**

FINAL FOUNDATION INVESTIGATION REPORT

Date: March 31, 2015
Ref. Nº: 13/05/13073-F11

Geocres No. 42A-101





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Final Foundation Investigation Report

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TABLE OF CONTENTS

1 INTRODUCTION	1
2 SITE DESCRIPTION	1
2.1 Site Physiography and Surficial Geology	1
3 INVESTIGATION PROCEDURES	2
4 SUBSURFACE CONDITIONS	3
4.1 Culvert Station 17+380, Township of Boston.....	3
4.1.1 <i>Pavement Structure</i>	3
4.1.2 <i>Granular Fill</i>	3
4.1.3 <i>Silty Clay</i>	4
4.2 Dynamic Cone Penetration Testing	4
4.3 Groundwater Data.....	4

Appendices

Appendix 1	Key Plan
Appendix 2	Subsurface Data
Appendix 3	Borehole Plan and Laboratory Data
Appendix 4	Photo Essay

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Test results mentioned herein are only valid for the sample(s) stated in this report.

LVM Inc.'s subcontractors who may have accomplished work either on site or in laboratory are duly qualified as stated in our Quality Manual's procurement procedure. Should you require any further information, please contact your Project Manager."

Client:

AECOM Canada Ltd.
189 Wyld Street, Suite 103
North Bay, Ontario
P1B 1Z2
Attention: **Mr. Al Rose**

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1 hard copy	File

1 INTRODUCTION

LVM-Merlex, a division of Englobe Corp., has been retained by AECOM Canada Ltd., on behalf of the Ministry of Transportation of Ontario (MTO), to carry out a foundation investigation at the site of an existing centerline culvert. The site is located at Station 17+380 on Highway 112, some 7.5 km north of Highway 11 (4.7 km north of the Blanche River Bridge), in the Township of Boston.

The foundation investigation location was specified by the MTO in the Terms of Reference for additional work under Agreement No. 5012-E-0025. The terms of reference for the scope of work are outlined in LVM-Merlex Ltd.'s Proposal 13/05/13073-F11-R2, dated May 26, 2014 (approved on July 23, 2014). The purpose of this investigation was to determine the subsurface conditions in the area of the culvert. LVM-Merlex investigated the foundation area by the drilling of boreholes, carrying out in-situ tests, and performing laboratory testing on select samples.

2 SITE DESCRIPTION

The topography at the site is a low moderately sloped valley area along an unnamed creek. The existing highway supports two undivided lanes of highway, generally running from the south to the north direction. For the purposes of this project, Highway 112 is considered to be orientated in a south-north direction.

The local topography at the site is a low wetland to the left and right of the embankment. The existing highway embankment currently supports two undivided lanes of highway, locally running in an east to west direction. The existing highway, at the culvert location, is constructed on a granular fill embankment some 5 m in height above the stream bed, with centerline elevation of 271.9 m at the culvert location. The culvert at this location has been described as 3048 x 2438 x 21.76 Structural Plate Corrugated Steel Pipe Arch (SPCSPA) culvert. Flow through the culvert is from the east to the west (right to left). A beaver dam was present at about 10 m upstream of the culvert inlet as described in a publication titled "Hydrology and Hydraulics Report Final" prepared by McCormick Rankin in December 2013. The beaver dam was also observed during the period of foundation investigation (see Photo Essay, Appendix 4).

2.1 Site Physiography and Surficial Geology

This project is located in the Geomorphic Sub-province known as the Temiskaming Clay Plain. The topography on this section of Highway 112 is generally flat to slightly rolling. Organic terrain was also observed. Within the specific project area overburden consists primarily of silts and clays. The crossing is approximately 150 m upstream of the watercourse outlet into Round Lake. Bedrock in the area, as indicated on Ontario Geological Survey (OGS) Map 2506, is of the late to middle Precambrian consisting of carbonatite, nepheline and alkalic syenites, fenite and associated mafic and ultramafic rocks.

3 INVESTIGATION PROCEDURES

The field work for this investigation was carried out during the period of September 22nd to October 7th, 2014 during which time four (4) sampled boreholes, were advanced. Two (2) boreholes were advanced through the existing embankment at the culvert location, and a single borehole was advanced at location close to each of the inlet (east) and outlet (west) ends of the culverts.

The field investigation was carried out using a truck and bombardier mounted CME drilling rig equipped with hollow stem augers, standard augers, casing equipment and routine geotechnical sampling equipment. Soil samples were obtained at the borehole locations 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). The SPT method involves advancing a 50 mm O.D. split spoon sampler with the force of a 63.5 kg hammer freely dropping 760 mm. The number of blows per 300 mm penetration was recorded as the "N" value. At select 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 field 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.

Groundwater conditions in the open boreholes were observed during the advancement of and immediately following, completion of the individual boreholes. Two 19 mm diameter standpipes were installed in selected open boreholes prior to backfilling to allow for further monitoring of the shallow groundwater levels. 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 in accordance with requirements of Ontario Regulation 903. At the borehole(s) through the embankment, the upper portion of the hole, where necessary, was backfilled with an asphalt cold patch to seal the existing asphalt surface.

The fieldwork for this investigation was under the full time direction of a senior member of the LVM-Merlex 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 2), with a summary of results presented on the laboratory sheets in Appendix 3 (Figures Nos. L-1 to L-4 and Table No. L-5).

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 boring locations. Elevations contained in this report are referenced to a geodetic datum which was established by others. The borehole elevations are based on a survey carried out by others.

4 SUBSURFACE CONDITIONS

Details of the subsurface conditions revealed by the investigation program are presented on the enclosed Record of Borehole Logs (Appendix 2) and on Drawing No. 2 (Appendix 3). 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, plus field observations. Typically such boundaries represent transitions from one zone to another and are not an exact demarcation of 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 illustration purposes only.

4.1 Culvert Station 17+380, Township of Boston

A plan and profile illustrating the borehole locations and stratigraphic sequences is shown on Drawing No. 2, Appendix 3. During the course of the exploration program, four (4) sampled boreholes were put down at this site, with Borehole Nos. 1 and 2 advanced through the embankment, Borehole No. 3 advanced close to the culvert inlet, and Borehole No. 4 advanced next to the culvert outlet. At the time of the subsurface investigation, the ground surface elevations at Boreholes Nos. 1 to 4 were recorded at elevations 271.8, 271.8, 268.6, and 268.5 m, respectively.

4.1.1 Pavement Structure

Borehole No. 1 was advanced through the embankment where a pavement structure consisting of 76 mm asphalt and 229 mm crushed gravel underlain by 76 mm asphalt and 152 mm crushed gravel was penetrated. Borehole No. 2 was advanced through the embankment where a pavement structure consisting of 127 mm asphalt and 279 mm crushed gravel was penetrated.

4.1.2 Granular Fill

Underlying the pavement structure at Borehole Nos. 1 and 2, a layer of granular fill consisting of brown sand with gravel to gravelly trace silt was penetrated. The natural moisture content measured on samples of this deposit was in the order of 4 to 8%. Gradation analyses were carried out on four (4) sample of this deposit, the results of which indicated 27 to 34% gravel size particles, 58 to 65% sand size particles, and 8 to 10% silt and clay size particles (Figure No. L-1 in Appendix 3). Results of gradation analyses for the two boreholes indicate that the granular fill generally meets the requirements of Granular "B" Type I stated in OPS.PROV 1010

except the fine content passing 75 μm for Samples Nos. 1 and 5 of Borehole No. 2. The fine content is 9 % to 10%, which slightly exceed the OPS.PROV 1010 limit of 8%.

Based on SPT 'N' values of 17 to 45 blows per 300 mm penetration, the compactness of this deposit was described as compact to dense. This deposit was encountered to depths of 2.9 m and 3.7 m below grade at Borehole Nos. 1 and 2 respectively (elevations 268.9 m and 268.1 m, respectively).

4.1.3 Silty Clay

Underlying the granular fill at Boreholes Nos. 1 and 2, and at ground surface at Borehole Nos. 3 and 4, a silty clay deposit described as grey silty clay, occasional gravel, grass rootlets and wood pieces, varved with clay was encountered to the depths at which sampling was terminated (8.4 m to 16 m below ground surface). The nature moisture contents of the silty clay samples ranges from about 30% to 67%. Results of grain size distribution hydrometer testing carried out on seven (7) samples recovered from Boreholes Nos. 1 to 4 are shown on Figure No. L-2, Appendix 3. Results of Atterberg limits testing carried out on seven (7) samples in Boreholes Nos. 1 to 4 gave Liquid Limits of some 35% to 61% and Plastic Limits of some 20% to 26% to give correspondent Plasticity Index ranging from some 15% to 40% (see Figure No. L-3, Appendix 3). The results of the Atterberg Limits testing indicated this material is classified as silty clay of medium plasticity (CI) to clay of high plasticity (CH).

Standard penetration tests carried out within the silty clay deposit returned "N" values ranging from 0 to 8 blows per 300 mm of penetration. Based on the in-situ shear strength testing, which returned values ranging from 66 kPa to 28 kPa, this deposit was described as stiff to soft, generally firm consistency, medium to sensitive with sensitivities ranging from 2 to 7. The shear strengths generally decreased with depth in this deposit, to the depth sampled (see Figure No. L-4, Appendix 3). Regular sampling was terminated within this deposit at a depth of 16 m, 16 m, 8.4 m, 8.4 m below ground surface at Boreholes Nos. 1 to 4 (Elevations 255.8 m, 255.8 m, 260.2m and 260.1 m, respectively).

4.2 Dynamic Cone Penetration Testing

A dynamic cone penetration test (DCPT) was advanced from the sampled bottom of Borehole No. 3. DCPT refusal was encountered at a depth 19.1 m below ground surface (Elevation 249.6 m). Based on the response of the DCPT advance, it is estimated that the native soils are a continuation of the silty clay, to within about 1 m above the refusal depth.

4.3 Groundwater Data

At the time of this investigation (October 7, 2014), the water level in the creek was measured at elevation 268.0 m.

Measurements of the groundwater table and cave-in levels were undertaken, where possible, in the open boreholes during the advance of the individual borings and upon completion. Two standpipes were installed in Borehole Nos. 2 and 4 to obtain post borehole completion water levels. The groundwater level in the standpipe at Borehole No.2 appears stable at elevation

269.2 m after 14 days. However, the groundwater level in the standpipe at Borehole No. 4 does not appear to have stabilized. These levels are recorded on the individual Record of Borehole Log Sheets (Appendix 2).

The groundwater and river water levels will fluctuate seasonally/yearly.

Appendix 1 Key Plan

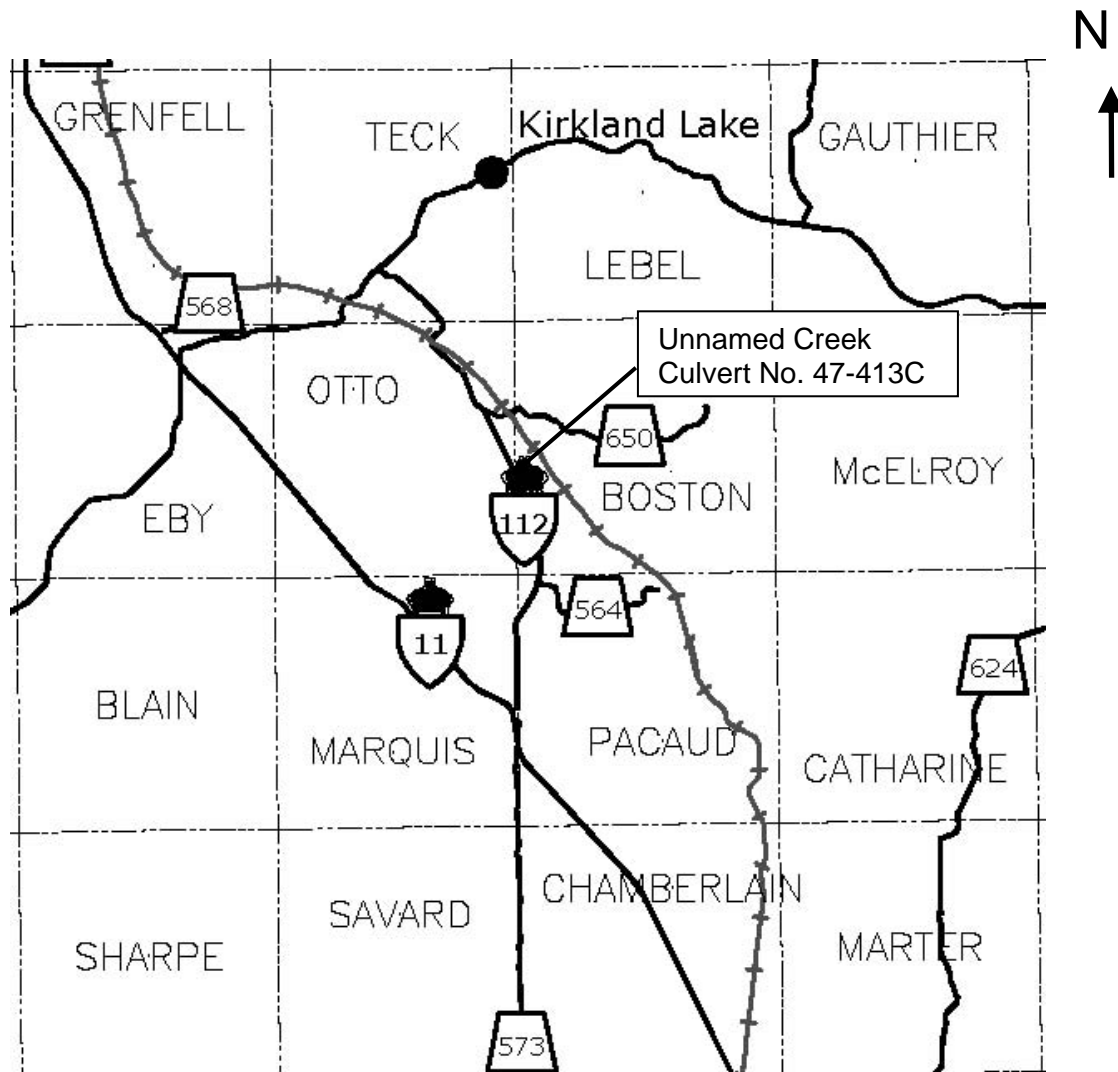
Drawing No. 1

Key Plan

MACRO KEY PLAN

Drawing No.1

NOT TO SCALE



FINAL FOUNDATION INVESTIGATION REPORT

GWP 5105-12-00

Highway 112

Unnamed Creek Culvert



Reference No: 13/05/13073-F11

March 2015

Appendix 2 Subsurface Data

Enclosure No. 1	List of Abbreviations and Symbols
Enclosure Nos. 2 to 5	Record of Borehole Sheet

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
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
WS	Wash Sample
WH	Sampler advanced by static weight of hammer and/or rods
Rec	% recovery from individual run of rock core
RQD	Rock quality designation (%)

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 60° cone attached to AW rod 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

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

3. SOIL DESCRIPTION (Cont'd)

c) Cohesive Soils:

RQD (%)	Classification
Less than 25	Very poor quality
25 to 50	Poor quality
50 to 75	Fair quality
75 to 90	Good quality
90 to 100	Excellent quality

d) 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.

e) Soil Moisture:

Moisture	Described as
Dry	Below optimum moisture content
Moist	Near optimum moisture content
Wet	Above optimum moisture content

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%

Terminology for cobbles and boulders is based on auger response and field observations:

Occasional	Obstructions encountered in borehole, however advance is not impeded
Numerous	Obstructions are essentially continuous over drilled length

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. 1



REFERENCE	13/05/13073-F11	DATUM	Geodetic	LOCATION	N 5322094.9 E 378548.5 - Boston Township, Station 17+405	ORIGINATED BY	JL
PROJECT	GWP 5105-12-00, Highway 112 - Unnamed Creek			BOREHOLE TYPE	Truck Mounted CME 45 - Hollow Stem Augers	COMPILED BY	SH
CLIENT	AECOM Inc.	DATE (Started)	22 September 2014	TIME		CHECKED BY	MAM
		DATE (Completed)	22 September 2014	(Completed)	4:45:00 PM		

[illegible]

MEL-GEO 13073-F11 - BOREHOL LOGS - DRAFT.GPJ MEL-GEO.GDT 10/3/15

METRIC**RECORD OF BOREHOLE NO. 1**

REFERENCE 13/05/13073-F11 DATUM Geodetic LOCATION N 5322094.9 E 378548.5 - Boston Township, Station 17+405 ORIGINATED BY JL
 PROJECT GWP 5105-12-00, Highway 112 - Unnamed Creek BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY SH
 CLIENT AECOM Inc. DATE (Started) 22 September 2014 TIME
 DATE (Completed) 22 September 2014 (Completed) 4:45:00 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	SHEAR STRENGTH kPa					
	Continued from Previous Page												
			12	SS	PM								
			13	SS	PM								
			14	SS	PM								
			15	SS	PM								
255.8 16.0	End of Sampling End of Borehole												

MEL-GEO 13073-F11 - BOREHOLE LOGS - DRAFT.GPJ MEL-GEO.GDT 10/3/15

METRIC**RECORD OF BOREHOLE NO. 2**

REFERENCE 13/05/13073-F11 DATUM Geodetic LOCATION N 5322096.1 E 378537.7 - Boston Township, Station 17+413 ORIGINATED BY JL
 PROJECT GWP 5105-12-00, Highway 112 - Unnamed Creek BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY SH
 CLIENT AECOM Inc. DATE (Started) 23 September 2014 TIME 23 September 2014 (Completed) 2:00:00 PM CHECKED BY MAM

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT W _p NATURAL MOISTURE CONTENT W LIQUID LIMIT W _L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES						
271.8	Ground Surface										
0.0	127 mm Asphalt 279 mm Crushed Gravel		1	SS	23						28 64 (9)
	FILL - sand with gravel trace silt brown (compact/dense)		2	SS	37						
			3	SS	40						
			4	SS	43						
			5	SS	22						27 63 (10)
268.1	SILTY CLAY trace sand occasional gravel, grass rootlets and wood pieces		6	SS	4						
3.7	grey (stiff)		7	TO	WH						
	(firm)		8	TO	PM						0 0 25 75
	varved clay at depths between 9.1 m and 16 m		9	SS	PM						
			10	TO	PM						
			11	SS	PM						
	Continued Next Page										
COMMENTS							+ 3, × 3 : Numbers on right refer to Sensitivity Numbers on left refer to values greater than 120 kPa ○ 3% STRAIN AT FAILURE				
							WATER LEVEL RECORDS Date (dd/mm/yy)/Time Water Depth (m) Cave In (m) 1) 23/9/14 2:00:00 PM Dry - 驗 2) 7/10/14 3:30:00 PM 2.6 - - 3) - - -				

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

LVM-Merlex, a Division of EnGlobe Corp.

120 Progress Court, North Bay, On P1A 0C2 Phone: (705)476-2550 Fax: (705)476-8882 Email: northbay@lvm.ca

MEL-GEO 13073-F11 - BOREHOLE LOGS - DRAFT.GPJ MEL-GEO.GDT 10/3/15

METRIC**RECORD OF BOREHOLE NO. 2**

REFERENCE 13/05/13073-F11 DATUM Geodetic LOCATION N 5322096.1 E 378537.7 - Boston Township, Station 17+413 ORIGINATED BY JL
 PROJECT GWP 5105-12-00, Highway 112 - Unnamed Creek BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY SH
 CLIENT AECOM Inc. DATE (Started) 23 September 2014 TIME 23 September 2014
 DATE (Completed) 23 September 2014 (Completed) 2:00:00 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	SHEAR STRENGTH kPa					
	Continued from Previous Page												
			12	SS	PM								
			13	SS	PM								
			14	SS	PM								
			15	SS	PM								
255.8 16.0	End of Sampling End of Borehole												

MEL-GEO 13073-F11 - BOREHOLE LOGS - DRAFT.GPJ MEL-GEO.GDT 10/3/15

METRIC

RECORD OF BOREHOLE NO. 3



REFERENCE	<u>13/05/13073-F11</u>	DATUM	<u>Geodetic</u>	LOCATION	<u>N 5322110.1 E 378552.6 - Boston Township, Station 17+413</u>	ORIGINATED BY	<u>JL</u>
PROJECT	<u>GWP 5105-12-00, Highway 112 - Unnamed Creek</u>			BOREHOLE TYPE	<u>Track Mounted CME 45 - Hollow Stem Augers</u>	COMPILED BY	<u>SH</u>
CLIENT	<u>AECOM Inc.</u>	DATE (Started)	<u>7 October 2014</u>	TIME (Completed)	<u>12:00:00 PM</u>	CHECKED BY	<u>MAM</u>
		DATE (Completed)	<u>7 October 2014</u>				

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC LIMIT W _p	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W _L	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)						
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES		ELEVATION SCALE	SHEAR STRENGTH kPa							WATER CONTENT (%)					
								○ UNCONFINED	+ FIELD VANE						● QUICK TRIAXIAL	× LAB VANE				
268.6	Ground Surface						20	40	60	80	100	20	40	60						
0.0	SILTY CLAY trace sand occasional grass rootlets Brown (stiff) dark grey grey (firm) varved clay at depths between 2.3 m and 8.4 m		1	SS	4															
			2	SS	WH															
			3	SS	PM															
			4	SS	PM															
			5	SS	PM															
			6	SS	PM															
			7	SS	PM															
			8	SS	PM															
			9	SS	PM															
260.2	End of Sampling Continuation of DCPT																			
8.4																				
Continued Next Page																				
COMMENTS							+ 3, × 3 : Numbers on right refer to Sensitivity Numbers on left refer to values greater than 120 kPa							WATER LEVEL RECORDS						
After pulling AW rods, after driving DCPT, water observed rising in hollow stem augers. Upon reversing augers to plug hole and pulling 3 m of augers, artesian flow stopped. Borehole fully plugged with clay and 3 bags of bentonite.							○ 3% STRAIN AT FAILURE							Date (dd/mm/yy)/Time			Water Depth (m)		Cave In (m)	
														1) 7/10/14 12:00:00 PM			0		0.91	
														2) -			-		-	
The stratification lines represent approximate boundaries. The transition may be gradual.														3) -			-			

MEL-GEO 13073-F11 - BOREHOLE LOGS - DRAFT.GPJ MEL-GEO.GDT 10/3/15

METRIC**RECORD OF BOREHOLE NO. 3**

REFERENCE 13/05/13073-F11 DATUM Geodetic LOCATION N 5322110.1 E 378552.6 - Boston Township, Station 17+413 ORIGINATED BY JL
 PROJECT GWP 5105-12-00, Highway 112 - Unnamed Creek BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers COMPILED BY SH
 CLIENT AECOM Inc. DATE (Started) 7 October 2014 TIME
 DATE (Completed) 7 October 2014 (Completed) 12:00:00 PM CHECKED BY MAM

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT W _p W W _L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m ³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
ELEV. DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE						
	Continued from Previous Page									
258										
257										
256										
255										
254										
253										
252										
251										
250										
249.6										
19.1	DCPT Refusal End of Borehole									

MEL-GEO 13073-F11 - BOREHOLE LOGS - DRAFT.GPJ MEL-GEO.GDT 10/3/15

METRIC**RECORD OF BOREHOLE NO. 4**

REFERENCE 13/05/13073-F11 DATUM Geodetic LOCATION N 5322081.8 E 378532.3 - Boston Township, Station 17+407 ORIGINATED BY JL
 PROJECT GWP 5105-12-00, Highway 112 - Unnamed Creek BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers COMPILED BY SH
 CLIENT AECOM Inc. DATE (Started) 7 October 2014 TIME
 DATE (Completed) 7 October 2014 (Completed) 3:30:00 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								
268.5	Ground Surface												
0.0	SILTY CLAY trace sand dark Brown, occasional grass rootlets wood encountered at depth of 1.2 m (stiff)		1	SS	5		268						
			2	SS	3								
	grey												
	(firm)		3	SS	PM		267						
	varved clay at depths between 3.8 m and 8.4 m		4	SS	PM		266						
			5	SS	PM		265						
			6	SS	PM		264						
			7	SS	PM		263						
			8	SS	PM		262						
			9	SS	PM		261						
260.1	End of Sampling End of Borehole												
8.4													

COMMENTS		+ 3, × 3 : Numbers on right refer to Sensitivity Numbers on left refer to values greater than 120 kPa		WATER LEVEL RECORDS	
Water level probably not stabilized				Date (dd/mm/yy)/Time	Water Depth (m)
				1) 7/10/14 3:50:00 PM	6.4
				2)	-
				3)	-

○ 3% STRAIN AT FAILURE

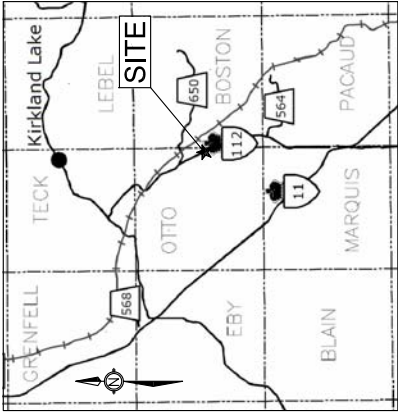
The stratification lines represent approximate boundaries. The transition may be gradual.





MEL-GEO 13073-F11 - BOREHOLE LOGS - DRAFT.GPJ MEL-GEO.GDT 10/3/15

Appendix 3 Borehole Plan and Laboratory Data

Drawing No. 2: Borehole Location and Soil Strata
Figure Nos. L-1 and L-2: Grain Size Distribution Curves
Figure No. L-3: Atterberg Limits Chart
Figure No. L-4: In-situ Shear Strengths Chart
Table No. L-5: Laboratory Tests - Summary Sheet

DISTRICT CONT. No. GWP No. 5105-12-00		
UNNAMED CREEK CULVERT BOSTON TOWNSHIP	DRAWING 2	METRIC
BOREHOLE LOCATIONS AND SOIL STRATA		



LEGEND				
	Borehole			
	Borehole w/ Dynamic Cone Penetration Test			
N	Blows/0.3 m (Std Pen Test, 475 J/blow)			
DPT	Blows/0.3 m (60° Cone, 475 J/blow)			
	Water Level at Time of Investigation			
A/R	Auger Refusal at Elevation			
E/S	End of Sampling			
	Piezometer			
BOREHOLE No.	ELEVATION	O/S	NORTHING	EASTING
1	271.8	3.4m Rt	5322094.9	378548.5
2	271.8	3.5m Lt	5322096.1	378537.7
3	268.6	17.0m Rt	5322110.1	378552.6
3	268.5	17.4m Lt	5322081.8	378532.3

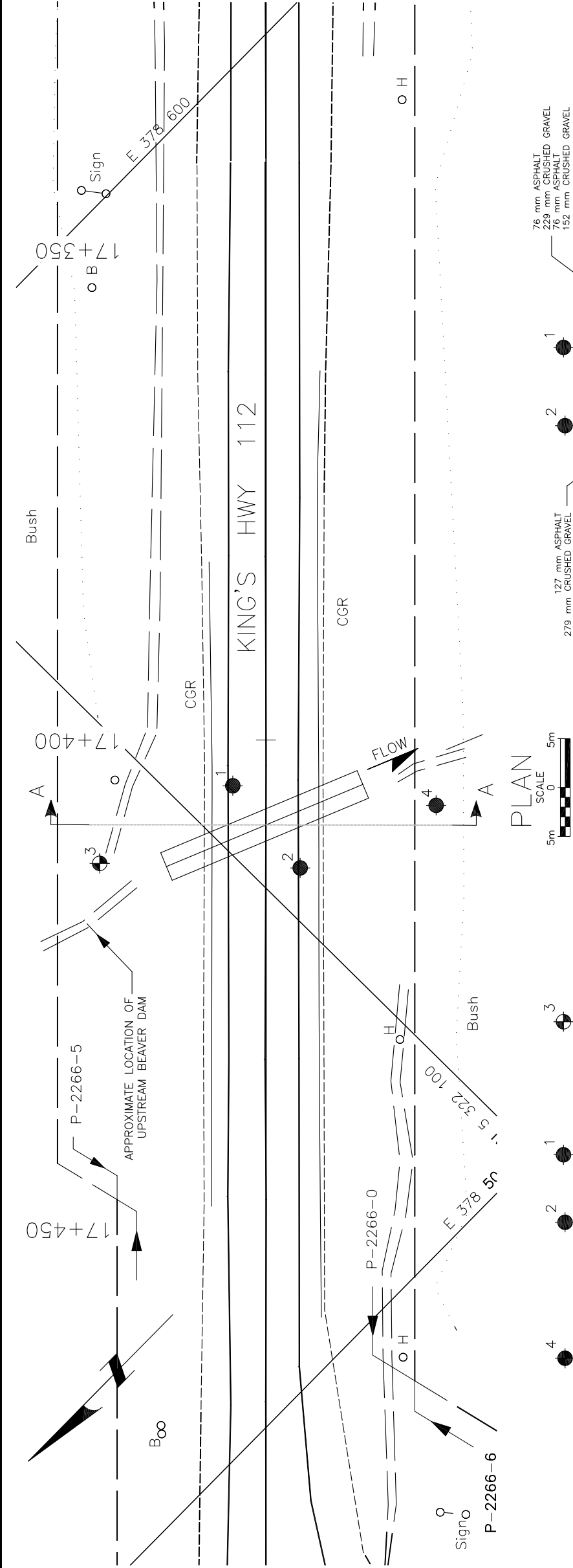
NOTES:

The boundaries between soil strata have been established at the borehole locations only. The boundaries illustrated and stratigraphy between boreholes on this drawing are assumed based on borehole data and may vary. They are intended for design only.

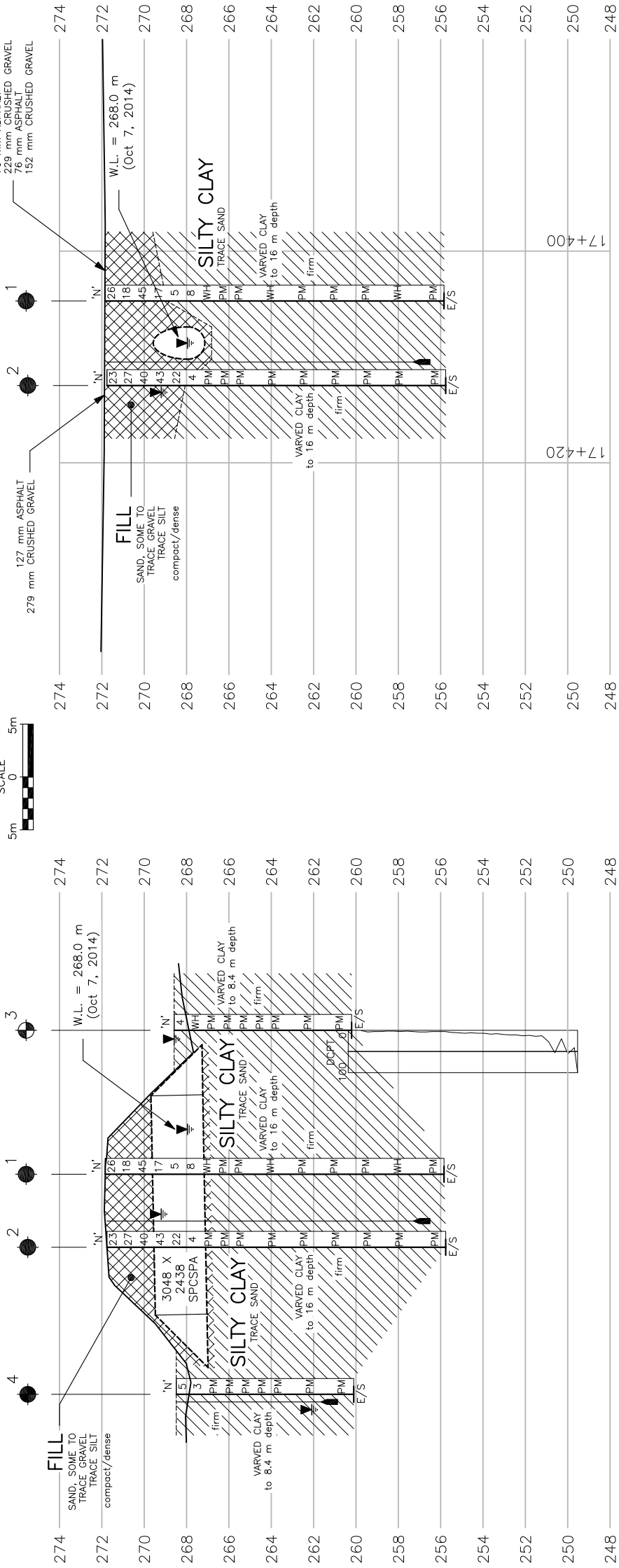
Base plan and alignment provided in digital format by exp. on October 22, 2014.

GEOCRES No. 42A-101

REVISIONS		JAN/15	RG	DRAFT
		MAR/15	RG	FINAL
DESIGN	CHK	CODE	DESCRIPTION	
DRAWN	RG	CHK	LOAD	
		AT	STRUCT	
			SCHEME	DWG - 2



PLAN



A-A

SECTION



CENTERLINE

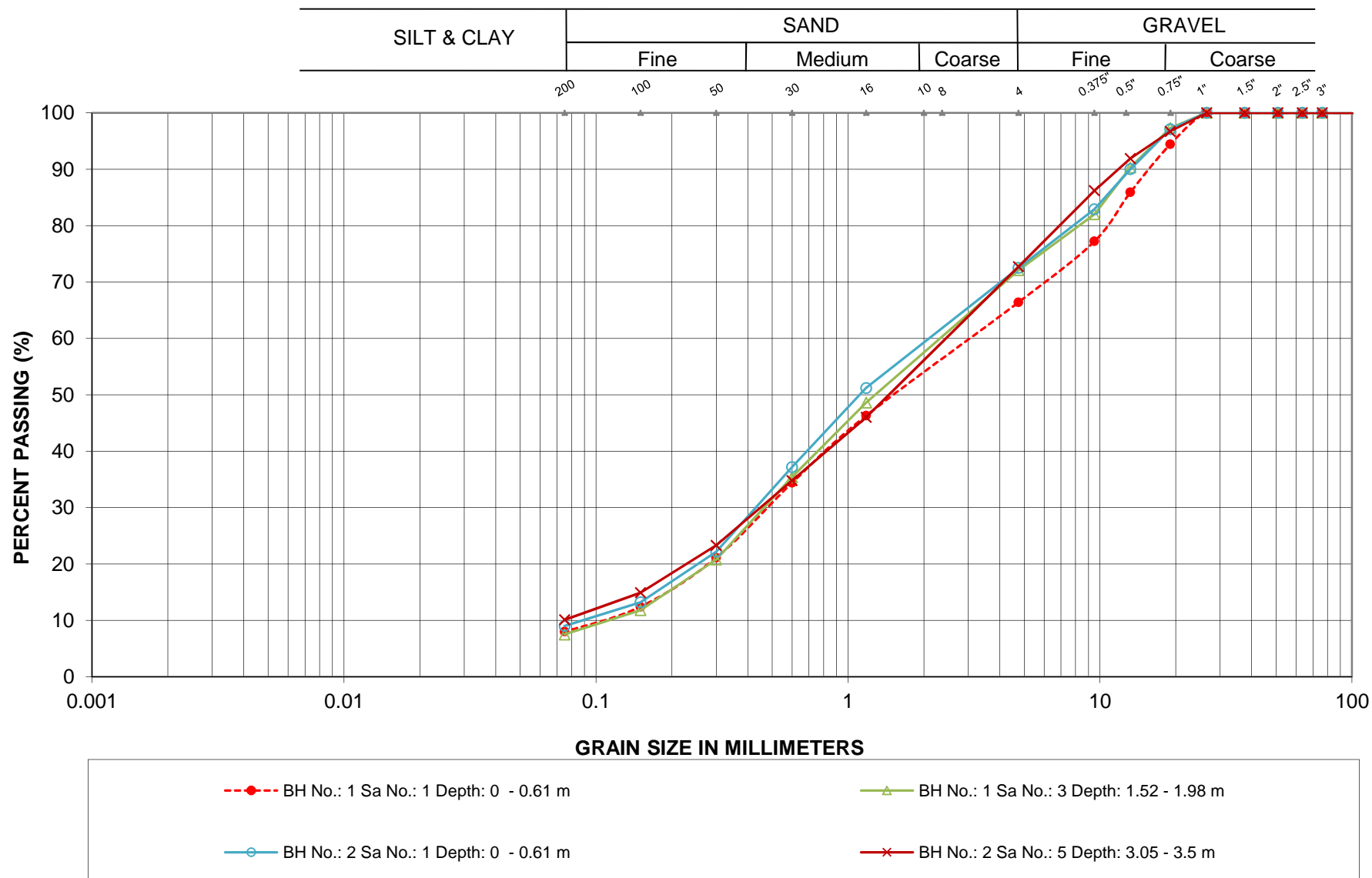
PROFILE



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.

DRAWING NOT TO BE SCALED
50mm ON ORIGINAL DRAWING

GRAIN SIZE ANALYSIS



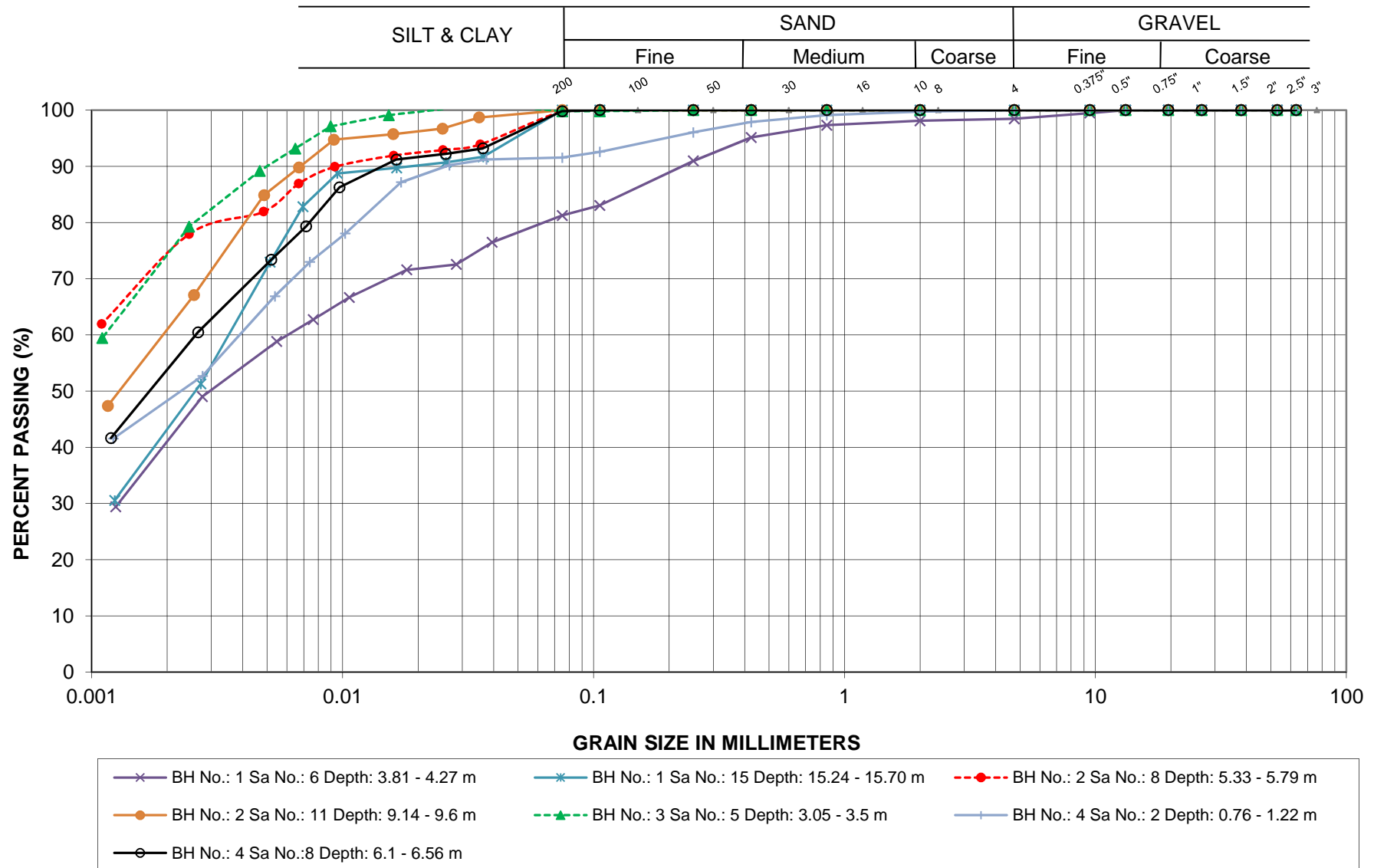
LOCATION: Hwy 112 Unnamed Creek Culvert
TWP Boston, Ontario

SAND FILL

LVM-Merlex, a Division EnGlobe Corp.

FIGURE L-1

GRAIN SIZE ANALYSIS

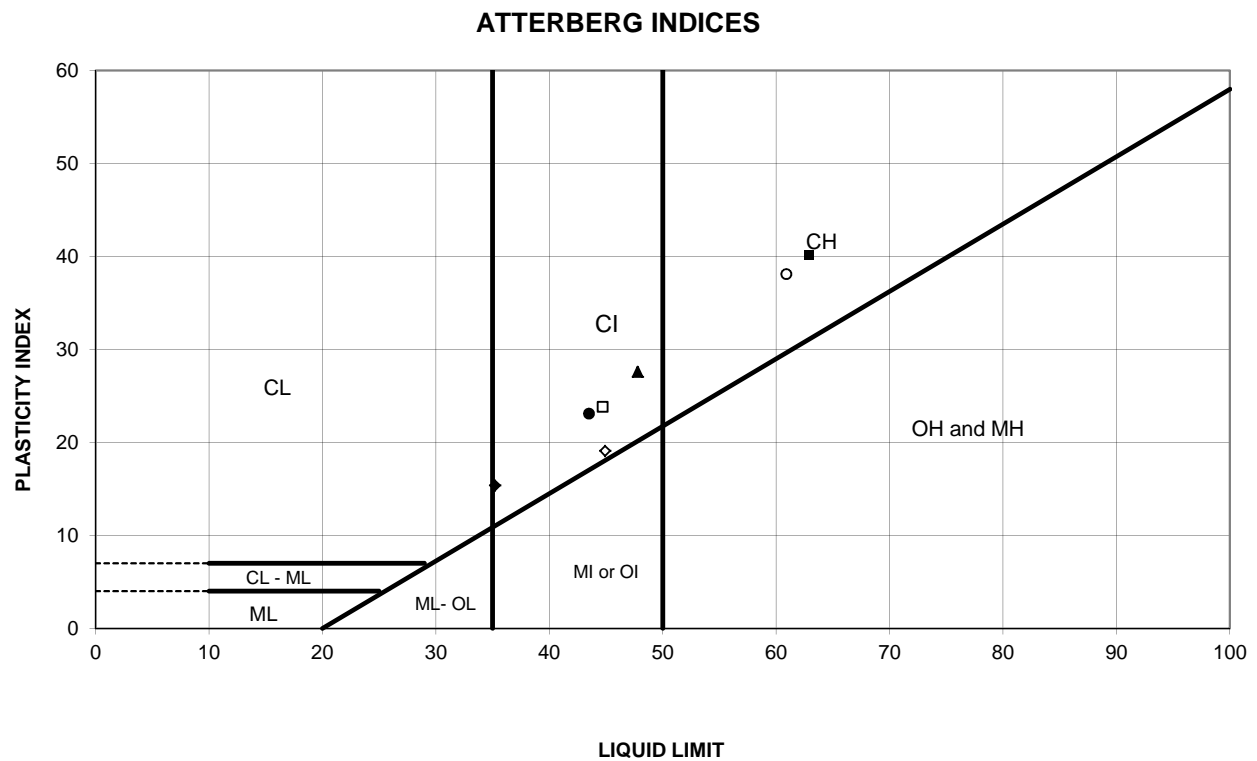


LOCATION: Hwy 112 Unnamed Creek Culvert
TWP Boston, Ontario

SILTY CLAY to CLAY

ATTERBERG LIMITS CHART

FIGURE L-3

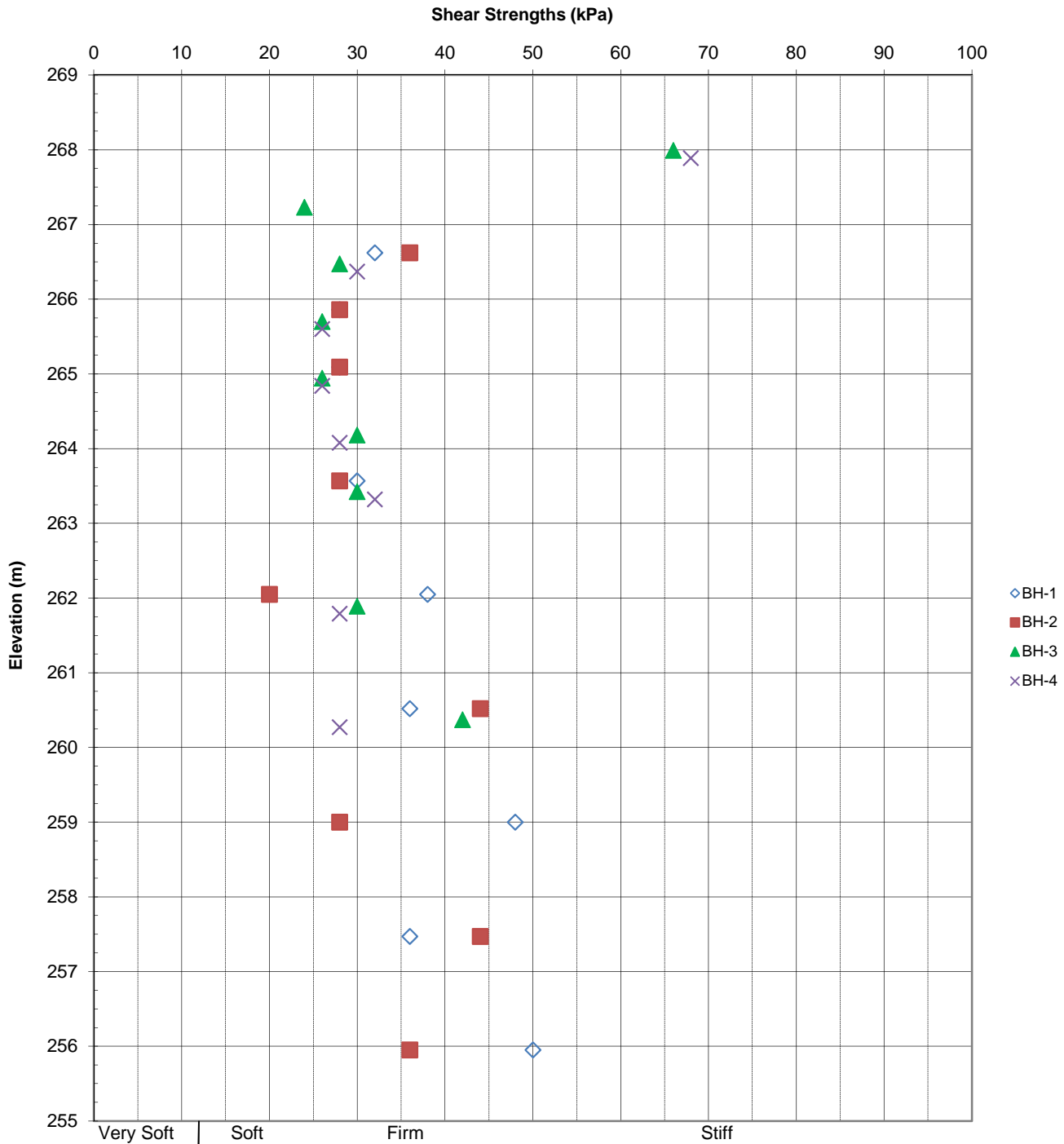


SYMBOL	BH	Sa. No.	Depth(m)	Elev.(m)	Liquid Limit	Plastic Limit	Plasticity Index	NMC %
●	1	6	4.0	267.8	43.5	20.4	23.1	30.2
◆	1	15	15.5	256.3	35.2	19.8	15.4	42.9
■	2	8	5.6	266.2	62.9	22.8	40.1	57.0
▲	2	11	9.4	262.4	47.8	20.2	27.6	54.5
○	3	5	3.3	265.3	60.9	22.8	38.1	65.0
◇	4	2	1.0	267.5	44.9	25.8	19.1	46.5
□	4	8	6.3	262.2	44.7	20.9	23.8	53.1

Date: Mar-15
Project: Hwy 112, Unnamed Creek Culvert
Location: Sta. 17+400

Prep'd: SH
Chkd: MAM
Ref. No.: 13/05/13073-F11

In-Situ Shear Strengths vs. Depth



Note: Shear strength greater than 100 kPa is shown as >100 kPa

Laboratory Tests - Summary Sheet



Borehole No.	Sample No.	Depth	Grain Size Analysis				NMC	Atterberg Limits			SPT 'N'	USCS	Unit Weight (kN/m3)	Remarks
			Gravel Size (%)	Sand Size (%)	Silt Size (%)	Clay Size (%)		LL (%)	PL (%)	IP (%)				
1	1	0.3	34	58	8		4.0				26			
	2	1.0					3.6				18			
	3	1.8	28	65	8		4.5				45			
	4	2.5					6.6				17			
	5	3.3					33.2				5			
	6	4.0					30.2	43.5	20.4	23.1	8			
	7	4.8					62.6				WH			
	8	5.6					57.0				PM			
	9	6.3					58.4				PM			
	10	7.9					56.2				PM			
	11	9.4					54.0				PM			
	12	10.9					49.6				PM			
	13	12.4					36.5				PM			
	14	14.0					40.4				PM			
	15	15.5					42.9	35.2	19.8	15.4	PM			
2	1	0.3	28	63	9		4.7				23			
	2	1.0					3.9				37			
	3	1.8					3.5				40			
	4	2.5					4.5				43			
	5	3.3	27	63	10		8.0				22			
	6	4.0					34.3				4			
	7	4.8					49.5				WH			
	8	5.6	0	0	25	75	57.0	62.9	22.8	40.1	PM			
	9	6.3					55.9				PM			
	10	7.9					65.6				PM			
	11	9.4					54.5	47.8	20.2	27.6	PM			
	12	10.9					43.0				PM			

Laboratory Tests - Summary Sheet



Borehole No.	Sample No.	Depth	Grain Size Analysis				NMC	Atterberg Limits			SPT 'N'	USCS	Unit Weight (kN/m3)	Remarks
			Gravel Size (%)	Sand Size (%)	Silt Size (%)	Clay Size (%)		LL (%)	PL (%)	IP (%)				
	13	12.42					33.4				PM			
	14	13.95					37.7				PM			
	15	15.5					39.2				PM			
3	1	0.23					50.3				4			
	2	0.99					60.5				WH			
	3	1.75					66.2				PM			
	4	2.5					64.6				PM			
	5	3.3	0	0	26	74	65.0	60.9	22.8	38.1	PM			
	6	4.0					55.1				PM			
	7	4.8					57.6				PM			
	8	6.3					42.4				PM			
	9	7.9					30.7				PM			
4	1	0.2					39.0				5			
	2	0.99					46.5	44.9	25.8	19.1	3			
	3	1.75					66.6				PM			
	4	2.52					64.7				PM			
	5	3.28					62.3				PM			
	6	4.04					64.1				PM			
	7	4.8					51.8				PM			
	8	6.33					53.1	44.7	20.9	23.8	PM			
	9	7.85					40.8				PM			

Appendix 4

Photo Essay

Enclosure No. 6:

Photo Essay

Embankment at Culvert Location – Looking North

Photo: 1



Culvert Inlet – Looking East

Photo: 2



Project: Hwy 112 – Culvert 17+400

Photos Provided By: LVM

Date: September 2014

Beaver Dam at Creek Upstream north of Culvert Inlet– Looking East

Photo: 3



Culvert Outlet – Looking West

Photo: 4



Project: Hwy 112 – Culvert 17+400

Photos Provided By: LVM

Date: September 2014

