LVM Merlex

Geotechnical, Materials and Environmental Engineering

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

Culvert Replacement
Highway 60
Station 10+080 - Twp. of Chaffey
GWP 5005-05-00

FINAL FOUNDATION INVESTIGATION REPORT

Date: July 23, 2015
Ref. Nº: 14/07/14083-F1

Geocres No. 31E-351

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Final Foundation Investigation Report

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TABLE OF CONTENTS

Appendices

Property and Confidentiality

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REVISION AND PUBLICATION REGISTER		
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1 INTRODUCTION

LVM-Melex, a Division of EnGlobe Corp. (LVM-Merlex) has been retained by AECOM Canada Ltd., on behalf of the Ministry of Transportation of Ontario (MTO), to carry out a foundation investigation at an existing centerline culvert site. The site is located at approximately Station 10+080 in the Township of Chaffey on Highway 60, some 80 m east of the centreline of Highway 11.

The foundation investigation location was specified by the MTO in the Terms of Reference for work under Agreement No. 5013-E-0032. The terms of reference for the scope of work are outlined in LVM-Merlex's Proposal P-13-051, dated May, 2014. The purpose of this investigation was to determine the subsurface conditions in the area of the existing 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 Corrugated Steel Pipe (CSP) culvert is located on Highway 60 at Station 10+080 in the Township of Chaffey. The topography in the area of this site is generally rolling. The existing highway embankment currently supports two undivided lanes of highway, running in a west-east direction. The existing highway, at the culvert location, is constructed on a fill embankment (bridge approach) some 8.1 m in height, with centerline elevation of 310.0 m at the culvert location. The existing embankment slopes in the area of the culvert have been established at angles of approximately 2.1H:1V. The culvert at this location is a 910 mm diameter Corrugated Steel Pipe (CSP) culvert, some 51 m in length. Flow through the culvert is from north to south (left to right).

2.1 SITE PHYSIOGRAPHY AND SURFICIAL GEOLOGY

This project is located in the Geomorphic Sub-province known as the Muskoka Ridges and Pockets. The topography on this section of Highway 60 is generally rolling. Significant layers of earth overlay the bedrock. Organic materials were also observed. Within the project area native overburden consists primarily of sands overlying bedrock.

Bedrock in the area consists of migmatitic rocks and gneisses of undetermined protolith.

3 INVESTIGATION PROCEDURES

The fieldwork for this investigation was carried out during the period of October 14th to December 18th, 2014 during which time five (5) sampled boreholes, were advanced. Three (3) boreholes were advanced through the embankment at the location of the culvert, and a single borehole was advanced at each of the inlet (north) and outlet (south) ends of the culvert.

The field investigation was carried out using both 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. 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. A single 19 mm diameter standpipe was 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. 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 Records 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 10+080, TWP OF CHAFFEY

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, five (5) sampled boreholes were put down at this site, with Borehole No. 1, 2, and 3, advanced through the embankment, Borehole No. 4 advanced at the culvert invert, and Borehole No. 5 advanced at the culvert outlet. At the time of the subsurface investigation, the ground surface elevations at Boreholes Nos. 1 to 5 were recorded at elevations 309.6, 309.9, 310.0, 303.2, and 303.3 m, respectively.

4.1.1 Pavement Structure

A pavement layer consisting of 100 to 150 mm of asphalt was encountered at Borehole Nos. 1 and 2. At Borehole No. 3, advanced through the paved raised median, a layer of asphalt some 60 mm thick was penetrated. Underlying the asphalt at Borehole No. 1, a layer of crushed gravel, some 50 mm thick, was penetrated.

4.1.2 Granular Fill

Underlying the pavement layers at Borehole Nos. 1, 2, and 3, and at surface at Borehole No, 5, a layer of fill consisting of brown sand trace to some silt trace to some gravel, was penetrated. Cobbles size rock pieces were encountered in this fill layer. The natural moisture content measured on samples of this deposit was in the order of 2 to 11%. Gradation analyses were carried out on four (4) samples of this deposit, the results of which indicated 3 to 16% gravel size particles, 78 to 93% sand size particles, and 4 to 6% silt and clay size particles (Figure No. L-1, Appendix 3). Based on SPT ‘N’ values of 8 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 5.6, 5.6, 5.6, and 0.7 m below grade at Borehole Nos. 1, 2, 3, and 5, respectively (elevations 304.0, 304.3, 304.4, and 302.6 m).

4.1.3 Silt Fill

Underlying the granular fill deposit at BH Nos. 1, 2, and 3, a deposit of fill consisting silt trace sand trace clay was penetrated. A layer of asphalt and crushed gravel was encountered underlying the silt fill at a depth of 6.2 m below grade (elevation 303.4 m) at the location of Borehole No. 1. The natural moisture content measured on samples of this deposit was in the order of 19 to 22%. A hydrometer analyses was carried out on one (1) sample of this deposit, the results of which indicated 0% gravel size particles, 5% sand size particles, 89% silt size particles, and 6% clay size particles (Figure No. L-2, Appendix 3). Based on SPT ‘N’ values of 15 to 34 blows per 300 mm penetration, the compactness of this deposit was described as compact to dense. This deposit was encountered to a depth of 6.7, 7.2, and 7.2 m below grade at Borehole Nos. 1, 2, and 3, respectively (elevations 302.9, 302.7, and 302.8 m, respectively).

4.1.4 Silty Sand Fill

Underlying the granular fill at BH No. 5, a layer of fill consisting of silty sand trace gravel was encountered. The natural moisture content measured on samples of this deposit was in the order of 18%. A gradation analysis was carried out on one (1) sample of this deposit, the results of which indicated 1% gravel size particles, 60% sand size particles, and 39% silt and clay size particles (Figure No. L-3, Appendix 3). Based on SPT 'N' values of 32 blows per 300 mm penetration, the compactness of this deposit was described as dense. This deposit was encountered to a depth of 1.4 m below grade at Borehole No. 5 (elevation 301.9 m).

4.1.5 Sands

Underlying the silt fill at Borehole Nos. 1, 2, and 3, underlying the silty sand fill at Borehole No. 5, and at surface at Borehole No. 4, a deposit of grey sand some to with silt trace to with gravel was penetrated. Cobble size rock pieces were encountered in this deposit. The natural moisture content measured on samples of this deposit was in the order of 10 to 16%. Gradation analyses were carried out on two (2) samples of this deposit, the results of which indicated 0 to 29% gravel size particles, 58 to 88% sand size particles, and 12 to 13% silt and clay size particles (Figure No. L-4, Appendix 3). Based on SPT 'N' values of 51 to 80 blows per 300 mm penetration, this deposit was described as very dense. Auger refusal on bedrock was encountered at depths of 9.8, 9.7, 9.4, 0.2, and 3.4 m below grade at Borehole Nos. 1 to 5, respectively (elevations 299.8, 300.2, 300.6, 303.0, and 299.9 m, respectively).

4.1.6 Bedrock

Underlying the above described sands at Borehole Nos. 1 to 5, bedrock was proven by diamond core drilling. The bedrock was described as grey gneiss bedrock. Based on RQD values of 73 to 100% the bedrock was described as fair to excellent quality. Sampling in the bedrock was terminated at depths of 12.9, 12.7, 12.8, 3.2, and 6.4 m below grade at Borehole Nos. 1 to 5, respectively (elevations 296.7, 297.2, 297.2, 300.0, and 296.9 m, respectively). It should be noted that, when encountered, the underlying bedrock surfaces in this area can be very erratic in nature, varying substantially in elevation over short horizontal distances.

4.2 GROUNDWATER DATA

At the time of this investigation (December 18, 2014), the creek water level at the culvert outlet was measured at elevation 302.2 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. A standpipe was installed in Borehole Nos. 1 and 4 to obtain the water levels post borehole completion. These levels are recorded on the individual Record of Borehole Log Sheets (Appendix 2). The water levels were measured at elevations 302.5, 302.4, 302.3, 302.5, and 302.1 m at Borehole Nos. 1 to 5 between November 24 and December 18, 2014, respectively.

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

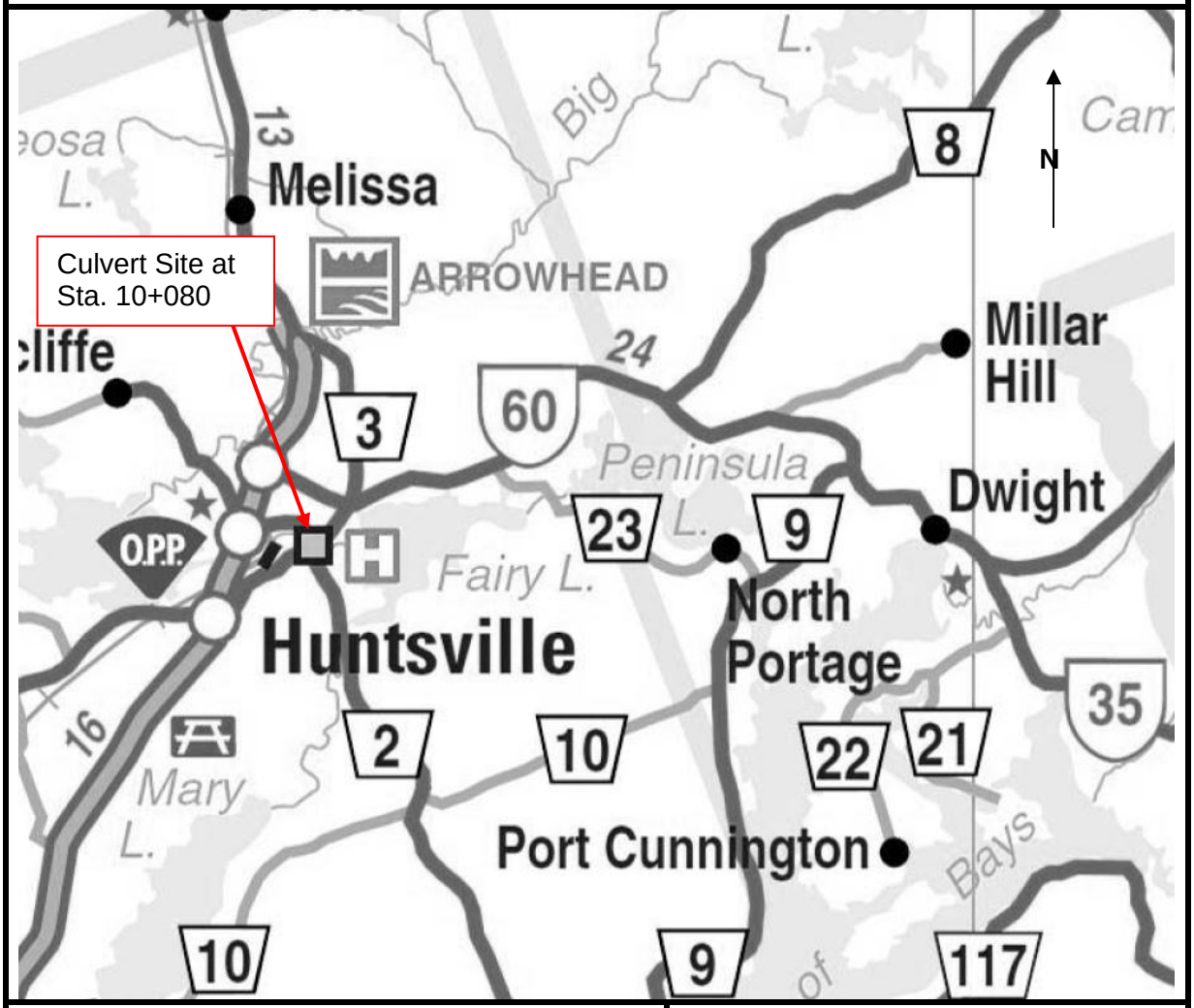
Appendix 1 Key Plan

Drawing No. 1 Key Plan

KEY PLAN

Drawing No. 1

NOT TO SCALE



FINAL FOUNDATION INVESTIGATION REPORT
GWP 5005-00-00

Highway 60

Culvert 10+080, Township of Chaffey

Reference No: 14/07/13083-F1

July 2015

LVM Merlex

Appendix 2 Subsurface Data

Enclosure No. 1	List of Abbreviations and Symbols
Enclosure Nos. 2 to 6	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
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.

ENCLOSURE NO.:2 (Pg. 1 of 2)

METRIC

RECORD OF BOREHOLE NO. 1

LVM Merlex

REFERENCE 14/07/14083-F1 DATUM Geodetic LOCATION N 5022967.1 E 325956.0 - Chaffey Twp., Station 10+089 ORIGINATED BY JL

PROJECT GWP 5005-05-00, Highway 60 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers and NQ Coring COMPILED BY AT

CLIENT AECOM DATE (Started) 14 October 2014 TIME (Completed) 11:30:00 AM CHECKED BY MAM

DATE (Completed) 17 October 2014

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × 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)
309.6	Ground Surface										
0.0	100 mm Asphalt 50 mm Crushed Gravel FILL - sand trace silt trace gravel brown, dry		1	SS	35		309		○		
	(compact/dense)		2	SS	31				○		16 78 (6)
			3	SS	44		308		○		
			4	SS	40		307		○		
			5	SS	30		306		○		
			6	SS	31				○		10 84 (6)
			7	SS	41		305		○		
304.0											
5.6	FILL - silt trace sand trace clay cobbles encountered (compact) Asphalt and crushed gravel encountered at 6.2 m depth		8	SS	27		304		○		
302.9							303				
6.7	SAND - some silt trace gravel cobbles encountered brown (very dense)		9	SS	81/175 mm	▼	302		○		
			10		25/0 mm		301				
299.8							300				
9.8	Continued Next Page										

COMMENTS

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

+ 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) 17/10/14 11:30:00 AM	DRY	-
2) 17/10/14 11:38:00 AM	7.2	-
3) 25/11/14 12:45:00 PM	7.1	-

MEL-GEO 14083 - BOREHOL LOGS - F1.GPJ MEL-GEO.GDT 23/3/15

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

ENCLOSURE NO.:2 (Pg. 2 of 2)

METRIC

RECORD OF BOREHOLE NO. 1

LVM Merlex

REFERENCE 14/07/14083-F1 DATUM Geodetic LOCATION N 5022967.1 E 325956.0 - Chaffey Twp., Station 10+089 ORIGINATED BY JL

PROJECT GWP 5005-05-00, Highway 60 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers and NQ Coring COMPILED BY AT

CLIENT AECOM DATE (Started) 14 October 2014 TIME (Completed) 11:30:00 AM CHECKED BY MAM

DATE (Completed) 17 October 2014

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / 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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES						
	Continued from Previous Page										
	BEDROCK - grey gneiss good to excellent quality		11	RC	Rec= 98% RQD= 88%		299				
			12	RC	Rec= 100% RQD= 100%		298				
							297				
296.7 12.9	End of Borehole										

MEL-GEO 14083 - BOREHOL LOGS - F1.GPJ MEL-GEO.GDT 23/3/15

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ENCLOSURE NO.:3 (Pg. 1 of 2)

METRIC

RECORD OF BOREHOLE NO. 2

LVM Merlex

REFERENCE 14/07/14083-F1 DATUM Geodetic LOCATION N 5022959.6 E 325936.7 - Chaffey Twp., Station 10+072 ORIGINATED BY AT

PROJECT GWP 5005-05-00, Highway 60 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers and NQ Coring COMPILED BY AT

CLIENT AECOM DATE (Started) 24 November 2014 TIME (Completed) 2:15:00 PM CHECKED BY MAM

DATE (Completed) 24 November 2014

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
309.9	Ground Surface						
0.0	150 mm Asphalt FILL - sand some gravel trace silt brown, dry (compact/dense)		1	SS	19		309
			2	SS	17		
			3	SS	12		308
	cobble encountered below 2.3 m depth		4	SS	25		307
			5	SS	25		
			6	SS	55/225 mm		306
			7	SS	42		305
304.3							
5.6	FILL - silt trace sand trace clay grey (compact)		8	SS	15		304
302.7							303
7.2	SAND - some to with silt trace gravel cobbles encountered grey (very dense)		9	SS	65/200 mm	▽	302
			10	SS	51	▨	301
300.2							
9.7	BEDROCK - grey gneiss Continued Next Page				Rec= 96%		300

DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100

SHEAR STRENGTH kPa 20 40 60 80 100
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE

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)

COMMENTS

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

+ 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) 24/11/14 2:15:00 PM	7.5 ▽	9.6 ▨
2)	- ▽	-
3)	- ▼	-

MEL-GEO 14083 - BOREHOL LOGS - F1.GPJ MEL-GEO.GDT 23/3/15

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METRIC

RECORD OF BOREHOLE NO. 2

LVM Merlex

REFERENCE 14/07/14083-F1 DATUM Geodetic LOCATION N 5022959.6 E 325936.7 - Chaffey Twp., Station 10+072 ORIGINATED BY AT

PROJECT GWP 5005-05-00, Highway 60 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers and NQ Coring COMPILED BY AT

CLIENT AECOM DATE (Started) 24 November 2014 TIME (Completed) 2:15:00 PM CHECKED BY MAM

DATE (Completed) 24 November 2014

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / 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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES						
	Continued from Previous Page										
	good to excellent quality		11	RC	RQD= 85%						
			12	RC	Rec= 93% RQD= 87%		299				
			13	RC	Rec= 100% RQD= 100%		298				
297.2											
12.7	End of Borehole										

MEL-GEO 14083 - BOREHOL LOGS - F1.GPJ MEL-GEO.GDT 23/3/15

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ENCLOSURE NO.:4 (Pg. 1 of 2)

METRIC

RECORD OF BOREHOLE NO. 3

LVM Merlex

REFERENCE 14/07/14083-F1 DATUM Geodetic LOCATION N 5022962.3 E 325947.3 - Chaffey Twp., Station 10+082 ORIGINATED BY AT

PROJECT GWP 5005-05-00, Highway 60 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers and NQ Coring COMPILED BY AT

CLIENT AECOM DATE (Started) 25 November 2014 TIME (Completed) 9:48:00 AM CHECKED BY MAM

DATE (Completed) 25 November 2014

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × 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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
310.0	Ground Surface										
0.0	60 mm Asphalt FILL - sand trace silt trace gravel brown, dry (compact/dense)		1	SS	16				○		
	cobble encountered at 0.8 m depth		2	SS	18		309		○		
			3	SS	18				○		3 93 (4)
			4	SS	38		308		○		
			5	SS	28		307		○		
	cobble encountered at 4.0 m depth		6	SS	33		306		○		
			7	SS	30		305		○		8 87 (5)
304.4											
5.6	FILL - silt trace sand trace clay grey (dense)		8	SS	34		304		○		0 5 89 6 (NP)
302.8							303				
7.2	SAND - some silt trace gravel cobble size rock pieces encountered grey (very dense)		9	SS	52	▽	302		○		0 88 (12)
300.6						▨	301				
9.4	BEDROCK - grey gneiss fair to excellent quality		10	RC	Rec= 100% RQD=						

Continued Next Page

COMMENTS

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

+ 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) 25/11/14 9:48:00 AM	7.7 ▽	9.3 ▨
2)	- ▽	-
3)	- ▼	-

MEL-GEO 14083 - BOREHOL LOGS - F1.GPJ MEL-GEO.GDT 23/3/15

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METRIC

RECORD OF BOREHOLE NO. 3

REFERENCE 14/07/14083-F1 DATUM Geodetic LOCATION N 5022962.3 E 325947.3 - Chaffey Twp., Station 10+082 ORIGINATED BY AT

PROJECT GWP 5005-05-00, Highway 60 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers and NQ Coring COMPILED BY AT

CLIENT AECOM DATE (Started) 25 November 2014 TIME (Completed) 9:48:00 AM CHECKED BY MAM

DATE (Completed) 25 November 2014

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / 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/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES						
	Continued from Previous Page				71%						
			11	RC	Rec= 100% RQD= 93%		299				
			12	RC	Rec= 88% RQD= 82%		298				
297.2											
12.8	End of Borehole										

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ENCLOSURE NO.:5 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. 4

LVM Merlex

REFERENCE 14/07/14083-F1 DATUM Geodetic LOCATION N 5022986.4 E 325955.2 - Chaffey Twp., Station 10+083 ORIGINATED BY JL

PROJECT GWP 5005-05-00, Highway 60 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers and NQ Coring COMPILED BY AT

CLIENT AECOM DATE (Started) 17 December 2014 TIME (Completed) 2:55:00 PM CHECKED BY MAM

DATE (Completed) 18 December 2014

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
303.2	Ground Surface										
0.0 303.0	SAND - sand some silt		1	SS	31/150 mm		303		○		
0.2	BEDROCK - grey gneiss fair to good quality		2	RC	Rec= 100% RQD= 73%		302				
			3	RC	Rec= 97% RQD= 89%		301				
300.0							300				
3.2	End of Borehole										

COMMENTS

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

+ 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) 17/12/14 2:55:00 PM	0.8	-
2) 18/12/14 10:00:00 AM	0.7	-
3) 18/12/14 2:20:00 PM	0.7	-

MEL-GEO 14083 - BOREHOL LOGS - F1.GPJ MEL-GEO.GDT 23/3/15

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ENCLOSURE NO.:6 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. 5

LVM Merlex

REFERENCE 14/07/14083-F1 DATUM Geodetic LOCATION N 5022937.2 E 325935.0 - Chaffey Twp., Station 10+077 ORIGINATED BY JL

PROJECT GWP 5005-05-00, Highway 60 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers and NQ Coring COMPILED BY AT

CLIENT AECOM DATE (Started) 18 December 2014 TIME (Completed) 10:30:00 AM CHECKED BY MAM

DATE (Completed) 18 December 2014

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
303.3	Ground Surface										
0.0	FILL - sand trace to some silt trace gravel, brown		1	SS	8		303				
302.6	(loose)										
0.7	FILL - silty sand trace gravel, trace organics, brown		2	SS	32	▽	302				1 60 (39)
301.9	(dense)										
1.4	SAND - trace to some silt with gravel, cobbles encountered below 1.8 m depth, (very dense)		3	SS	80						
			4	SS	69	▽	301				29 58 (13)
299.9			5	SS	100/50 mm						
3.4	BEDROCK - grey gneiss, good to excellent quality		6	RC	Rec= 100% RQD= 89%		300				
			7	RC	Rec= 100% RQD= 100%		299				
296.9							298				
6.4							297				

COMMENTS

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

+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) 18/12/14 10:30:00 AM	1.2 ▽	2.6 ▨
2) 18/12/14 2:05:00 PM	1.2 ▽	2.6
3)	- ▼	-

MEL-GEO 14083 - BOREHOL LOGS - F1.GPJ MEL-GEO.GDT 23/3/15

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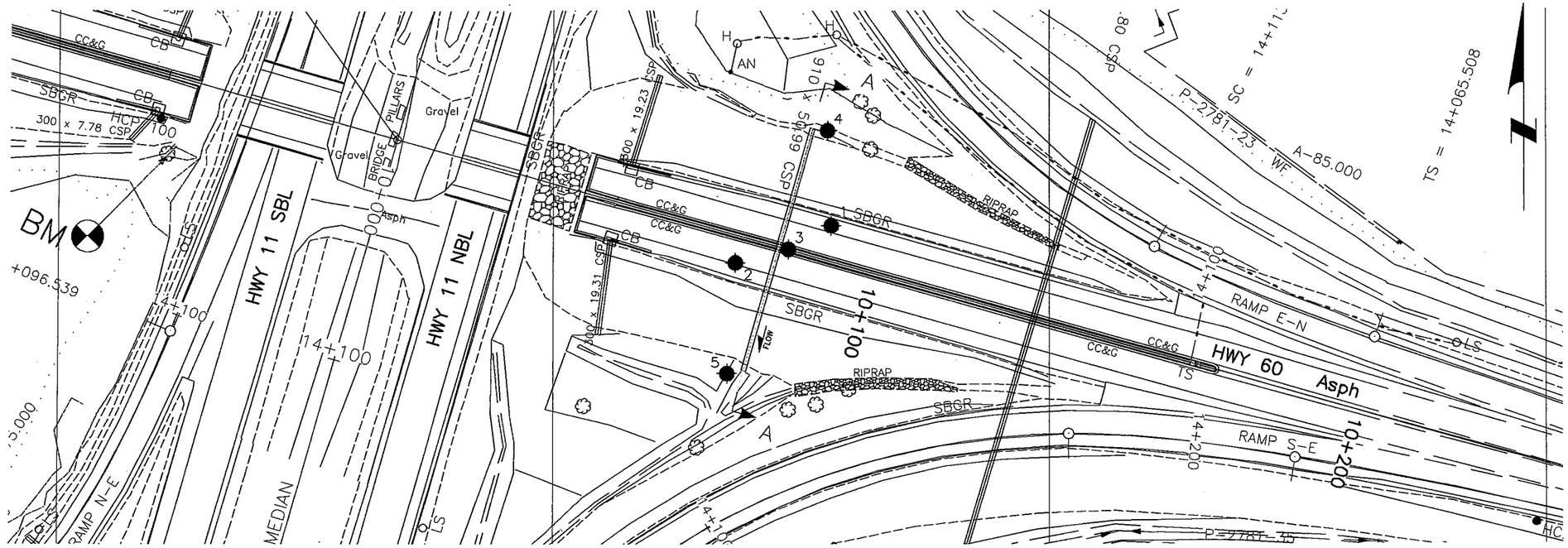
120 Progress Court, North Bay, On P1A 0C2 Phone: (705)476-2550 Fax: (705)476-8882 Email: northbay@lvm.ca

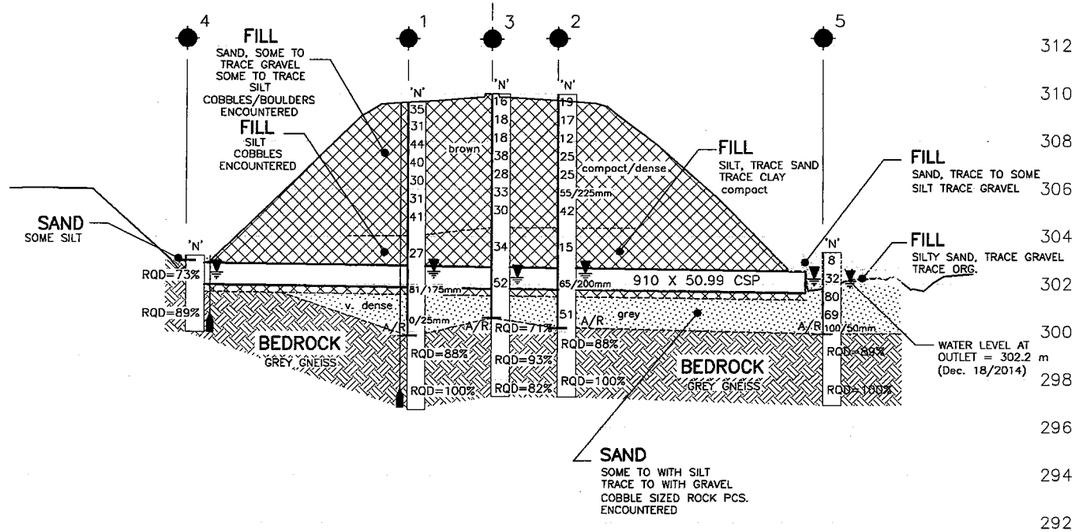
Appendix 3 Borehole Plan and Lab Data

Drawing No. 2:	Borehole Location and Soil Strata
Figure Nos. L-1 to L-4:	Grain Size Distribution Curves
Table No. L-5:	Lab Test Summary Sheet



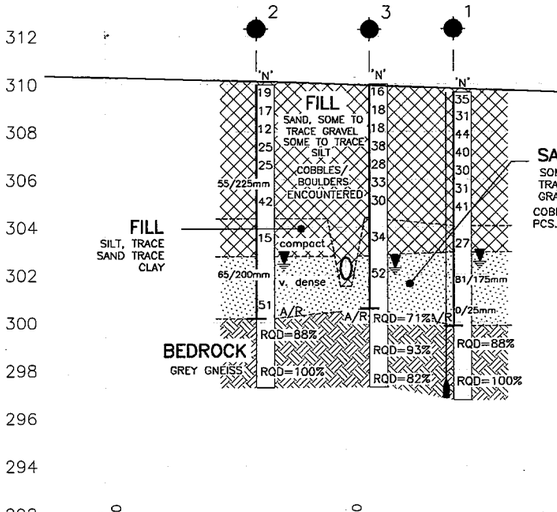
PLAN

SCALE
10m 0m 10m



SECTION A–A

SCALE
HOR 10 5 0 10 20m
VERT 5 2.5 0 5 10m



C/L PROFILE of HWY 60

SCALE
HOR 10 5 0 10 20m
VERT 5 2.5 0 5 10m

DRAWING NOT TO BE SCALED
50mm ON ORIGINAL DRAWING

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.

REGISTERED PROFESSIONAL ENGINEER
M. A. MERLEAU
15/07/27
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
S. HU
90524232
15/07/23
PROVINCE OF ONTARIO

DISTRICT
CONT. No.
GWP No. 5005-05-00

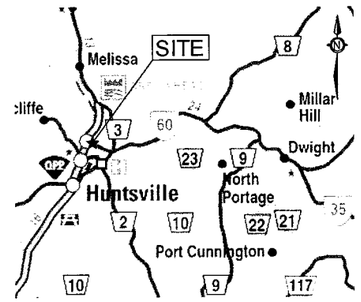
HWY 60
CULVERT AT STATION 10+080
CHAFFEY TOWNSHIP

BOREHOLE LOCATIONS AND SOIL STRATA

LVM Mertex

DRAWING 2

METRIC



KEY PLAN
N.T.S.

LEGEND

●	Borehole
⊕	Borehole w/ Dynamic Cone Penetration Test
N	Blows/0.3 m (Std Pen Test, 475 J/blow)
DCPT	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	309.6	7.0m Lt	5022967.1	325956.0
2	309.9	5.5m Rt	5022959.6	325936.7
3	310.0	0m	5022962.3	325947.3
4	303.2	25.4m Lt	5022986.4	325955.2
5	303.3	27.5m Rt	5022937.2	325935.0

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 bosed on borehole data and may vary. They are intended for design only.

Base plan and alignment provided in digital format by exp. on February 6, 2015.

GEOCRES No. 31E-351

REVISIONS

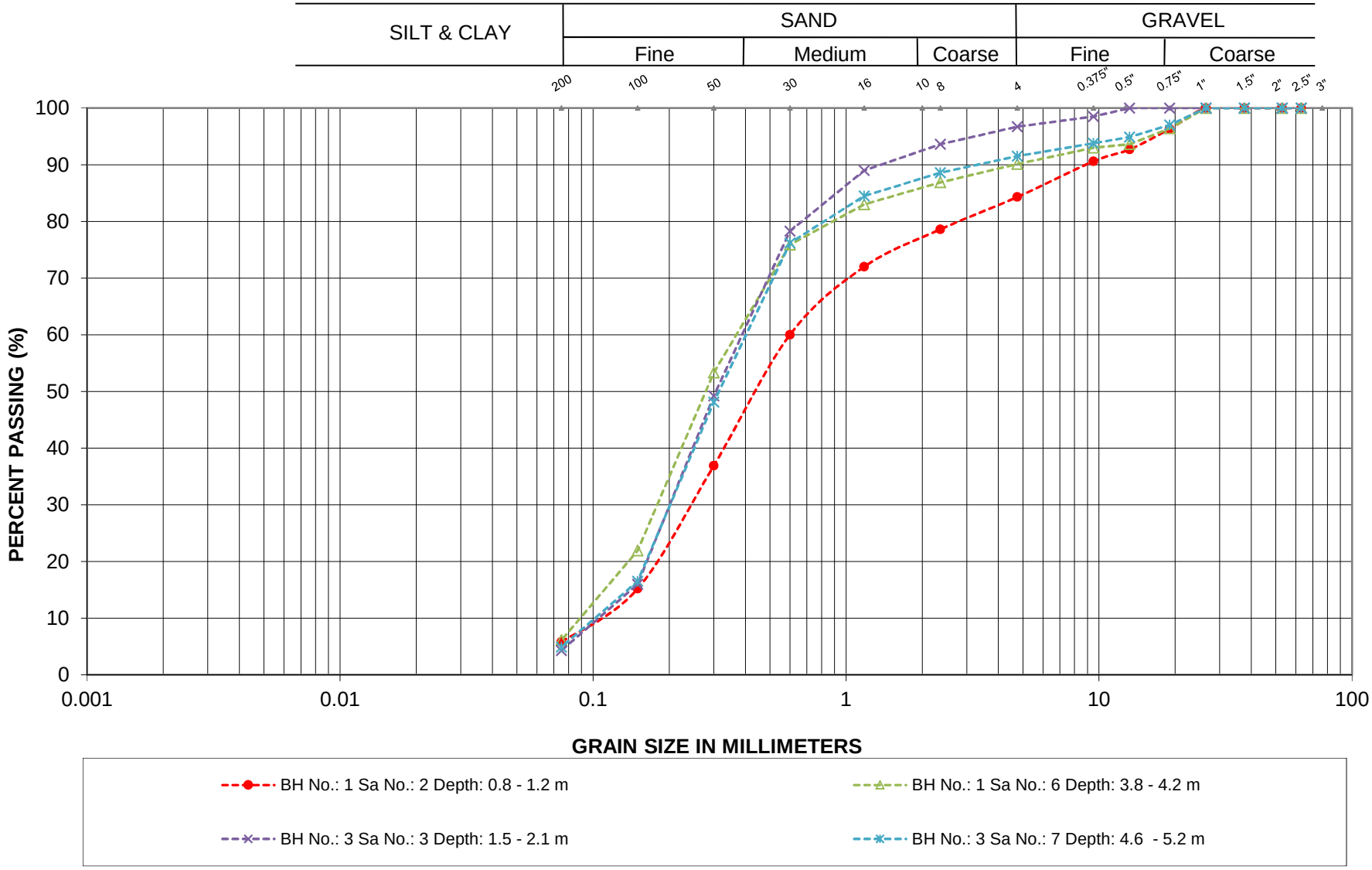
FEB/15	RG	DRAFT	
JUL/15	RG	FINAL	

DESCRIPTION

DESIGN	CHK	CODE	LOAD	DATE JUL/15
DRAWN RG	CHK AT	SITE	STRUCT	SCHEME	DWG 2

Reference No.: 14/07/14083-F1
Date: July 2015

GRAIN SIZE ANALYSIS



LOCATION: Hwy 60 CSP, Station 10+080
Chaffey TWP, Ontario

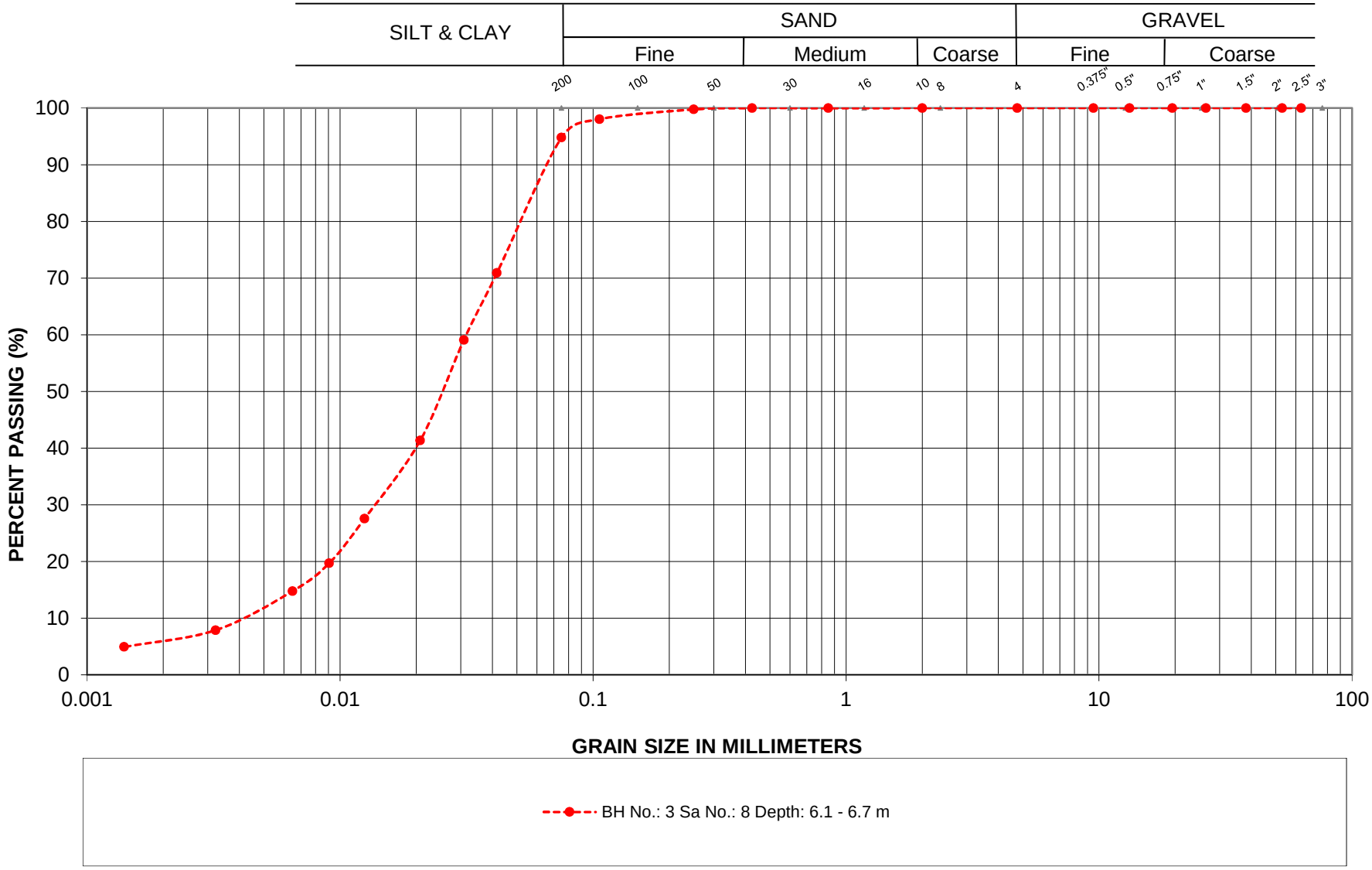
GRANULAR FILL

LVM-Merlex, a Division EnGlobe Corp.

FIGURE L-1

Reference No.: 14/07/14083-F1
Date: July 2015

GRAIN SIZE ANALYSIS



LOCATION: Hwy 60 CSP, Station 10+080
Chaffey TWP, Ontario

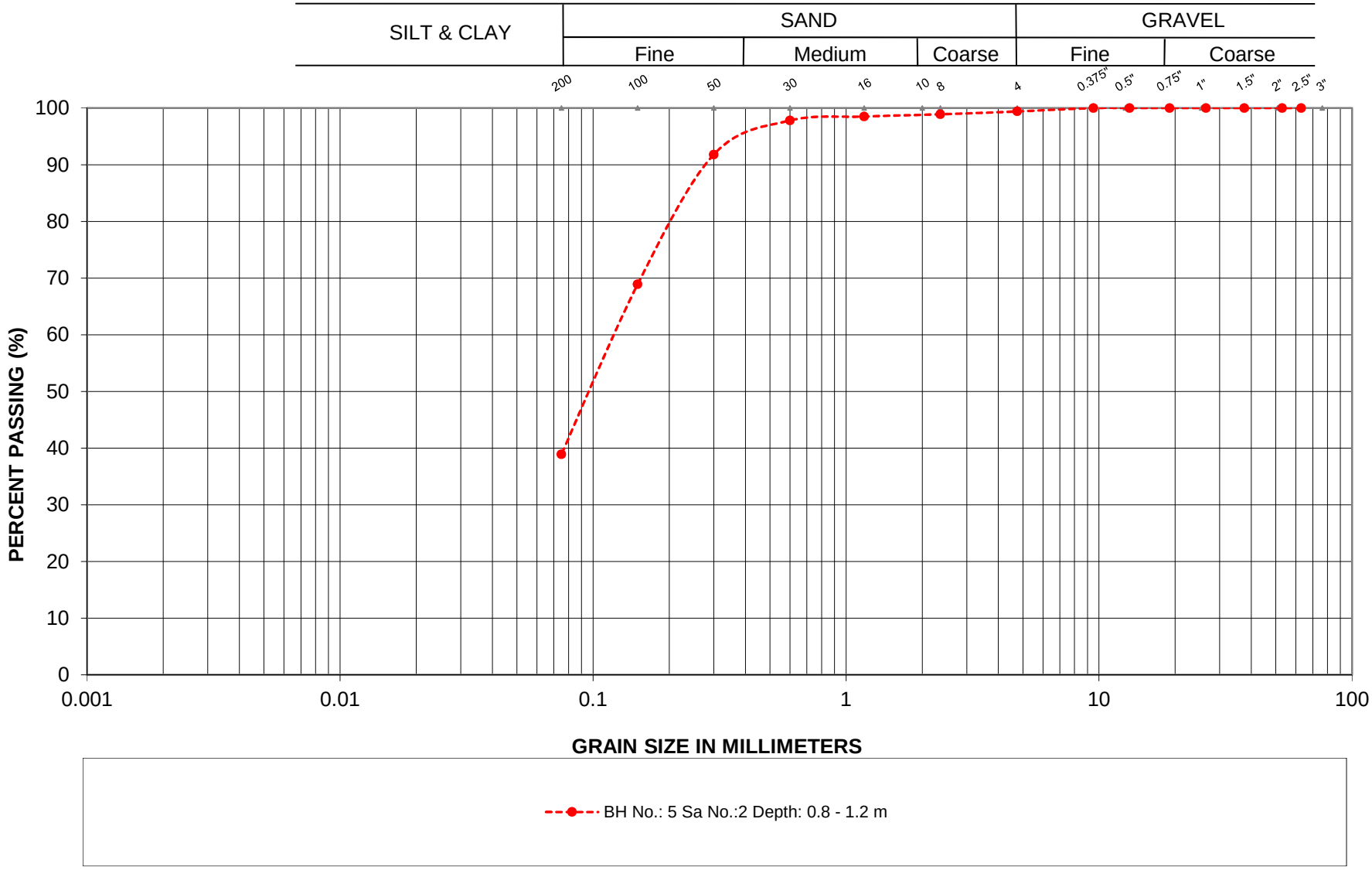
SILT FILL

LVM-Merlex, a Division EnGlobe Corp.

FIGURE L-2

Reference No.: 14/07/14083-F1
Date: July 2015

GRAIN SIZE ANALYSIS



LOCATION: Hwy 60 CSP, Station 10+080
Chaffey TWP, Ontario

SILTY SAND FILL

LVM-Merlex, a Division EnGlobe Corp.

FIGURE L-3

Reference No.: 14/07/14083-F1
Date: July 2015

GRAIN SIZE ANALYSIS

LOCATION: Hwy 60 CSP, Station 10+080
Chaffey TWP, Ontario

SAND to SAND with GRAVEL

LVM-Merlex, a Division EnGlobe Corp.

FIGURE L-4

Reference No.: 14/07/14083-F1

Date: July 2015

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	0.0					2.4				35			
	2	0.8	16	78	6		3.0				31			
	3	1.5					4.0				44			
	4	2.3					3.9				40			
	5	3.1					3.7				30			
	6	3.8	10	84	6		3.7				31			
	7	4.6					4.9				41			
	8	6.1					20.7				27			
	9	7.6					10.6				81/175 mm			
	10	9.1									25/0 mm			
	11	9.9												Rec=98%, RQD=88%
	12	11.4												Rec=100%, RQD=100%
2	1	0.0					3.7				19			
	2	0.8					3.0				17			
	3	1.5					3.4				12			
	4	2.3					3.6				25			
	5	3.1					3.8				25			
	6	3.8					3.4				55/225 mm			
	7	4.6					4.1				42			
	8	6.1					21.8				15			
	9	7.6					15.6				65/200 mm			
	10	9.1					16.2				51			
	11	9.7												Rec=96%, RQD=85%
	12	10.3												Rec=93%, RQD=87%
	13	11.8												Rec=100%, RQD=100%

Project: Hwy 60, CSP Station 10+080, Chaffey TWP

Table No. L-5

Reference No.: 14/07/14083-F1

Date: July 2015

Laboratory Tests - Summary Sheet

LVM Merlex

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 (%)				
3	1	0.0					4.9				16			
	2	0.8					4.4				18			
	3	1.52	3	93	4		6.1				18			
	4	2.29					4.3				38			
	5	3.05					3.1				28			
	6	3.81					2.6				33			
	7	4.57	8	87	5		2.8				30			
	8	6.1	0	5	86	6	18.6				34			Non Plastic (NP)
	9	7.6	0	88	12		13.7				52			
	10	9.4												Rec=100%, RQD=71%
	11	10.4												Rec=100%, RQD=93%
	12	11.9												Rec=88%, RQD=82%
4	1	0					16.2				31/150 mm			
	2	0.2												Rec=100%, RQD=73%
	3	1.7												Rec=97%, RQD=89%
5	1	0					10.3				8			
	2	0.76	1	60	39		18.0				32			
	3	1.52					10.4				80			
	4	2.29	29	58	13		10.1				69			
	5	3.05					10.4				100/50 mm			
	6	3.4												Rec=100%, RQD=89%
	7	4.9												Rec=100%, RQD=100%

Project: Hwy 60, CSP Station 10+080, Chaffey TWP

Table No. L-5

Appendix 4 Photo Essay

Enclosure No. 7: Photo Essay

Existing Embankment – Looking West	Photo: 1

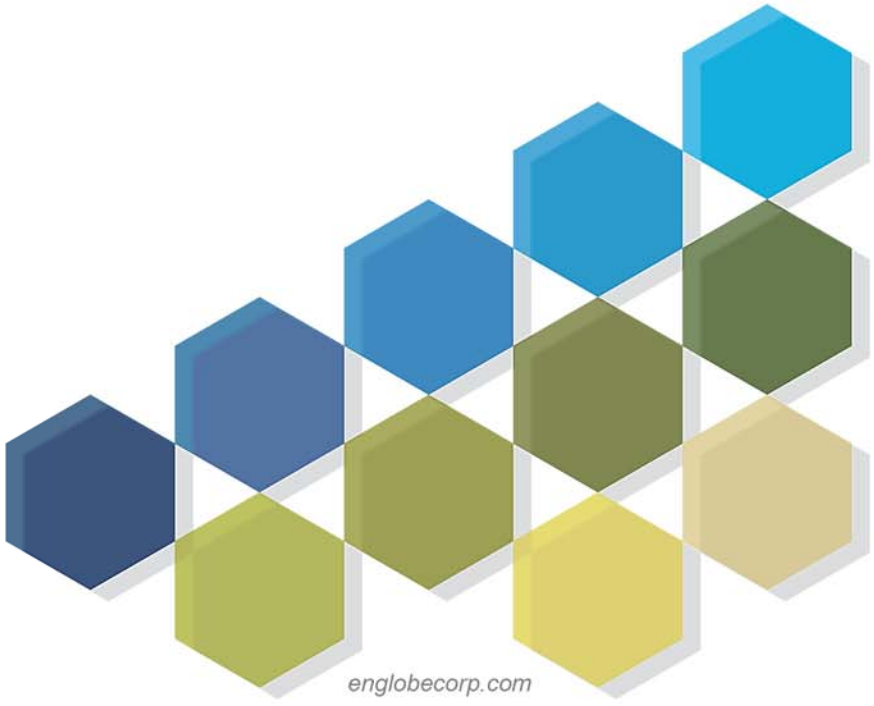
Culvert Inlet – Looking North	Photo: 2

Project: Hwy 60 – Culvert at Station 10+080, Township of Chaffey	Photos Provided By: LVM Date: Oct, 2014/Dec, 2014

Culvert Outlet – Looking South	Photo: 3

Culvert Outlet - Looking East	Photo: 4

Project: Hwy 60 – Culvert at Station 10+080, Township of Chaffey	Photos Provided By: LVM Date: December 2014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