Englobe
Soils Materials Environment

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 16+580 - Twp. of Sproule
GWP 5264-13-00

FINAL FOUNDATION INVESTIGATION REPORT

Date: November 2, 2016
Ref. Nº: 15/04/15020-F4

Geocres No. 31E-374

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 16+580 - Twp. of Sproule
GWP 5264-13-00

Final Foundation Investigation Report

Prepared by:

Alexander Tepylo, P. Eng.
Project Engineer

Sen Hu, P. Eng.
Senior Geotechnical Engineer

Reviewed by:

Michael H. MacKay, M.Eng., P. Eng.
Vice President – Expertise
Pavement Technology & Geotechnical Engineering
MTO Designated Contact

TABLE OF CONTENTS

Appendices

Property and Confidentiality

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

REVISION AND PUBLICATION REGISTER		
Revision N°	**Date**	**Modification And/Or Publication Details**
00	2016-07-25	DRAFT FIDR Issued
01	2016-11-02	Final FIR Issued

REPORT DISTRIBUTION	
5 hard copies and 1 electronic copy	MTO Project Manager
1 hard copy and 1 electronic copy	MTO Pavement and Foundations Section, Foundation Group
1 hard copy	File

1 INTRODUCTION

Englobe Corp. (Englobe), formerly 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 an existing centreline culvert site. The site is located at Station 16+580 in the Township of Sproule on Highway 60, about 0.5 m east of Visitor Centre Road.

The foundation investigation location was specified by the MTO in the Terms of Reference for work under Agreement No. 5014-E-0004: GWP 5264-13-00 for Detailed Design. The terms of reference for the scope of work are outlined in Englobe's Proposal P-14-199-R2, dated January 15, 2015. The purpose of this investigation was to determine the subsurface conditions in the area of the existing culvert for the contract preparation of the Detailed Design package. Englobe investigated the foundation area by the drilling of boreholes, carrying out in-situ tests, and performing laboratory testing on select samples.

2 SITE DESCRIPTION

A 750 mm Corrugated Steel Pipe (CSP) culvert is located on Highway 60 at Station 16+580 in the Township of Sproule, Ontario. 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 some 4.2 m in height above the culvert invert (at centreline), with centreline at Elevation 421.6 m at the culvert location. The existing embankment slopes in the area of the culvert have been generally established at an inclination angle of approximately 2.3H:1V at the north and the south slopes. The culvert at this location is a 750 mm diameter Corrugated Steel Pipe (CSP) culvert, some 27.5 m in length. Flow through the culvert is from the north to the south (left to right).

Observed infrastructure at the culvert location includes overhead wires to the north of the highway embankment.

2.1 SITE PHYSIOGRAPHY AND SURFICIAL GEOLOGY

The topography on this section of Highway 60 is generally rolling. Layers of earth overlie bedrock. Organic materials were also observed in the region. Within the project area, the native overburden consists primarily of sands overlying bedrock.

Bedrock, based on Ontario Geologic Survey (OGS) Map MRD-126, in the area consists of magmatic rocks and gneisses.

3 INVESTIGATION PROCEDURES

The fieldwork for this investigation was carried out between October 29th and and March 4th, 2016, according to availability of the drilling rigs and crew, during which time four (4) sampled boreholes, were advanced. Two (2) boreholes were advanced through the embankment, and one (1) borehole was advanced adjacent to each inlet and outlet end of the culvert, respectively (total of two (2) inlet and outlet boreholes).

The field investigation was carried out using a truck and a bombardier mounted CME drilling rigs 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. 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 19 mm diameter standpipe was installed in Borehole Nos. 2 and 3 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 same general order in which 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 boreholes 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 Englobe engineering staff (Jame Lavigne), 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 the Englobe North Bay laboratory, plus overall drill supervision. All samples received a visual confirmatory inspection in the 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-5 and Table No. L-6).

The location of the individual boreholes was determined in the field using highway chainage established by Callon Dietz Inc. (Callon Dietz) and offsets relative to highway centreline. The

MTO co-ordinates, northing and easting, were then established for the boring locations using coordinates from MTM Zone 10, NAD 83 CSRS. The borehole elevations are based on coordinating the borehole locations with the highway survey carried out by Callon Dietz. Elevations contained in this report are referenced to geodetic datum.

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 the 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 16+580, TWP OF SPROULE

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 adjacent to the culvert inlet, and Borehole No. 4 advanced adjacent 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 421.5, 421.5, 417.7, and 418.5 m, respectively.

4.1.1 Pavement Structure

Borehole Nos. 1 and 2, were advanced through the embankment. Borehole Nos. 1 and 2 confirmed the pavement structure consisted of 75 to 100 mm asphalt concrete overlying a layer of crushed gravel base/subbase approximately 150 mm thick.

4.1.2 Embankment Fill

Underlying the pavement structure at Borehole Nos. 1 and 2, a layer of embankment fill described as of brown sand, some to trace gravel, with to trace silt, trace clay was penetrated. Cobble/boulder sized rock pieces were encountered in the embankment fill layer at various depths below ground surface. The natural moisture content measured for recovered samples from this deposit was generally in the order of 2 to 20%. Gradation (sieve) analyses were carried out on two (2) samples of this deposit, the results of which indicated 5 to 13% gravel size particles, 67 to 82% sand size particles, and 13 to 20% silt and clay size particles (Figure No. L-1, Appendix 3). An additional gradation (hydrometer) analysis was carried out on one sample of this deposit, and the results indicated 10% gravel size particles, 62% sand size

particles, 26% silt size particles, 2% clay size particles (Figure No. L-1, Appendix 3). Based on SPT 'N' values of 9 to 41 blows per 300 mm penetration, the relative density/compactness of this deposit was described as loose to dense, generally compact. This embankment fill was encountered to a depth of 4.4 m below grade at Borehole Nos. 1 and 2 (Elevation 417.1 m).

4.1.3 Sand

Underlying the embankment fill at Borehole Nos. 1 and 2, and at surface at Borehole Nos. 3 and 4, a deposit of sand, some to trace gravel, with to trace silt, trace clay was penetrated. The natural moisture content measured on samples of this deposit ranged from 16 to 30%. Gradation (sieve) analyses were carried out on three (3) sample of this deposit, and indicated 0 to 5% gravel size particles, 86 to 94% sand size particles, and 4 to 9% silt and clay size particles (Figure No. L-2, Appendix 3). Gradation (hydrometer) analyses were carried out on four (4) sample of this deposit, and indicated 0 to 14% gravel size particles, 61 to 84% sand size particles, 15 to 24% silt size particles, and 1% clay size particles (Figure No. L-2, Appendix 3). Based on SPT 'N' values of 1 to 27 blows per 300 mm penetration, this deposit was described as very loose to compact.

Localized sandy silt to silty sand deposits were penetrated within the sand deposit to depths of 13.1, 13.2, and 8.1 m below ground surface at Borehole Nos. 1, 2, and 3, respectively (Elevations 408.4, 408.3, and 409.6, respectively). Descriptions of these localized deposits are described in Sections 4.1.4 to 4.1.6 below.

Borehole Nos. 1, 3, and 4 were terminated in this deposit at depths of 14.6, 10.7, and 10.7 m below ground surface, respectively (Elevations 406.9, 407.0, and 407.8 m, respectively). Sampling of the borehole was terminated in this deposit at depth of 15.1 m below grade at Borehole No. 2 due to auger refual (Elevation 406.4 m).

4.1.4 Sandy Silt

Within the sand at Borehole No. 1, a local deposit of sandy silt, trace clay was penetrated. The natural moisture content measured on a sample of this deposit was in the order of 36%. A gradation (hydrometer) analysis was carried out on one (1) sample of this deposit, and the results indicated 0% gravel size particles, 34% sand size particles, 65% silt size particles, and 1% clay size particles (Figure No. L-3, Appendix 3). Based on SPT 'N' values of 12 blows per 300 mm penetration, this deposit was described as compact. This deposit was encountered to depths of 13.1 m below ground surface at Borehole Nos. 1 (Elevation 408.4 m).

4.1.5 Silty Sand

Within the sand deposit at Borehole No. 2, a local deposit of silty sand, trace clay was penetrated. The natural moisture content measured on samples of this deposit was in the order of 24 to 25%. A gradation (hydrometer) analysis was carried out on one (1) sample of this deposit, and the results indicated 0% gravel size particles, 63% sand size particles, 36% silt size particles, and 1% clay size particles (Figure No. L-4, Appendix 3). Based on SPT 'N' values

of 5 to 11 blows per 300 mm penetration, this deposit was described as loose to compact. This deposit was encountered to depths of 13.2 m below ground surface at Borehole No. 2 (Elevation 408.3 m).

4.1.6 Sand and Silt

Within the sand at Borehole No. 3, a local deposit of sand and silt, trace clay was penetrated. The natural moisture content measured on a sample of this deposit was in the order of 22%. A gradation (hydrometer) analysis was carried out on one (1) sample of this deposit, and the results indicated 0% gravel size particles, 55% sand size particles, 44% silt size particles, and 1% clay size particles (Figure No. L-5, Appendix 3). Based on a SPT 'N' value of 4 blows per 300 mm penetration, this deposit was described as loose. This deposit was encountered to depths of 8.1 m below ground surface at Borehole No. 2 (Elevation 409.6 m).

4.2 GROUNDWATER DATA

At the time of this investigation, the free surface water was not observed at this culvert location.

Measurements of the groundwater tables 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. 2 and 3 to obtain post borehole completion water levels. These levels are recorded on the individual Record of Borehole Log Sheets (Appendix B).

The groundwater levels were measured at Elevations 417.0 m and 416.6 m at Borehole Nos. 2 and 3 during the site investigation period, respectively. The groundwater level was encountered at Elevations 417.1 m and 417.5 m at Borehole Nos. 1 and 4, respectively, upon completion of sampling at the boreholes; however these water levels likely had not stabilized at the time of recording.

The groundwater was measured at Elevations 417.2 and 417.0 m at Borehole Nos. 2 and 3, respectively, at the time of decommissioning on August 16, 2016.

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

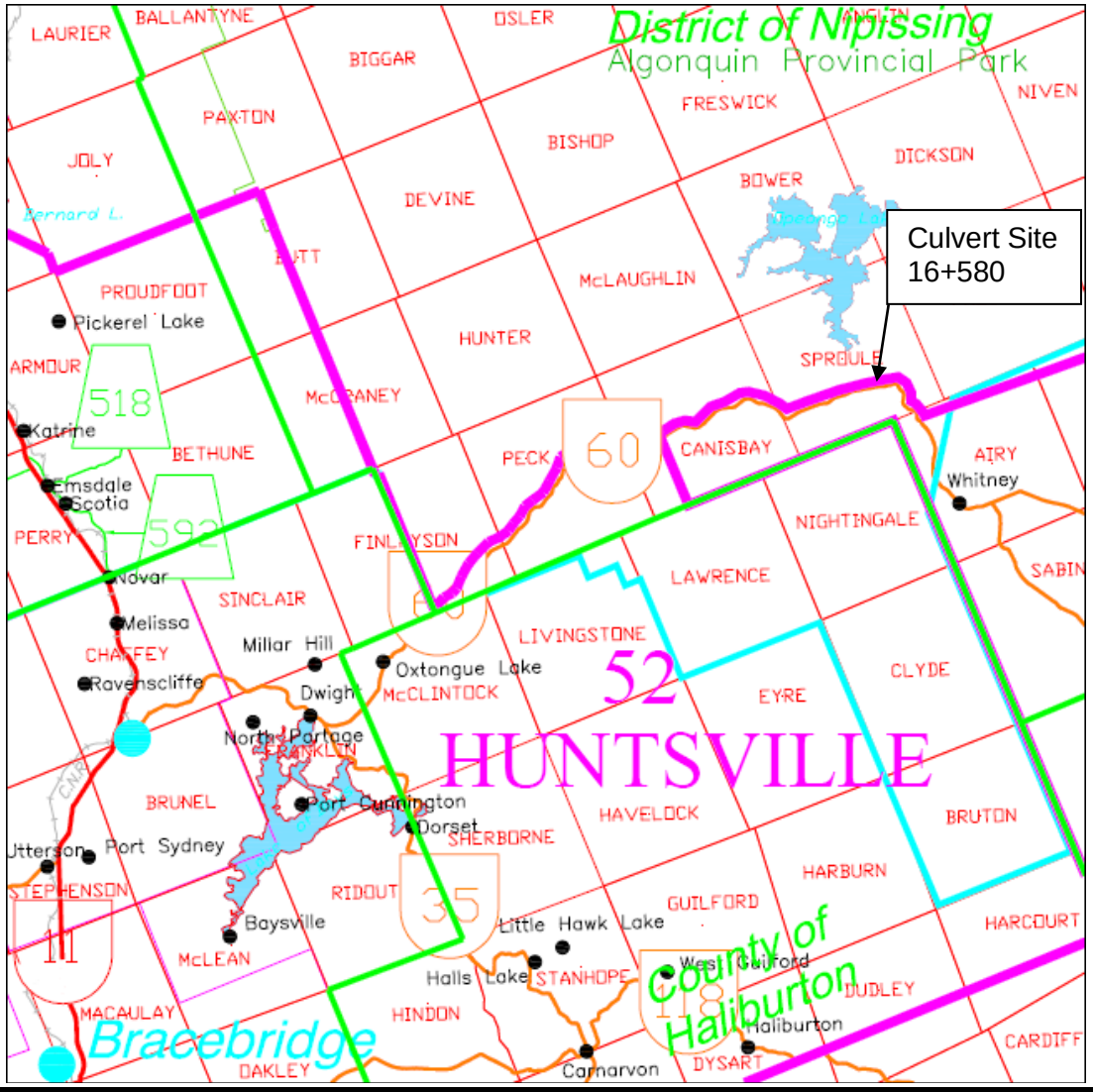
Appendix 1 Key Plan

Drawing No. 1 Key Plan

MACRO KEY PLAN

Drawing No.1

NOT TO SCALE



FOUNDATION INVESTIGATION REPORT

GWP 5264-13-00

Highway 60

Station 16+580 Culvert

Township of Sproule

Reference No: 15/04/15020-F4

November 2016

Englobe

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) Bedrock:

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

Englobe

REFERENCE 15/04/15020-F4 DATUM Geodetic LOCATION N 5050258.5 E 392709.7 - Sproule Twp., Station 16+580.6 ORIGINATED BY JL

PROJECT GWP 5264-13-00, Highway 60 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY DM

CLIENT AECOM DATE (Started) 2015 October 27 TIME (Completed) CHECKED BY SH

DATE (Completed) 2015 December 9

ELEV / DEPTH	DESCRIPTION (see Enclosure No. 1)	STRATA PLOT	NUMBER	TYPE	"N" VALUES	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)
421.5	Ground Surface										
0.0	100 mm Asphalt 150 mm Crushed Gravel		1	SS	34		421				
	EMBANKMENT FILL - sand, some gravel, with to trace silt, trace clay brown (dense/compact)		2	SS	24						
			3	SS	9		420				10 62 26 2
	cobble/boulder sized rock pieces encountered between depths of 2.1 and 2.4 m		4	SS	39		419				
			5	SS	22		418				
417.1			6	SS	14						
4.4	SAND - some to trace gravel, with to some silt, trace clay greyish brown to brown wet (compact)		7	SS	27		417				14 61 24 1
			8	SS	14		416				
			9	SS	15		415				
			10	SS	16		414				0 82 17 1
			11	SS	17		413				
			12	SS	13		412				
409.8							411				
11.7	SANDY SILT - trace clay grey, wet (compact)		13	SS	12		410				
							409				0 34 65 1
	Continued Next Page										

COMMENTS

150 mm casing advanced to a depth of 3.9 m below ground surface and left in the ground on Oct. 27, 2015. Returned to complete remaining drill on Dec. 9, 2015

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) 15/12/9 1:00:00 PM	4.4	4.4
2)	-	-
3)	-	-

MEL-GEO 15020 - BOREHOLE LOGS - F4.GPJ MEL-GEO.GDT 16/11/2

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

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

METRIC

RECORD OF BOREHOLE NO. 1

Englobe

REFERENCE 15/04/15020-F4 DATUM Geodetic LOCATION N 5050258.5 E 392709.7 - Sproule Twp., Station 16+580.6 ORIGINATED BY JL

PROJECT GWP 5264-13-00, Highway 60 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY DM

CLIENT AECOM DATE (Started) 2015 October 27 TIME (Completed) CHECKED BY SH

DATE (Completed) 2015 December 9

ELEV / DEPTH	DESCRIPTION (see Enclosure No. 1)	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) 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)
408.4	Continued from Previous Page										
13.1	SAND - trace silt greyish brown, wet (compact)						408				
			14	SS	21				○		
406.9							407				
14.6	End of Sampling End of Borehole										

MEL-GEO 15020 - BOREHOLE LOGS - F4.GPJ MEL-GEO.GDT 16/11/2

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

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

METRIC

RECORD OF BOREHOLE NO. 2

Englobe

REFERENCE 15/04/15020-F4 DATUM Geodetic LOCATION N 5050265.3 E 392705.7 - Sproule Twp., Station 16+578 ORIGINATED BY JL

PROJECT GWP 5264-13-00, Highway 60 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY DM

CLIENT AECOM DATE (Started) 2015 November 5 TIME (Completed) CHECKED BY SH

DATE (Completed) 2015 November 5

ELEV / DEPTH	DESCRIPTION (see Enclosure No. 1)	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 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)
421.5	Ground Surface							SHEAR STRENGTH kPa 20 40 60 80 100 ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE			
0.0	75 mm Asphalt 150 mm Crushed Gravel										
	FILL - sand, some to trace gravel, some to trace silt		1	SS	35		421				
	brown		2	SS	19						13 67 (20)
	(dense/loose)		3	SS	41		420				
	cobble/boulder sized rock pieces ecountered between 1.7 and 2.1 m depth		4	SS	10		419				
			5	SS	9		418				
417.1			6	SS	18	▽ ▽ ▽					5 82 (13)
4.4	SAND - some to trace silt						417				
	grey, wet		7	SS	14						
	(compact/very loose)		8	SS	12		416				
			9	SS	4		415				
			10	SS	1		414				
			11	SS	5		413				
411.4							412				
10.1	SILTY SAND - trace clay						411				
	wet		12	SS	5						0 63 36 1
	(loose/compact)						410				
			13	SS	11		409				
	Continued Next Page										

COMMENTS

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

$+^3$, $\times^3$: 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) 15/11/5 3:10:00 PM	4.1 ▽	4.4 ▨
2) 15/11/5 3:20:00 PM	4.5 ▽	-
3) 16/8/16	4.3 ▽	-

MEL-GEO 15020 - BOREHOLE LOGS - F4.GPJ MEL-GEO.GDT 16/11/2

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

METRIC

RECORD OF BOREHOLE NO. 2

Englobe

REFERENCE 15/04/15020-F4 DATUM Geodetic LOCATION N 5050265.3 E 392705.7 - Sproule Twp., Station 16+578 ORIGINATED BY JL

PROJECT GWP 5264-13-00, Highway 60 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY DM

CLIENT AECOM DATE (Started) 2015 November 5 TIME (Completed) CHECKED BY SH

DATE (Completed) 2015 November 5

ELEV / DEPTH	DESCRIPTION (see Enclosure No. 1)	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) 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)
408.3	Continued from Previous Page										
13.2	SAND - some silt wet (loose)		14	SS	5		408 407		○ at 20		
406.4											
15.1	Auger Refusal End of Borehole										

MEL-GEO 15020 - BOREHOLE LOGS - F4.GPJ MEL-GEO.GDT 16/11/2

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

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

METRIC

RECORD OF BOREHOLE NO. 3

Englobe

REFERENCE 15/04/15020-F4 DATUM Geodetic LOCATION N 5050277.5 E 392703.1 - Sproule Twp., Station 16+578 ORIGINATED BY JL

PROJECT GWP 5264-13-00, Highway 60 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY DM

CLIENT AECOM DATE (Started) 2016 March 3 TIME (Completed) CHECKED BY SH

DATE (Completed) 2016 March 3

ELEV / DEPTH	DESCRIPTION (see Enclosure No. 1)	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 + 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)
417.7	Ground Surface										
0.0	SAND - trace gravel, some to trace silt, trace clay brown, wet (compact/very loose)		1	AS							
			2	SS	17						3 93 (4)
			3	SS	15		417				
			4	SS	7		416				
			5	SS	5		415				0 84 15 1
			6	SS	4		414				
			7	SS	2		413				
411.1			8	SS	2		412				
6.6	SAND and SILT - trace clay grey, wet (loose)		9	SS	4		411				0 55 44 1
409.6							410				
8.1	SAND - some to trace silt, trace clay wet (loose)		10	SS	4		409				
			11	SS	5		408				
407.0							407				
10.7	End of Sampling 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) 16/3/3 3:30:00 PM	1.1	2.9
2) 16/3/4 2:10:00 PM	1.1	-
3) 16/8/16	0.7	-

MEL-GEO 15020 - BOREHOLE LOGS - F4.GPJ MEL-GEO.GDT 16/11/2

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

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

METRIC

RECORD OF BOREHOLE NO. 4

Englobe

REFERENCE 15/04/15020-F4 DATUM Geodetic LOCATION N 5050244.4 E 392711.0 - Sproule Twp., Station 16+579 ORIGINATED BY JL

PROJECT GWP 5264-13-00, Highway 60 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY DM

CLIENT AECOM DATE (Started) 2016 March 4 TIME (Completed) CHECKED BY SH

DATE (Completed) 2016 March 4

ELEV / DEPTH	DESCRIPTION (see Enclosure No. 1)	STRATA PLOT	NUMBER	TYPE	"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)
418.5	Ground Surface										
0.0	SAND - some to trace silt, trace clay		1	AS			418				
			2	SS	15						
	trace grass rootlets to depth of 0.3 m					▽					
	brown to greyish brown, wet		3	SS	8	▽	417				0 94 (6)
	(compact/very loose)										
			4	SS	6		416				
			5	SS	3						
			6	SS	2		415				
			7	SS	2		414				0 84 15 1
			8	SS	5		413				
			9	SS	4		412				
			10	SS	2		411				
							410				
							409				
407.8	trace gravel		11	SS	2		408				5 86 (9)
10.7	End of Sampling 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

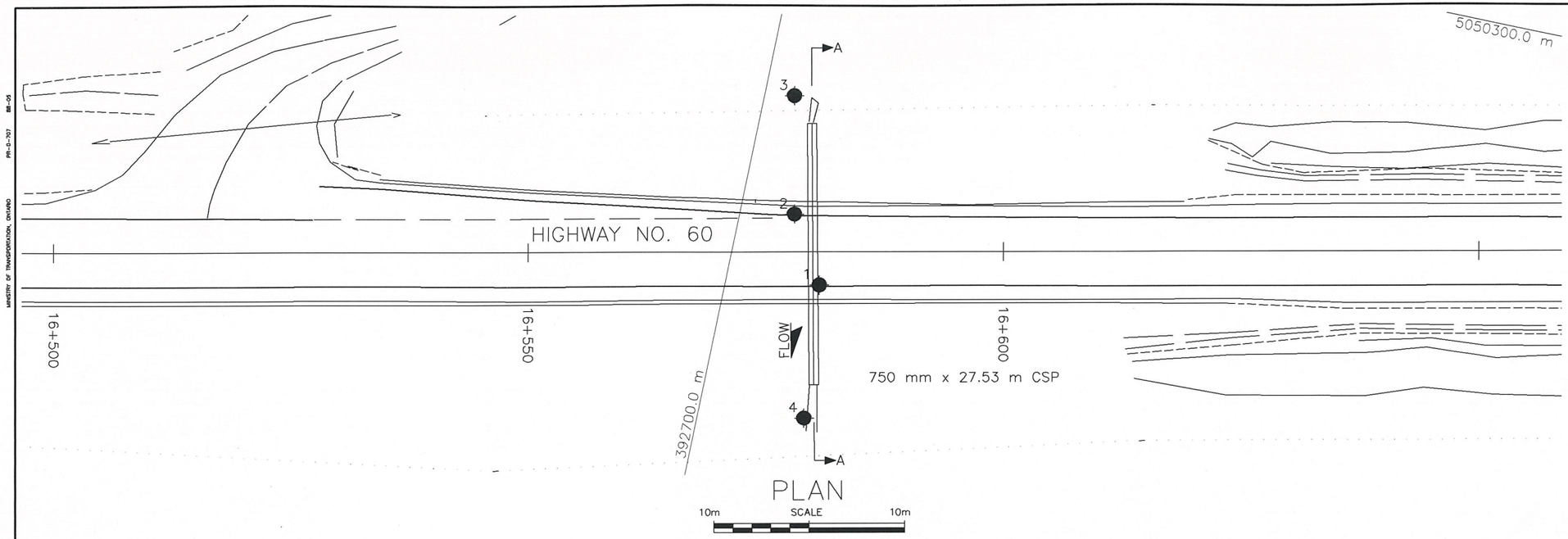
Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
1) 16/3/4 2:35:00 PM	1 ▽	1.2 ▩
2)	- ▽	-
3)	- ▼	-

MEL-GEO 15020 - BOREHOLE LOGS - F4.GPJ MEL-GEO.GDT 16/11/2

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

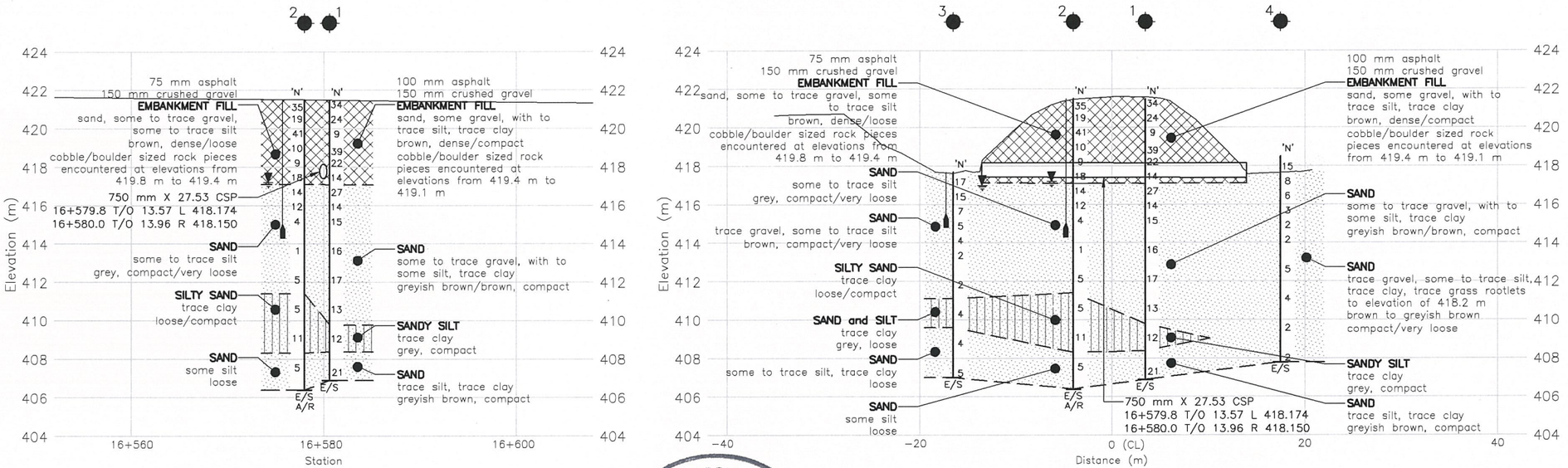
Appendix 3 Borehole Plan and Lab Data

Drawing No. 2: Borehole Location and Soil Strata
Figure Nos. L-1 to L-5: Grain Size Distribution Curves
Table No. L-6: Lab Test Summary Sheet



PLAN

10m SCALE 10m



C/L PROFILE HWY 60

SCALE

HOR 10 5 0 10 20m

VERT 5 2.5 0 5 10m

CROSS SECTION A–A

SCALE

HOR 10 5 0 10 20m

VERT 5 2.5 0 5 10m

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.

LICENSED PROFESSIONAL ENGINEER
S. HU
90524232
2016-11-02
PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER
M. H. MacKAY
PROVINCE OF ONTARIO

2016-11-02

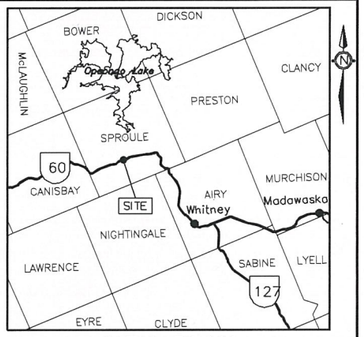
DISTRICT
CONT. No.
GWP No. 5264-13-00

HWY 60 CULVERT
STA. 16+580

BOREHOLE LOCATIONS
AND SOIL STRATIGRAPHY

DRAWING 2

Englobe



KEY PLAN
N.T.S.

LEGEND

●	Borehole
N	Blows/0.3 m (Std Pen Test, 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	421.5	3.5 Rt	5050258.5	392709.7
2	421.5	4.0 Lt	5050265.3	392705.7
3	417.7	16.5 Lt	5050277.5	392703.1
4	418.5	17.5 Rt	5050244.4	392711.0

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

Base plan and alignment provided in digital format by Callon Dietz on July 6, 2016

Coordinates based on MTM Zone 10 NAD83 CSRS

GEOCRES No. 31E-374

REVISIONS			
JUL/16	DM	DRAFT	
NOV/16	DM	FINAL	
DESCRIPTION			

DESIGN	CHK	CODE	LOAD	DATE NOV/16
DRAWN DM	CHK SH	SITE	STRUCT	SCHEME DWG 2

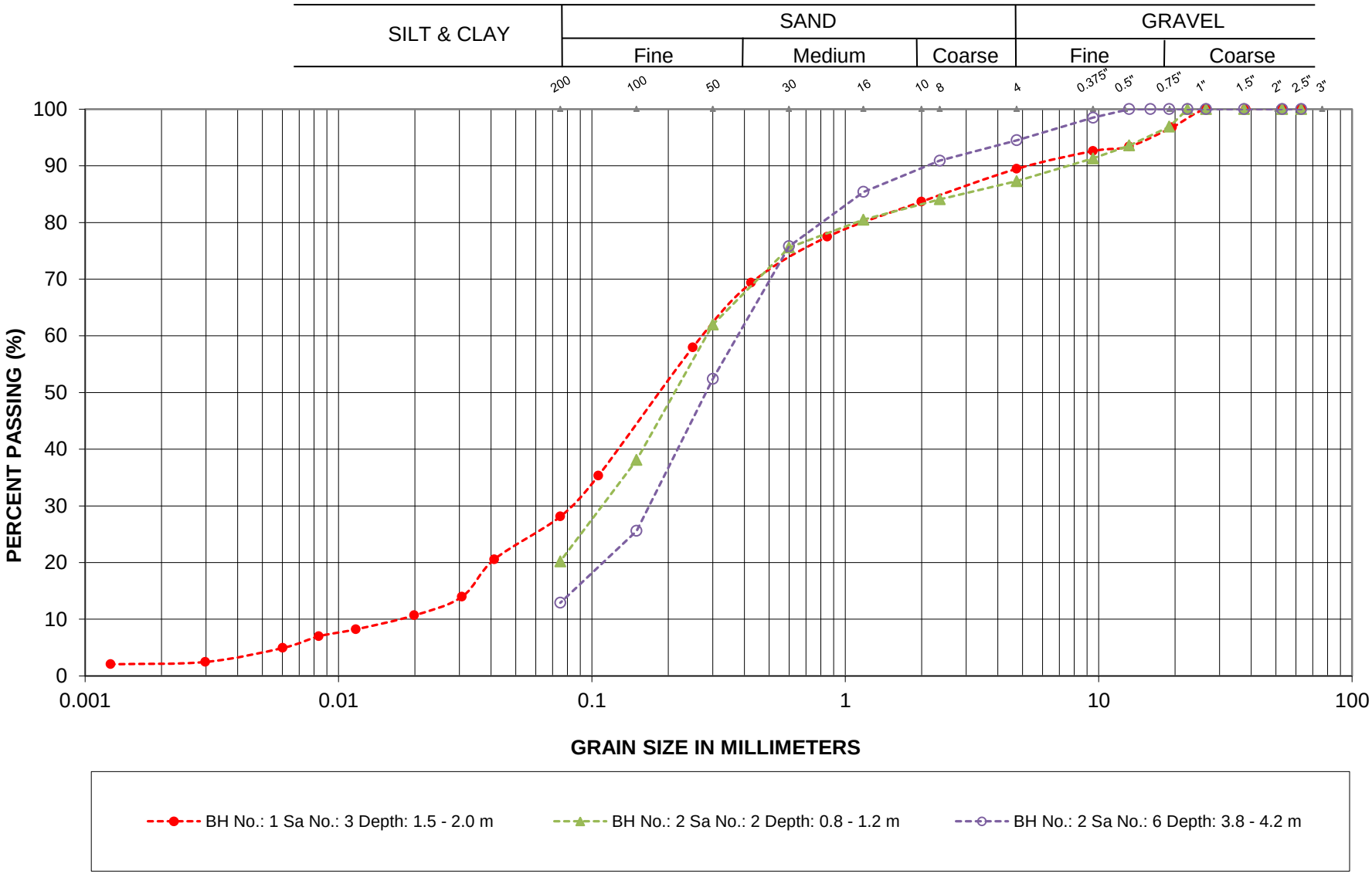
CAD FILE LOCATION AND NAME: G:\2015\15020 – PAV & FDN, Hwy 60 & 118, 5014-E-0004 (ACCOM)\FOUNDATION\Drawings\F4\15020 F4 – 16+580.dwg
MODIFIED: 11/2/2016 10:49:00 AM BY: MITCDU
DATE PLOTTED: 11/2/2016 10:50:49 AM BY: DUNCAN MITCHELL

MINISTRY OF TRANSPORTATION, ONTARIO PH-5-707 BR-05

Reference No.: 15/04/15020-F4
Date: July 2016

Englobe

GRAIN SIZE ANALYSIS



EMBANKMENT FILL

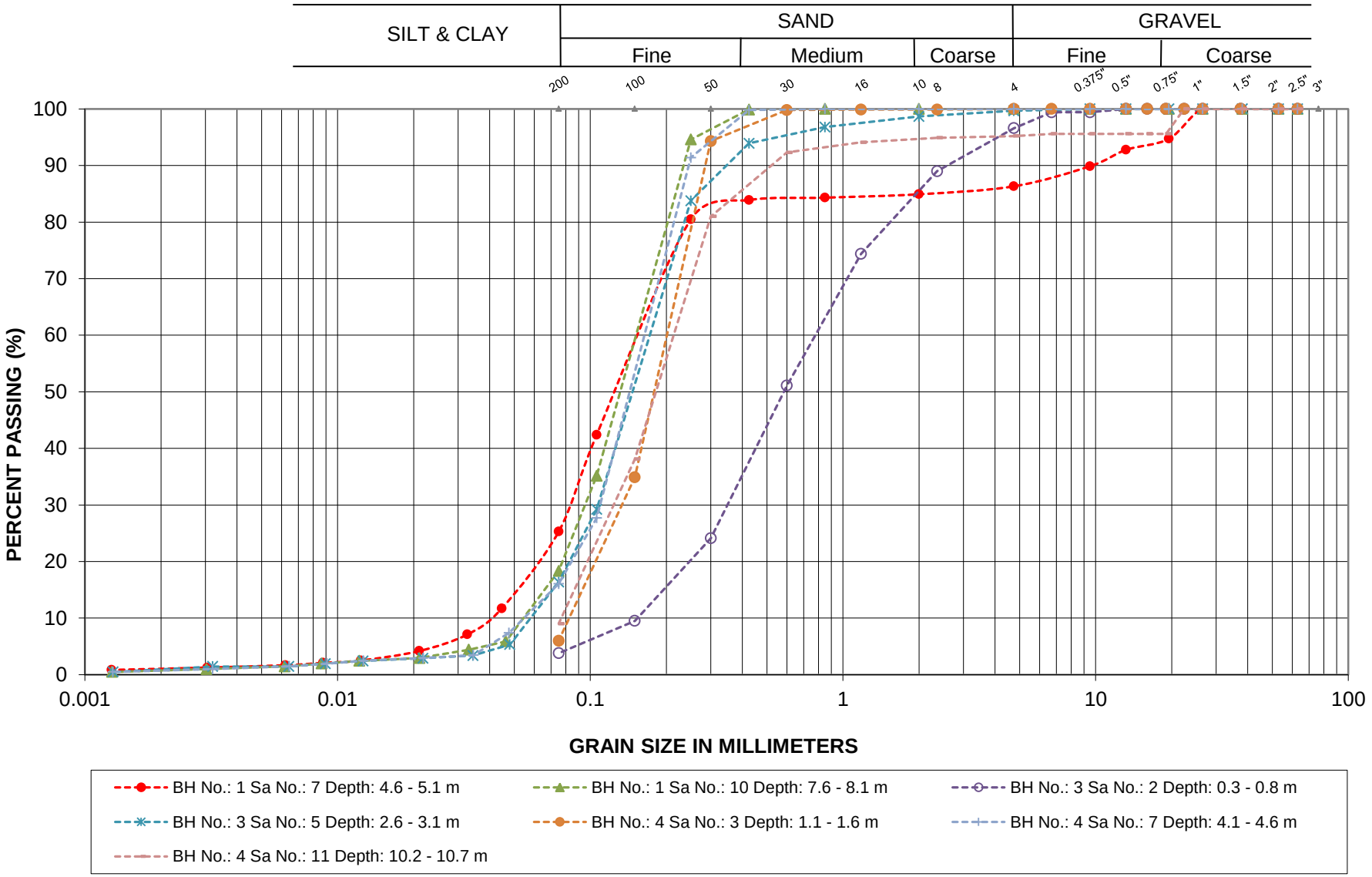
LOCATION: Hwy 60, Station 16+580
TWP of Sproule

Englobe Corp.

FIGURE L-1

Reference No.: 15/04/15020-F4
Date: July 2016

GRAIN SIZE ANALYSIS



SAND

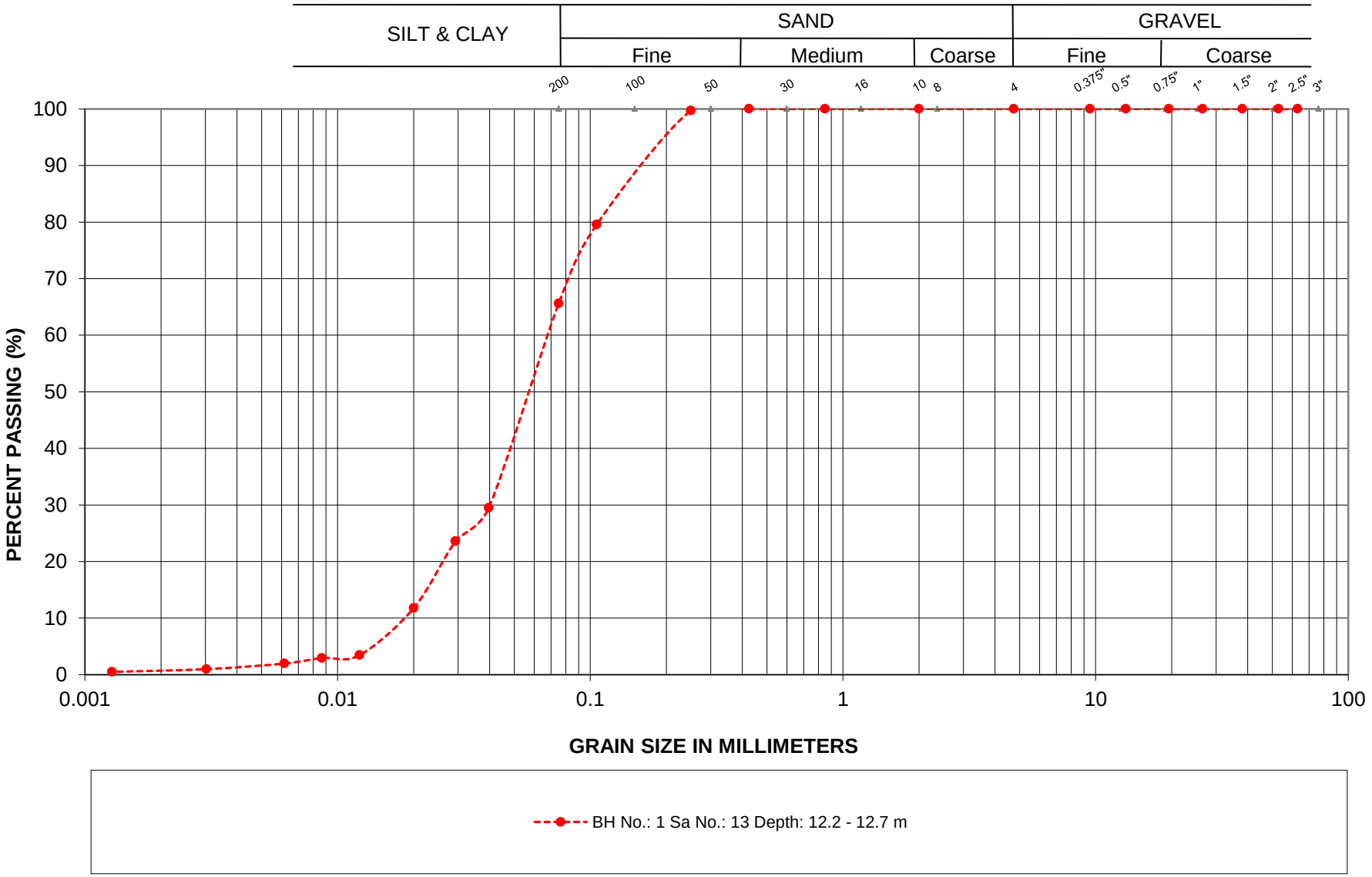
LOCATION: Hwy 60, Station 16+580
TWP of Sproule

Englobe Corp.

FIGURE L-2

Reference No.: 15/04/15020-F4
Date: July 2016

GRAIN SIZE ANALYSIS



SANDY SILT

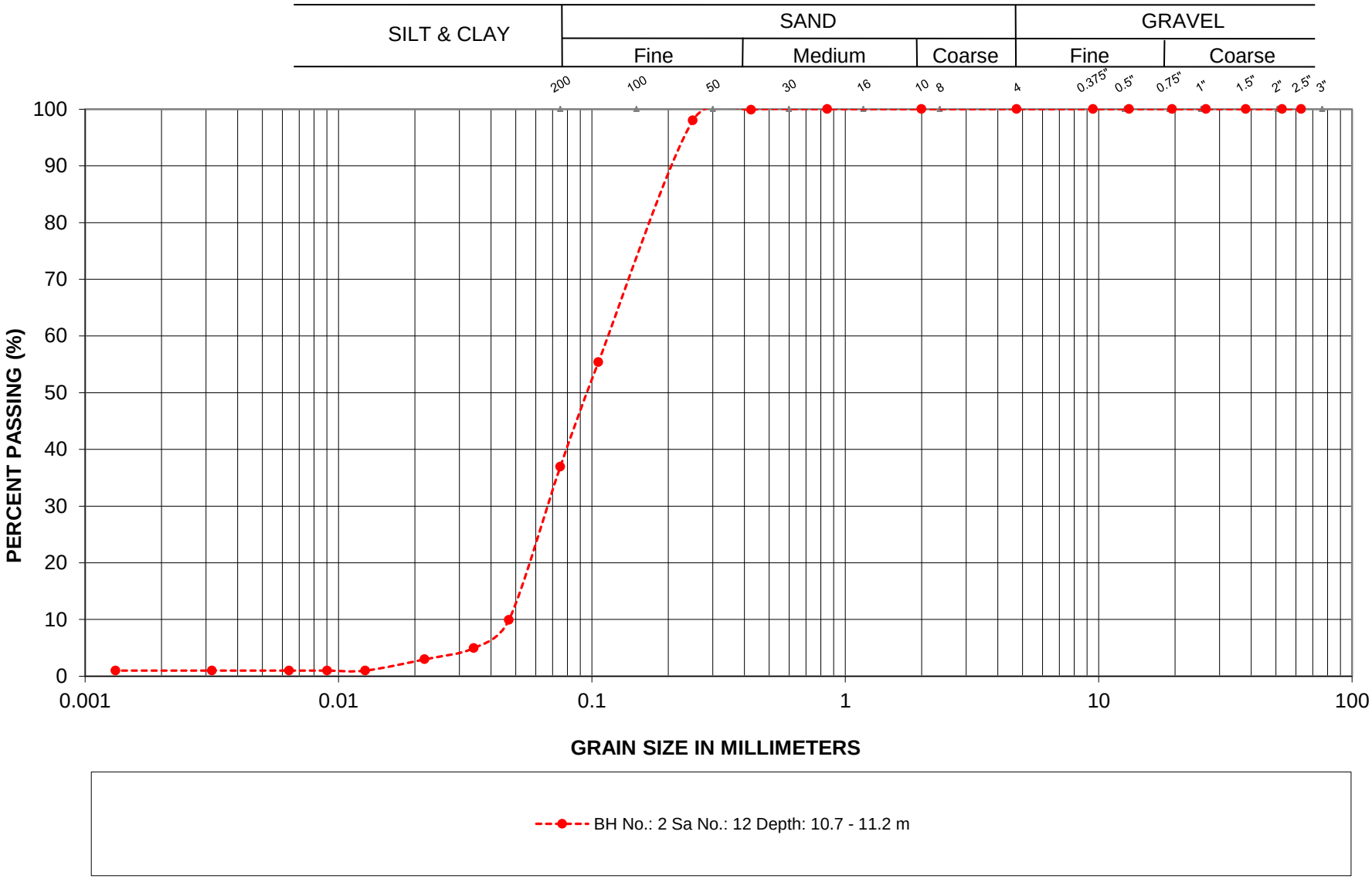
LOCATION: Hwy 60, Station 16+580
TWP of Sproule

Englobe Corp.

FIGURE L-3

Reference No.: 15/04/15020-F4
Date: July 2016

GRAIN SIZE ANALYSIS



SILTY SAND

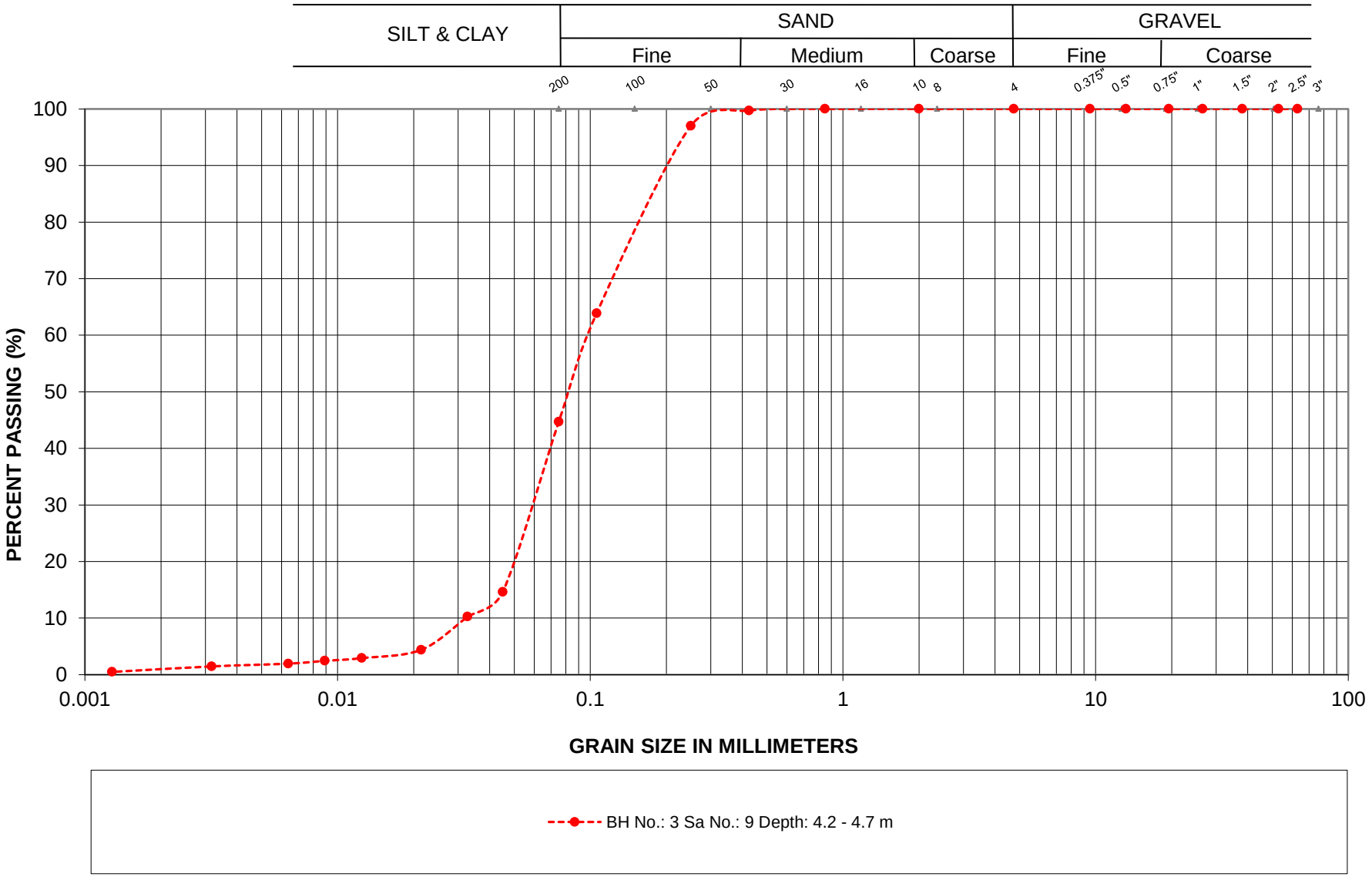
LOCATION: Hwy 60, Station 16+580
TWP of Sproule

Englobe Corp.

FIGURE L-4

Reference No.: 15/04/15020-F4
Date: July 2016

GRAIN SIZE ANALYSIS



SAND AND SILT

LOCATION: Hwy 60, Station 16+580
TWP of Sproule

Englobe Corp.

FIGURE L-5

Reference No.: 15/04/15020-F4
Date: July 2016

Laboratory Tests - Summary Sheet

Englobe

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					3.4				34			
	2	0.8					4.4				24			
	3	1.5	10	62	26	2	8.2				9			
	4	2.4					0.8				39			
	5	3.1					20.0				22			
	6	3.8					15.5				14			
	7	4.6	14	61	24	1	20.8				27			
	8	5.3					17.9				14			
	9	6.1					29.2				15			
	10	7.6	0	82	17	1	21.7				16			
	11	9.1					23.9				17			
	12	10.7					27.1				13			
	13	12.2	0	34	65	1	36.3				12			
	14	13.7					21.2				21			
2	1	0.2					2.2				35			
	2	0.8	13	67	20		6.4				19			
	3	1.5					8.6				41			
	4	2.3					10.5				10			
	5	3.1					4.4				9			
	6	3.8	5	82	13		16.4				18			
	7	4.6					27.3				14			
	8	5.3					28.5				12			
	9	6.1					28.0				4			
	10	7.62					22.0				1			
	11	9.14					26.1				5			
	12	10.67	0	63	36	1	24.8				5			

Laboratory Tests - Summary Sheet

Englobe

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 (%)				
2	13	12.2					23.8				11			
	14	13.7					22.6				5			
3	1	0.0					25.1							
	2	0.3	3	93	4		17.5				17			
	3	1.1					22.4				15			
	4	1.8					24.7				7			
	5	2.6	0	84	15	1	23.0				5			
	6	3.4					24.5				4			
	7	4.1					21.3				2			
	8	5.6					23.2				2			
	9	7.2	0	55	44	1	22.0				4			
	10	8.7					22.0				4			
	11	10.2					19.6				5			
4	1	0.0					29.4							
	2	0.3					27.8				15			
	3	1.1	0	94	6		26.1				8			
	4	1.8					26.7				6			
	5	2.6					16.0				3			
	6	3.4					28.1				2			
	7	4.1	0	84	15	1	24.2				2			
	8	5.6					25.0				5			
	9	7.2					30.1				4			
	10	8.69					29.3				2			
	11	10.24	5	86	9		22.3				2			

Appendix 4 Photo Essay

Enclosure No. 6: Photo Essay

Embankment at Culvert Location – Looking West	Photo: 1

Embankment at Culvert Location – Looking East	Photo: 2

Project: Hwy 60 – Culvert, Station 16+580, Township of Sproule	Photos Provided By: Englobe Date: Mar 2016/Dec 2015

Culvert Inlet – Looking South	Photo: 3

Culvert Outlet – Looking North	Photo: 4

Project: Hwy 60 – Culvert, Station 16+580, Township of Sproule	Photos Provided By: Englobe Date: December 2015