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 11
Station 11+545 – Township of Eilber
Site No. 39W-054
GWP 5145-05-00

FINAL FOUNDATION INVESTIGATION REPORT

Date: February 23, 2016
Ref. N^{o}: 15/05/15059-F5

Geocres No. 42G-57

Englobe

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Site No. 39W-054
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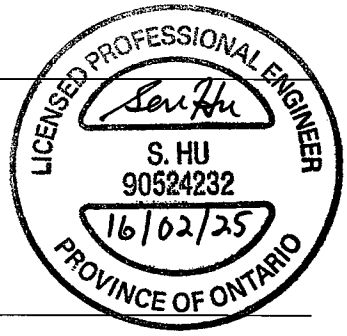
Final Foundation Investigation Report

Prepared by:

Alexander Teplylo, P. Eng.
Englobe – Project Engineer



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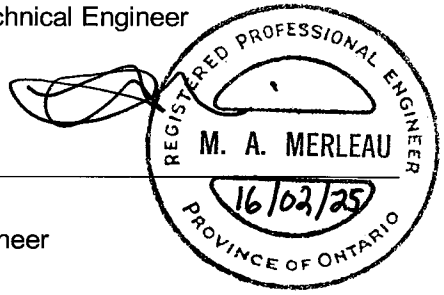

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M.A. Merleau, P. Eng.
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Property and Confidentiality

Client:
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Attention: **Mr. Al Rose**

REVISION AND PUBLICATION REGISTER		
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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 culvert site. The site has been identified as Site No. 39W-054 and is located on Highway 11 at Station 11+545 in the Township of Eilber, some 260 m east of the intersection between Highway 11 and 3rd Street in Mattice.

The foundation investigation location was specified by the MTO in the Terms of Reference for work under Agreement No. 5014-E-0001: GWP 5145-05-00. The terms of reference for the scope of work are outlined in Englobe's Proposal Reference P-14-178, dated February 18, 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 for the design build ready 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

The existing 7.3 m single span reinforced concrete arch culvert is located on Highway 11 at Station 11+545 in the Township of Eilber. The topography of this site is generally flat, with the culvert located in a shallow valley. 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 supporting on an embankment consisting of sand fills overlying mixed fills some 8.2 m in height, with centerline elevation of 225.6 m at the culvert location. The existing south embankment slope in the area of the culvert have been built at an angle of approximately 1.75H:1V. At the north side a timber retaining wall was constructed over the top of the culvert at approximately elevation 221.2 m at the location of the culvert outlet. The culvert at this location has been described as a 7.3 m single span reinforced concrete. The current survey has indicated the culvert is a 3660x7010 mm Corrugated Steel Pipe Arch (CSPA) culvert. For the purpose of this report the culvert will be described as a 7.3 m reinforced concrete arch culvert, some 29.6 m in length. The flow through the culvert is from the south to the north (right to left).

Infrastructure at this site consists of overhead communication lines running parallel to the highway embankment to the north and south of the embankment. Underground services include gas, communication, and municipal services. An Ontario Northland Rail Line runs to the south of the highway embankment.

2.1 SITE PHYSIOGRAPHY AND SURFICIAL GEOLOGY

This project is located in the Geomorphic Sub-province known as the Cochrane Clay Plain. The topography on this section of Highway 11 is generally flat. Significant layers of earth

overlay the bedrock. Within the project area native overburden primarily consists of fine grained soils (silty clays and silts) overlying a till deposit.

Bedrock in the area, as indicated on OGS Map 2506, is of the Early Precambrian felsic igneous and metamorphic rocks consisting of granitic, metasedimentary, and minor metavolcanic migmatite.

3 INVESTIGATION PROCEDURES

The fieldwork for this investigation was carried out between the period of July 24th and August 14th, 2015 during which time three (3) sampled boreholes were advanced. One (1) borehole was advanced through the embankment at the location of the culvert, and one (1) borehole was advanced at each of the inlet (south) and outlet (north) ends of the culverts.

The field investigation was carried out using a 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 post borehole completion 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 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, 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-5 and Table No. L-6).

The location of the individual boreholes was 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. The borehole elevations are based on coordinating the borehole locations with the Highway survey carried out by Callon Dietz Inc. Elevations contained in this report are referenced to a 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 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 11+545, TWP OF EILBER

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, three (3) sampled boreholes were put down at this site, with Borehole Nos. 1 advanced through the embankment adjacent to the culvert, Borehole No. 2 advanced adjacent to the culvert inlet, and Borehole No. 3 advanced adjacent to the culvert outlet. At the time of the subsurface investigation, the ground surface elevations at Boreholes Nos. 1 to 3, inclusive, were recorded at elevations 225.6, 219.1, and 218.7 m, respectively.

4.1.1 Sand Fill

At surface at Borehole Nos. 1, a layer of fill consisting of brown sand some to with gravel, some to with silt, trace clay, was penetrated. The natural moisture content measured on samples of this deposit was in the order of 5 to 10%. Gradation analyses were carried out on two (2) sample of this deposit, the results of which indicated 12 to 23% gravel size particles, 50 to 63% sand size particles, and 14 to 38% silt and clay size particles (Figure No. L-1, Appendix 3). Based on SPT ‘N’ values of 5 to 11 blows per 300 mm penetration, the compactness of this deposit was described as loose to compact. This sand fill layer was encountered to a depth of 2.9 m below grade at Borehole No. 1 (elevation 222.7 m, respectively).

4.1.2 Mixed Fills

Underlying the sand fills at Borehole No. 1, at surface at Borehole Nos. 2 and 3, a layer of mixed fills consisting of a mixture of silty sand and brown to grey silty clay, trace to some gravel, trace sand, trace organics (i.e. grass, rootlets, etc.) was encountered. The natural moisture content measured on samples of this deposit was in the order of 16 to 26%. A gradation (hydrometer) analysis was carried out on one (1) sample of this deposit, the results of which indicated 0% gravel size particles, 4% sand size particles, 45% silt size particles, and 51% clay size particles (Figure No. L-2, Appendix 3). Atterberg Limits testing was carried out on one (1) sample of this deposit the results of which indicated a Plastic Limit in the order of 24% and a Liquid Limit in the order of 39%, indicating a silty clay of medium plasticity (Figure No. L-5, Appendix 3). Based on SPT 'N' values of 7 to 25 blows per 300 mm penetration, the consistency of this deposit was described as stiff to very stiff. This fill layer was encountered to depths of 8.2, 1.8, and 0.6 m below grade at Borehole Nos. 1, 2, and 3, respectively (elevations 217.4, 217.3, and 218.1 m, respectively).

4.1.3 Silty Sand Fill

Underlying the silty clay fill at Borehole No. 2, a thin layer of fill described as silty sand, some clay was encountered. Decayed wood was encountered in this layer at depths of 1.8 to 1.9 m below ground surface. This deposit was encountered to a depth of 2.4 m below grade at Borehole No. 2 (elevation 216.7 m).

4.1.4 Sandy Silt Till

Underlying the mixed fills at Borehole Nos. 1 and 3, and underlying the silty sand fill at Borehole No. 2, a deposit of till described as grey sandy silt, trace to with gravel, trace to some clay was penetrated. At Borehole No. 1 gravel size rock pieces were encountered in this deposit from depth of 8.4 to 8.7m below grade. Trace wood was encountered in this deposit at depths of 9.1 to 9.6 m below grade at Borehole No. 1. The natural moisture content measured on samples of this deposit was in the order of 5 to 19%. Gradation (hydrometer) analyses were carried out on six (6) samples of this deposit, the results of which indicated 2 to 22% gravel size particles, 25 to 37% sand size particles, 39 to 67% silt size particles, and 4 to 12% clay size particles (Figure No. L-3, Appendix 3). Atterberg Limits testing was carried out on six (6) samples of this deposit, the results of which indicated a non-plastic silt to silts with a Plastic Limit in the order of 12 to 14% and a Liquid Limit in the order of 15 to 19% (Figure No. L-5, Appendix 3). Based on SPT 'N' values of 12 to 51 blows per 300 mm penetration, the compactness of this deposit was described as compact to very dense, generally dense. This deposit was encountered to depth of 10.1, 10.2 and 10.1 m below grade at Borehole Nos. 1, 2, and 3, respectively (elevations 215.5, 208.9 and 208.6 m, respectively).

4.1.5 Silty Sand Till

Underlying the sandy silt till at Borehole No. 1 a deposit of till described as grey silty sand, trace gravel trace clay, was penetrated. The natural moisture content measured on samples of this deposit was in the order of 7 to 8%. A gradation (sieve) analysis was carried out on one (1) sample of this deposit, the results of which indicated 2% gravel size particles, 62% sand size particles, and 36% silt and clay size particles (Figure No. L-4, Appendix 3). Based on the SPT 'N' values of 50 blows per 76 mm penetration, the compactness of this deposit was described as very dense. Sampling was terminated in this deposit at a depth of 15.4 m below grade at Borehole No. 1 (elevation 210.2 m).

4.1.6 Bedrock

Underlying the sandy silt till at Borehole Nos. 2 and 3, bedrock was proven by diamond core drilling. The bedrock was described as pink granitic rock to black gneiss. Based on RQD values of 38 to 77% the bedrock was described as poor to good quality. Sampling in the bedrock was terminated at depths of 13.2 and 13.1 m below grade at Borehole Nos. 2 and 3, respectively (elevations 205.9 and 205.6 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

During the period of investigation (August 13th, 2015), the creek water levels was measured at an elevation of some 217.4 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. Standpipes were installed in Borehole Nos. 1 and 2 to obtain post borehole completion water levels. These levels are recorded on the individual Record of Borehole Log Sheets (Appendix 2).

The groundwater levels were measured at elevations 218.5 and 218.1 m at Borehole Nos. 1 and 2, respectively.

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

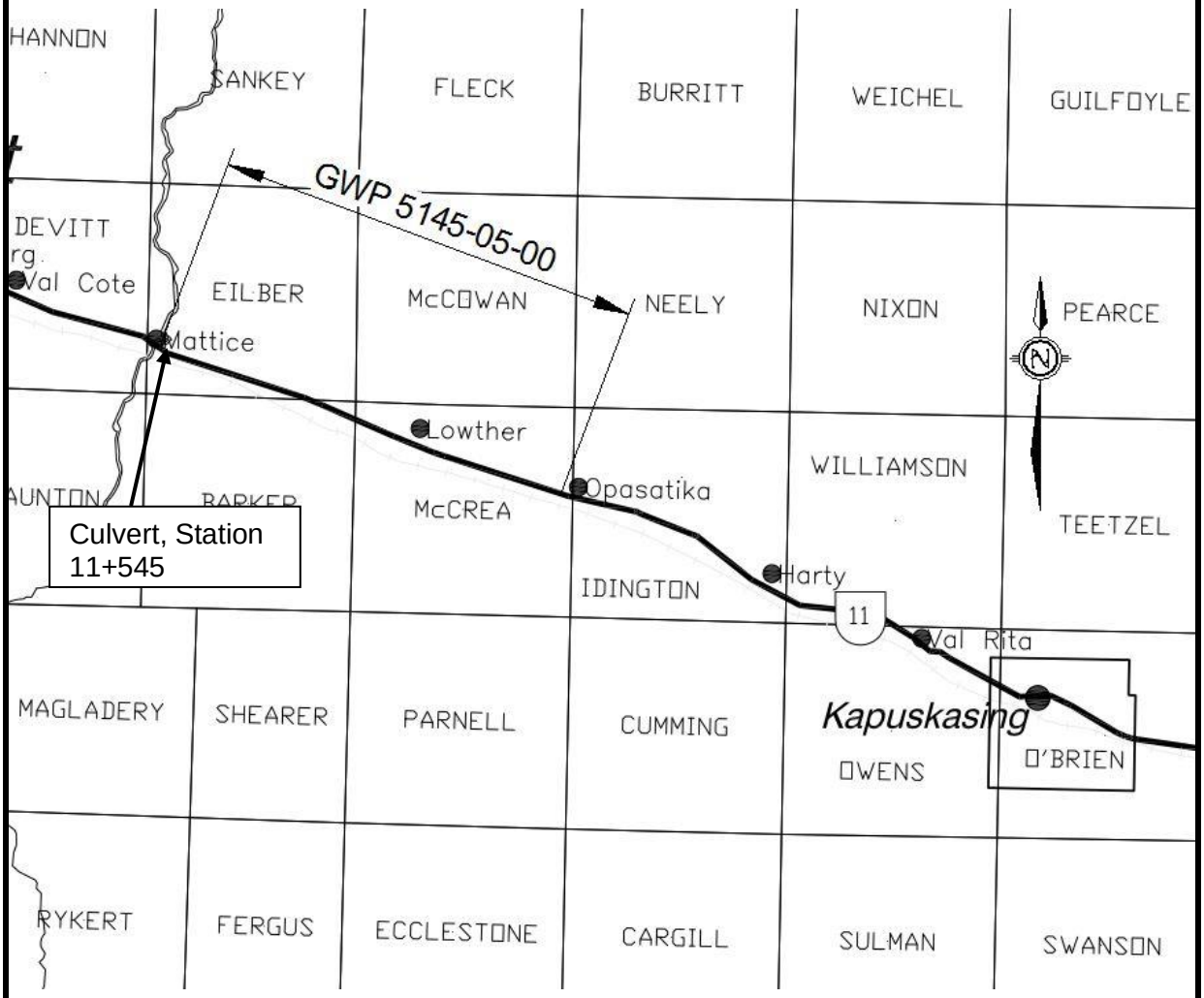
Appendix 1 Key Plan

Drawing No. 1 Key Plan

MACRO KEY PLAN

Drawing No.1

NOT TO SCALE



FOUNDATION INVESTIGATION REPORT

GWP 5145-05-00

Highway 11

Station 11+545 Culvert

Township of Eilber

Reference No: 15/05/15059-F5 February 2016

Englobe

Appendix 2 Subsurface Data

Enclosure No. 1	List of Abbreviations and Symbols
Enclosure Nos. 2 to 4	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

REFERENCE 15/05/15059-F5 DATUM Geodetic LOCATION N 5497239.4 E 358478.1 - Eilber Twp., Station 11+539 ORIGINATED BY JL

PROJECT GWP 5145-05-00, Highway 11 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers COMPILED BY SH

CLIENT AECOM DATE (Started) 24 July 2015 TIME (Completed) 12:50:00 PM CHECKED BY MAM

DATE (Completed) 25 July 2015

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)
225.6	Ground Surface											
0.0	FILL- sand, some to with gravel, some to with silt, trace clay seams of silt encountered at depths from 1.8 m to 2.7 m brown, moist (loose/compact)		1	SS	11		225					
			2	SS	5							23 63 (14)
			3	SS	9		224					
222.7			4	SS	10		223					12 50 30 8 (NP)
2.9	FILL - silty clay trace sand trace organics brown (very stiff)		5	SS	24		222					
			6	SS	24							
			7	SS	17		221					0 4 45 51
	Grey to greyish brown		8	SS	18		220					
			9	SS	22		219					
			10	SS	25	▽▼						
217.4			11	SS	23	▽	218					
8.2	sandy SILT TILL - some gravel trace clay Gravel size rock pieces encountered at depths from 8.4 m to 8.7 m. Auger refusal encountered at 8.4 m depth. Advanced casing continuously to allow sampling. Trace wood encountered at depths from 9.1 m to 9.6 m		12	SS	50/51 mm		217					
			13	SS	48		216					
215.5												
10.1	grey (dense/very dense) silty SAND TILL - trace gravel, trace clay Wood encountered at depths from 10.4 m to 10.7 m. Borehole terminated due to wood. Borehole moved to 1 m west. Wash bored to a depth of 10.7 m. grey (very dense)		14	SS	50/76 mm		215					2 62 (36)
			15	SS	50/76 mm		214					
							213					
			16	SS	50/76 mm		212					

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) 25/7/15 1:30:00 PM	7.7	-
2) 13/8/15 11:00:00 AM	7.1	-
3) 14/8/15 3:30:00 PM	7.1	-

MEL-GEO 15059 - F5 BOREHOL LOGS.GPJ MEL-GEO.GDT 23/2/16

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

Englobe

REFERENCE 15/05/15059-F5 DATUM Geodetic LOCATION N 5497239.4 E 358478.1 - Eilber Twp., Station 11+539 ORIGINATED BY JL

PROJECT GWP 5145-05-00, Highway 11 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers COMPILED BY SH

CLIENT AECOM DATE (Started) 24 July 2015 TIME (Completed) 12:50:00 PM CHECKED BY MAM

DATE (Completed) 25 July 2015

SOIL PROFILE			SAMPLES									
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)
	Continued from Previous Page										
210.2			17	SS	50/102 mm		211		○		
15.4	End of Sampling End of Borehole										

MEL-GEO 15059 - F5 BOREHOL LOGS.GPJ MEL-GEO.GDT 23/2/16

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

METRIC

RECORD OF BOREHOLE NO. 2

REFERENCE 15/05/15059-F5 DATUM Geodetic LOCATION N 5497217.8 E 358482.8 - Eilber Twp., Station 11+553.5 ORIGINATED BY JL

PROJECT GWP 5145-05-00, Highway 11 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers COMPILED BY SH

CLIENT AECOM DATE (Started) 13 August 2015 TIME (Completed) 4:25:00 PM CHECKED BY MAM

DATE (Completed) 13 August 2015

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)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
219.1	Ground Surface						219	SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE; ● QUICK TRIAXIAL × LAB VANE (20 40 60 80 100)	WATER CONTENT (%) (20 40 60)		
0.0	FILL- mixture of silty sand and silty clay, trace gravel, trace black organics brown to grey moist (stiff)		1	SS	7						
			2	SS	9		218				
217.3			3	SS	14						
1.8	FILL - silty sand, some clay decayed wood encountered at depth from 1.8 m to 1.9 m						217				
216.7	grey (compact)		4	SS	12						19 32 41 8 (NP)
2.4	sandy SILT TILL - trace to some gravel, trace to some clay grey, moist (compact/very dense)		5	SS	40		216		H		9 37 46 8
			6	SS	90/279 mm		215				
			7	SS	50/76 mm						
			8	SS	50/100 mm		213				
			9	SS	92/279 mm		211		H		5 28 55 12
			10	SS	94/279 mm		210				
208.9							209				
10.2	Start Rock Coring Bedrock - pink granite/black gneiss poor to good quality		11	RC	Rec.=97% RQD=43%						
			12	RC	Rec.=100% RQD=77%		207				
205.9							206				
13.2	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) 13/8/15 4:35:00 PM	1.1	-
2) 14/8/15 7:40:00 AM	1	-
3) 14/8/15 3:30:00 PM	1	-

MEL-GEO 15059 - F5 BOREHOL LOGS.GPJ MEL-GEO.GDT 23/2/16

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

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

METRIC

RECORD OF BOREHOLE NO. 3

Englobe

REFERENCE 15/05/15059-F5 DATUM Geodetic LOCATION N 5497265.5 E 358491.0 - Eilber Twp., Station 11+537 ORIGINATED BY JL

PROJECT GWP 5145-05-00, Highway 11 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers COMPILED BY SH

CLIENT AECOM DATE (Started) 14 August 2015 TIME (Completed) 4:30:00 PM CHECKED BY MAM

DATE (Completed) 14 August 2015

ELEV / DEPTH	DESCRIPTION (see Enclosure No. 1)	STRATA PLOT	SAMPLES 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)
218.7	Ground Surface										
0.0 / 218.1	FILL- mixture grey and brown silty clay, some gravel, trace grass rootlets		1	SS	7						
0.6	moist (stiff) sandy SILT TILL - trace to with gravel, trace clay		2	SS	30	▽	218				22 33 41 4
	grey moist		3	SS	19		217				
	(compact/very dense)		4	SS	51		216				
			5	SS	82/279 mm						2 25 67 6 (NP)
			6	SS	50/127 mm		215				
	clayey silt, sandy, some gravel		7	SS	50/127 mm		214				14 37 39 10
			8	SS	50/127 mm		213				
			9	SS	50/127 mm		212				
			10	SS	84/279 mm		211				
208.6							210				
10.1	Start Rock Coring						209				
	Bedrock - pink granite/black gneiss fair to poor quality		11	RC	Rec.=98% RQD=52%		208				
			12	RC	Rec.=95% RQD=38%		207				
205.6							206				
13.1	End of Sampling End of Borehole										

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) 14/8/15 4:30:00 PM	1.1 ▽	-
2)	- ▽	-
3)	- ▼	-

MEL-GEO 15059 - F5 BOREHOL LOGS.GPJ MEL-GEO.GDT 23/2/16

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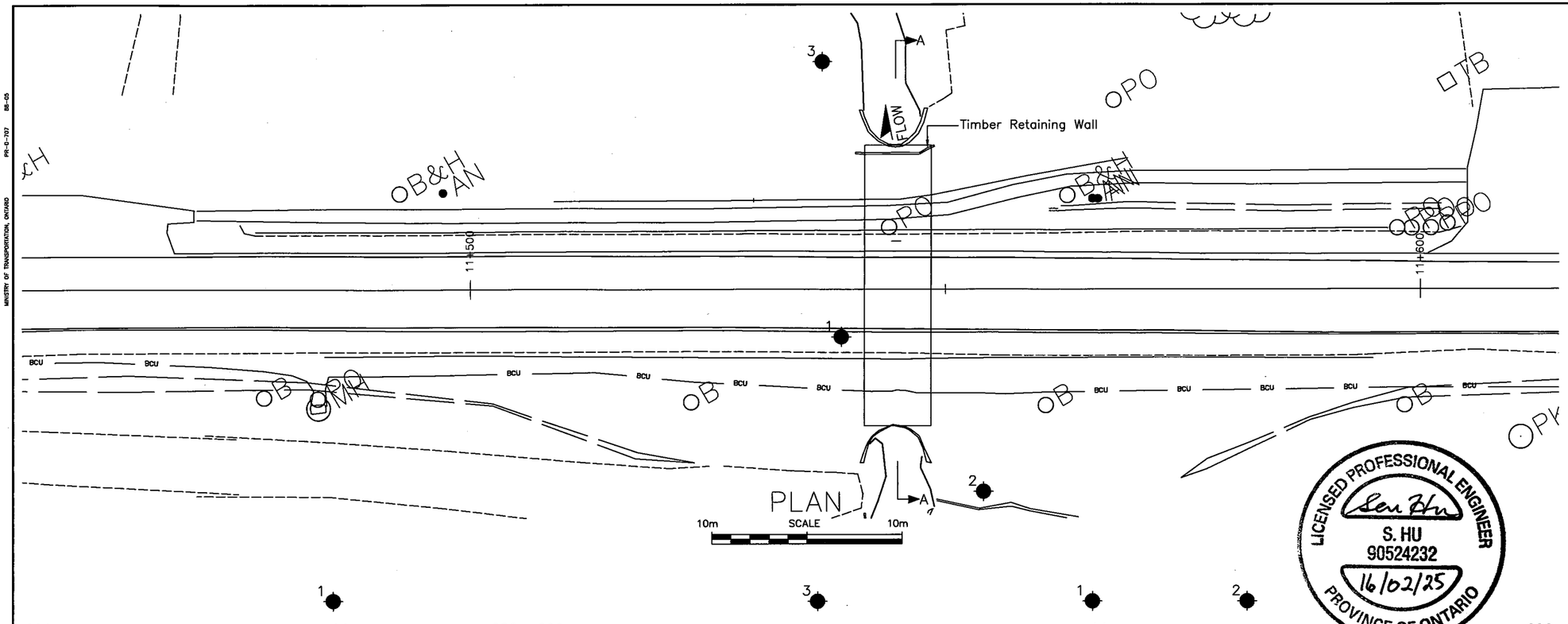
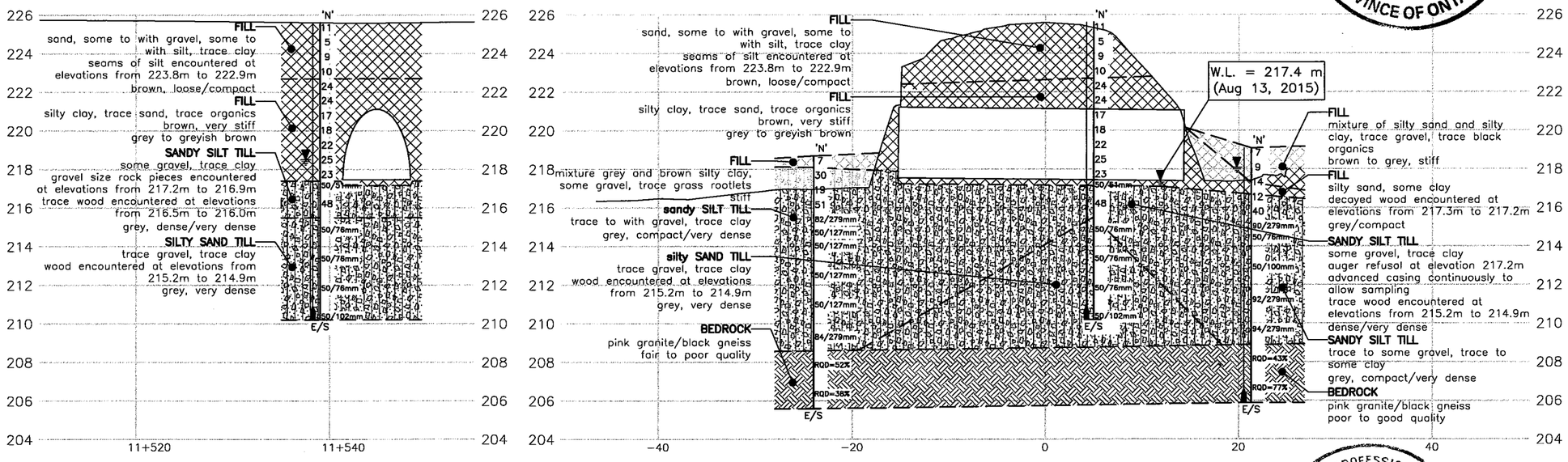
Appendix 3 Borehole Plan and Laboratory Data

Drawing No. 2:	Borehole Location and Soil Strata
Figure Nos. L-1 to L-4:	Grain Size Distribution Curves
Figure No. L-5:	Atterberg Limits
Table No. L-6:	Laboratory Test Summary Sheet

Englobe





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
16/02/25
PROVINCE OF ONTARIO

REGISTERED PROFESSIONAL ENGINEER
M. A. MERLEAU
16/02/25
PROVINCE OF ONTARIO

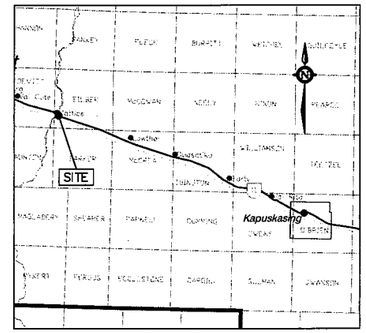
DISTRICT
CONT. No.
GWP No. 5145-05-00

HWY 11 CULVERT
STA. 11+545
SITE NO. 39W-054

BOREHOLE LOCATIONS AND SOIL STRATIGRAPHY

DRAWING 2

Englobe



KEY PLAN
N.T.S.

LEGEND

	Borehole w/ DCPT
	Borehole
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	225.6	5.0m Rt	5497239.4	358478.1
2	219.1	21.3m Rt	5497217.8	358482.8
3	218.7	24.0m Lt	5497265.5	358491.0

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 September 17, 2015

Coordinates based on MTM Zone 13 NAD83 CSRS

GEOCRES No. 42G-57

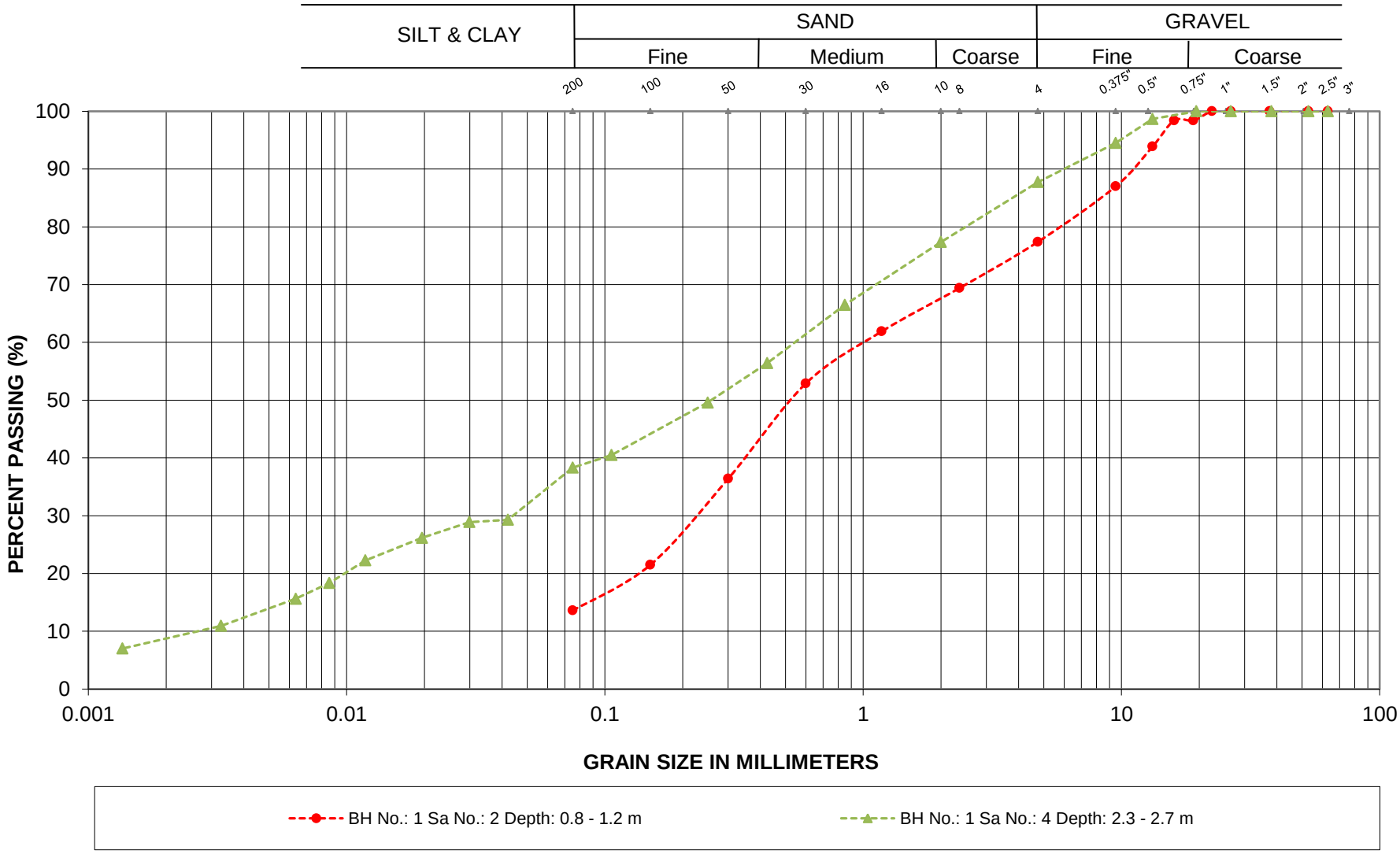
REVISIONS			
NOV/15	DM	DRAFT	
FEB/16	DM	FINAL	
		DESCRIPTION	

DESIGN	CHK	CODE	LOAD	DATE DEC/15
DRAWN DM	CHK SH	SITE 39W-054	STRUCT	SCHEME	DWG 2

CAD FILE LOCATION AND NAME: G:\2015\15059 - PAV & FDN, Hwy 11 - 163-98-00 & 5145-05-00 (AECOM)\FOUNDATIONS\Drawings\F5\15059 F5 - sta 11+545.dwg
MODIFIED: 12/2/2015 1:32:13 PM BY: MITCDU
DATE PLOTTED: 2/11/2016 10:39:04 AM BY: DUNCAN MITCHELL
MINISTRY OF TRANSPORTATION, ONTARIO PR-D-707 05-05

Reference No.: 15/05/15059-F5
Date: October 2015

GRAIN SIZE ANALYSIS



SAND FILL

LOCATION: Hwy 11, Station 11+545
TWP of Eiber

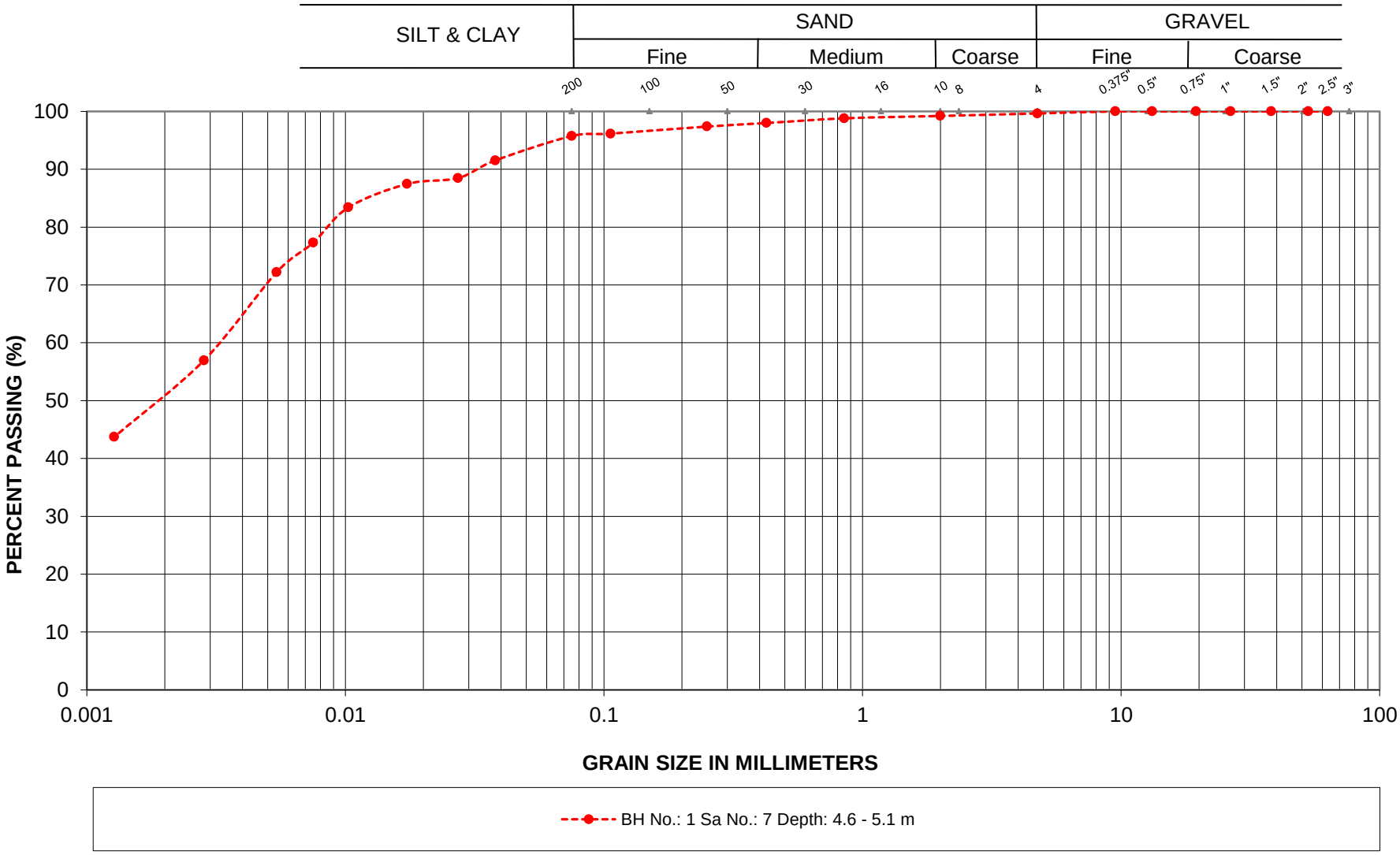
Englobe Corp.

FIGURE L-1

Reference No.: 15/05/15059-F5
Date: October 2015

Englobe

GRAIN SIZE ANALYSIS



SILTY CLAY FILL

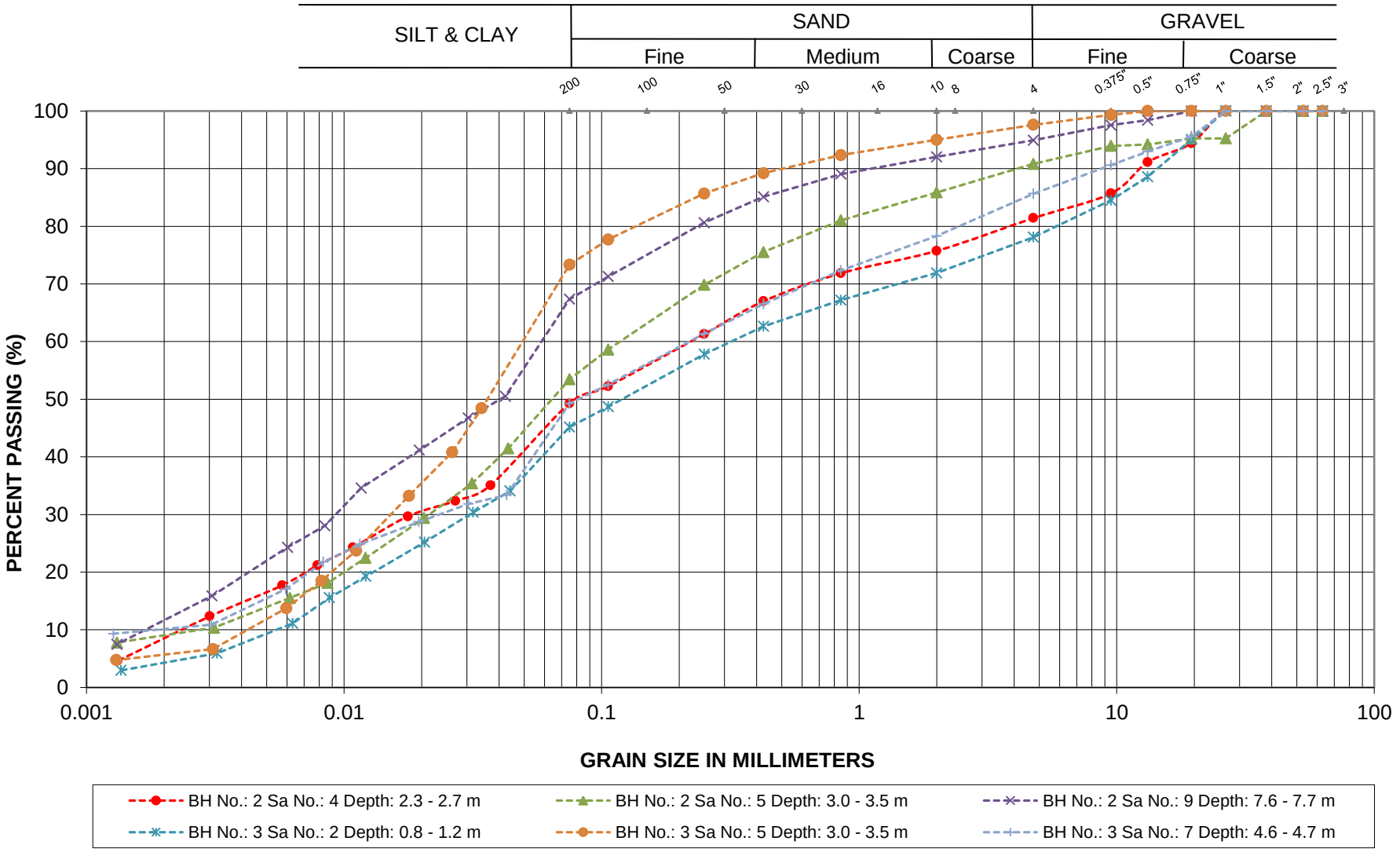
LOCATION: Hwy 11, Station 11+545
TWP of Eiber

Englobe Corp.

FIGURE L-2

Reference No.: 15/05/15059-F5
Date: September, 2015

GRAIN SIZE ANALYSIS



SANDY SILT TILL

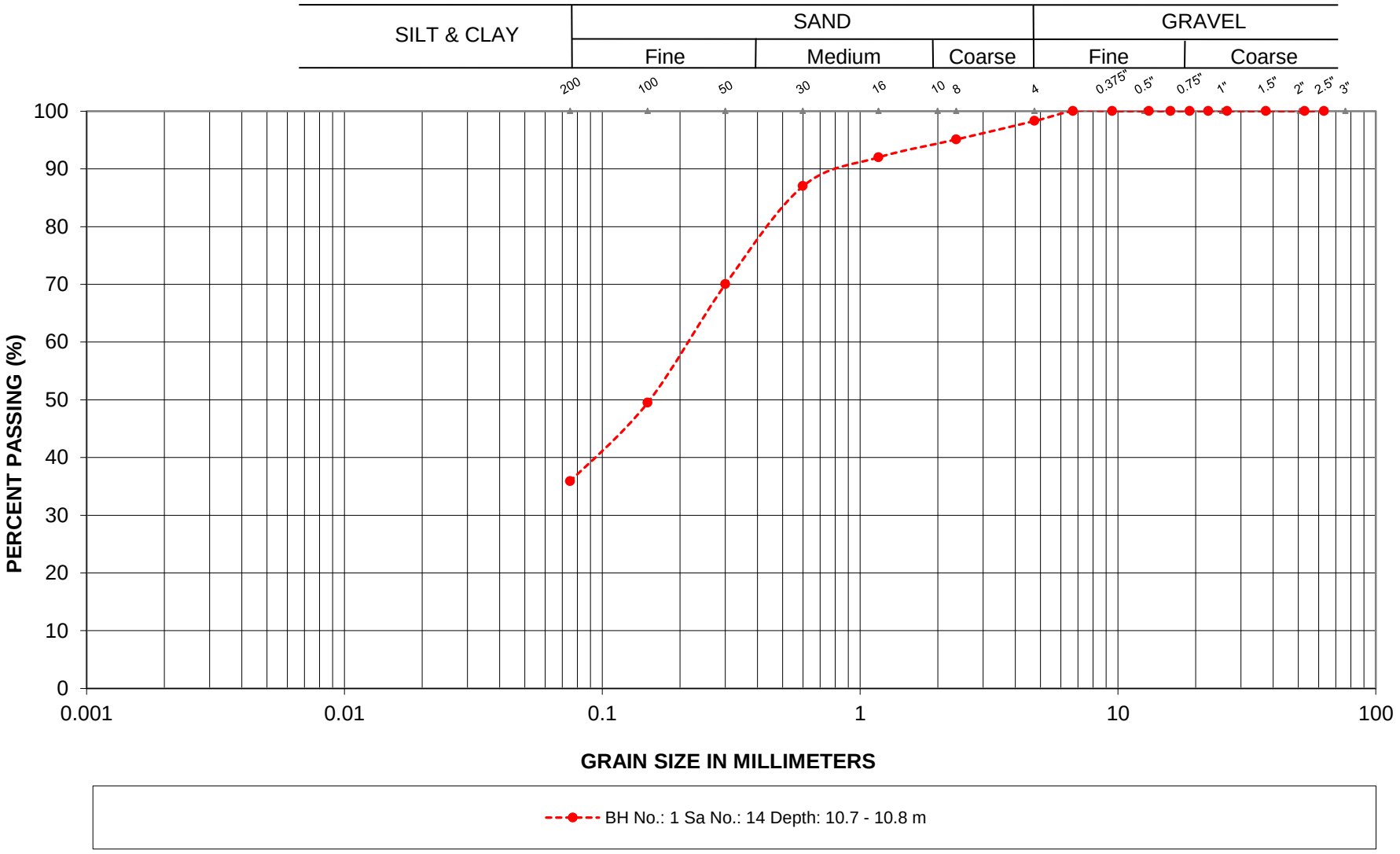
LOCATION: Hwy 11, Station 11+545
TWP of Eiber

Englobe Corp.

FIGURE L-3

Reference No.: 15/05/15059-F5
Date: October 2015

GRAIN SIZE ANALYSIS



SILTY SAND TILL

LOCATION: Hwy 11, Station 11+545
TWP of Eiber

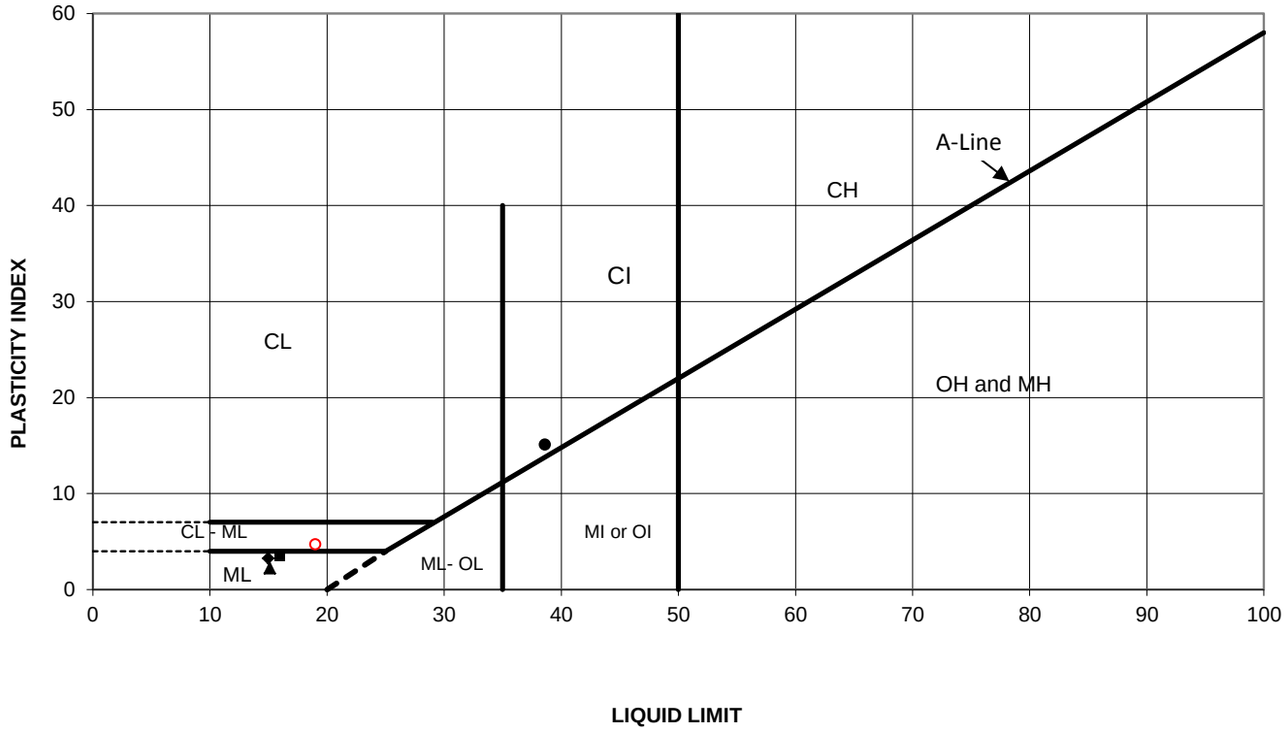
Englobe Corp.

FIGURE L-4

ATTERBERG LIMITS TEST RESULTS

FIGURE L-5

ATTERBERG INDICES



SYMBOL	BH	Sa. No.	Depth(m)	Elev.(m)	Liquid Limit	Plastic Limit	Plasticity Index	NMC %
●	1	7	4.8	220.8	38.6	23.5	15.1	20.0
◆	2	5	3.3	215.8	15.0	11.7	3.3	7.4
■	2	9	7.8	211.3	16.0	12.6	3.4	4.9
▲	3	2	1.0	217.7	15.1	12.9	2.2	5.2
○	3	7	4.6	214.1	19.0	14.3	4.7	7.4

Date: Oct-15
Project: Hwy 11,
Location: Sta. 11+545, TWP. of Eiber

Prep'd: AT
Chkd: MAM
Ref. No.: 15/05/15059-F5

Englobe Corp.

Reference No.: 15/05/15059-F4
Date: October 2015

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					6.6				11			
	2	0.8	23	63	14		5.2				5			
	3	1.5					9.5				9			
	4	2.3	12	50	30	8	7.6				10			Non-Plastic (NP)
	5	3.1					23.7				24			
	6	3.8					19.1				24			
	7	4.6	0	4	45	51	20.0	38.6	23.5	15.1	17			
	8	5.3					22.9				18			
	9	6.1					20.6				22			
	10	6.9					19.3				25			
	11	7.6					25.5				23			
	12	8.4					0.1				50/51 mm			
	13	9.1					8.8				48			
	14	10.7	2	62	36		7.0				50/76 mm			
	15	12.2					7.1				50/76 mm			
	16	13.7					7.1				50/76 mm			
	17	15.2					8.4				50/102 mm			

Project: Hwy 11, Culvert Sta. 18+062, Township of Eiber

Table No. L-6

Laboratory Tests - Summary Sheet

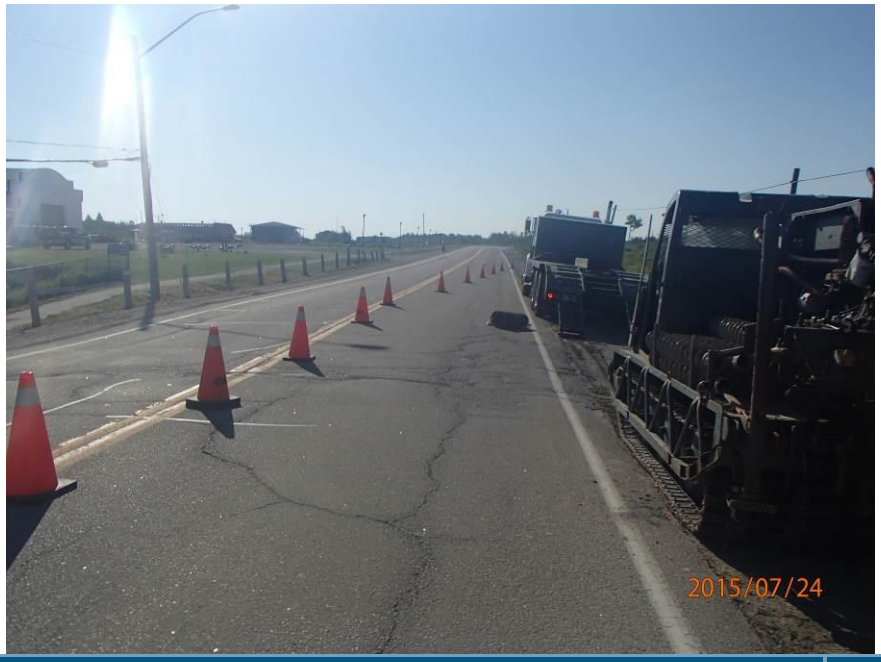
Englobe

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	1	0.0					22.9				7			
	2	0.8					22.3				9			
	3	1.5					21.2				14			
	4	2.3	19	32	41	8	18.7				12			Non-Plastic (NP)
	5	3.1	9	37	46	8	7.4	15.0	11.7	3.3	40			
	6	3.8					8.6				90/279 mm			
	7	4.6					6.3				50/76 mm			
	8	6.1					6.5				50/100 mm			
	9	7.6	5	28	55	12	4.9	16.0	12.6	3.4	92/279 mm			
	10	9.1					11.3				94/279 mm			
	11	10.2												Recover= 97%, RQD=43%
	12	11.7												Recover= 100%, RQD=77%
3	1	0.0					15.8				7			
	2	0.8	22	33	41	4	5.2	15.1	12.9	2.2	30			
	3	1.5					10.3				19			
	4	2.3					12.0				51			
	5	3.1	2	25	67	6	11.0				82/279 mm			
	6	3.8					8.3				50/127 mm			
	7	4.6	14	37	39	10	7.4	19.0	14.3	4.7	50/127 mm			
	8	6.1					10.1				50/127 mm			
	9	7.6					9.4				50/127 mm			
	10	9.1					9.5				84/279 mm			
	11	10.1												Recover= 98%, RQD=52%
	12	11.6												Recover= 95%, RQD=38%

Appendix 4 Photo Essay

Enclosure No. 5: Photo Essay

Existing Embankment – Looking East	Photo: 1



South Slope – Looking South, Note ONR Culvert	Photo: 2

Project: Hwy 11 – Culvert, Station 11+545, Township of Eiber	Photos Provided By:Englobe Date: August 2015

Culvert Outlet – Looking South-East	Photo: 3

View Through Culvert – Looking south	Photo: 4

Project: Hwy 11 – Culvert, Station 11+545, Township of Eiber	Photos Provided By:Englobe Date: August 2015