

Englobe Reference: P-0014012-0-00-100-F7

January 17, 2020

Planmac Engineering Inc.  
80 North Queen Street, Suite 302,  
Toronto, Ontario M8Z 2C9

Attention: Mr. Mike Neumann, P. Eng.

**Re: Technical Memorandum - Final  
Grouse Creek Culvert, Site No. 30-508/C  
GWP 2197-17-00  
Geocres No. 31D-712**

Englobe Corp. (Englobe) has been retained by Planmac Engineering Inc. (Planmac), on behalf of the Ministry of Transportation of Ontario (MTO), to carry out a foundation investigation for the proposed rehabilitation of the existing Grouse Creek Culvert – Site No. 30-508/C. The Grouse Creek Culvert is located on Highway 11 in the Township of Oro-Medonte, Ontario (see Drawing No. 1, Appendix 1). The culvert was constructed in 1993 and is located on Highway 11 approximately 400 m south of Oro-Medonte Line 15 in the Township of Orillia (Latitude 44.5618523, Longitude -79.4444721).

Englobe Corp. (Englobe) has carried out a foundation investigation for the Grouse Creek Culvert as required in the RFQ and its addendums/clarifications for this project. The results of the foundation investigation are provided under separate cover in the Foundation Investigation Report, Reference No. P-0014012-0-00-100-F7, Dated August, 2018. In addition, as required in the RFQ, Englobe undertook a review of a previous Foundation Investigation and Design Report for Highway 11 Grouse Creek Culvert Extension, WP 140-58, MTO, November 1959 (Geocres No. 31D-076) by the Departments of Highways - Ontario. This technical memorandum summarizes our review comments and is to be read in conjunction with the FIR.

The purpose of this technical memorandum is to provide geotechnical engineering interpretation of the factual information to facilitate a structural stability evaluation. This technical memorandum includes recommendations for mitigating the erosion issues currently being experienced at the culvert ends, as well as recommendations for dewatering/unwatering of the site during construction, and recommendations for any temporary protection systems that may be required to carry out the works.

## Historical FIDR Review

Constructed in 1993, the Grouse Creek Culvert (Site No. 30-508/C) is a 4.6 m span x 1.5 m height Rigid Frame Open Culvert, some 55 m in length. Flow through the culvert is from left to right (i.e. west to east).

The previous foundation investigation (Geocres No. 31D-076) was carried out in 1959. Based on the review of the existing report, Englobe has prepared the following summary:

- Native soils generally consisted of granular soils (sands) with layers of peat at surface;
- Above Elevation 720.0' (219.5 m), the soils were considered to be unsuitable to support an open culvert;
- Footings for the open culvert were recommended to be founded at Elevation 720.0' (219.5 m), with an allowable bearing capacity of 2 tons/ft<sup>2</sup> (191 kPa);
- Footings were recommended to be a minimum 3' (0.9 m) in width;
- Timber sheeting was recommended to support excavations during installation and were recommended to be left in place.

## DISCUSSION AND RECOMMENDATIONS

### General

The native soils encountered at the culvert inlet and outlet generally consist of surficial organic deposits, overlying sands, overlying sandy tills and silty tills. A thin layer of silty clay was observed near the surface at the inlet.

The rehabilitation of Grouse Creek Culvert is expected to include: repairs to the culvert components, removal of the rotted timber cofferdams and the addition of mitigation measures to prevent any further scour issues at inlet and outlet to prevent footing rotation at end segments. As such, it is likely that temporary cofferdams at the inlet and outlet will be required to allow the rehabilitation work. Permanent scour and/or erosion protection will also be required for the culvert.

### Design Bearing Capacity

Considering an open culvert with footings some 900 mm wide founded at or below Elevation 219.5 m, a factored geotechnical resistance at ULS of 250 kPa, and a geotechnical reaction at SLS of 150 kPa would apply for design, in consideration of the normally tolerable 25 mm total settlement and 19 mm of differential settlement depending on structure rigidity.

The estimated depth of frost penetration in the area of the Grouse Creek Culvert is about 1.6 m below the lowest surrounding grade. As such, foundations located at or below elevation 219.5 m will be below the depth of frost penetration.

### **Excavation and Dewatering**

The construction areas must be maintained in a dewatered condition during culvert rehabilitation. The groundwater levels at the time of this investigation were recorded at approximately Elevations 223.2 to 223.7 m on October 13, 2017 at Borehole Nos. 1 and 2 that were located adjacent to the culvert inlet and outlet, respectively. The water level in the creek at the culvert inlet was measured at Elevation 223.2 m on October 13, 2017. It should be noted that the groundwater and surface water levels will fluctuate seasonally/yearly.

Dewatering in accordance with Groundwater control, as per OPSS.PROV 517, Special Provision No. 517F01, and NSSP FOUN0003 (March 2018), will be required during rehabilitation construction. A complete cofferdam at the inlet and outlet with bypass pumping is the recommended method of controlling the creek flow. Considering the water levels and organic soils encountered at the inlet and outlet, as well as the underlying cohesionless sand deposit, it is recommended that an interlocking steel sheet pile wall be used for the cofferdam. The sheet piles should be advanced through the organic soils and into the native mineral soils. Considering the native sand subgrades, piping may result in disturbed subgrades and as such, the cofferdam sheeting must be installed to sufficient depth to prevent piping. It is recommended that the Dewatering Design Engineer and Design-Checking Engineer have a minimum of 5 years of experience in designing systems of similar nature and scope. NSSP FOUN0003 shall state the requirements for the Dewatering Design Engineer and Design-Checking Engineer for this project.

Regardless, pumping from filtered sump holes in the base of the excavation will likely be required within the cofferdam area.

In addition, depending on the depth of the sheet piles, they must be sufficiently robust to allow penetration into the underlying sandy and silty tills (if required based on design depth) which were noted to contain cobbles and boulders. Based on auger response during drilling, suspected cobbles and boulders were indicated at, and below, approximately Elevations 214.0 and 219.0 m at Boreholes Nos. 1 and 2, respectively, see Notice to Contractor (enclosed).

If the sheeting cannot be installed to sufficient depth to provide lateral support for the cofferdam, bracing, walers and rakers, etc. shall be used to provide support. Bracing systems should be designed with the lateral earth pressures provided in the following section.

Consideration could also be given to alternative methods of cofferdam construction such as using an earth fill having a low permeable core, sand bag/metre bag, or aquadam (water filled bladder) type dam. However, water flow and seepage below the dam must be controlled and would likely require a dewatering system such as vacuum well points to control/prevent piping/boiling at the base of the excavation.

The bypass pipes could be installed at the bottom of the existing culvert or elevated on temporary supports. Alternatively, considering the culvert size and depending on the structural condition of the culvert, bypass pipes could also be temporarily suspended from the top culvert during rehabilitation.

Registering with the Environmental Activity and Sector Registry (EASR) for the construction activity may be required, possibly along with a Permit to take Water (PTTW). Considering the water levels at the culvert site, a PTTW will likely be required, however, this will depend upon the Contractors proposed methodology and schedule.

The cofferdam/protection system must be removed following completion of the project.

Ultimately, the method of excavation, dewatering, and stream flow diversion will be the choice of the Contractor, provided that the methods adhere to the MOECC requirements for EASR and PTTW. The importance of maintaining the subgrade in a dewatered stable condition during excavation and construction operations cannot be stressed enough.

### Lateral Earth Pressures

Lateral earth pressures should be computed in accordance with the Canadian Highway Bridge Design Code (CHBDC). The parameters for bedding, cover, embankment and backfill materials are based on compaction levels of 100% SPMDD. The design parameters for the bedding/embedment and backfill materials are as follows:

PARAMETER	GRANULAR A	GRANULAR B TYPE I	EXISTING FILL	NATIVE SAND
Unit Weight (kN/m <sup>3</sup> )	22.8	21.2	19.0	18.0
Effective Angle of Internal Friction	35°	32°	32°	30°

PARAMETER	GRANULAR A	GRANULAR B TYPE I	EXISTING FILL	NATIVE SAND
Coefficient of Active Earth Pressure ( $K_a$ )	0.27	0.31	0.31	0.33
Coefficient of Passive Earth Pressure ( $K_p$ )	3.69	3.22	3.23	3.00
Coefficient of Earth Pressure at Rest ( $K_o$ )	0.43	0.47	0.47	0.50
PARAMETER	SILTY CLAY	SAND TILL	CLAYEY TILLS	
Unit Weight ( $kN/m^3$ )	16.5	19.0	18.5	
Effective Angle of Internal Friction	26°	35°	33°	
Cohesion (kPa)	88	-	-	
Coefficient of Active Earth Pressure ( $K_a$ )	0.39	0.27	0.29	
Coefficient of Passive Earth Pressure ( $K_p$ )	2.56	3.69	3.39	
Coefficient of Earth Pressure at Rest ( $K_o$ )	0.56	0.43	0.46	

For rigid structures, such as a precast concrete culverts, deflection cannot occur, as such the “at-rest” condition ( $K_o$ ) applies. For flexible structures, such as open concrete culverts, deflection can occur, as such the “active” condition ( $K_a$ ) applies. The “passive” condition ( $K_p$ ) applies when the wall is in compression (in a direction opposite to the wall loading).

### Scour and Erosion

Open culvert structures on shallow foundations require scour and erosion protection. This is generally accomplished by establishing the footing at sufficient depth to prevent scour or by protecting the footing with alternative permanent means such as rip-rap, sheet piles, etc. Based on available information, the existing 900 mm (3') wide strip footings have been established at Elevation 219.5 m. It is understood that scour/erosion is occurring at this culvert site, and as such, additional/new protection is required. Considering that it appears that the footings have been established within the depth of scour, two options can be considered for providing scour/erosion protection for the culvert:

- Sheet pile cut off walls, and/or
- Rip Rap protection throughout the culvert.

Rip-rap can be considered to provide scour protection at the inlet and outlet. The inlet and outlet stream bed can be protected with a rip-rap (R-50 size as per OPSS.PROV 1004) apron. The apron shall be 5 m in length, 400 mm thick, and extend across the stream bed to 5 m beyond the outside edges of the

culvert, extending up the embankment to at a minimum the top of culvert. The rip rap protection shall also extend through the entire culvert to protect the interior face of the footings from scour.

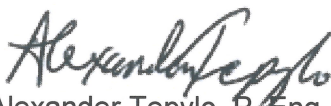
According to the results of gradation testing and the criteria for Frost-susceptibility and Erodibility of Soils stated in the MTO Pavement Design and Rehabilitation Manual (2013) (PDRM), the native sands and silty clays are classified as non-erodible.

Sheet pile cut off walls can also be installed at both the culvert inlet and outlet, extending from the top of the existing foundations to a sufficient depth (based on local hydrology) to prevent flow below the culvert foundations. Considering that the sheet piles will only be able to be installed along the end of the footing and around the exterior face into the embankment, the sheet pile wall will have to extend across the stream bed between footings and driven to sufficient depth to allow unrestricted stream flow. Rip rap protection (400 mm thick) within the culvert will still be needed to prevent scour from developing behind the sheet pile walls and also to protect the interior face of the footings from scour.

We trust the enclosed is sufficient for your present requirements. Should any questions arise, please do not hesitate to contact the undersigned.

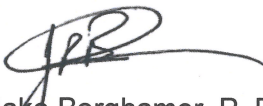
Yours very truly,

Englobe Corp.

  
Alexander Tepylo, P. Eng.  
Project Engineer



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

  
Jake Berghamer, P. Eng.  
Service Director



Encl (1).

2020-01-17

\\Northbay-sf1\projets\152\IP-0014012 - PAV & FDN, Hwy 11 Orillia (Planmac)\Foundation\1\_Deliverables\Draft\F7 - Grouse Creek Culvert\IP-0014012-F7 - Culvert Rehabilitation, Grouse Creek Culvert - Final Memorandum.docx



# KEY PLAN

Drawing No. 1

NOT TO SCALE



## FINAL FOUNDATION INVESTIGATION REPORT

**GWP 2197-17-00**

Highway 11

Grouse Creek Culvert

Reference No: P-0014012-0-00-100-01-F7

January 2020



## 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)	Compactness Condition
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.

**METRIC****RECORD OF BOREHOLE NO. 1**

REFERENCE P-0014012-F7 DATUM Geodetic LOCATION N 4935773.5 E 309209.1, Twp. of Oro ORIGINATED BY JL  
 PROJECT GWP 2197-17-00, Hwy 11 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY DM  
 CLIENT Planmac Engineering Inc. DATE (Started) 11 October 2017 TIME   
 DATE (Completed) 11 October 2017 (Completed)  CHECKED BY AT

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT  SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT W <sub>p</sub> NATURAL MOISTURE CONTENT W LIQUID LIMIT W <sub>L</sub> WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m <sup>3</sup>	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
ELEV DEPTH	DESCRIPTION (see Enclosure No. 1)	STRATA PLOT	NUMBER	TYPE	"N" VALUES						
223.3	Ground Surface										
0.0	SILTY ORGANIC SOIL - trace sand, trace wood black (very loose)		1	SS	1		223				
222.2			2	SS	4		222				
1.1	SAND - trace silt grey (loose)										
221.9											
1.4	SILTY CLAY - trace gravel, some sand brown (very stiff)		3	SS	4						4 13 27 56
221.2											vane encountered sand deposit
2.1	SAND - trace gravel, trace silt grey, saturated (very loose/very dense)		4	SS	14		221				
			5	SS	13		220				0 91 (9)
			6	SS	3		219				
			7	SS	14		218				
			8	SS	29		217				
							216				
			9	SS	12		215				
							214				
213.9			10	SS	46/280 mm						
9.4	TILL - sand and gravel, trace silt grey, saturated 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 100 kPa  
 ○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS		
Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
1) 12/10/17 5:10:00 PM	0.1	▽ -
2) 13/10/17 7:20:00 AM	0.1	▽ -
3) 13/10/17 5:30:00 PM	0.1	▽ -

MEL-GEO P-0014012 - BOREHOLE LOGS - F7.GPJ MEL-GEO.GDT 21/08/18

**METRIC****RECORD OF BOREHOLE NO. 1**

REFERENCE P-0014012-F7 DATUM Geodetic LOCATION N 4935773.5 E 309209.1, Twp. of Oro ORIGINATED BY JL  
 PROJECT GWP 2197-17-00, Hwy 11 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY DM  
 CLIENT Planmac Engineering Inc. DATE (Started) 11 October 2017 TIME   
 DATE (Completed) 11 October 2017 (Completed)  CHECKED BY AT

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV DEPTH	DESCRIPTION (see Enclosure No. 1)	STRATA	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
	Continued from Previous Page												
	(very dense)												
	boulders encountered at a depth of 9.8 m												
211.6			11	SS	69								48 43 (9)
11.7	TILL - silty clay, trace sand												
	grey, saturated												
	(very dense)		12	SS	82/280 mm								0 3 54 43
			13	SS	50/100 mm								
208.0			14	SS	50/100 mm								
15.3	End of Sampling End of Borehole												

MEL-GEO P-0014012 - BOREHOLE LOGS - F7.GPJ MEL-GEO.GDT 21/08/18



**METRIC****RECORD OF BOREHOLE NO. 2**

REFERENCE P-0014012-F7 DATUM Geodetic LOCATION N 4935739.5 E 309258.7, Twp. of Oro ORIGINATED BY JL  
 PROJECT GWP 2197-17-00, Hwy 11 BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY DM  
 CLIENT Planmac Engineering Inc. DATE (Started) 13 October 2017 TIME   
 DATE (Completed) 13 October 2017 (Completed)  CHECKED BY AT

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT					PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT			UNIT WEIGHT $\gamma$	REMARKS & GRAIN SIZE DISTRIBUTION (%)
ELEV. DEPTH	DESCRIPTION (see Enclosure No. 1)	STRATA PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					WATER CONTENT (%)			
						20 40 60 80 100 ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE					20 40 60 W <sub>p</sub> W W <sub>L</sub>					
	Continued from Previous Page															
			11	SS	59											
			12	SS	50/130 mm											
			13	SS	75											
209.6																
14.6	TILL - silt, some clay to clayey, trace gravel, some sand															
	grey, saturated															
	(very dense)															
208.7			14	SS	50/130 mm											
15.5	End of Sampling End of Borehole															

MEL-GEO P-0014012 - BOREHOLE LOGS - F7.GPJ MEL-GEO.GDT 21/08/18

**Englobe Corp.**

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



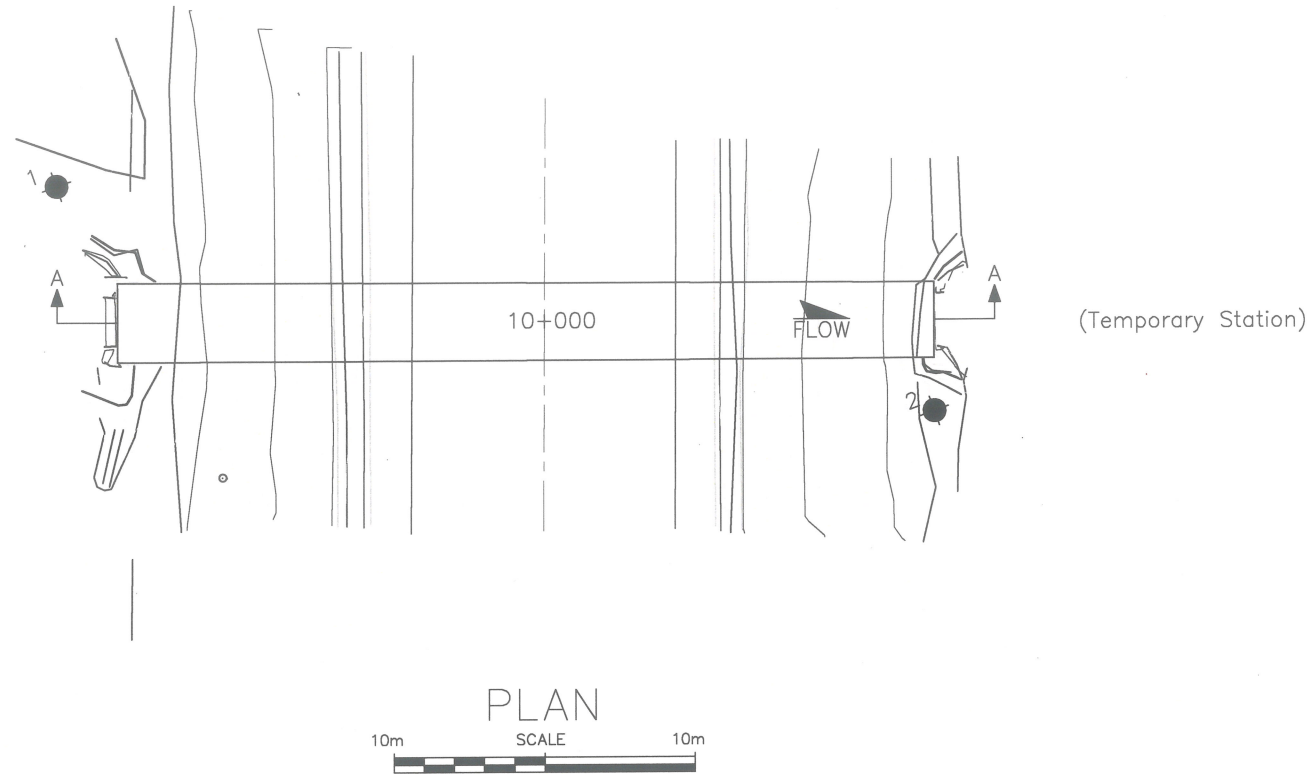
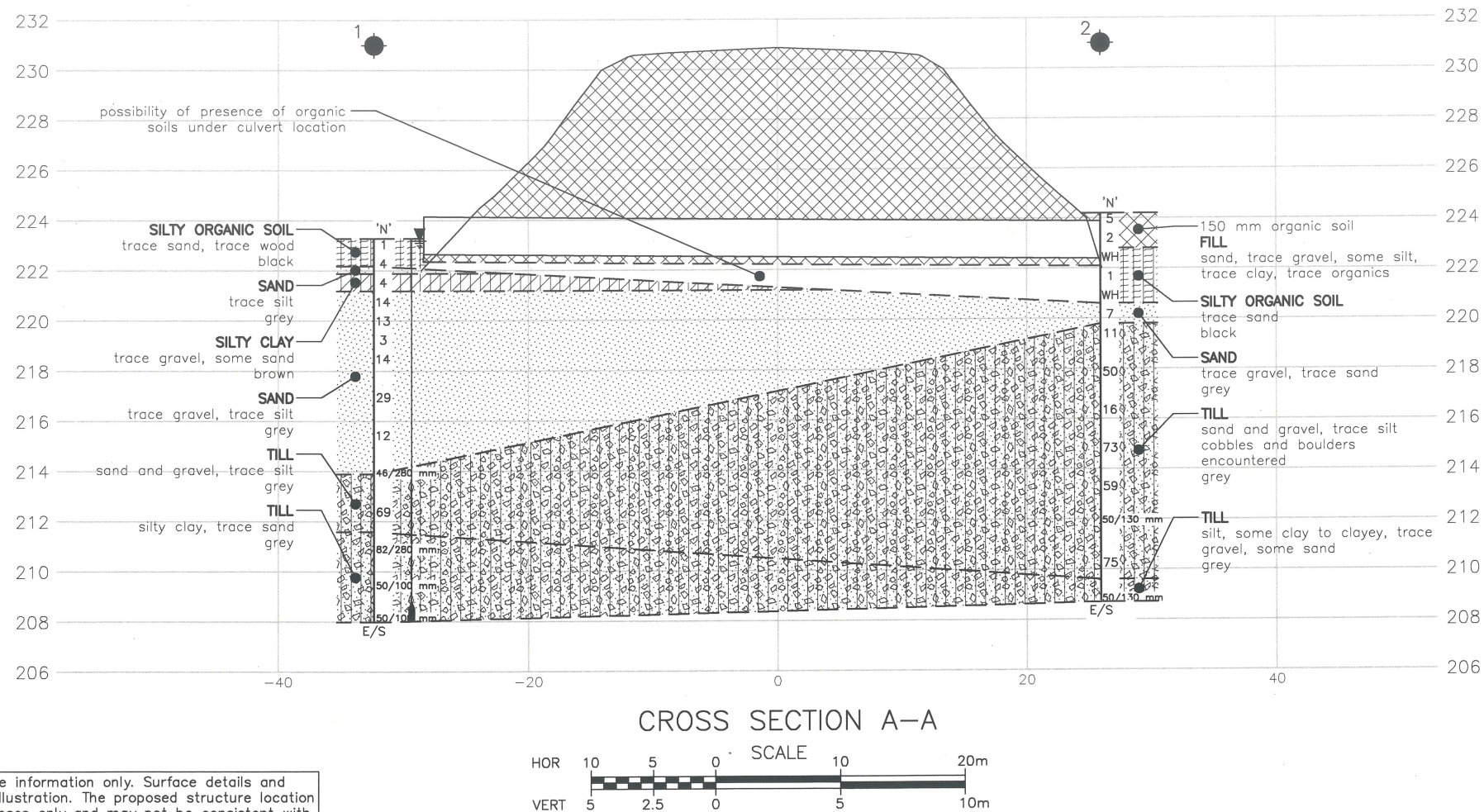
CAD FILE LOCATION AND NAME: G:\152\p-0014012 - PAV & FDN, Hwy 11 Drilling (Planmac)\Foundation\4\_CAD\YVP-0014012-F7 - Borehole Location Plan (19-11-06).dwg  
MODIFIED: 1/17/2020 9:35:29 AM BY: MITOU  
DATE PLOTTED: 1/17/2020 9:36:44 AM BY:

MINISTRY OF TRANSPORTATION, ONTARIO  
PR-D-707 BR-05



2020-01-17

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.



DISTRICT  
CONT. No.  
GWP No. 2197-17-00

HWY 11, GROUSE CREEK CULVERT  
SITE NO. 30-508/C

BOREHOLE LOCATIONS  
AND SOIL STRATIGRAPHY

SHEET  
2

**KEY PLAN**  
N.T.S.

Borehole w/ DCPT

Borehole

Blows/0.3 m (Std Pen Test, 475 J/blow)

Blows/0.3 m (60° Cone, 475 J/blow)

Water Level at Time of Investigation

Auger Refusal at Elevation

End of Sampling

Piezometer

BOREHOLE No.	ELEVATION	O/S	NORTHING	EASTING
1	223.3	32.4 m Lt	4935773.5	309209.1
2	224.2	26.0 m Rt	4935739.5	309258.7

**NOTES:**

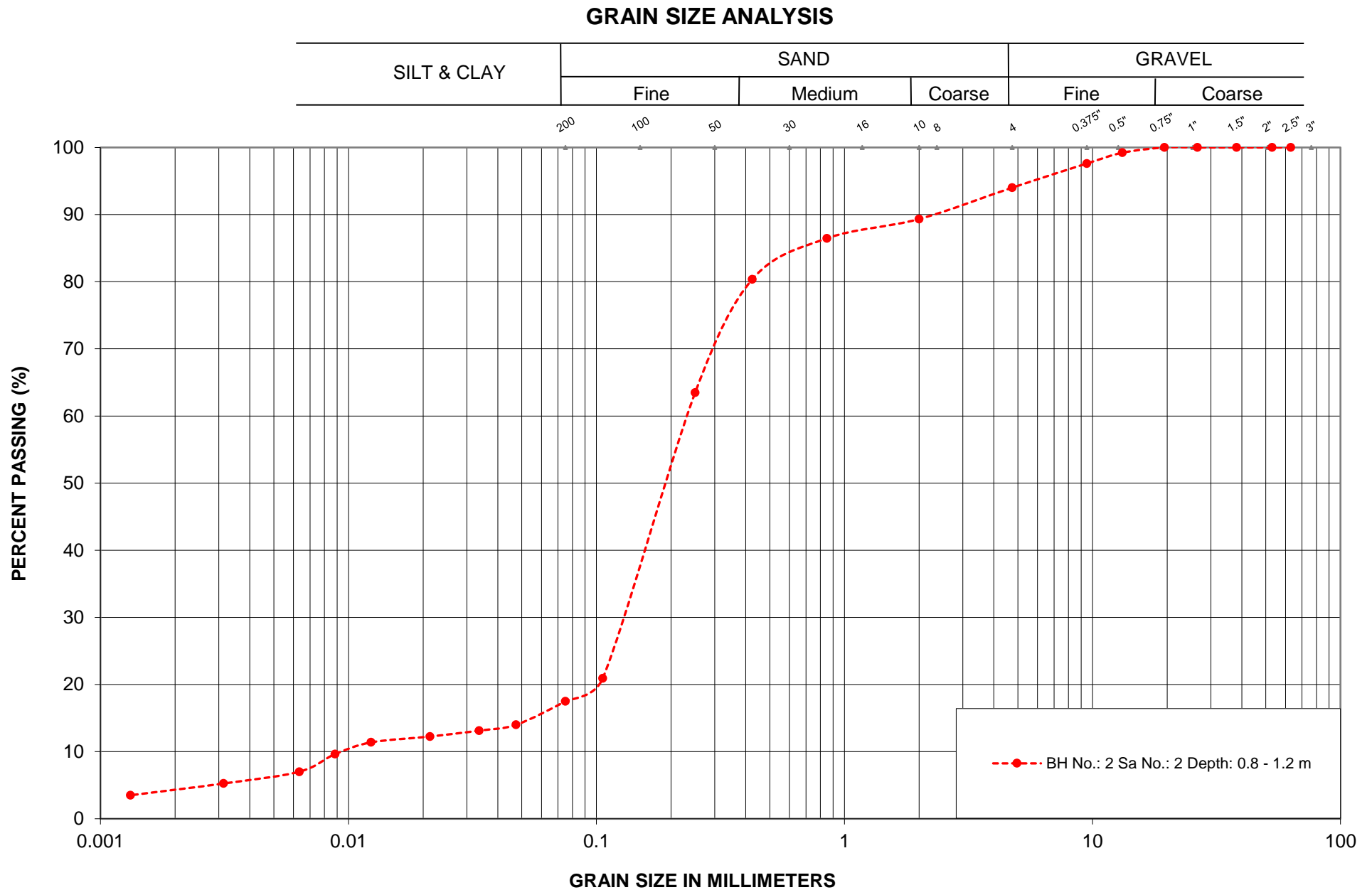
The boundaries between soil strata have been established at the borehole locations only. The boundaries illustrated and stratigraphy between boreholes on this drawing are assumed based on borehole data and may vary. They are intended for design only.

Base plan and alignment provided in digital format by Planmac Engineering Inc. on May 5, 2018

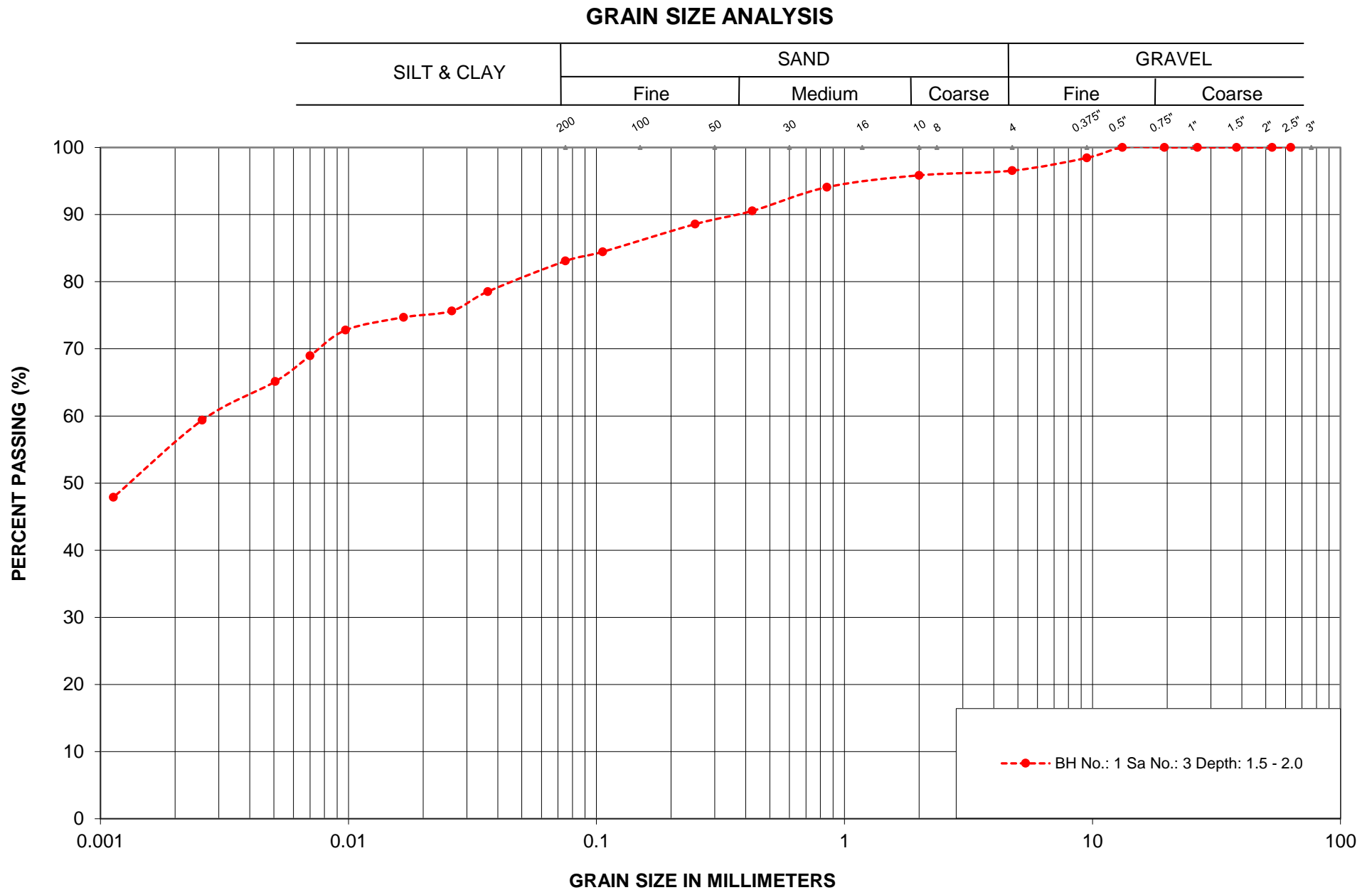
Coordinates based on MTM Zone 10 NAD83 CSRS

**GEOCRES No. 31D-712**

REVISIONS	JUL/18	DM	DRAFT	
	JAN/20	DM	FINAL	
DESCRIPTION				
DESIGN	CHK	CODE	LOAD	DATE JAN/20
DRAWN DM	CHK AT	SITE 30-508/C	STRUCT	SCHEME DWG 2



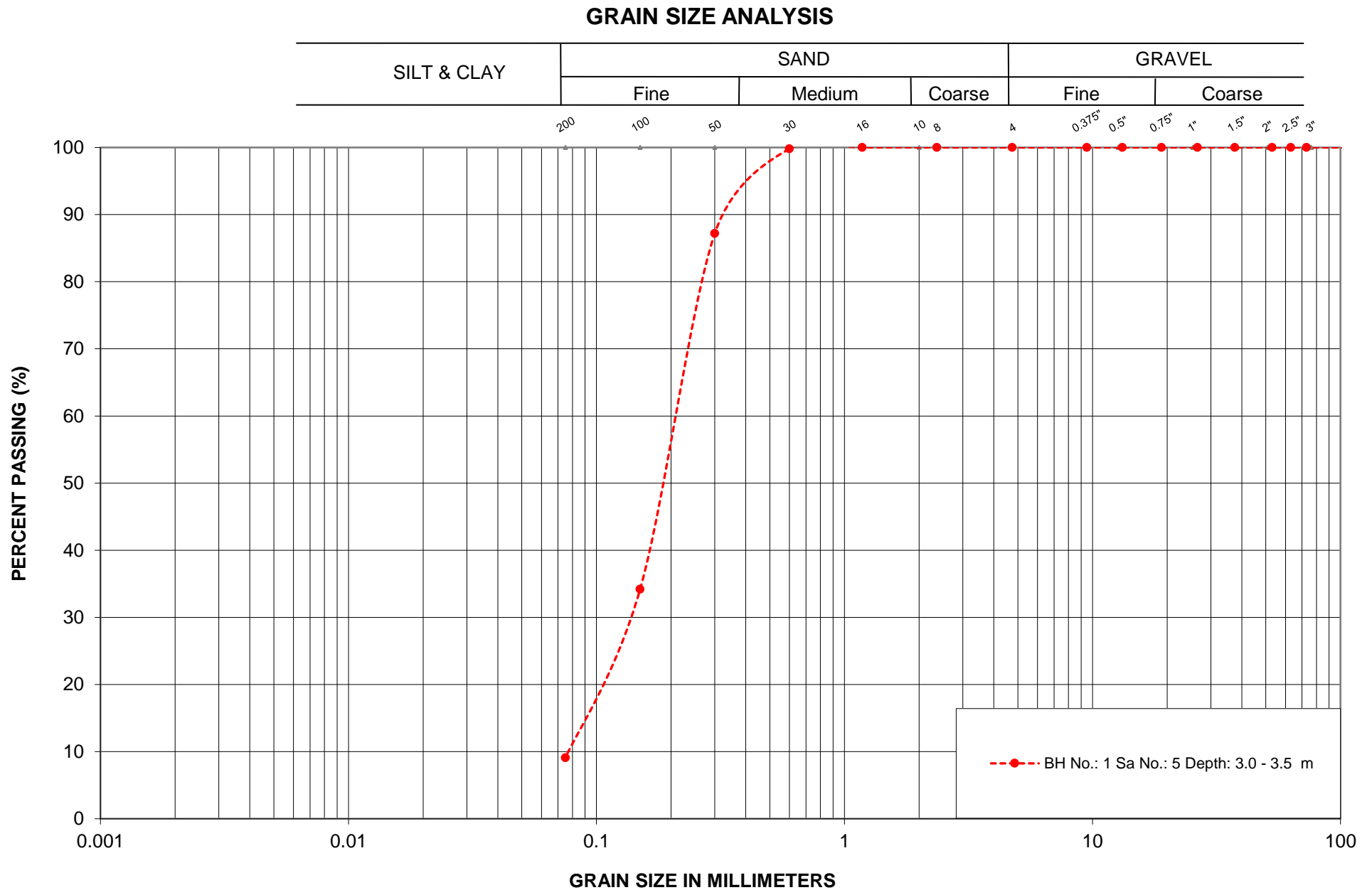
FILL



SILTY CLAY

Englobe Corp.

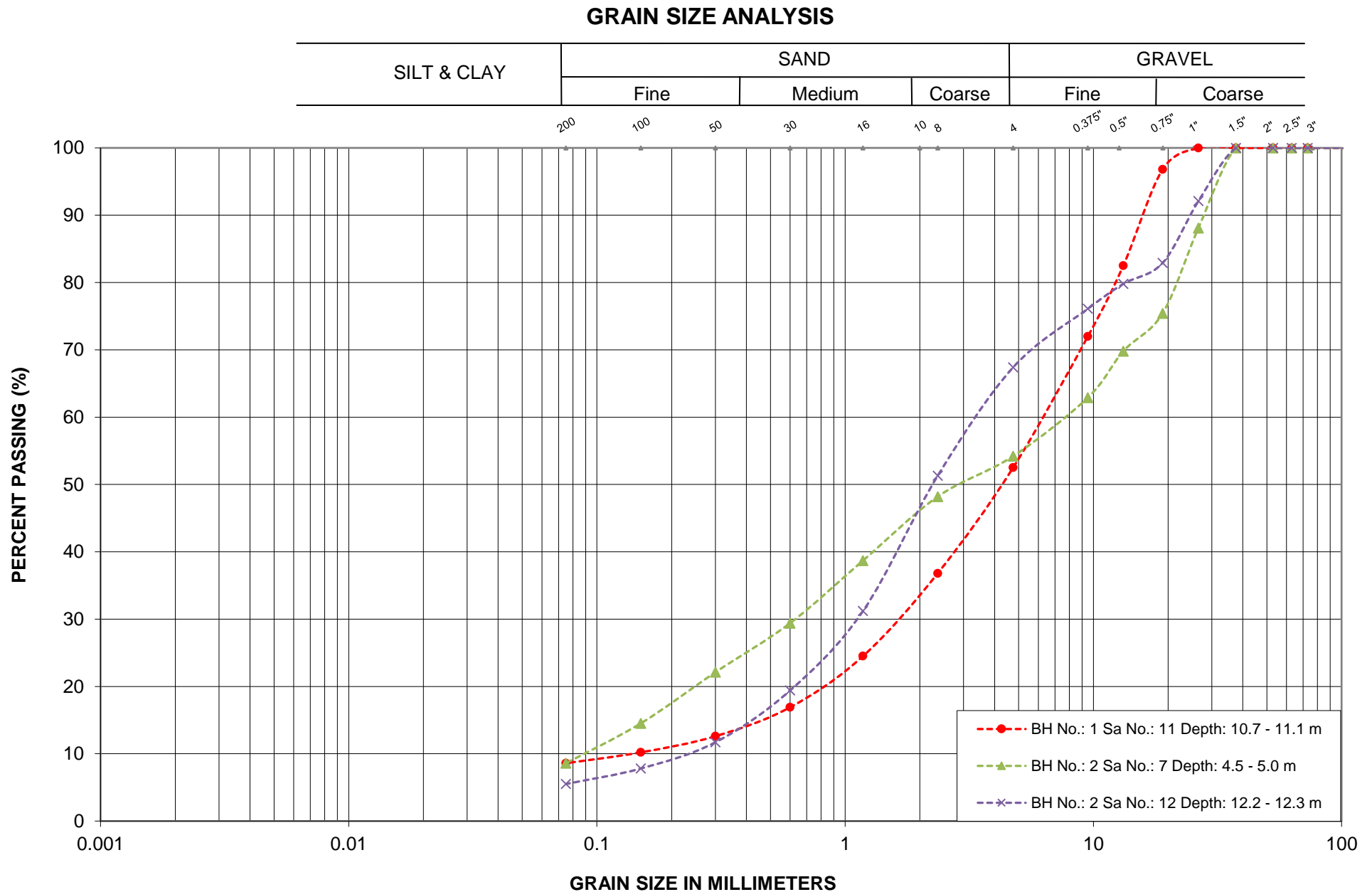
FIGURE L-2  
LOCATION: Hwy 11, Grouse Creek Culvert  
TWP of Orillia



SAND

Englobe Corp.

FIGURE L-3  
 LOCATION: Hwy 11, Grouse Creek Culvert  
 TWP of Orillia

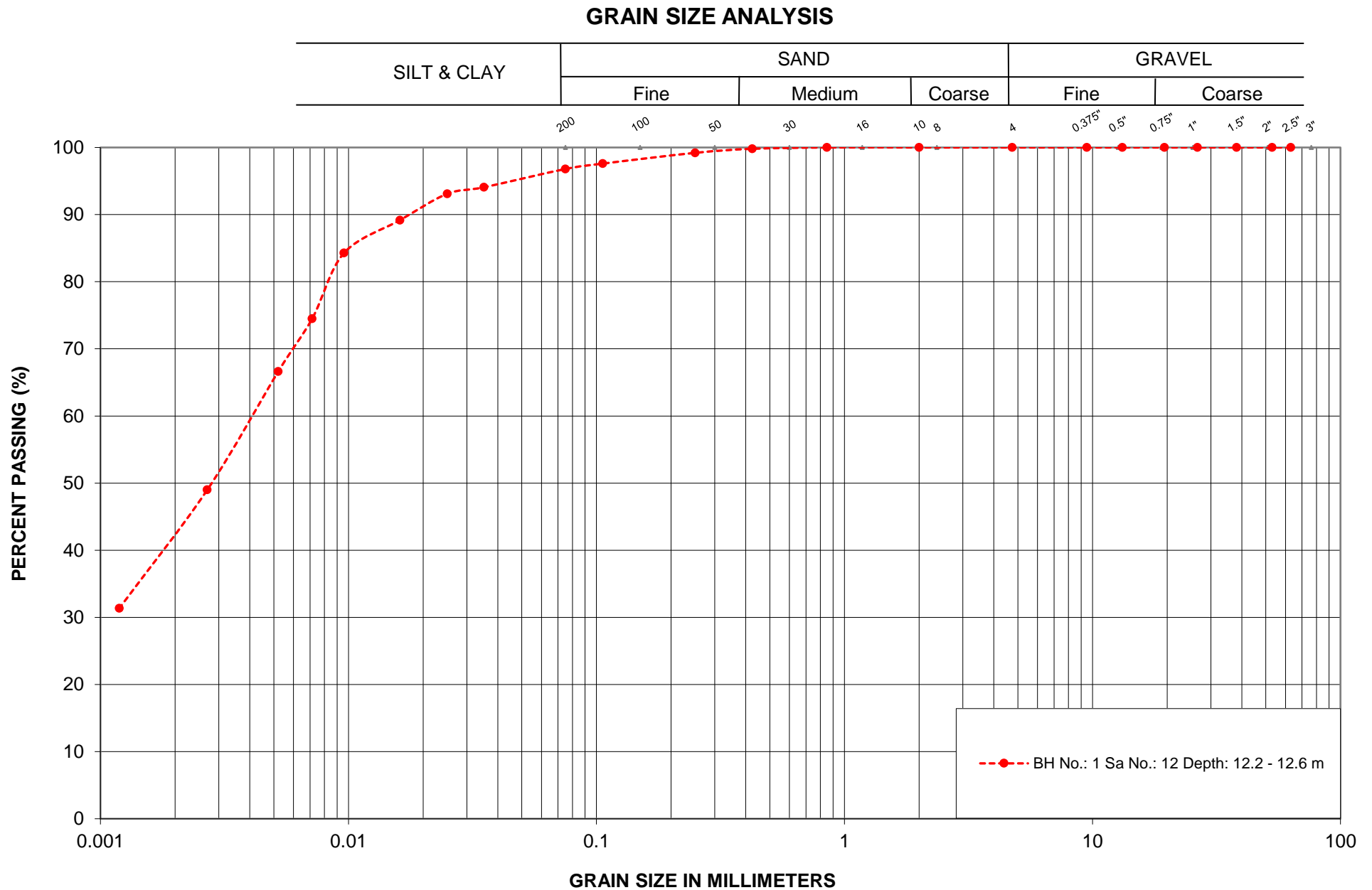


SAND and GRAVEL TILL

Englobe Corp.

FIGURE L-4  
LOCATION: Hwy 11, Grouse Creek Culvert  
TWP of Orillia

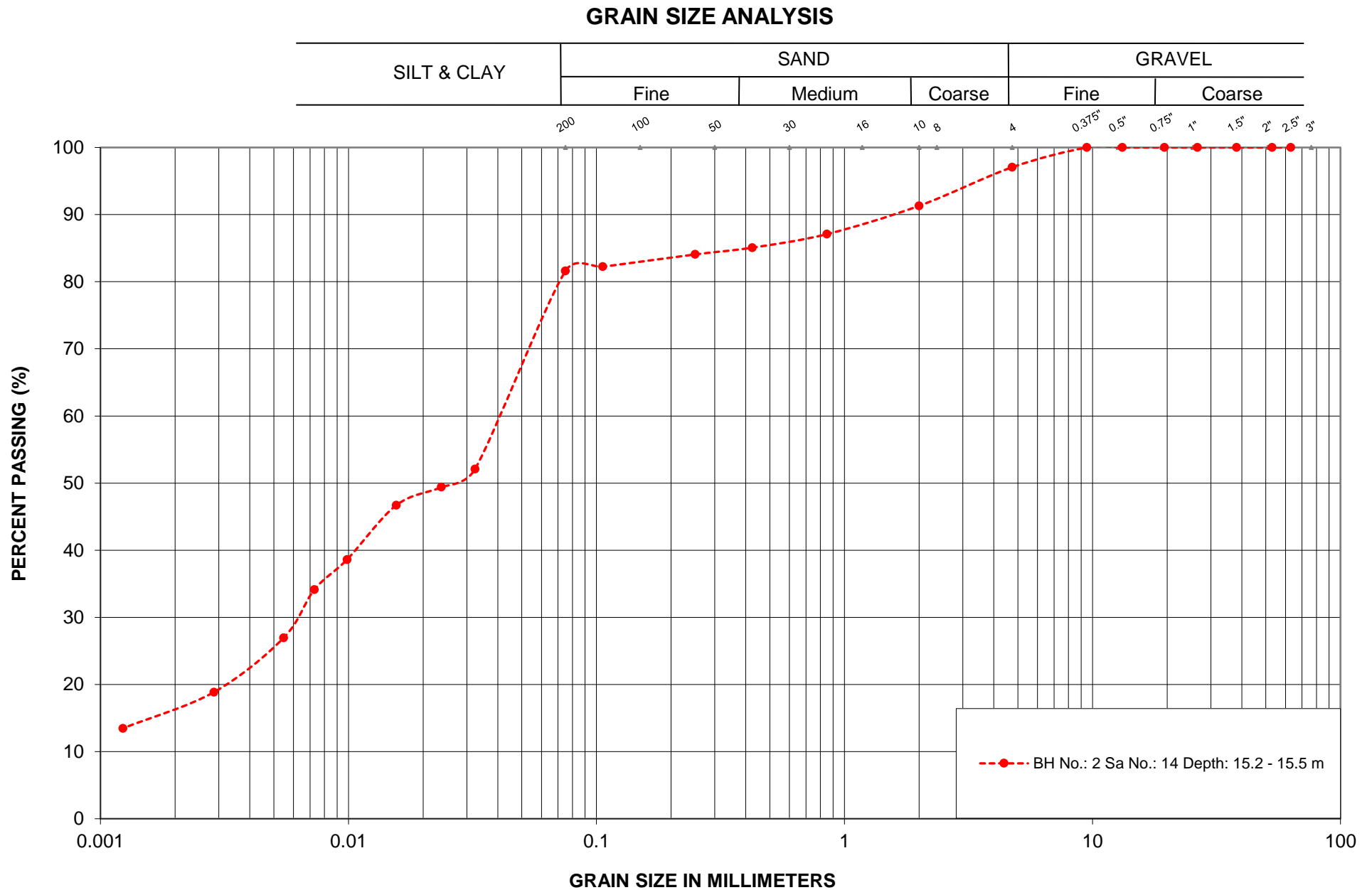




SILTY CLAY TILL

Englobe Corp.

FIGURE L-5  
LOCATION: Hwy 11, Grouse Creek Culvert  
TWP of Orillia



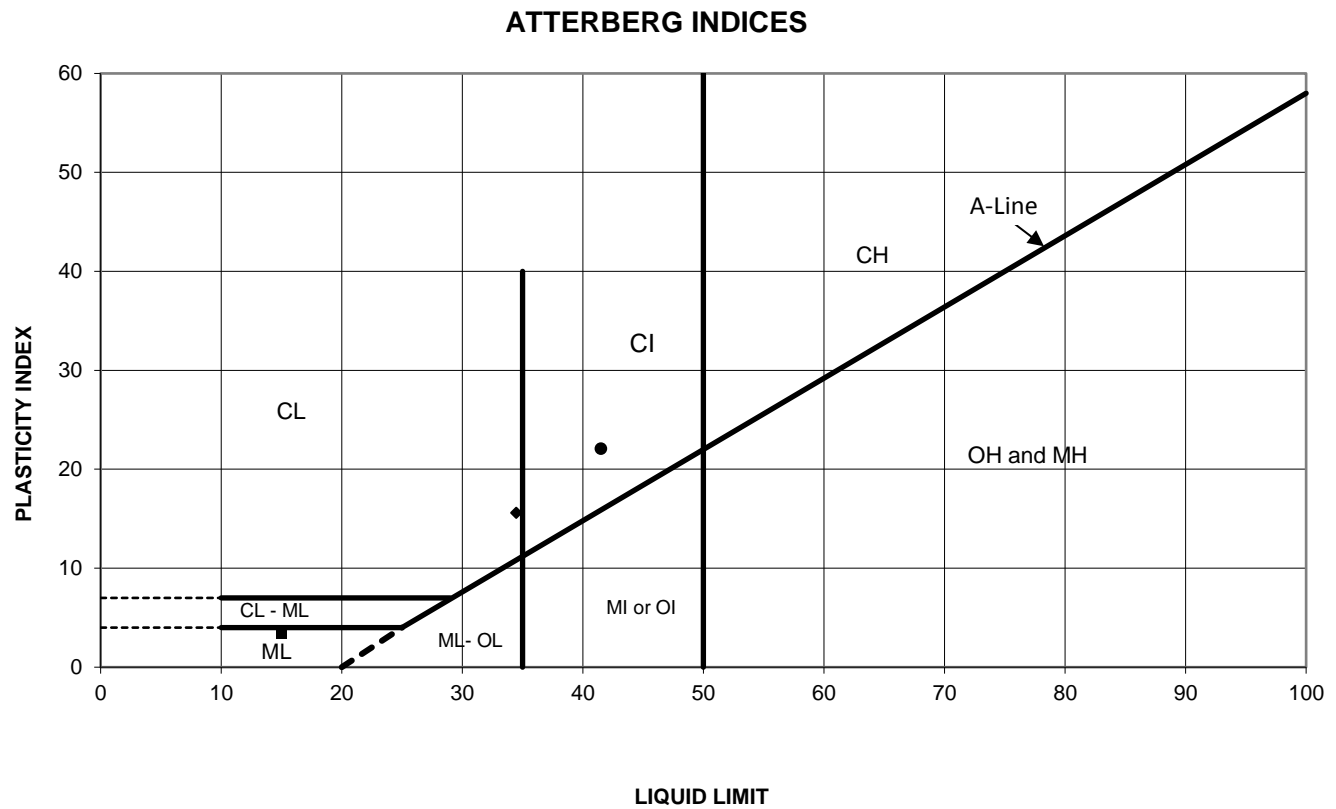
SILT TILL some clay to clayey

Englobe Corp.

FIGURE L-6  
LOCATION: Hwy 11, Grouse Creek Culvert  
TWP of Orillia

# ATTERBERG LIMITS TEST RESULTS

FIGURE L-7



SYMBOL	BH	Sa. No.	Depth(m)	Elev.(m)	Liquid Limit	Plastic Limit	Plasticity Index	NMC %
●	1	3	1.7	221.6	41.5	19.4	22.1	41.3
◆	1	12	12.4	210.9	34.5	18.9	15.6	21.8
■	2	14	15.4	208.8	15.0	11.6	3.4	13.3

Date: Aug-18  
Project: GWP 2197-17-00, Hwy 11  
Location: Grouse Creek Culvert

Prep'd: DM  
Chkd: JRB  
Ref. No.: P-0014012-0-00-100-01-F7

Englobe Corp.

## 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	0.2					59.9				1			
	2	1.0					55.4				4			
	3	1.8	4	13	27	56	41.3	19.4	41.5	22.1	4			
	4	2.5					18.1				14			
	5	3.3	0	91	9		19.1				13			
	6	4.0					20.6				3			
	7	4.8					22.1				14			
	8	6.3					10.7				29			
	9	7.9					19.8				12			
	10	9.4					14.7				46/280 mm			
	11	10.9	48	43	9		9.1				69			
	12	12.4	0	3	54	43	21.8	18.9	34.5	15.6	82/280 mm			
	13	13.8					21.6				50/100 mm			
	14	15.3					22.1				50/100 mm			
2	1	0.2					15.0				5			
	2	1.0	6	76	14	4	23.6				2			Non-Plastic
	3	1.8					77.4				WH			
	4	2.5					87.0				1			
	5	3.3					200.0				WH			
	6	4.0					23.1				7			
	7	4.8	46	45	9		13.1				11			
	8	6.3					11.2				50			
	9	7.9					15.1				16			
	10	9.4					15.5				73			
	11	10.9					8.8				59			
	12	12.3	33	61	6		11.3				50/130 mm			
	13	14.0					11.7				75			
	14	15.4	3	15	65	17	13.3	11.6	15.0	3.4	50/130 mm			

CLIENT NAME: ENGLOBE CORP  
120 PROGRESS CRT.  
NORTH BAY , ON P1A0C2  
(705) 476-2550

ATTENTION TO: Victoria Steuernol

PROJECT: P-0014012-0-00-100-01

AGAT WORK ORDER: 17T286462

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Coordinator

DATE REPORTED: Nov 30, 2017

PAGES (INCLUDING COVER): 6

VERSION\*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

\*NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.





## Certificate of Analysis

AGAT WORK ORDER: 17T286462

PROJECT: P-0014012-0-00-100-01

5835 COOPERS AVENUE  
MISSISSAUGA, ONTARIO  
CANADA L4Z 1Y2  
TEL (905)712-5100  
FAX (905)712-5122  
<http://www.agatlabs.com>

CLIENT NAME: ENGLOBE CORP

SAMPLING SITE:

ATTENTION TO: Victoria Steuernol

SAMPLED BY:

### Corrosivity Package

DATE RECEIVED: 2017-11-21

DATE REPORTED: 2017-11-30

		SAMPLE DESCRIPTION:		F1-BH1-Sa2	F2-BH2-Sa2	F3-BH1-Sa3	F4-BH2-Sa2	F5-BH2-Sa3	F6-BH1-Sa2	F7-BH1-Sa8	F8-BH1-Sa3
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:									
Parameter	Unit	G / S	RDL	8924749	8924752	8924753	8924754	8924755	8924756	8924757	8924758
Sulfide (S2-)	%		0.05	<0.05	0.06	<0.05	<0.05	<0.05	<0.05	<0.05	0.08
Chloride (2:1)	µg/g		2	8	55	190	17	25	12	5	345
Sulphate (2:1)	µg/g		2	4	21	21	7	4	10	7	44
pH (2:1)	pH Units		NA	9.81	9.06	9.80	9.14	8.87	8.91	9.05	9.44
Electrical Conductivity (2:1)	mS/cm		0.005	0.218	0.263	0.557	0.137	0.118	0.104	0.066	0.710
Resistivity (2:1)	ohm.cm		1	4590	3800	1800	7300	8470	9620	15200	1410
Redox Potential (2:1)	mV		5	143	156	118	148	156	158	151	127
		SAMPLE DESCRIPTION:		F9-BH1-Sa2		F10-BH1-Sa5		F11-BH1-Sa3		F12-BH1-Sa4	
		SAMPLE TYPE:		Soil		Soil		Soil		Soil	
		DATE SAMPLED:									
Parameter	Unit	G / S	RDL	8924759	RDL	8924760	RDL	8924761	8924762		
Sulfide (S2-)	%		0.05	<0.05	0.05	0.09	0.05	<0.05	<0.05		
Chloride (2:1)	µg/g		2	166	4	1210	2	175	334		
Sulphate (2:1)	µg/g		2	14	4	19	2	66	30		
pH (2:1)	pH Units		NA	9.62	NA	8.95	NA	9.22	9.33		
Electrical Conductivity (2:1)	mS/cm		0.005	0.435	0.005	1.79	0.005	0.622	0.773		
Resistivity (2:1)	ohm.cm		1	2300	1	559	1	1610	1290		
Redox Potential (2:1)	mV		5	121	5	138	5	123	117		

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

8924749-8924759 EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).

\*Sulphide analyzed at AGAT 5623 McAdam

Sampling dates were not mentioned on COC.

8924760 EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).

\*Sulphide analyzed at AGAT 5623 McAdam

Sampling date was not mentioned on COC.

Elevated RDL indicates the degree of sample dilution prior to the analysis for Anions in order to keep analytes within the calibration range of the instrument and to reduce matrix interference.

8924761-8924762 EC/Resistivity, pH, Chloride, Sulphate and Redox Potential were determined on the extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part soil).

\*Sulphide analyzed at AGAT 5623 McAdam

Sampling dates were not mentioned on COC.

Certified By:

*Amanjot Bhela*



## Quality Assurance

CLIENT NAME: ENGLOBE CORP

PROJECT: P-0014012-0-00-100-01

SAMPLING SITE:

AGAT WORK ORDER: 17T286462

ATTENTION TO: Victoria Steuernal

SAMPLED BY:

### Soil Analysis

RPT Date:			DUPLICATE			Method Blank	REFERENCE MATERIAL		METHOD BLANK SPIKE		MATRIX SPIKE	
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper

#### Corrosivity Package

Sulfide (S2-)	8924749	8924749	< 0.05	< 0.05	NA	< 0.05	98%	80%	120%						
Chloride (2:1)	8924749	8924749	8	8	NA	< 2	108%	80%	120%	106%	80%	120%	104%	70%	130%
Sulphate (2:1)	8924749	8924749	4	4	NA	< 2	95%	80%	120%	99%	80%	120%	103%	70%	130%
pH (2:1)	8924749	8924749	9.81	9.79	0.2%	NA	101%	90%	110%	NA			NA		
Electrical Conductivity (2:1)	8924749	8924749	0.218	0.209	4.2%	< 0.005	98%	90%	110%	NA			NA		
Redox Potential (2:1)	8924749	8924749	143	143	0.0%	< 5	104%	70%	130%	NA			NA		

#### Corrosivity Package

Sulfide (S2-)	8924753	8924753	< 0.05	< 0.05	NA	< 0.05	99%	80%	120%						
---------------	---------	---------	--------	--------	----	--------	-----	-----	------	--	--	--	--	--	--

Comments: NA signifies Not Applicable.

Duplicate Qualifier: As the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Certified By:

*Amanjot Bhela*

## Method Summary

CLIENT NAME: ENGLOBE CORP

PROJECT: P-0014012-0-00-100-01

SAMPLING SITE:

AGAT WORK ORDER: 17T286462

ATTENTION TO: Victoria Steuernol

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Sulfide (S <sup>2-</sup> )	MIN-200-12025	ASTM E1915-09	GRAVIMETRIC
Chloride (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
Sulphate (2:1)	INOR-93-6004	McKeague 4.12 & SM 4110 B	ION CHROMATOGRAPH
pH (2:1)	INOR 93-6031	MSA part 3 & SM 4500-H+ B	PH METER
Electrical Conductivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B	EC METER
Resistivity (2:1)	INOR-93-6036	McKeague 4.12, SM 2510 B, SSA #5 Part 3	CALCULATION
Redox Potential (2:1)		McKeague 4.12 & SM 2510 B	REDOX POTENTIAL ELECTRODE

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# AGAT Laboratories

5835 Coopers Avenue  
Mississauga, Ontario L4Z 1Y2  
Ph: 905.712.5100 Fax: 905.712.5122  
web@earth.agatlabs.com

## Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

### Report Information:

Company: Englobe Corp  
Contact: Victoria Steuermol  
Address: 2-120 Progress Court  
North Bay, Ontario  
Phone: 705 476 2550 Fax: 705 476 8882  
Reports to be sent to:  
1. Email: alexander.tepylo@englobecorp.com  
2. Email: victoria.steuernol@englobecorp.com

### Project Information:

Project: P-0014012 0-00-100-08  
Site Location: \_\_\_\_\_  
Sampled By: \_\_\_\_\_  
AGAT Quote #: \_\_\_\_\_ PO: A12736

Please note: If quotation number is not provided, client will be billed full price for analysis.

### Invoice Information:

Bill To Same: Yes ☒ No ☐

Company: \_\_\_\_\_  
Contact: \_\_\_\_\_  
Address: \_\_\_\_\_  
Email: \_\_\_\_\_

### Regulatory Requirements:

(Please check all applicable boxes)

☐ Regulation 153/04 ☐ Sewer Use ☐ Regulation 558  
☐ Table Indicate One ☐ Sanitary ☐ CCME  
☐ Ind/Com ☐ Storm ☐ Prov. Water Quality  
☐ Res/Park ☐ Agriculture ☐ Objectives (PWQO)  
☐ Soil Texture (Check One) Region Indicate One ☐ Other  
☐ Coarse ☐ MISA ☐ Fine ☐ Indicate One

### Is this submission for a Record of Site Condition?

☐ Yes ☐ No

### Report Guideline on Certificate of Analysis

☒ Yes ☐ No

### Sample Matrix Legend

**B** Biota  
**GW** Ground Water  
**O** Oil  
**P** Paint  
**S** Soil  
**SD** Sediment  
**SW** Surface Water

Field Filtered - Metals, Hg, CrVI

### 0. Reg 153

Metals and Inorganics

☐ All Metals ☒ 153 Metals (excl. Hydrides)  
☐ Hydride Metals ☐ 153 Metals (incl. Hydrides)

ORPs: ☐ B-HWS ☐ Cl ☐ CN  
☐ Cr+ ☐ EC ☐ FOC ☐ Hg  
☐ pH ☐ SAR

Full Metals Scan

Regulation/Custom Metals

Nutrients: ☐ TP ☐ NH<sub>3</sub> ☐ TKN  
☐ NO<sub>3</sub> ☐ NO<sub>2</sub> ☐ NO<sub>3</sub>+NO<sub>2</sub>

Volatiles: ☐ VOC ☐ BTEX ☐ THM

PHCs F1 - F4

ABNs

PAHs

PCBs: ☐ Total ☐ Aroclors

Organochlorine Pesticides

TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs

Sewer Use

Corrosivity Package

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Y / N	Metals and Inorganics	ORPs	Full Metals Scan	Regulation/Custom Metals	Nutrients	Volatiles	PHCs F1 - F4	ABNs	PAHs	PCBs	Organochlorine Pesticides	TCLP	Sewer Use	Corrosivity Package
F1-BH1-Sa2			1	S	Corrosivity Package Test for all:															<input checked="" type="checkbox"/>
F2-BH2-Sa2			1	S	pH, water soluble sulphate,															<input checked="" type="checkbox"/>
F3-BH1-Sa3			1	S	sulphide, chloride, resistivity and															<input checked="" type="checkbox"/>
F4-BH2-Sa2			1	S	electrical conductivity															<input checked="" type="checkbox"/>
F5-BH2-Sa3			1	S																<input checked="" type="checkbox"/>
F6-BH1-Sa2			1	S																<input checked="" type="checkbox"/>
F7-BH1-Sa8			1	S																<input checked="" type="checkbox"/>
F8-BH1-Sa3			1	S																<input checked="" type="checkbox"/>
F9-BH1-Sa2			1	S																<input checked="" type="checkbox"/>
F10-BH1-Sa5			1	S																<input checked="" type="checkbox"/>
F11-BH1-Sa3			1	S																<input checked="" type="checkbox"/>

Samples Relinquished By (Print Name and Sign):

Sonia Clelland SC

Date

Nov 20/17

Time

7:00

Samples Received By (Print Name and Sign):

Poehli Patel

Date

21/11/17

Time

8:33

Samples Relinquished By (Print Name and Sign):

Samples Received By (Print Name and Sign):

Samples Relinquished By (Print Name and Sign):

Samples Received By (Print Name and Sign):

Page 1 of 2

N#:





On Road Looking East

Photo: 1



East End of Culvert

Photo: 2



Project: GWP 2197-7-00, Hwy 11, Grouse Creek Culvert

Photos By: Englobe

Date: October 2017

On Road Looking West

Photo: 3



West End of Culvert

Photo: 4



Project: GWP 2197-7-00, Hwy 11, Grouse Creek Culvert

Photos By: Englobe

Date: October 2017