



# 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 of Riberdy Tributary Culvert  
Highway 64  
Site No. 43-310  
Stations 15+052 and 15+055 – Township of Caldwell  
GWP 5166-13-10**

## **FINAL FOUNDATION INVESTIGATION REPORT**

Date: November 2, 2016  
Ref. N<sup>o</sup>: 16/03/16019

**Geocres No. 41I-343**

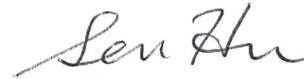
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Highway 64  
Site No. 43-310  
Stations 15+052 and 15+055 – Township of Caldwell  
GWP 5166-13-10

## Final Foundation Investigation Report



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2016-11-02

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

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

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## 1 INTRODUCTION

Englobe Corp. (Englobe) has been retained by AECOM Canada Ltd., on behalf of the Ministry of Transportation of Ontario (MTO), to carry out a foundation investigation at the existing Riberdy Tributary Creek culvert site. The site has been identified as Site No. 43-310 and is located on Highway 64 at Stations 15+052 and 15+055 in the Township of Caldwell, some 6.1km south of the intersection between Highway 64 and Highway 17 in Verner, Ontario.

The foundation investigation location was specified by the MTO in the Terms of Reference for work under Agreement No. 5014-E-0058: GWP 5166-13-00. The terms of reference for the scope of work are outlined in Englobe's Proposal P-15-111 dated October 22, 2015. The purpose of this investigation was to determine the subsurface conditions in the area of the existing culverts. 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 twin Corrugated Steel Pipe Arch (CSPA) culverts are located on Highway 64 at Stations 15+052 and 15+055 in the Township of Caldwell, Ontario. The topography of this site is generally flat. 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 supported on an embankment consisting of sand fills some 3.7 m in height, with centreline Elevation of 203.8 m at the culvert location. The existing embankment slopes in the area of the culverts have been built between inclination angles ranging from approximately 1H:1V to 3.2H:1V along the north side, and about 2.3H:1V along the south side.

The culverts at this location have been described in the RFP as twin 2x1.8 m Corrugated Steel Pipe (CSP) culverts built in 1976. A profile sheet (Plate No. 627-64/10b-0) dated December 1997 included in the previous Contract package of WP 115-88-00 indicates the culverts as twin 1.6x1.1 m Corrugated Steel Pipe Arch (CSPA) with approximate length of 29.4 m. The current survey has indicated the culverts are 1.6x1.2 m Corrugated Steel Pipe Arch (CSPA) culverts some 29.6 m in length and will be noted as such in this report. The flow through the culverts is from the north to the south (left to right).

Infrastructure at this site consists of overhead and underground communication and power lines running parallel to the highway embankment on both sides.

### 2.1 SITE PHYSIOGRAPHY AND SURFICIAL GEOLOGY

This project is located in the Geomorphic Sub-province known as the Eastern Sandy Uplands. The topography on this section of Highway 64 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 bedrock.

Bedrock in the area, as indicated on OGS Map MRD-126, consists of migmatitic rocks and gneisses of undetermined protolith of the late to middle Precambrian period.

### 3 INVESTIGATION PROCEDURES

The fieldwork for this investigation was carried out between April 29th and May 4th, 2016 during which time a total of six (6) sampled boreholes were advanced. Two (2) boreholes were advanced through the embankment at locations adjacent the culverts, and one (1) borehole was advanced adjacent to each inlet (north) and outlet (south) ends of the culverts (total of four (4) inlet boreholes).

The field investigation was carried out using a bombardier track mounted CME drilling rig equipped with hollow stem augers, standard augers, casing equipment and routine geotechnical sampling equipment. The drill equipment is owned by Chrisdamat Management Ltd. and was operated by an Englobe drill crew. 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 Borehole Nos. 1 and 3 prior to backfilling to allow for monitoring of the shallow groundwater levels post borehole completion. 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 boreholes through the embankment, the upper portion of the borehole, where necessary, was backfilled with an asphalt cold patch to seal the existing asphalt surface. The two standpipes installed at Borehole Nos. 1 and 3 were decommissioned on June 2, 2016 as per the requirements of Ontario Regulation 903.

The fieldwork for this investigation was carried out 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-6 and Table No. L-7).

Section 6.8.2.2 of the RFP states that a minimum of 1 chemical test package (including PH, water soluble sulphate, chloride, resistivity and electrical conductivity analyses) is required at each foundation element at the culverts. In accordance with requirements stated in the RFP, two soil chemical tests were carried out by AGAT Laboratories in Mississauga. Results of chemical tests are presented in Appendix 3.

The location of the individual boreholes was determined in the field using highway chainage established by Callon Dietz Inc. (Callon Dietz) and offset 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. Elevations contained in this report are referenced to a geodetic datum. The borehole elevations are based on a survey carried out by Callon Dietz.

## **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 Nos. 2A and 2B (Appendix 3). Please note that the stratigraphic delineations 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 STATIONS 15+052 AND 15+055, TWP OF CALDWELL**

A plan and profile illustrating the borehole locations and stratigraphic sequences is shown on Drawing Nos. 2A and 2B, Appendix 3. During the course of the exploration program, six (6) sampled boreholes were put down at this site, with Borehole Nos. 2 and 3 advanced through the embankment adjacent to the culverts, Borehole Nos. 1 and 6 advanced adjacent to the culvert inlets, and Borehole Nos. 4 and 5 advanced adjacent to the culvert outlets. At the time of the subsurface investigation, the ground surface elevations at Borehole Nos. 1 to 6, inclusive, were recorded at Elevations 201.0, 203.8, 203.8, 200.6, 200.6, and 201.5 m, respectively.

#### 4.1.1 Pavement Structure

Borehole Nos. 2 and 3 were advanced through the embankment shoulder where 50 to 100 mm of asphalt concrete overlying a layer of crushed gravel base/subbase approximately 150 to 300 mm thick was penetrated.

#### 4.1.2 Sand Fill

Underlying the pavement structure at Borehole Nos. 2 and 3, a layer of sand fill consisting of brown sand with to trace gravel, trace silt, trace clay was penetrated. A 300 mm boulder-sized rock was encountered at a depth of 1.2 m below grade at Borehole No.2 (Elevation 202.6 m). The natural moisture content measured on samples of this deposit ranged from 4 to 21%. Gradation (hydrometer) analyses were carried out on four (4) samples of this deposit from Boreholes 1 and 2, the results of which indicated 0 to 24% gravel size particles, 60 to 86% sand size particles, 8 to 12% silt size particles, and 3 to 4% clay size particles (Figure No. L-1, Appendix 3). Results of this grain size distribution testing indicate that the sand fill generally meets gradation requirements for Granular "B" Type I stated in OPSS.PROV 1010. Based on SPT 'N' values of 8 to 42 blows per 300 mm penetration, the relative density of this deposit was described as loose to dense, generally compact. This sand fill layer was encountered to a depth of 3.7 m below grade at Borehole Nos. 2 and 3 (Elevation 200.1 m).

#### 4.1.3 Topsoil

At the ground surface at Borehole Nos. 4 and 5, a layer of topsoil of organic silty clay, trace gravel, with sand was penetrated. This topsoil layer was encountered to depths of 0.2 to 0.3 m below ground surface at Borehole Nos. 4 and 5, respectively (Elevations 200.4 and 200.3 m, respectively). The natural moisture content measured on samples of this deposit was 48 to 49%. Gradation (hydrometer) analyses were carried out on one (1) sample of this deposit, the results of which indicated 8% gravel size particles, 22% sand size particles, 35% silt size particles, and 35% clay size particles (Figure No. L-2, Appendix 3). Atterberg Limits testing was carried out on two (2) samples of this deposit, the results of which indicated a Plastic Limit in the order of 30 to 39% and a Liquid Limit in the order of 51 to 55% (Figure No. L-5, Appendix 3). Based on a SPT 'N' value of 4 blows per 300 mm penetration, the consistency of this deposit was described as soft. The stratum was not sufficiently thick to allow for in-situ vane shear testing.

#### 4.1.4 Silty Clay to Clay

Underlying the soil fill at Borehole Nos. 2 and 3, and at ground surface of Borehole Nos. 1 and 6, a deposit of brownish grey to grey silty clay to clay, trace sand was penetrated. This deposit was encountered to depths of 7.2, 4.6, 10.1, and 8.5 m below grade at Borehole Nos. 1, 2, 3 and 6, respectively (Elevations 193.8, 199.2, 193.7 and 193.0 m, respectively). The natural moisture content measured on samples of this deposit was in the order of 28 to 85%. Gradation (hydrometer) analyses were carried out on six (6) samples of this deposit, the results



of which indicated 0% gravel size particles, 0 to 2% sand size particles, 7 to 83% silt size particles, and 17 to 93% clay size particles (Figure No. L-4, Appendix 3). Atterberg Limits testing was carried out on seven (7) samples of this deposit, the results of which indicated a Plastic Limit in the order of 17 to 43% and a Liquid Limit in the order of 28 to 71% (Figure No.

L-5, Appendix 3). Results of Atterberg Limits testing indicate medium to high degrees of plasticity of the deposit of. Based on in-situ shear strengths ranging from greater than 100 kPa to 24 kPa, the consistency of this deposit was described as very stiff to soft.

#### 4.1.5 Sand

Underlying the silty clay to clay at Borehole Nos. 1 and 6, a deposit of grey sand, trace to some gravel, some silt, trace clay was penetrated. The natural moisture content measured on samples of this deposit was in the order of 19 to 20%. Gradation (hydrometer) analyses were carried out on two (2) samples of this deposit, the results of which indicated 4 to 19% gravel size particles, 57 to 78% sand size particles, 11 to 16% silt size particles, and 7 to 8% clay size particles (Figure No. L-4, Appendix 3). Based on SPT 'N' values ranging from 10 blows per 300 mm penetration to 20 blows per 150 mm penetration, the compactness of the deposit was described as loose to very dense. This deposit was encountered to a depth of 7.9 m below grade at Borehole No. 1 (Elevation 193.1 m). Borehole No. 6 was terminated in this deposit at a depth of 9.6 m below grade (Elevation 191.9 m).

#### 4.1.6 Bedrock

Underlying the sand deposit at Borehole No.1, underlying the silty clay to clay deposit at Borehole Nos. 2 and 3, and underlying the organic soil deposit at Borehole Nos.4 and 5, the bedrock was proven by diamond core drilling. The bedrock was described as black gneiss with pink granite. Based on RQD values of 67 to 95%, the bedrock was described as fair to excellent quality. Sampling in the bedrock was terminated at depths of 11.0, 7.6, 13.2, 3.4 and 3.4 m below grade at Borehole Nos. 1 to 5, respectively (Elevations 190.0, 196.2, 190.6, 197.2, and 197.2 m, respectively). Photos of rock core recovered at Borehole Nos. 1 to 5 are shown in Enclosure No. 8, Appendix 4. A bedrock outcrop was observed to the southeast adjacent to the culvert outlet during the foundation investigation period. 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 (April 29th to May 4th, 2016), the creek water level was measured at about Elevation 200.5 m at the culverts.

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 3 to obtain post borehole completion water levels. These levels are recorded on the individual Record of Borehole Sheets (Appendix 2).



The groundwater levels were measured at Elevations 200.1 and 201.3 m on June 2, 2016 at Borehole Nos. 1 and 3, respectively. The groundwater levels were encountered at Elevations 201.8, 200.6, 200.4 and 200.6 m at Borehole Nos. 2, 4, 5 and 6 upon completion of sampling at each borehole, respectively; however these water levels likely had not stabilized at the time of recording.

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

## Appendix 1   Key Plan

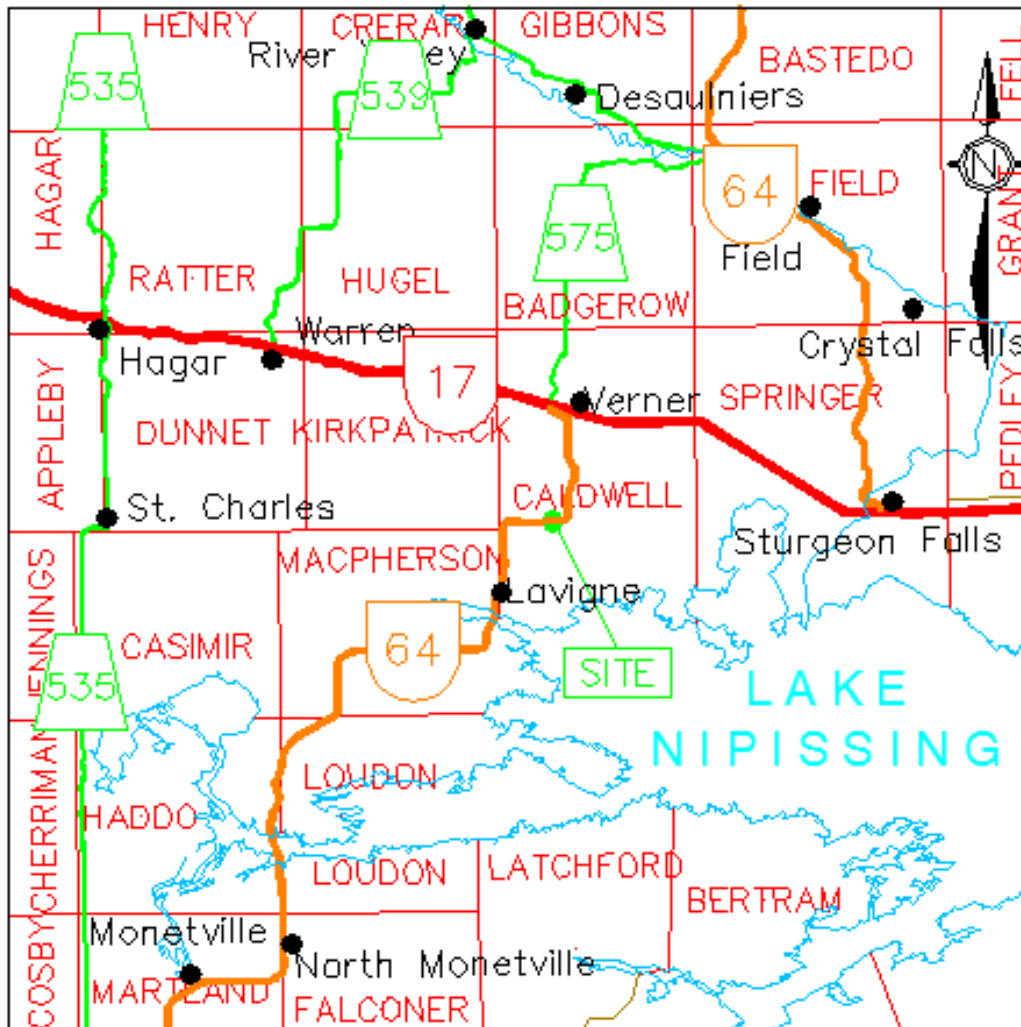
Drawing No. 1

Key Plan

# MACRO KEY PLAN

Drawing No.1

NOT TO SCALE



## FINAL FOUNDATION INVESTIGATION REPORT

GWP 5166-13-00

Highway 64

Stations 15+052 and 15+055

Riburdy Tributary Culvert

Site No. 43-310

Township of Caldwell, Ontario



Reference No: 16/03/16019

November 2016

## **Appendix 2    Subsurface Data**

Enclosure No. 1	List of Abbreviations and Symbols
Enclosure Nos. 2 to 7	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.

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

REFERENCE 16019 DATUM Geodetic LOCATION N 5136187.7 E 256244.5 - Twp. of Caldwell, Station 15+066 ORIGINATED BY JL  
 PROJECT GWP 5166-13-00, Highway 64 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers COMPILED BY DM  
 CLIENT AECOM DATE (Started) 2016 April 29 TIME   
 DATE (Completed) 2016 April 29 (Completed) 10:40:00 AM CHECKED BY

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	UNIT WEIGHT γ	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
ELEV. DEPTH	DESCRIPTION (see Enclosure No. 1)	STRATA PLOT	NUMBER	TYPE								
201.0	Ground Surface											
0.0	SILTY CLAY (probable FILL) - some sand, some grass rootlets grey (stiff)		1	SS	2							
200.4	SILTY CLAY to CLAY - trace sand, trace grass rootlets to depth of 1.4 m brownish grey to grey		2	SS	2							
0.6	occasional reddish brown varved clay (stiff/firm)		3	SS	WH							
			4	SS	PM							
			5	SS	PM							
			6	SS	PM							
			7	SS	PM							
			8	SS	PM							
	organic CLAY											
193.8	SAND - trace gravel, some silt, trace clay grey (loose/very dense)		9	SS 20/150mm								
193.1	Auger Refusal Start Rock Coring		10	RC	REC=100% ROD=83%							
7.9	BEDROCK - black gneiss with pink granite good quality		11	RC	REC=100% ROD=83%							
190.0	End of Sampling End of Borehole											
11.0												

WATER LEVEL RECORDS	
Date (dd/mm/yy)/Time	Water Depth (m) / Cave In (m)
1) 16/4/29 3:20:00 PM	0 ▽ - 5
2) 16/5/4 1:35:00 PM	0.9 ▽ -
3) 16/6/2 4:00:00 PM	0.9 ▽ -

COMMENTS: + 3, × 3 : Numbers on right refer to Sensitivity  
 Numbers on left refer to values greater than 120 kPa  
 ○ 3% STRAIN AT FAILURE

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

MEL-GEO 16019 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 16/11/1



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

REFERENCE 16019 DATUM Geodetic LOCATION N 5136169.2 E 256233.4 - Twp. of Caldwell, Station 15+055 ORIGINATED BY JL  
 PROJECT GWP 5166-13-00, Highway 64 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers COMPILED BY DM  
 CLIENT AECOM DATE (Started) 2016 May 2 TIME   
 DATE (Completed) 2016 May 2 (Completed) 5:20:00 PM CHECKED BY

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 PLOT	NUMBER	TYPE	"N" VALUES			20	40	60					
203.8	Ground Surface														
0.0	50 mm asphalt 150 mm crushed gravel SAND FILL - with to trace gravel, some to trace silt, trace clay  brown to brownish grey (compact)  300 mm boulder encountered at depths from 1.2 m to 1.5 m below grade		1	SS	16										
			2	SS	28										24 60 12 4
			3	SS	11										
			4	SS	27										
			5	SS	13										0 86 10 4
200.1															
3.7	SILTY CLAY to CLAY - trace sand grey soft		6	SS	PM										
199.2															
4.6	Start Rock Coring  BEDROCK - black geiss fair quality		7	RC	REC=95% RQD=67%										
			8	RC	REC=100% RQD=68%										
196.2															
7.6	End of Sampling End of Borehole														

COMMENTS		WATER LEVEL RECORDS		
		Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
		1) 16/5/2 5:20:00 PM	2	5.8
		2)	-	-
		3)	-	-

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

MEL-GEO 16019 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 16/11/1

**METRIC****RECORD OF BOREHOLE NO. 3**

REFERENCE 16019 DATUM Geodetic LOCATION N 5136178.6 E 256231.5 - Twp. of Caldwell, Station 15+053 ORIGINATED BY JL  
 PROJECT GWP 5166-13-00, Highway 64 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers COMPILED BY DM  
 CLIENT AECOM DATE (Started) 3016 May 3 TIME   
 DATE (Completed) 2016 May 3 (Completed) 3:00:00 PM CHECKED BY

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 PLOT	NUMBER	TYPE	"N" VALUES																				
203.8	Ground Surface																								
0.0	100 mm asphalt 300 mm crushed gravel		1	SS	15																				
	SAND FILL - some to trace gravel, trace silt, trace clay																								
	brown		2	SS	9																				
	(loose/dense)																								
			3	SS	42								3 85 8 4												
			4	SS	11																				
	brownish grey		5	SS	8								13 75 9 3												
200.1																									
3.7	SILTY CLAY to CLAY - trace sand grey (stiff/firm)		6	SS	3																				
			7	SS	WH								0 2 37 61												
			8	SS	PM																				
	reddish brown clay varves encountered to a depth of approximately 7.3 m																								
			9	SS	PM								0 0 17 83												
			10	SS	PM																				
193.7	Auger Refusal Start Rock Coring																								
10.1	BEDROCK - black gneiss good quality		11	RC	REC=100% RQD=80%																				
	black gneiss with pink granite excellent quality		12	RC	REC=100% RQD=92%																				
	Continued Next Page																								
COMMENTS								+ 3, × 3 : Numbers on right refer to Sensitivity Numbers on left refer to values greater than 120 kPa ○ 3% STRAIN AT FAILURE																	
								<b>WATER LEVEL RECORDS</b> <table border="1"> <thead> <tr> <th>Date (dd/mm/yy)/Time</th> <th>Water Depth (m)</th> <th>Cave In (m)</th> </tr> </thead> <tbody> <tr> <td>1) 16/5/3 3:00:00 PM</td> <td>0</td> <td>▽ - 5</td> </tr> <tr> <td>2) 16/5/4 1:30:00 PM</td> <td>0.9</td> <td>▽ -</td> </tr> <tr> <td>3) 16/6/2 4:00:00 PM</td> <td>2.5</td> <td>▽ -</td> </tr> </tbody> </table>						Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)	1) 16/5/3 3:00:00 PM	0	▽ - 5	2) 16/5/4 1:30:00 PM	0.9	▽ -	3) 16/6/2 4:00:00 PM	2.5	▽ -
Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)																							
1) 16/5/3 3:00:00 PM	0	▽ - 5																							
2) 16/5/4 1:30:00 PM	0.9	▽ -																							
3) 16/6/2 4:00:00 PM	2.5	▽ -																							
The stratification lines represent approximate boundaries. The transition may be gradual.																									

MEL-GEO 16019 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 16/11/1

**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. 3**

REFERENCE 16019 DATUM Geodetic LOCATION N 5136178.6 E 256231.5 - Twp. of Caldwell, Station 15+053 ORIGINATED BY JL  
 PROJECT GWP 5166-13-00, Highway 64 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers COMPILED BY DM  
 CLIENT AECOM DATE (Started) 3016 May 3 TIME   
 DATE (Completed) 2016 May 3 (Completed) 3:00:00 PM CHECKED BY

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 (%) GR SA (SI CL)
ELEV. DEPTH	DESCRIPTION (see Enclosure No. 1)	STRATA PLOT	NUMBER	TYPE			"N" VALUES	20	40	60	80					
190.6	Continued from Previous Page	X														
13.2	End of Sampling End of Borehole															

MEL-GEO 16019 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 16/11/1

**METRIC****RECORD OF BOREHOLE NO. 4**

REFERENCE 16019 DATUM Geodetic LOCATION N 5136157.4 E 256221.4 - Twp. of Caldwell, Station 15+043 ORIGINATED BY JL  
 PROJECT GWP 5166-13-00, Highway 64 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers COMPILED BY DM  
 CLIENT AECOM DATE (Started) 2016 May 2 TIME   
 DATE (Completed) 2016 May 3 (Completed) 7:00:00 PM CHECKED BY

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 PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa						WATER CONTENT (%)											
200.6	Ground Surface		1	SS	10/50mm								GR SA (SI CL)												
200.4	Topsoil - silty clay, trace gravel, with sand, some grass rootlets brownish grey		2	RC	REC=100% RQD=93%								8 22 35 35												
0.2	Auger Refusal Start Rock Coring		3	RC	REC=100% RQD=95%																				
	BEDROCK - black gneiss with pink granite excellent quality																								
197.2	End of Sampling End of Borehole																								
3.4																									
COMMENTS						+ 3, × 3 : Numbers on right refer to Sensitivity Numbers on left refer to values greater than 120 kPa ○ 3% STRAIN AT FAILURE		<b>WATER LEVEL RECORDS</b> <table border="1"> <thead> <tr> <th>Date (dd/mm/yy)/Time</th> <th>Water Depth (m)</th> <th>Cave In (m)</th> </tr> </thead> <tbody> <tr> <td>1) 16/5/3 7:00:00 AM</td> <td>0</td> <td>3.4</td> </tr> <tr> <td>2)</td> <td>-</td> <td>-</td> </tr> <tr> <td>3)</td> <td>-</td> <td>-</td> </tr> </tbody> </table>						Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)	1) 16/5/3 7:00:00 AM	0	3.4	2)	-	-	3)	-	-
Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)																							
1) 16/5/3 7:00:00 AM	0	3.4																							
2)	-	-																							
3)	-	-																							

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

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MEL-GEO 16019 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 16/11/1

**METRIC****RECORD OF BOREHOLE NO. 5**

REFERENCE 16019 DATUM Geodetic LOCATION N 5136159.6 E 256277.4 - Twp. of Caldwell, Station 15+049 ORIGINATED BY JL  
 PROJECT GWP 5166-13-00, Highway 64 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers COMPILED BY DM  
 CLIENT AECOM DATE (Started) 2016 May 4 TIME   
 DATE (Completed) 2016 May 4 (Completed) 12:00:00 PM CHECKED BY

SOIL PROFILE		STRATA PLOT	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)		NUMBER	TYPE			"N" VALUES	20					
200.6	Ground Surface		1	SS	4								
0.0 200.3 0.3	Topsoil - silty clay, some gravel, sandy, some grass rootlets brownish grey (soft) Auger Refusal Start Rock Coring BEDROCK - black gneiss with thin pink granite good quality		2	RC	REC=100% RQD=78%								
			3	RC	REC=100% RQD=90%								
197.2	End of Sampling End of Borehole												
3.4													

WATER LEVEL RECORDS	
Date (dd/mm/yy)/Time	Water Depth (m) / Cave In (m)
1) 16/5/4 12:00:00 PM	0.2
2)	-
3)	-

COMMENTS

+ 3, × 3 : Numbers on right refer to Sensitivity  
 Numbers on left refer to values greater than 120 kPa  
 ○ 3% STRAIN AT FAILURE

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

**Englobe Corp.**

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MEL-GEO 16019 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 16/11/1

## METRIC

## RECORD OF BOREHOLE NO. 6



REFERENCE 16019 DATUM Geodetic LOCATION N 5136187.3 E 256233.5 - Twp. of Caldwell, Station 15+055 ORIGINATED BY JL  
 PROJECT GWP 5166-13-00, Highway 64 BOREHOLE TYPE Track Mounted CME 45 - Hollow Stem Augers COMPILED BY DM  
 CLIENT AECOM DATE (Started) 2016 May 4 TIME (Completed) 2:00:00 PM CHECKED BY

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 PLOT	NUMBER	TYPE			"N" VALUES	SHEAR STRENGTH kPa					
201.5	Ground Surface												
0.0	SILTY CLAY - trace sand, trace grass rootlets and organics to a depth of 0.5 m		1	SS	6								
200.9	brown varved clay encountered		2	SS	6								
0.6	(very stiff) SILTY CLAY to CLAY- trace sand												
	Reddish brown varved clay to depth of 5.5 m		3	SS	4								
	grey		4	SS	WH								
	(very stiff/firm)		5	SS	WH								
			6	SS	PM								
			7	SS	PM								
			8	SS	PM								
			9	SS	PM								
193.0	SAND - some gravel, some silt, trace clay		10A	SS	10								
8.5	grey, wet (loose)		10B										
191.9	End of Sampling												
9.6	End of Borehole												
COMMENTS							+ 3, × 3 : Numbers on right refer to Sensitivity Numbers on left refer to values greater than 120 kPa ○ 3% STRAIN AT FAILURE						
							WATER LEVEL RECORDS Date (dd/mm/yy)/Time 1) 16/5/4 2:00:00 PM 2) 3)						
							Water Depth (m) 0.9 - -						
							Cave In (m) 8 - -						

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

MEL-GEO 16019 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 16/11/1

## **Appendix 3      Borehole Plan and Laboratory Data**

Drawing No. 2A and 2B: Borehole Location and Soil Strata

Figure Nos. L-1 to L-6:      Grain Size Distribution Curves

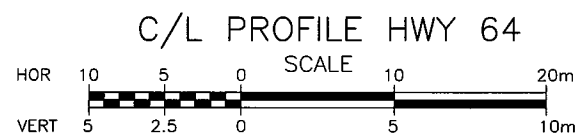
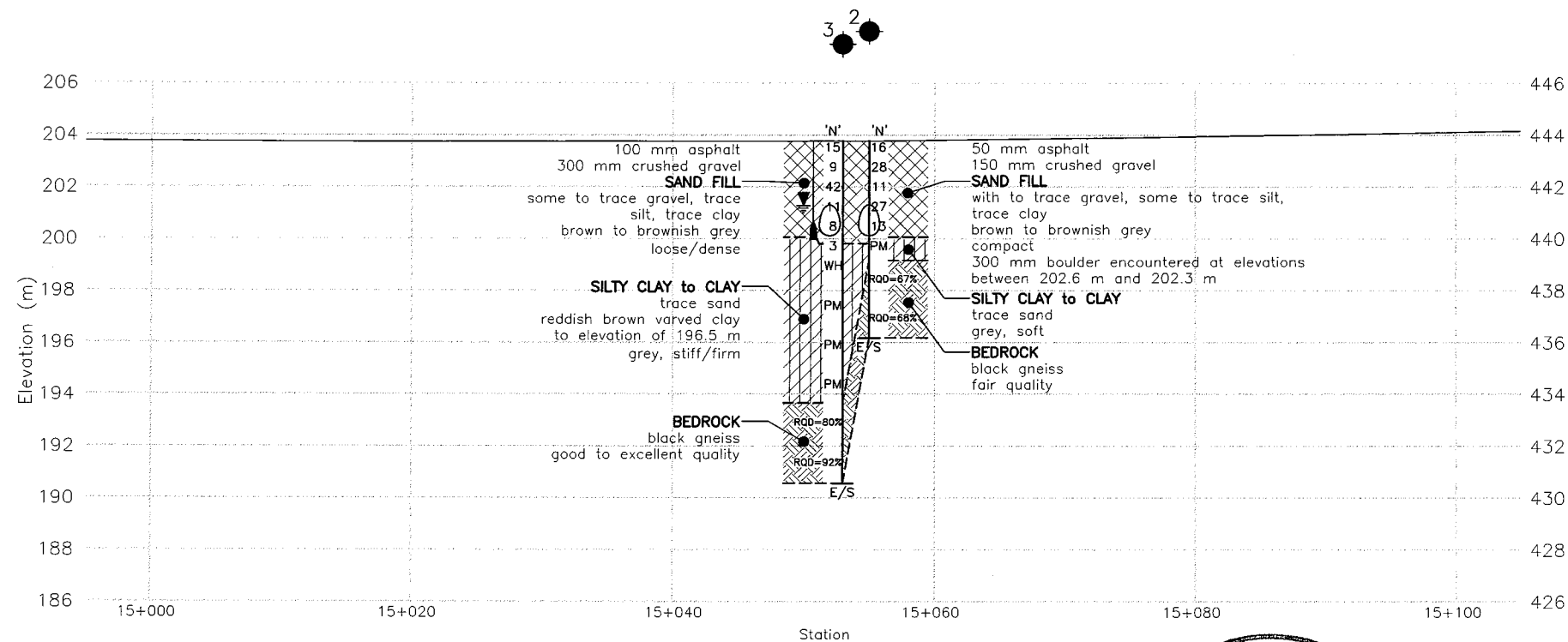
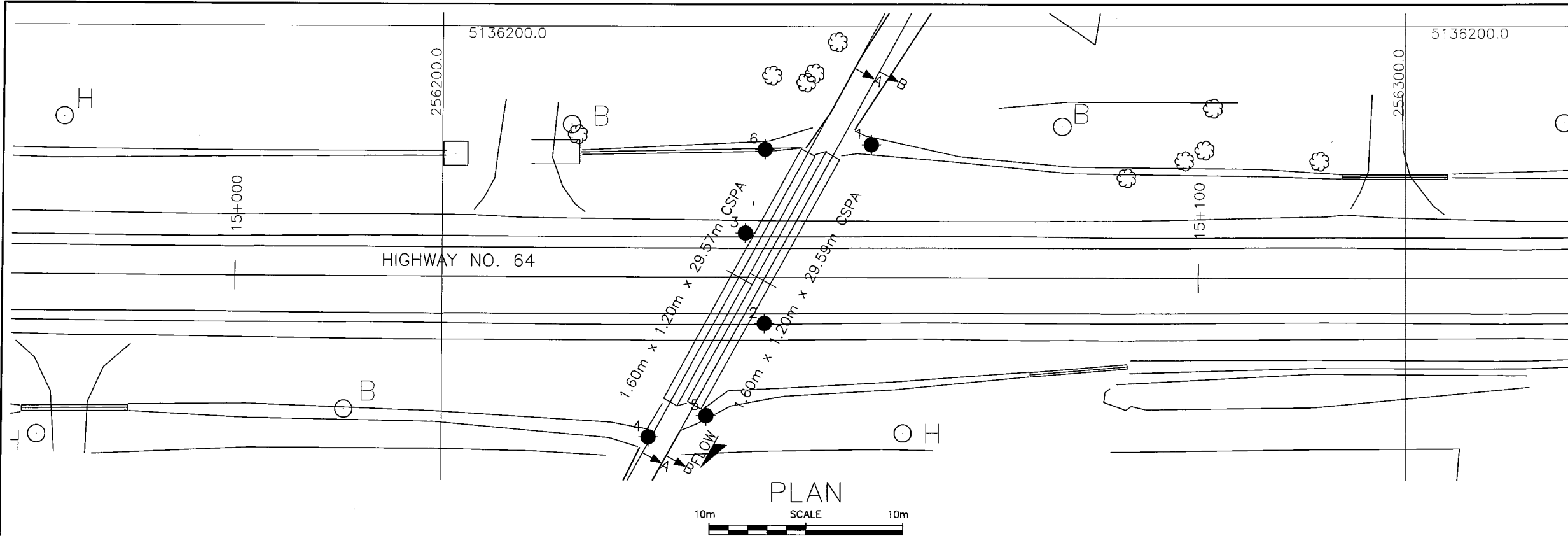
Figure No. L-7:      Atterberg Limits

Table No. L-8: Geotechnical Laboratory Test Summary Sheet

Results of Soil Chemical Tests

CAD FILE LOCATION AND NAME: G:\2016\16019 - PAV & FDN, Hwy 64 Field, GWP 5166-13-00 (AECOM)\FOUNDATIONS\Drawing\F1\6019 - Culvert at Station 15+045.dwg  
MODIFIED: 11/3/2016 1:17:01 PM BY: MITCOU  
DATE PLOTTED: 11/3/2016 1:17:48 PM BY:

MINISTRY OF TRANSPORTATION, ONTARIO  
PR-D-707 88-05



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.



2016-11-04

DISTRICT  
CONT. No.  
GWP No. 5166-13-10  
HWY 64, STA. 15+052 & 15+055  
RIBERDY TRIBUTARY CULVERT  
SITE NO. 43-310  
BOREHOLE LOCATIONS  
AND SOIL STRATIGRAPHY  
DRAWING  
2A



KEY PLAN  
N.T.S.

LEGEND

- Borehole
- Blows/0.3 m (Std Pen Test, 475 J/blow)
- Water Level at Time of Investigation
- E/S End of Sampling
- Piezometer

BOREHOLE No.	ELEVATION	O/S	NORTHING	EASTING
1	201.0	13.8m Lt	5136187.7	256244.5
2	203.8	4.8m Rt	5136169.2	256233.4
3	203.8	4.6m Lt	5136178.6	256231.5
4	200.6	16.6m Rt	5136157.4	256221.4
5	200.6	14.4m Rt	5136159.6	256277.4
6	201.5	13.3m Lt	5136187.3	256233.5

#### 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 May 12, 2016  
Coordinates based on MTM Zone 10 NAD83 CSRS

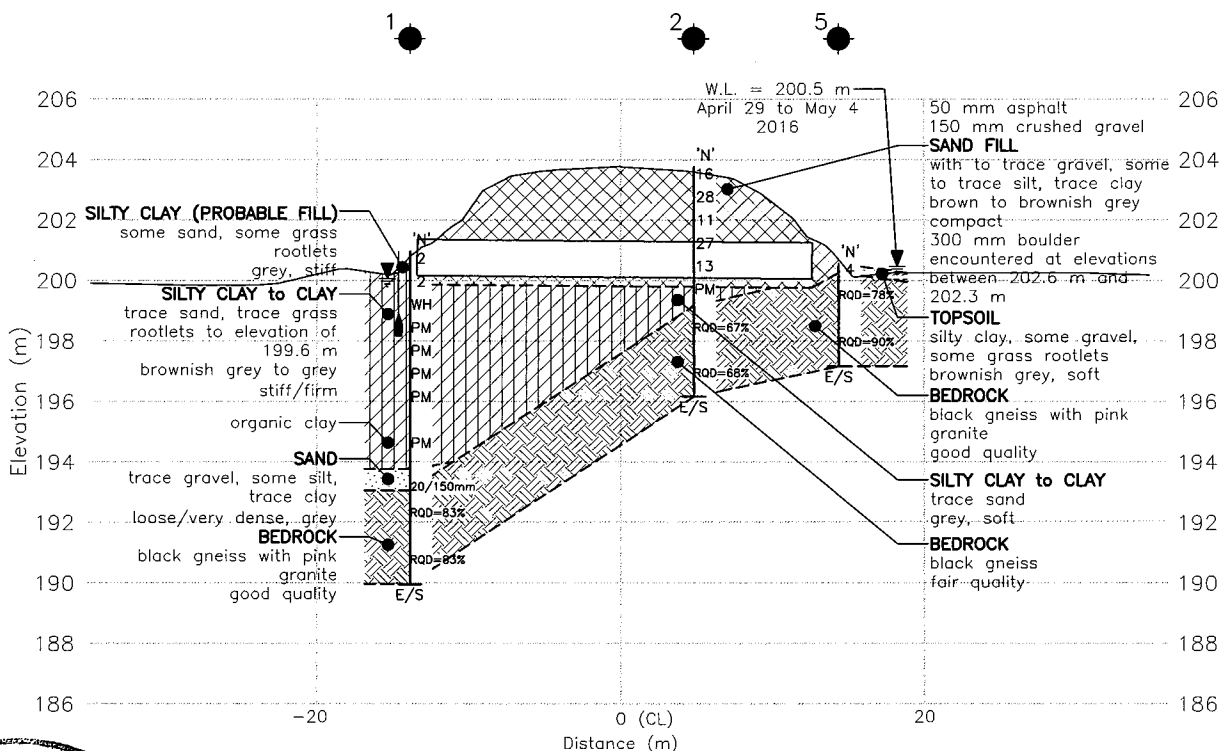
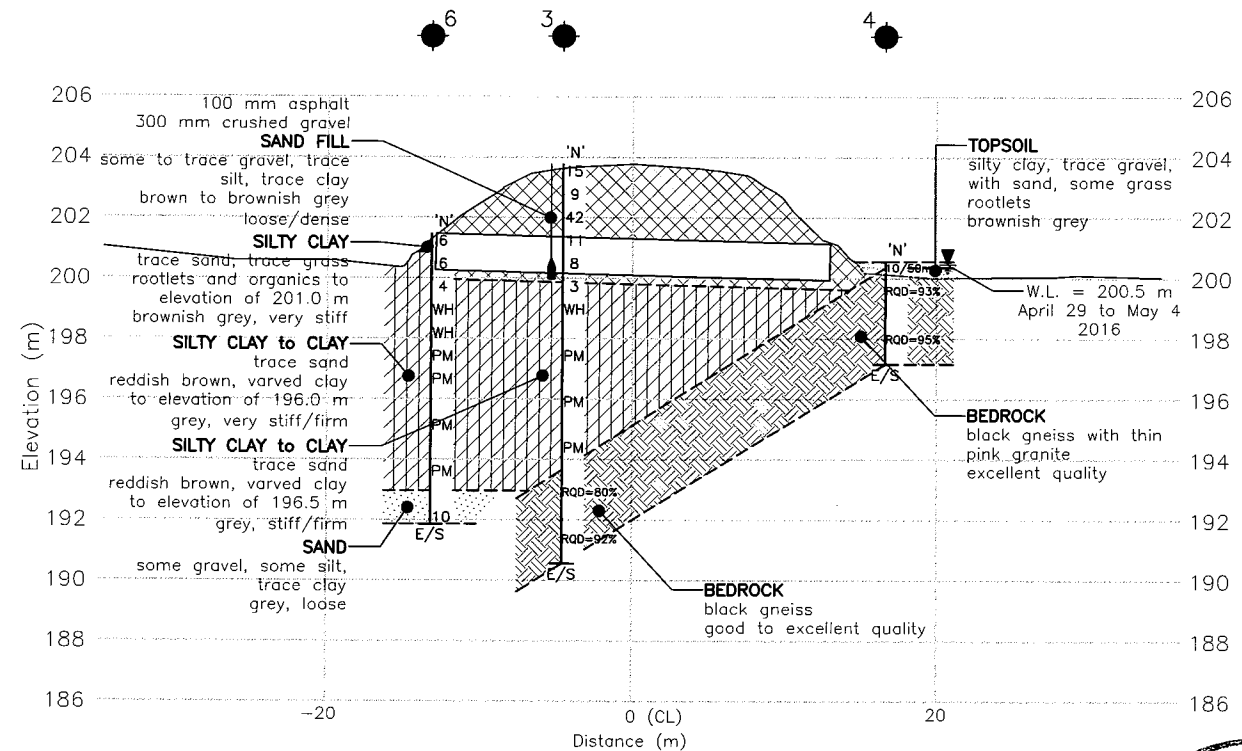
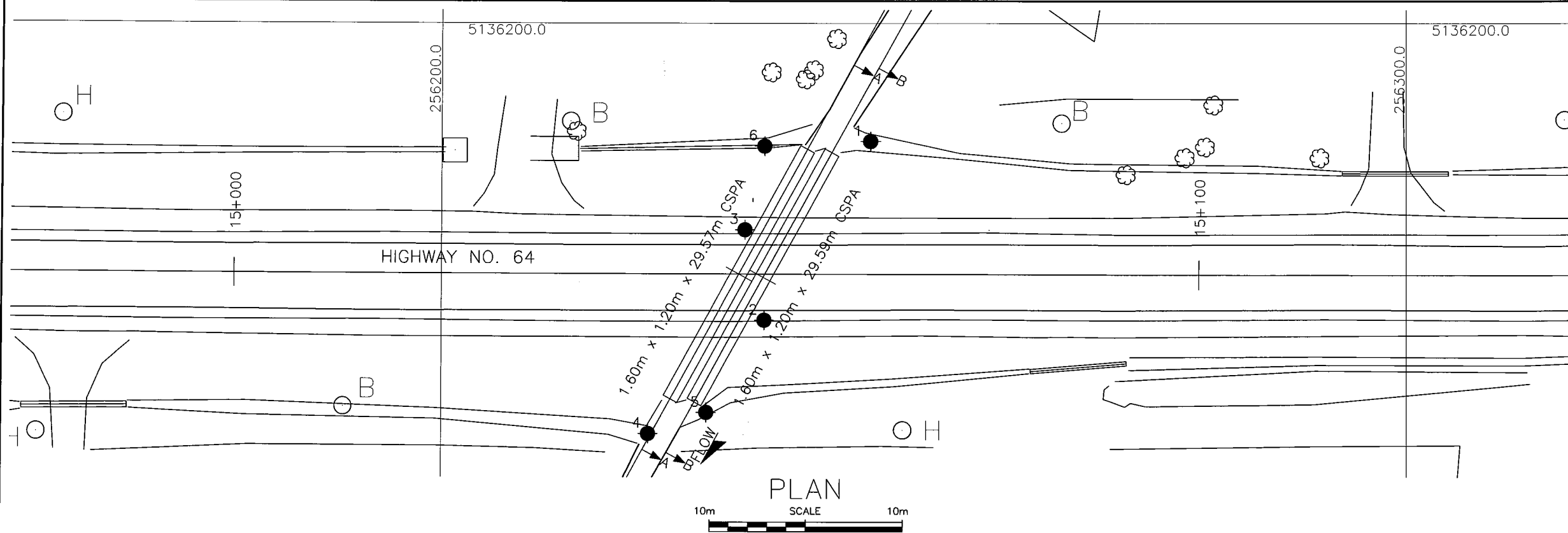
GEOCRES No. 411-343

REVISIONS	DESIGN	CHK	CODE	LOAD	DATE
JUN/16	DM	DRAFT			
NOV/16	DM	FINAL			
DESIGN	CHK	CODE	LOAD	DATE	
DRAWN DM	CHK SH	SITE 43-310	STRUCT	SCHEME	DWG 2A



CAD FILE LOCATION AND NAME: G:\2016\16019 - PAV & FDN, Hwy 64 Field, GWP 5170-12-00, 5166-13-00 (AECOM)\FOUNDATIONS\Drawings\16019 - Culvert at Station 15+045.dwg  
MODIFIED: 11/3/2016 1:17:01 PM BY: MTCOU  
DATE PLOTTED: 11/3/2016 1:18:12 PM BY:

PR-D-107 88-05  
MINISTRY OF TRANSPORTATION, ONTARIO



DISTRICT  
CONT. No.  
GWP No. 5166-13-10  
HWY 64, STA. 15+052 & 15+055  
RIBERDY TRIBUTARY CLVERT  
SITE NO. 43-310  
BOREHOLE LOCATIONS  
AND SOIL STRATIGRAPHY  
DRAWING  
2B



KEY PLAN  
N.T.S.

LEGEND

- Borehole
- Blows/0.3 m (Std Pen Test, 475 J/blow)
- Water Level at Time of Investigation
- End of Sampling
- Piezometer

BOREHOLE No.	ELEVATION	O/S	NORTHING	EASTING
1	201.0	13.8m Lt	5136187.7	256244.5
2	203.8	4.8m Rt	5136169.2	256233.4
3	203.8	4.6m Lt	5136178.6	256231.5
4	200.6	16.6m Rt	5136157.4	256221.4
5	200.6	14.4m Rt	5136159.6	256277.4
6	201.5	13.3m Lt	5136187.3	256233.5

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.

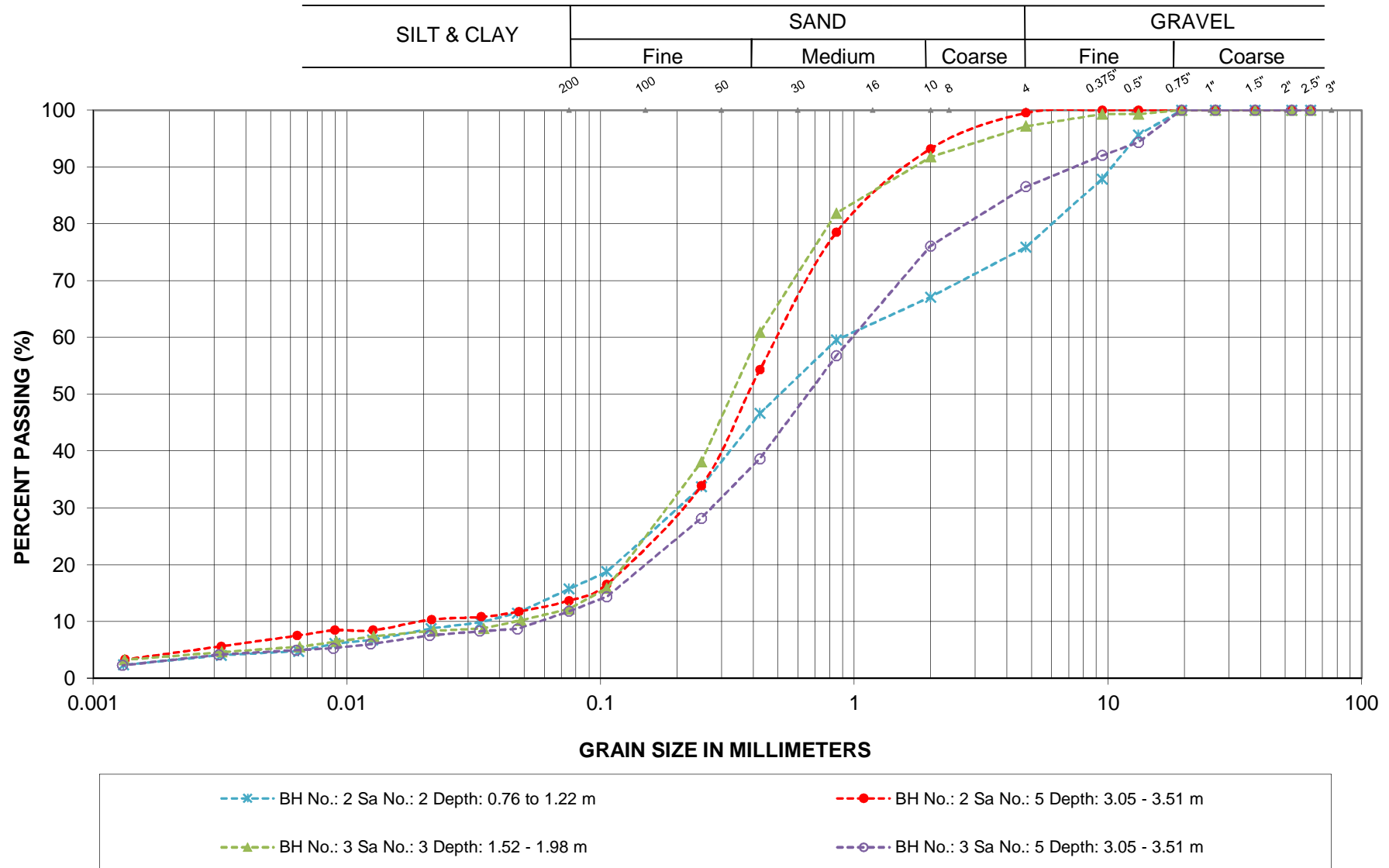
Base plan and alignment provided in digital format by Callon Dietz on May 12, 2016  
Coordinates based on MTM Zone 10 NAD83 CSRS

GEOCRES No. 411-343

REVISIONS	JUN/16	DM	DRAFT				
	NOV/16	DM	FINAL				
DESCRIPTION							
DESIGN		CHK		CODE		LOAD	DATE NOV/16
DRAWN	DM	CHK	SH	SITF	43-310	STRUCT	SCHEME DWG 2B

2016-11-04

## GRAIN SIZE ANALYSIS

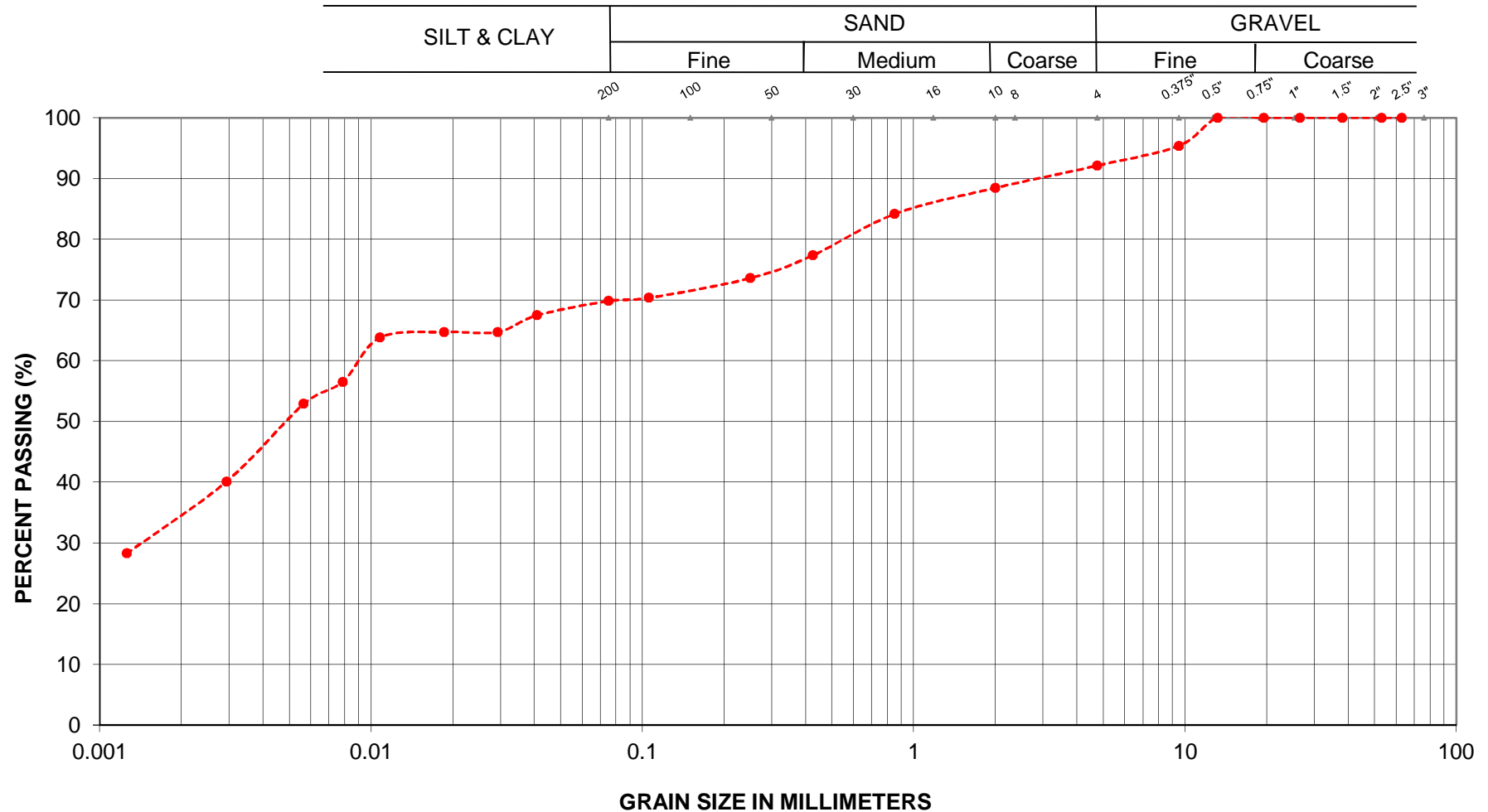


LOCATION: Hwy 64,  
Ribudy Creek Culvert at Stations 15+052 to 15+055  
TWP of Caldwell

SAND FILL  
Englobe Corp.

FIGURE L-1

# GRAIN SIZE ANALYSIS



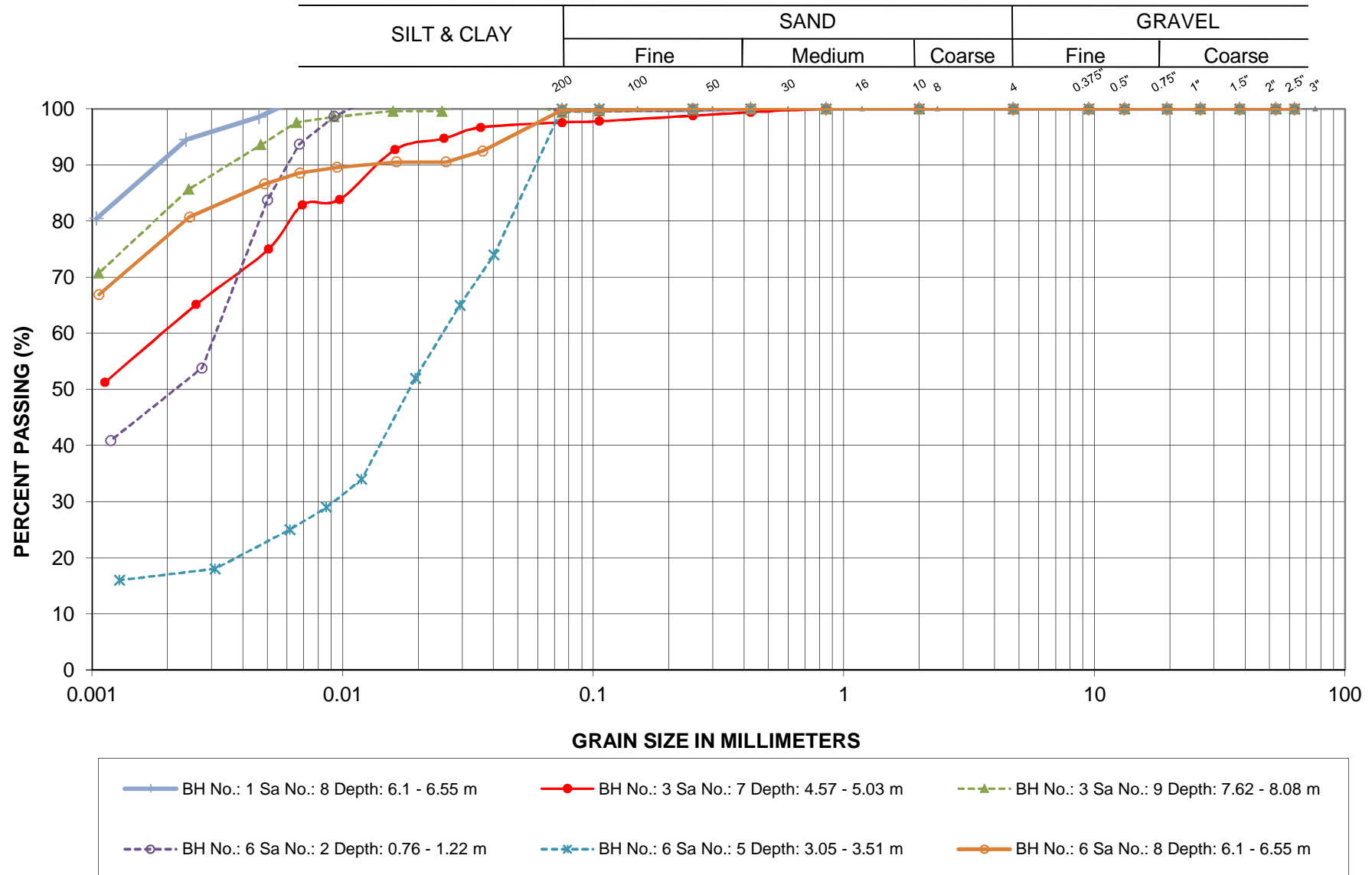
---●--- BH No.: 4 Sa No.: 1 Depth: 0 - 0.2 m

LOCATION: Hwy 64,  
Ribudy Creek Culvert at Stations 15+052 to 15+055  
TWP of Caldwell

TOPSOIL  
Englobe Corp.

FIGURE L-2

## GRAIN SIZE ANALYSIS



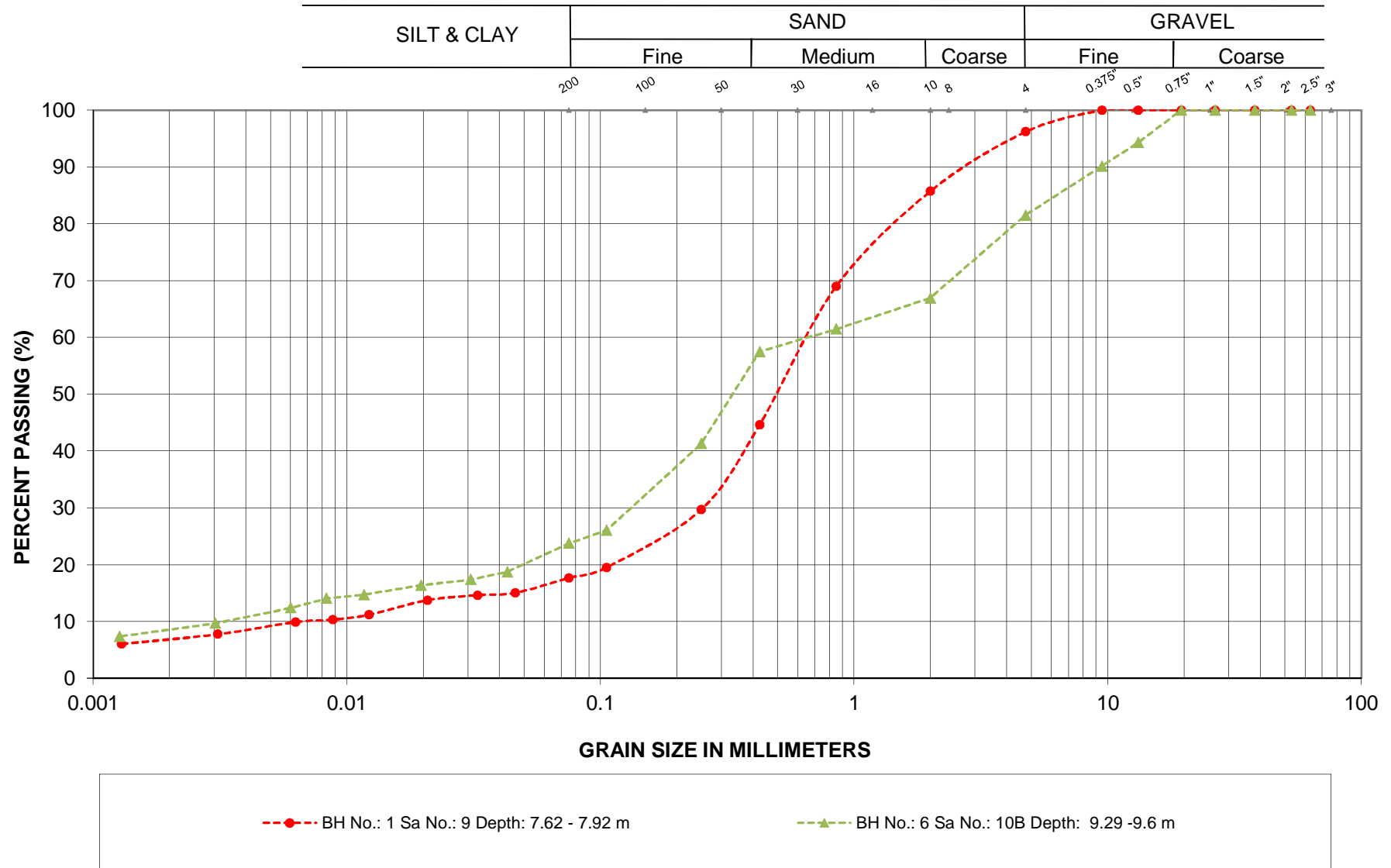
LOCATION: Hwy 64,  
Ribudy Creek Culvert at Stations 15+052 to 15+055  
TWP of Caldwell

Silty CLAY to CLAY

Englobe Corp.

FIGURE L-3

# GRAIN SIZE ANALYSIS



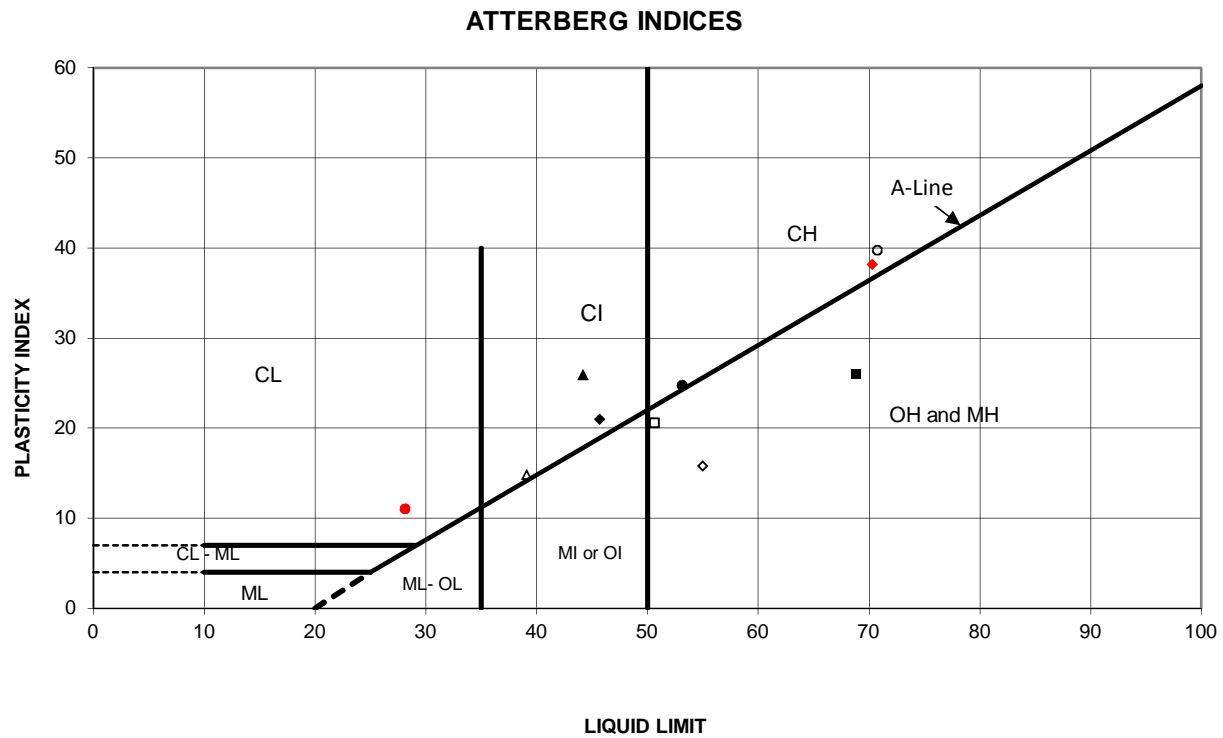
LOCATION: Hwy 64,  
Ribudy Creek Culvert at Stations 15+052 to 15+055  
TWP of Caldwell

SAND  
Englobe Corp.

FIGURE L-4

# ATTERBERG LIMITS TEST RESULTS

FIGURE L-5



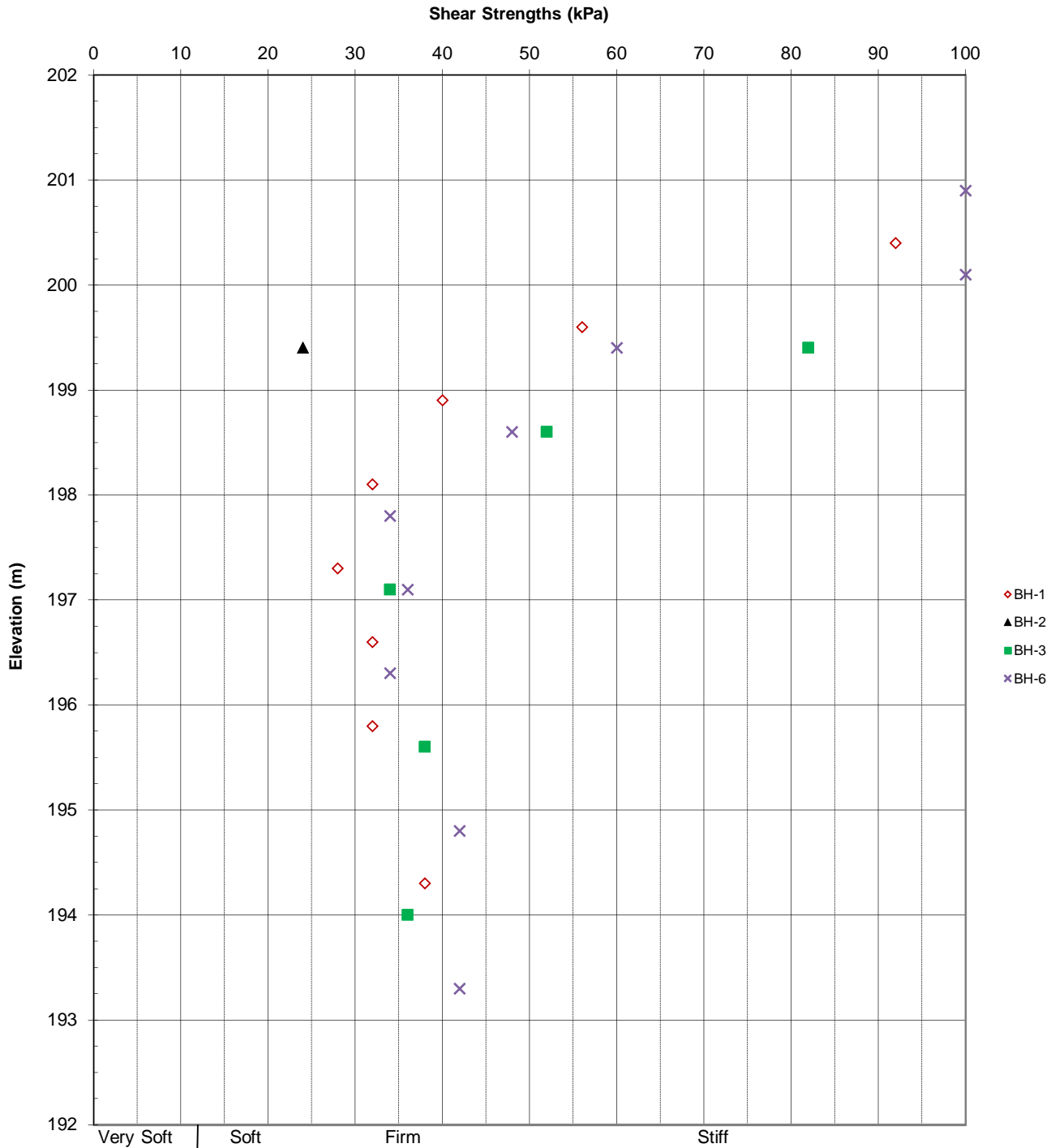
SYMBOL	BH	Sa. No.	Depth(m)	Elev.(m)	Liquid Limit	Plastic Limit	Plasticity Index	NMC %
●	1	2	1.0	200.0	53.2	28.5	24.7	49.3
◆	1	5	3.3	197.7	45.7	24.7	21.0	51.8
■	1	8	6.3	194.7	68.9	42.9	26.0	84.7
▲	3	7	4.8	199.0	44.2	18.3	25.9	41.1
○	3	9	7.85	195.95	70.8	31.1	39.7	70.0
◇	4	1	0.1	200.5	55.0	39.2	15.8	47.5
□	5	1	0.15	200.45	50.7	30.2	20.5	49.3
△	6	2	1.0	200.5	39.1	24.3	14.8	36.0
●	6	5	3.3	198.2	28.2	17.2	11.0	27.9
◆	6	8	6.3	195.2	70.3	32.1	38.2	63.9

Date: Jun-16  
 Project: Hwy 64, Ribudy Creek Tributary Culvert  
 Location: Sta. 15+052 and 15+055, TWP. of Caldwell

Prep'd: SH  
 Chkd: MHM  
 Ref. No.: 16/03/16019

Englobe Corp.

## In-Situ Shear Strengths vs. Depth



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

Ref No.: 16/03/16019

Project: Hwy 64

Culvert at Stations 15+052 to 15+055  
TWP of Caldwell

Englobe Corp.

Date: June 2016

Checked:MHM

## 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					39.8				2			
	2	1.0					49.3	53.2	28.5	24.7	2			
	3	1.8					56.3				WH			
	4	2.5					34.8				PM			
	5	3.3					51.8	45.7	24.7	21.0	PM			
	6	4.0					53.9				PM			
	7	4.8					63.2				PM			
	8	6.3	0	0	7	93	84.7	68.9	42.9	26.0	PM			
	9	7.8	4	78	11	7	19.2				20/150mm			
2	1	0.2					9.3				16			
	2	1.0	24	60	12	4	4.3				28			
	3	1.8					13.8				11			
	4	2.5					12.2				27			
	5	3.3					20.6				13			
	6	4.0	0	86	10	4	65.3				PM			
3	1	0.23					4.5				15			
	2	1					9.6				9			
	3	1.75	3	85	8	4	4.9				42			
	4	2.5					7.9				11			
	5	3.3	13	75	9	3	11.4				8			
	6	4.0					31.9				3			
	7	4.8	0	2	37	61	41.1	44.2	18.3	25.9	WH			
	8	6.3					48.2				PM			
	9	7.9	0	0	17	83	70.0	70.8	31.1	39.7	PM			
	10	9.4					54.7				PM			



## Laboratory Tests - Summary Sheet



Borehole No.	Sample No.	Depth	Grain Size Analysis				NMC	Atterberg Limits			SPT 'N'	USCS	Unit Weight (kN/m <sup>3</sup> )	Remarks
			Gravel Size (%)	Sand Size (%)	Silt Size (%)	Clay Size (%)		LL (%)	PL (%)	IP (%)				
4	0.1	0.5	8	22	35	35	47.5	55.0	39.2	15.8	10/50mm			
5	1	0.2					49.3	50.7	30.2	20.5	4			
6	1	0.2					34.5				6			
	2	1.0	0	0	59	41	36.0	39.1	24.3	14.8	6			
	3	1.8					38.4				4			
	4	2.5					49.4				WH			
	5	3.3	0	0	83	17	27.9	28.2	17.2	11.0	WH			
	6	4					65.9				PM			
	7	4.8					63.2				PM			
	8	6.3	0	0	23	77	63.9	70.3	32.1	38.2	PM			
	9	7.9					48.2				PM			
	10A	9.2					45.0				10			
	10B	9.5	19	57	16	8	19.8							

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

ATTENTION TO: Victoria Steuernol

PROJECT: 16019

AGAT WORK ORDER: 16T092251

SOIL ANALYSIS REVIEWED BY: Parvathi Malemath, Data Reviewer

DATE REPORTED: May 12, 2016

PAGES (INCLUDING COVER): 5

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.



**AGAT** Laboratories

## Certificate of Analysis

AGAT WORK ORDER: 16T092251

PROJECT: 16019

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:

### Inorganic Chemistry (Soil)

DATE RECEIVED: 2016-05-06

DATE REPORTED: 2016-05-12

		SAMPLE DESCRIPTION:		BH3 Sa7	BH2 Sa5
		SAMPLE TYPE:		Soil	Soil
		DATE SAMPLED:		5/5/2016	5/5/2016
Parameter	Unit	G / S	RDL	7540273	7540274
Chloride (2:1)	µg/g	2		194	88
Sulphate (2:1)	µg/g	2		8	4
pH, 2:1 CaCl2 Extraction	pH Units			7.67	7.31
Electrical Conductivity (2:1)	mS/cm		0.005	0.418	0.209
Resistivity (2:1)	ohm.cm		1	2390	4780

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

7540273-7540274 EC/Resistivity, Chloride & Sulphate were determined on a DI water extract obtained from the 2:1 leaching procedure (2 parts DI water: 1 part dry soil). PH was determined on the 0.01M CaCl2 extract obtained from the 2:1 leaching (2 parts extraction fluid 1 part wet soil).

Certified By:





## Quality Assurance

CLIENT NAME: ENGLOBE CORP

PROJECT: 16019

SAMPLING SITE:

AGAT WORK ORDER: 16T092251

ATTENTION TO: Victoria Steuernol

SAMPLED BY:

### Soil Analysis

RPT Date: May 12, 2016			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		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Inorganic Chemistry (Soil)															
Chloride (2:1)	7540274	7540274	88	92	4.4%	< 2	103%	80%	120%	105%	80%	120%	99%	70%	130%
Sulphate (2:1)	7540274	7540274	4	5	NA	< 2	98%	80%	120%	107%	80%	120%	102%	70%	130%
pH, 2:1 CaCl2 Extraction	7546685		6.56	6.64	1.2%	NA	100%	80%	120%	NA			NA		
Electrical Conductivity (2:1)	7540274	7540274	0.209	0.211	1.0%	< 0.005	97%	90%	110%	NA			NA		

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: \_\_\_\_\_





## Method Summary

CLIENT NAME: ENGLOBE CORP

PROJECT: 16019

SAMPLING SITE:

AGAT WORK ORDER: 16T092251

ATTENTION TO: Victoria Steuernol

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
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 CaCl <sub>2</sub> Extraction	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



## **Appendix 4    Photo Essay**

Enclosure No. 8:

Photo Essay



Existing Embankment of Highway 63– Looking East

Photo: 1



Culvert Inlet – Looking North

Photo: 2



Project: Hwy 64– Riberdy Tributary Creek Culvert, Stations 15+052 to 15+055, Township of Caldwell

Photos Provided by:Englobe

Date: April and May 2016



Culvert Outlet – Looking South next to Borehole No. 4

Photo: 3



Bedrock Outcrop Observed at Southeast next to Culvert Outlet – Looking Southwest

Photo: 4



Project: Hwy 64– Riberdy Tributary Creek Culvert, Stations 15+052 to 15+055, Township of Caldwell

Photos Provided by:Englobe

Date: April and May 2016

Rock Cores – Borehole 1 (left) and Borehole 2 (right)

Photos: 5 and 6



Project: Hwy 64– Riberdy Tributary Creek Culvert, Stations 15+052 to 15+055, Township of Caldwell

Photos Provided By: Englobe

Date: May 2016



## Rock Cores – Borehole 3 (left) and Borehole 4 (right)

Photos: 7 and 8



Project: Hwy 64– Riberdy Tributary Creek Culvert, Stations 15+052 to 15+055, Township of Caldwell

Photos Provided By: Englobe

Date: May 2016

## Rock Cores – Borehole 5 (left)

Photo: 9



Project: Hwy 64– Riberdy Tributary Creek Culvert, Stations 15+052 to 15+055, Township of Caldwell

Photos Provided By: Englobe

Date: May 2016