Englobe
Soils Materials Environment

Submitted to Planmac Engineering Inc.
80 North Queen Street, Suite 302, Toronto, Ontario M8Z 2C9
For the Ontario Ministry of Transportation

Improvements for Ryland Rest Area
Latitude: 49.731635°, Longitude: -83.913612°
Highway 11
GWP 5074-16-00

FINAL FOUNDATION INVESTIGATION AND DESIGN REPORT

Date: April 10, 2018
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Final Foundation Investigation and Design Report

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1 INTRODUCTION

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 Detail Design for the improvements of the Ryland Rest Area located on Highway 11, approximately 15.6 km east of Highway 663 in the Township of Stoddart, Ontario (see Drawing No. 1, Appendix 1).

The foundation investigation location was specified by the MTO in the Terms of Reference for work under Agreement No. 5017-E-0007: GWP 5074-16-00 for Detail Design, dated June 2017. The terms of reference for the scope of work are outlined in Englobe's Proposal 2017-P152-138, dated July 24, 2017. The purpose of this investigation was to determine the subsurface conditions in the area of the proposed new restroom structure with heating and the new septic bed for the contract preparation of the Detail Design package. Englobe investigated the foundation area by drilling boreholes, carrying out in-situ tests, and performing laboratory testing on selected samples.

In addition, six boreholes were drilled on site for the hydrogeology assessment per Section 3.5.9.3 Terms of Reference 'Project Specific' in the RFQ. Locations of the hydrogeological boreholes are shown on Drawing No.2 in Appendix 3. Detailed subsurface information is included in a separate draft report titled "Scoped Hydrogeology Study, Ryland Rest Area Improvement, Highway 11, Ryland, Ontario" (Englobe Ref. No. 152-P-0014221-0-00-300-HD-R-0001-0A) dated January, 2018.

2 SITE DESCRIPTION

The Ryland Rest Area is located at the north side of Highway 11, approximately 15.6 km east of Highway 663. The existing highway at the location of the Rest Area is locally running in an east-west direction. The existing Ryland Rest Area supports asphalt surface parking lots and two unheated restroom structures. To the north of the parking area, the site is currently forested. Drainage features at the site consist of the existing roadway ditch north of Highway 11. The site was snow covered at the time of the investigation and surficial drainage was not observed.

Known underground services within the rest area consist of underground communication lines.

2.1 SITE PHYSIOGRAPHY AND SURFICIAL GEOLOGY

In general, the topography on this section of Highway 11 is slightly rolling. Layers of surficial organic soils and native soils overlie bedrock. Organic materials are also observed in the region. Within the project area, the native overburden consists of silty clays, silts and sands overlying bedrock.

Based on Ontario Geologic Survey (OGS) MRD-126 [1; see List of References at end of this report], bedrock in the area consists of Archean Muscovite-bearing granitic rock.

3 INVESTIGATION PROCEDURES

The fieldwork for this investigation was carried out on October 26th and 27th, 2017 during which time three (3) sampled boreholes were advanced. Two boreholes were advanced in the area of the proposed new restroom structure. One borehole was advanced in the area of the proposed septic bed. The locations of the boreholes are shown on Drawing No. 2 in Appendix 3, and are provided in the following table.

BOREHOLE NO.	BOREHOLE LOCATION (MTM NAD 83)		BOREHOLE LOCATION (GEOGRAPHIC)	
1	N 5510444.5	E 311019.8	Lat: 49.731584°	Long: -83.913718°
2	N 5510450.7	E 311027.6	Lat: 49.731639°	Long: -83.913610°
3	N 5510471.1	E 311017.5	Lat: 49.731823°	Long: -83.913749°

There was no existing historical information for this site.

Local clearing was carried out at the time of investigation to allow access to select borehole locations.

The field investigation was carried out using a track mounted CME 45B drilling rig equipped with hollow stem augers, standard augers, casing equipment and routine geotechnical sampling equipment, and was carried out by Englobe staff using equipment rented from Chrisdanat Management Inc. 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 D1586). 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. Bedrock coring using ‘NQ’ size equipment was undertaken at select boreholes. The wash water for coring operations was obtained from a local natural water resource and stored in water tanks. 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 the individual boreholes. A 19 mm diameter standpipe was installed in Borehole Nos. 1 to 3 prior to backfilling without sealing to allow for further monitoring of the shallow groundwater levels. The standpipes were decommissioned prior to leaving site. Upon completion, all boreholes were backfilled in accordance with requirements of Ontario Regulation 903.

The fieldwork for this investigation was under the full time direction of a senior member of the Englobe engineering staff (Jame Lavigne), who was responsible for locating the boreholes, clearing the borehole locations of underground services, in-situ sampling and testing operations, logging of the boreholes, labeling and preparation of samples for transport to the

Englobe North Bay laboratory, plus overall drill supervision. All samples received a visual confirmatory inspection in the laboratory. Laboratory testing of select samples included routine testing for natural moisture content determination and particle size analysis. The results of the laboratory testing are presented on the individual Record of Borehole Sheets (Appendix 2), with a summary of results presented on the laboratory sheets in Appendix 3 (Figures Nos. L-1 to L-4, and Table No. L-5).

In accordance with requirements stated in the RFQ, two sets of soil chemical tests (i.e. pH, water soluble sulphate, sulphide, chloride, resistivity and electrical conductivity analyses) was carried out by AGAT Laboratories in Mississauga. The results of the chemical tests are presented in Appendix 3.

The locations of the individual boreholes were determined in the field based on offset from existing site structures. The MTO co-ordinates, northing and easting, were then established for the boring locations using coordinates from MTM Zone 13, NAD 83 CSRS. The borehole elevations are based on coordinating the borehole locations with the previous survey carried out by others and included in the tender documents of the project. Elevations contained in this report are referenced to geodetic datum.

4 SUBSURFACE CONDITIONS

Details of the subsurface conditions revealed by the investigation program are presented on the enclosed Records of Borehole Logs (Appendix 2) and on Drawing No. 2 (Appendix 3). It should be noted that the stratigraphic delineation presented on the borehole logs and soil strata plot is interpreted from the result 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 RYLAND REST AREA

A plan and cross section illustrating the borehole locations and stratigraphic sequences are shown on Drawing No. 2, Appendix 3. During the course of the exploration program, three (3) sampled boreholes were put down at this site, with Borehole Nos. 1 and 2 advanced in the area of the proposed new restroom structure and Borehole No. 3 advanced in the area of the proposed septic bed. At the time of the subsurface investigation, the ground surface elevations at Boreholes Nos. 1 to 3 were recorded at Elevations 248.6, 248.5, and 248.5 m, respectively.

4.1.1 Surficial Organic Layer

At surface at Borehole Nos. 1 to 3, a layer of organic soils approximately 100 to 150 mm thick was penetrated.

4.1.2 Silty Clay

Underlying the surficial organics at Borehole Nos. 1 to 3, a deposit of silty clay, trace to with sand was penetrated. The natural moisture content measured on samples recovered from this deposit ranged from 22 to 36%. Two gradation (hydrometer) analyses were carried out on two (2) samples of this deposit, and the results indicated 1 to 5% gravel size particles, 4 to 22% sand size particles, 41 to 50% silt size particles and 23 to 54% clay size particles (Figure No. L-1, Appendix 3). Atterberg Limits testing was carried out on two (2) samples of this deposit. The Atterberg Limits testing indicated Liquid Limits ranging from 23 to 40% and Plastic Limits ranging from 14 to 20%, indicating low to medium degree of plasticity (Figure No. L-4, Appendix 3). The natural moisture contents measured on all tested samples exceeded the measured Plastic Limits; however were generally lower than the measured Liquid Limit. Based on an in-situ vane shear strength of greater than 100 kPa and SPT 'N' values of 5 to 8, the consistency of this deposit was described as very stiff to stiff. This deposit was encountered to depths of 1.4, 2.1 and 1.4 m below grade at Borehole Nos. 1 to 3, respectively (Elevations 247.2, 246.4, and 247.1 m, respectively).

4.1.3 Clayey Silt

Underlying the silty clay at Borehole Nos. 1 and 3, a deposit of clayey silt, trace gravel, with sand, was penetrated. The natural moisture content measured on samples recovered from this deposit ranged from 15 to 26%. A Gradation (hydrometer) analysis was carried out on one (1) sample of this deposit, and the results indicated 1% gravel size particles, 20% sand size particles, 61% silt size particles and 18% clay size particles (Figure No. L-2, Appendix 3). Atterberg Limits testing was carried out on one (1) sample of this deposit. The Atterberg Limits testing indicated a Liquid Limit of 21% and a Plastic Limit of 14%, indicating a clayey silt with a low degree of plasticity (Figure No. L-4, Appendix 3). Based on SPT 'N' values of 12 and 15 blows per 300 mm penetration, the consistency of this deposit was described as very stiff. This deposit was encountered to a depth of 2.1 m below grade at Borehole Nos. 1 and 3, respectively (Elevations 246.5 and 246.4 m, respectively).

4.1.4 Sandy Silt

Underlying the clayey silt deposit at Borehole Nos. 1 to 3, a deposit of sandy silt, trace gravel, trace clay was penetrated. The natural moisture contents measured on samples recovered from this deposit ranged from 5 to 14%. A gradation (sieve) analysis was carried out on one (1) sample of this deposit, and the results indicated 2% gravel size particles, 29% sand size particles, and 69% silt and clay size particles (Figure No. L-3, Appendix 3). In addition, gradation (hydrometer) analyses were carried out on three (3) samples of this deposit, and the results indicated 5% gravel size particles, 29 to 33% sand size particles, 53 to 60% silt size particles and 6 to 10% clay size particles (Figure No. L-3, Appendix 3). Atterberg Limits testing was completed on one (1) sample of this deposit. The Atterberg Limits testing indicated a Liquid Limit of 16% and a Plastic Limit of 12%, indicating a cohesionless silt (Figure No. L-4,

Appendix 3). Based on SPT 'N' values of 15 to 51 blows per 300 mm penetration, the compactness of this deposit was described as compact to very dense, generally dense on average.

Auger refusal was encountered at depths of 4.4, 4.7, and 5.6 m below grade at Borehole Nos. 1 to 3, respectively (Elevations 244.2, 243.8, and 242.9 m, respectively).

4.1.5 Bedrock

Underlying the sandy silt at Borehole No. 2, bedrock was proven by diamond core drilling, at Elevation 243.8 m. The bedrock was described as pink granite. Based on RQD values of 83 to 99% the bedrock was described as good to excellent quality. Based on visual review, the bedrock was sound, generally exhibiting negligible weathering. Sampling in the bedrock was terminated at a depth of 6.7 m below grade at Borehole No. 2 (Elevation 241.8 m).

According to the empirical values recommended by Hoek et al. (1995) [2; see List of References at end of this report], the uniaxial strength of the sound bedrock is anticipated to be greater than 100 MPa. It is noted that the underlying bedrock surfaces in this area can be very erratic in nature and vary substantially in elevation over short horizontal distances.

4.2 GROUNDWATER DATA

A standpipe was installed in Borehole Nos. 1, 2, and 3 to obtain post borehole completion water levels. These levels are recorded on the individual Record of Borehole Log Sheets (Appendix 2).

The groundwater levels were measured between Elevations 247.9 and 248.6 m at Borehole Nos. 1 to 3, on October 27th, 2017 and are summarized in the following table.

BOREHOLE NO.	GROUND SURFACE ELEVATION (M)	GROUNDWATER DEPTH (M)	GROUNDWATER ELEVATION (M)
1	248.6	0.0	248.6
2	248.5	0.0	248.5
3	248.5	0.6	247.9

The groundwater and surface water levels should be expected to fluctuate significantly seasonally/yearly.

5 DISCUSSION AND RECOMMENDATIONS

5.1 GENERAL

The existing Ryland Rest Area supports asphalt surface parking lots and two unheated restroom structures. To the north of the parking area, the site is currently forested. The subsurface conditions at this site generally consisted of native silty clays overlying clayey silts, overlying sandy silts overlying bedrock.

It is understood that it is proposed to improve the Ryland Rest Area with a new heated restroom structure and septic bed. The approximate location of the proposed structure and septic bed are provided on the Borehole Location Plan, Appendix 3. The septic bed will be located approximately 8 m north and 5 m west of the new structure. The purpose of this investigation was to provide information of the subsurface conditions in the areas of the proposed new structure and septic bed to provide design recommendations for Detail Design.

5.2 FOUNDATION CONSIDERATIONS

5.2.1 Frost Penetration

The estimated depth of frost penetration in the area of the Ryland Rest Area is about 2.6 m. As such, foundation elements which will be affected by frost penetration must be supplied with a minimum of 2.6 m of earth cover (both horizontally and vertically) for frost protection. If a sufficient depth of earth cover cannot be provided for frost protection, equivalent Expanded Extruded Polystyrene insulation (EEP) may be used in conjunction with available soils cover to provide frost protection. If EEP is used for frost protection, precautions must be taken to protect the insulation from contact with hydrocarbons, solvents, or other destructive products.

5.2.2 Shallow Foundations

Based on the designed grade level of Elevation 250 m at the proposed new service building area shown in the design drawings, the required grade raise will be up to 1.5 m above the existing ground surface; therefore the induced ground settlement is anticipated to exceed 25 mm if a thickened slab/mat foundation is considered under various structural loads for the new structure. Accordingly the conventional shallow footings founding on Elevation 247.4 m (i.e. 2.6 m below the new grade level) are recommended for the proposed new service building.

To minimize differential movement, it is recommended that the proposed shallow foundations be constructed of reinforced concrete, and the foundation walls be constructed of reinforced concrete dowelled into the footings, or masonry block, grouted and doweled into the footings.

The shallow foundations are recommended be constructed prior to proceeding the grade raise around the new building to avoid the deep excavation and associated temporary protection of shoring if the foundation is constructed after completion of the grade raise.

The interior footings not subjected to frost penetration may be founded at a higher elevation, provided they are constructed at a minimum of 600 mm below the underside of the slab-on-grade on the approved engineered fill overlying the approved native soils.

Organics, fill, and other deleterious materials must be removed from the area of influence of the foundations down to native mineral subgrade. QVE is recommended to inspect the native subgrade below foundations to confirm and approve the native subgrade. The Contractor should minimize worker traffic within the foundation formwork and the excavation must be maintained in an unwatered condition during foundation construction.

5.3 GEOTECHNICAL RESISTANCE

The geotechnical recommendation is based on the assumption that the footings will be properly formed (i.e. earth forms are not acceptable) and any required rebar is placed in accordance with OPSS.PROV 905. Backfill around the foundations should consist of a well compacted graded free draining granular fill meeting OPSS.PROV 1010 for Granular B Type I. Requirements for the backfill under the slab-on-grade is described in Section 5.6 below.

A groundwater level at Elevation 248.6 m was assumed for design. Geotechnical resistances, under the conditions of vertical loading without load eccentricity as well as the grade raise not greater than Elevation 250 m, are provided for the proposed shallow foundations not less than 600 mm in width in the following table:

FOUNDATION DEPTH BELOW EXISTING GRADE (M)	FOUNDATION ELEVATION (M)	FACTORED GEOTECHNICAL RESISTANCE AT ULS (KPA)	GEOTECHNICAL REACTION AT SLS (KPA)
2.6	247.4	180	120

Based on the above design geotechnical pressures, and assuming proper subgrade preparation and grade raise, settlements of the shallow foundations on native soil for the new structure will be within the generally accepted tolerance (i.e. 25 mm total and 19 mm differential settlement, depending on the rigidity of structure).

5.4 FROST PROTECTION

The estimated depth of frost penetration in the area of the Ryland Rest Area is about 2.6 m, based on OPSD 3090.100 (Foundation Frost Penetration Depths for Northern Ontario). As such, foundation elements which will be affected by frost penetration must be supplied with a minimum of 2.6 m of earth cover (both horizontally and vertically) for frost protection. If a sufficient depth of earth cover cannot be provided for frost protection, equivalent Expanded Extruded Polystyrene insulation (EEP) may be used in conjunction with available soils cover to provide frost protection. If EEP is used for frost protection, precautions must be taken to protect the insulation from contact with hydrocarbons, solvents, or other destructive products.

The following insulation design can be considered based on the Canadian Foundation Engineering Manual [3; see List of References at end of this report] and the generalized design curves (Design of Insulated Foundations, Robinsky and Bespflug, 1973) [4; see List of References at end of this report] for minimum insulation requirements for heated structures founded on silty and clayey soil. Synthetic insulation a minimum 50 mm thick, should be placed down the face of the foundation, to a minimum 300 mm below grade or to the top footings and then extend horizontally outwards beyond the foundation edges a minimum of 1.2 m. The horizontal insulation should be sloped downwards slightly (i.e. 2 to 3%) to promote drainage away from the structure. The insulation should be overlapped (or step jointed) and pegged or spot glued together. The insulation must be unbroken and any damaged pieces must be replaced. To reduce the risk of damage to the polystyrene insulation from an accidental hydrocarbon spill, it is recommended that the insulation be covered, where appropriate, with a layer of 6 mil polyethylene.

5.5 ENGINEERED FILL

Where necessary, engineered fill below the footings/foundation units should consist of an imported material meeting Granular A or Granular B Type II (50 mm minus) per OPSS.PROV 1010, compacted to 100% Standard Proctor Maximum Dry Density (SPMDD). It should be noted that Granular B Type II is a manufactured material consisting of 100% crushed quarry stone. Lean concrete or Unshrinkable Fill can also be used alternatively. It is recommended that Class II geotextile separator layer per OPSS 1860 be placed between the native fine grained subgrade and the engineered fills.

The area of influence below the building footprint or individual foundation units, in cross section, is described as a trapezoid that extends outwards, horizontally from the edges of the foundation, a minimum of 300 mm and then downwards on a 45° (1V:1H) outward angle to undisturbed native competent soil.

An engineered fill consisting of Granular B Type I material per OPSS.PROV 1010, compacted to a minimum 98% SPMDD or better, can be considered between the founding level and below slab-on-grade, if required.

Engineered fill shall be placed in lifts a maximum 300 mm thick. Placement and compaction of engineered fill shall be as per OPSS.PROV 501.

5.6 SLAB-ON-GRADE CONSTRUCTION

As described above, conventional shallow foundations are designed for the proposed service building. A slab-on-grade of 100 mm in thickness will be constructed in conjunction with the shallow footings. After the subgrade is clear and approved, the subgrade can be raised up to 300 mm below the underside of the slab-on-grade using the engineered fill consisting of the imported granular material meeting OPSS.PROV 1010 for Granular B Type I, compacted to a minimum 98% Standard Proctor Maximum Dry Density (SPMDD) or better. The final 300 mm grade raise to the underside of the slab-on-grade should consist of imported material meeting OPSS.PROV 1010 for Granular A or Granular B Type II (50 mm minus) compacted to 100% SPMDD.

Generally, a sufficient height difference between the top of finished slab inside the new building and the surrounding exterior grade is considered to provide an optimal drainage of the slab and minimize the potential of moisture in the subsoil to contact with the underside of the slab. Moisture transmission through the slab can affect the floor coverings. Based on the current design drawings, the top of the slab inside the new service building will be located similar level at the top of pavers placed on the exterior grade; therefore a vapour barrier or drainage layer is recommended be installed below the slab-on-grade, if a floor covering will be placed inside the proposed new building, to minimize the potential moisture issue.

5.7 DRAINAGE

It is understood that the proposed building will not have below grade structure (i.e. basement); however full perimeter foundation drains should be considered due to the encountered high groundwater level near the top of existing grade. Adequate height difference between the top of finished slab inside the new building and the surrounding exterior grade is recommended be considered, depending on the designed drainage system in the building area, to provide an optimal drainage and avoid the potential for surface water to flow into the structure during periods of the seasonal heavy rains and snow melting in the spring.

The surface of the finished grade around the exterior of the building should be relatively impermeable and contouring of the perimeter exterior grade surface must direct all surface waters away from the structure.

5.8 SEISMIC SITE CLASSIFICATION

Considering the existing subsurface conditions, soil liquefaction is not considered an issue, and based on the National Building Code of Canada 2015 (NBCC 2015) and/or 2012 Ontario Building Code (2012 OBC), the Site Classification for Seismic Site Response for the project site would be classified as Site Class C.

5.9 LATERAL EARTH PRESSURE

The parameters for various type of backfill materials (OPSS Granular A and Granular B per OPS.PROV 1010) are based on compaction levels of 100% Standard Proctor Maximum Dry Density (SPMDD) are as follows:

PARAMETER	GRANULAR A	GRANULAR B TYPE II	GRANULAR B TYPE I	SILTY CLAY
Unit Weight (kN/m^3)	22.8	23.2	21.2	16.5
Effective Angle of Internal Friction	34°	34°	32°	26
Undrained Shear Strength (kPa)	-	-	-	75

PARAMETER	GRANULAR A	GRANULAR B TYPE II	GRANULAR B TYPE I	SILTY CLAY
Coefficient of Active Earth Pressure (K_a)	0.28	0.28	0.31	0.39
Coefficient of Passive Earth Pressure (Kp)	3.54	3.54	3.25	2.56
Coefficient of Earth Pressure at Rest (Ko)	0.44	0.44	0.47	0.56
PARAMETER	**CLAYEY SILT**	**SANDY SILT**		
Unit Weight (kN/m^3)	16.5	18.0		
Effective Angle of Internal Friction	26	33°		
Undrained Shear Strength (kPa)	100	-		
Coefficient of Active Earth Pressure (Ka)	0.39	0.54		
Coefficient of Passive Earth Pressure (K_p)	2.56	3.39		
Coefficient of Earth Pressure at Rest (K_o)	0.56	0.46		

For rigid structures, deflection cannot occur and as such, the “at-rest” condition (K_o) applies. For flexible structures, deflection can occur, as such the “active” condition (K_a) applies.

Below grade structures (septic tanks) shall be designed using a water level at surface. In addition, septic tank design shall account for potential uplift during conditions where the tank is empty. The tank can be tied down to counteract the uplift forces, if required.

5.10 EXCAVATION AND DEWATERING

All excavations greater than 1.2 m in depth must, at a minimum, be sloped or shored in accordance with the Occupational Health and Safety Act Regulations for Construction Projects. Temporary open excavations above the groundwater table, could be cut back at an angle of 1H:1V, provided they are monitored continuously, however, below the groundwater table, the side slopes will have to be cut back to an angle of 2H:1V, possibly shallower, dependent upon the Contractors’ chosen method of controlling the groundwater. The shallow foundations of the new building are recommended be constructed prior to proceeding the grade raise around the new structure to avoid the deep excavation and associated temporary protection if the foundation is constructed after completion of the grade raise.

Bedrock was not encountered at the borehole locations within the anticipated depth of shallow excavation, therefore bedrock excavation and/or blasting operations are not anticipated.

Excavations must be maintained in dry condition during excavation and foundation construction. Groundwater control, in accordance with OPSS.PROV 517 will be required to maintain a stable subgrade during construction.

The groundwater level at the borehole locations was recorded at Elevations 247.9 to 248.6 m (i.e. near and/or at ground surface). As such, dewatering will likely be required during excavation for the shallow foundation construction. It should be noted that groundwater levels will fluctuate seasonally/yearly.

The fine grained soils are anticipated to be encountered during construction of the shallow foundations; therefore a more effective groundwater control method, such as a vacuum well point, eductor well system or sheet pile cut-off wall, should be considered by the contractor to maintain a stable excavation base.

In fine grained soils, standard groundwater control techniques through the use of sump holes with pumps influences will be effective in only a small area. Temporary construction groundwater control in fine grained soils is typically undertaken using oversized excavations and installing perimeter/interior drains/ditches leading to a sufficient number of strategically placed filtered sump holes located in the base of the excavation outside the area of influence of engineered fill and/or foundations. It is noted that the efficiency of conventional sump holes to control the groundwater depends highly upon the number of sumps, the depth of their base below the ultimate subgrade level, method of construction (i.e. cased and filtered sump hole versus a pump at the base of the excavation), and their spacing. In our experience, to be efficient at groundwater control, conventional sump holes should not be placed more than 10 m apart, preferably less, although placement is highly dependent upon soil types (permeability, etc.) and conditions, depth of sump holes, extent/depth of drains/ditches leading to the sumps, as well as the intent of the project. Where greater draw down is required, a more sophisticated dewatering system will be required that will have to be developed by a qualified dewatering subcontractor. In order to be effective any dewatering operation must be started well in advance of the excavating operations and be run continuously throughout the subsurface construction operations.

The Contractor must also undertake to control surface water that develops from precipitation or snow melt that will become perched on top of the fine grained soils.

It must be emphasized that, when wet, fine-grained soils (such as encountered at this site) can be easily disturbed through excavation operations, foot traffic, etc. and such disturbed soils can lose a significant amount of the native bearing. To minimize the potential for disturbance, the groundwater must be drawn down a sufficient depth below the base of the excavation (i.e. 500 mm to 1 m).

Ultimately, the method of dewatering will be the choice of the contractor. The importance and benefits of maintaining a dry stable subgrade during excavation and foundation construction cannot be stressed enough. Failure by the contractor to adequately control the groundwater, and/or rainwater, surficial runoff, etc., can result in disturbance to the founding subgrades, which can result in having to carry out corrective measures (i.e. additional excavation, time delays, etc.) to improve the subgrade. Corrective measures required to improve subgrades where groundwater is not adequately controlled will be at the Contractors cost. As part of the Contractors proposed methodology of construction, the Contractor should be requested to submit a dewatering plan prior to commencement of the project that details how they will control groundwater. The plan should include all aspects from methodology (i.e. sump holes and pumps, drainage ditches, vacuum well points and/or eductor well system), to construction of system (sump hole details, placement, etc.), to operation of system, etc.

5.11 CHEMICAL TESTING

Two (2) soil samples recovered at Borehole Nos. 1 and 3 during the foundation investigation was submitted to AGAT analytical laboratory and tested for corrosivity potential to determine the potential for degradation of concrete in the presence of soluble sulphates used in foundations and buried infrastructure. The results of chemical testing (including PH, water soluble sulphate, chloride, resistivity and electrical conductivity analyses) are tabulated below and included in Appendix 3.

SAMPLE LOCATION	SAMPLE NO.	DEPTH BELOW GRADE (m)	pH	Soluble Sulphate (ppm)	Chloride (ppm)	Resistivity (Ohm.cm)	Electrical Conductivity (mS/cm)
BH 1	3	1.5	8.12	6	10	7520	0.133
BH 3	2	0.8	8.19	<2	4	7250	0.138

In order to estimate the corrosivity of soils, the resistivity can be used to give a general assessment as to the risk of corrosion. Sandy soils are high up on the resistivity scale; therefore considered the least corrosive. Clayey soils, especially those contaminated with saline water are on the opposite end of the spectrum. The results soil chemical testing indicate that concrete made with Type 10 Portland cement should be acceptable for substructures. The test results also indicate a low potential for corrosion of exposed ferrous metal.

5.12 CONSTRUCTION CONCERNS

No major construction concerns are anticipated if construction is carried out in general conformance with the above discussion and recommendations.

6 STATEMENT OF LIMITATIONS

The design recommendations given in this geotechnical report are applicable only to the project described in the text and only if constructed substantially in accordance with details of alignment and elevations stated in the report. Since all details of the design may not be known, in our analysis certain assumptions had to be made. The actual conditions may however, vary from those assumed, in which case changes and modifications may be required to our geotechnical recommendations. We recommend, therefore, that we be retained and provided the opportunity during the design stage to review the design drawings, site survey information, proposed elevations, etc. to verify that they are consistent with our recommendations or the assumptions made in our analysis. It is further recommended that we be retained to review the final design drawings and specifications relative to the geotechnical recommendations.

If, during construction, conditions in the field vary from those assumed at the design stage, an engineer from this office must be notified immediately.

Proper subgrade preparation, groundwater control, compaction, etc. are all critical aspects of the bearing capacity of native soils. It must be noted that different aspects of the geotechnical design are based on the assumption that Englobe will be retained during site preparation and construction of the proposed works to ensure that both the geotechnical site characteristics and the construction operations/techniques are consistent with our recommendations. Should Englobe not be involved during the full construction phase, our liability is strictly limited to the factual information contained herein only.

The comments in this report are intended solely for the guidance of the design engineer and address the geotechnical conditions only. The number of boreholes required to determine the localized conditions between boreholes directly affecting construction costs, equipment, scheduling, etc. would in fact be greater than what has been carried out for design purposes. Therefore, contractors bidding on this project or undertaking this work should make their own interpretations of the factual borehole results and carry out further work as they deem necessary to assess the scope of the project.

Section 5 of this reported is intended for the use of the client and the design team only and is not intended to be included in the tender documents. Inclusion of the factual information (Sections 1 to 5 inclusive) in the tender documents is furnished merely for the general information of bidders and is not in any way warranted or guaranteed by or on behalf of the owner or the owner's consultants and its subconsultants or the consultants' or subconsultants' employees, and neither the owner nor its consultants or its employees shall be liable for any representations negligent or otherwise contained in the documents.

REFERENCES

1. 1:250 000 scale bedrock geology of Ontario; Ontario Geological Survey, Miscellaneous Release---Data 126-Revision 1. ISBN 978-1-4435-5704-7 (CD) ISBN 978-1-4435-5705-4, Ontario Geological Survey, 2011
2. E. Hoek, P.K. Kaiser and W.F. Bawden, Support of Underground Excavations in Hard Rock, Table 8.2 Field Estimates of Uniaxial Compressive Strength, pp.96, ISBN-13: 978-9054101871, A.A. Balkema, 1995
3. Canadian Foundation Engineering Manual (Fourth Edition), Canadian Geotechnical Society, 2006
4. Robinsky, E.I. and Bespflug, K.E., Design of Insulated Foundations, Journal of the Soil and Mechanics and Foundations Division, ASCE, Volume 99, No. SM9, pp. 649-667, 1973

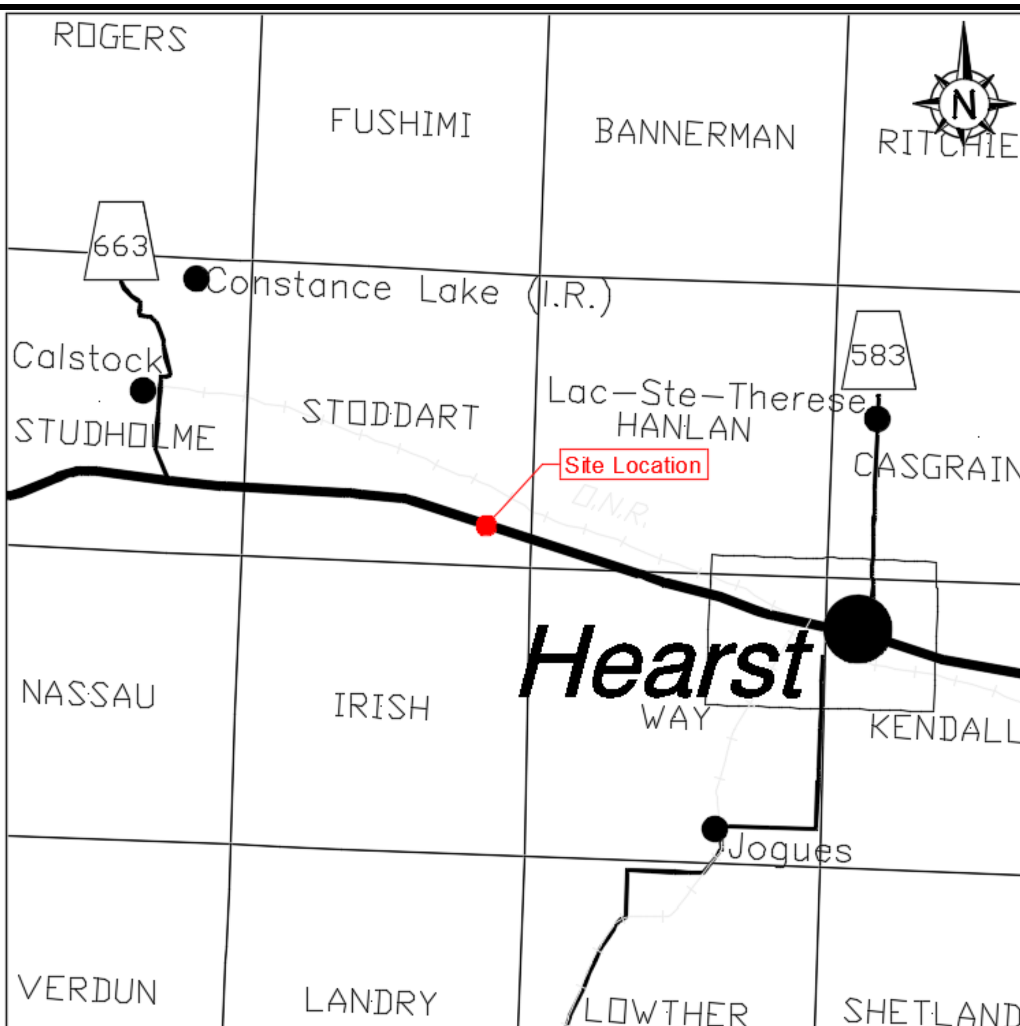
Appendix 1 Key Plan

Drawing No. 1	Key Plan

KEY PLAN

NOT TO SCALE

Drawing No. 1



FINAL FOUNDATION INVESTIGATION AND DESIGN REPORT

GWP 5074-16-00

Highway 11

Ryland Rest Area

Reference No: P-0014221-0-00-100-01-F1

April 2018

Englobe

Appendix 2 Subsurface Data

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

LIST OF ABBREVIATIONS & DESCRIPTION OF TERMS

The abbreviations and terms, used to describe retrieved samples and commonly employed on the borehole logs, on the figures and in the report are as follows:

1. ABBREVIATIONS

AS	Auger Sample
CS	Chunk Sample
DS	Denison type sample
FS	Foil Sample
NFP	No Further Progress
PH	Sampler advanced by hydraulic pressure
PM	Sampler advanced by manual pressure
RC	Rock core with size & percentage of recovery
SS	Split Spoon
ST	Slotted Tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash Sample
WH	Sampler advanced by static weight of hammer and/or rods
Rec	% recovery from individual run of rock core
RQD	Rock quality designation (%)

2. PENETRATION RESISTANCE/"N"

Dynamic Cone Penetration Test (DCPT):

A continuous profile showing the number of blows for each 300 mm of penetration of a 50 mm diameter 60° cone attached to AW rod driven by a 63 kg hammer falling 760 mm.

Plotted as ——•——•——•——•

Standard Penetration Test (SPT) or "N" Values

The number of blows of a 63 kg hammer falling 760 mm required to advance a 50 mm O.D. drive open sampler 300 mm.

3. SOIL DESCRIPTION

a) *Cohesionless Soils:*

"N" (blows/0.3 m)	*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.

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

METRIC

RECORD OF BOREHOLE NO. 1

Englobe

REFERENCE P-0014221-0-00-100-01-F1	DATUM Geodetic	LOCATION N 5510444.5 E311019.8, Twp. of Stoddart	ORIGINATED BY JL
PROJECT GWP 5074-16-00, Ryland Rest Area		BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers	COMPILED BY DM
CLIENT Planmac Engineering		DATE (Started) 26 October 2017 / DATE (Completed) 26 October 2017 / TIME (Completed)	CHECKED BY AT

SOIL PROFILE / SAMPLES / GROUND WATER CONDITIONS / ELEVATION SCALE / DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE; 20 40 60 80 100) / PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L — WATER CONTENT (%) 20 40 60 / UNIT WEIGHT γ kN/m³ / REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)

ELEV DEPTH	DESCRIPTION (see Enclosure No. 1)
248.6	Ground Surface
0.0	150 mm black organic soil SILTY CLAY - trace gravel, trace sand (CI) brown (very stiff)
247.2 1.4	CLAYEY SILT - with sand, trace gravel (CL - ML) brown (very stiff)
246.5 2.1	SANDY SILT - trace gravel, trace clay (ML) brown ---------- grey (dense)
244.2 4.4	Auger Refusal End of Borehole

Sample Number	Type	"N" Values	Water Content / Limits	GR	SA	SI	CL
1	SS	6					
2	SS	7	W with W_P–W_L	1	4	41	54
3	SS	15					
4	SS	31		2	29	(69)	
5	SS	38		5	29	60	6
6	SS	30					

Dynamic cone: >100 (near elev. 248.2)

Elevation scale: 248, 247, 246, 245

COMMENTS
Coordinates based on MTM Zone 13 NAD83 CSRS
Lat. 49.731584° Lon. -83.913718°

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) 26/10/17 12:00:00 PM	DRY	-
2) 26/10/17 1:40:00 PM	2.5	-
3) 27/10/17 8:10:00 AM	0	-

MEL-GEO P-0014221 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 7/4/18

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

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

METRIC

RECORD OF BOREHOLE NO. 2

Englobe

REFERENCE P-0014221-0-00-100-01-F1 DATUM Geodetic LOCATION N 5510450.7 E 311027.6, Twp. of Stoddart ORIGINATED BY JL

PROJECT GWP 5074-16-00, Ryland Rest Area BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY DM

CLIENT Planmac Engineering DATE (Started) 27 October 2017 DATE (Completed) 27 October 2017 TIME (Completed) CHECKED BY AT

ELEV / DEPTH (m)	DESCRIPTION (see Enclosure No. 1)	SAMPLE NUMBER	TYPE	"N" VALUES	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
248.5	Ground Surface				
0.0	150 mm black organic soil SILTY CLAY - trace sand (CI) brown (stiff)	1	SS	7	
		2	SS	8	
247.1 / 1.4	SILTY CLAY - with sand, trace gravel (CL) brown (stiff)	3	SS	8	5 22 50 23
246.4 / 2.1	SANDY SILT - trace gravel, trace clay (ML) grey (compact/dense)	4	SS	18	
		5	SS	49	
		6	SS	47	5 32 53 10
		7	SS	25/75 mm	
243.8 / 4.7	Auger Refusal Start Rock Coring BEDROCK - pink granite generally massive, moderately close to wide joint spacing negligible joint weathering	8	RC	Rec= 100% RQD= 99%	
	approximately ±100 mm highly fractured bedrock at 5.9 to 6.0 m depth (excellent to good quality)	9	RC	Rec= 100% RQD= 83%	
241.8 / 6.7	End of Sampling End of Borehole				

Elevation scale: 248, 247, 246, 245, 244, 243, 242

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

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

PLASTIC LIMIT W_P — NATURAL MOISTURE CONTENT W — LIQUID LIMIT W_L; WATER CONTENT (%) 20 40 60

UNIT WEIGHT γ kN/m³

COMMENTS
Coordinates based on MTM Zone 13 NAD83 CSRS
Lat. 49.731639° Lon. -83.913610°

+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)	27/10/17 10:20:00 AM	3.9	-
2)	27/10/17 3:30:00 PM	0	-
3)		-	-

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

MEL-GEO P-0014221 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 7/4/18

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

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

METRIC

RECORD OF BOREHOLE NO. 3

Englobe

REFERENCE P-0014221-0-00-100-01-F1 DATUM Geodetic LOCATION N 5510471.1 E 311017.5, Twp. of Stoddart ORIGINATED BY JL

PROJECT GWP 5074-16-00, Ryland Rest Area BOREHOLE TYPE Truck Mounted CME 45 - Hollow Stem Augers COMPILED BY DM

CLIENT Planmac Engineering DATE (Started) 27 October 2017 DATE (Completed) 27 October 2017 TIME (Completed) CHECKED BY AT

ELEV / DEPTH	DESCRIPTION (see Enclosure No. 1)	SAMPLE NUMBER	TYPE	"N" VALUES	NATURAL MOISTURE CONTENT / REMARKS	GR	SA	SI	CL
248.5	Ground Surface								
0.0	100 mm organic soil SILTY CLAY - trace sand (CI) brown (stiff)	1	SS	5					
		2	SS	7					
247.1 1.4	CLAYEY SILT - trace gravel, with sand (CL - ML) brown (very stiff)	3	SS	12		1	20	61	18
246.4 2.1	SANDY SILT - trace gravel, trace clay (ML) grey (compact/very dense)	4	SS	19					
		5	SS	15		5	33	56	6
		6	SS	36					
		7	SS	51					
242.9 5.6	Auger Refusal End of Borehole								

Chart column headings: STRATA PLOT; GROUND WATER CONDITIONS; ELEVATION SCALE (248, 247, 246, 245, 244, 243); DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100); SHEAR STRENGTH kPa: ○ UNCONFINED, + FIELD VANE, ● QUICK TRIAXIAL, × LAB VANE (20 40 60 80 100); PLASTIC LIMIT W_P, NATURAL MOISTURE CONTENT W, LIQUID LIMIT W_L; WATER CONTENT (%) (20 40 60); UNIT WEIGHT γ kN/m^3; REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)

COMMENTS
Coordinates based on MTM Zone 13 NAD83 CSRS
Lat. 49.731823° Lon. -83.913749°

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) 27/10/17 1:40:00 PM	4.5	-
2) 27/10/17 3:30:00 PM	1.7	-
3) 27/10/17 4:30:00 PM	0.6	-

MEL-GEO P-0014221 - BOREHOLE LOGS.GPJ MEL-GEO.GDT 7/4/18

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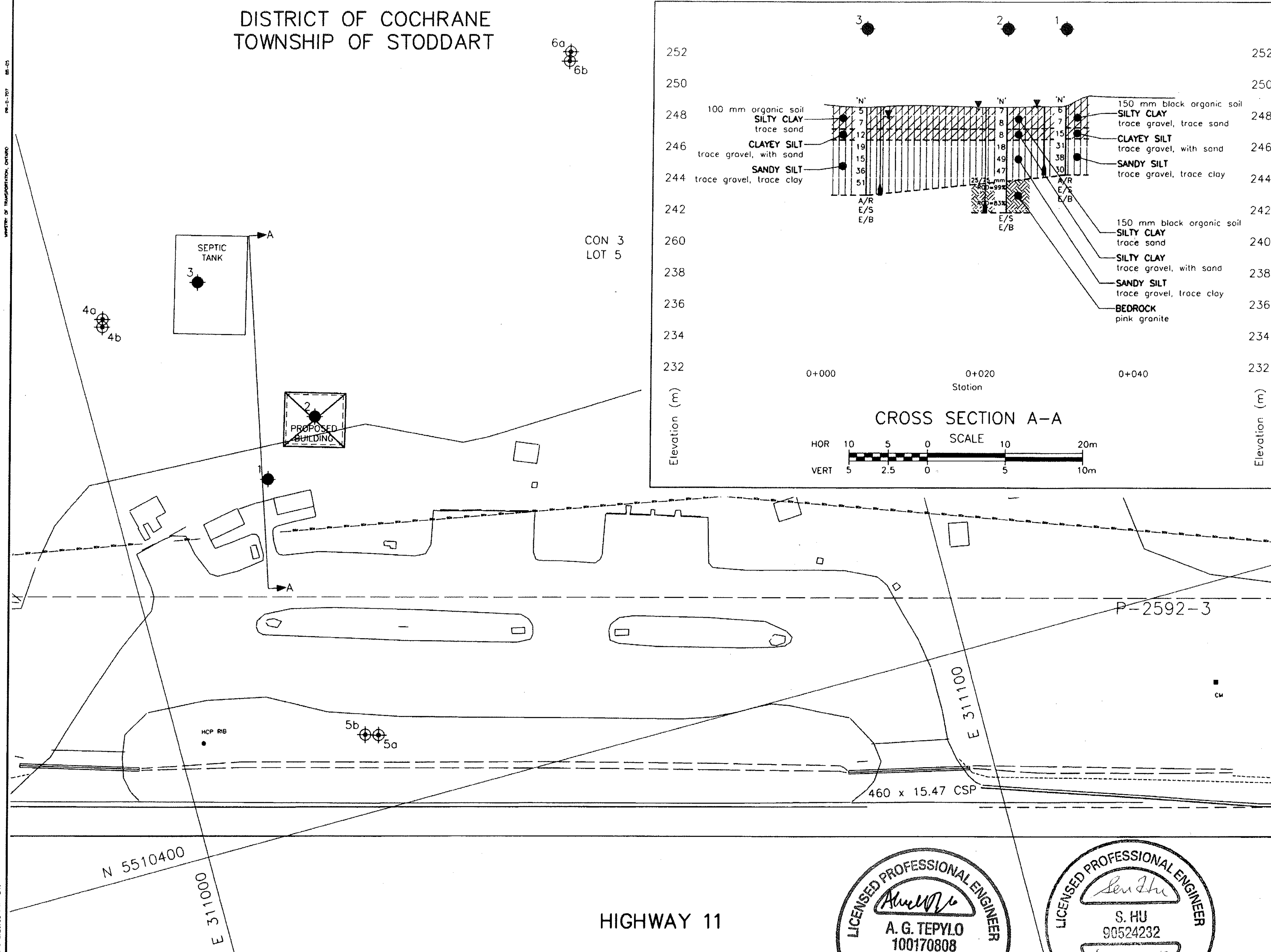
Appendix 3 Borehole Plan and Laboratory Data

Drawing No. 2:	Borehole Location Plan
Figure Nos. L-1 to L-3:	Grain Size Distribution Curves
Figure No. L-4:	Atterberg Limits
Table No. L-5:	Lab Test Summary Sheet
	Soil Chemical Tests

Englobe

DISTRICT OF COCHRANE
TOWNSHIP OF STODDART



This drawing is for subsurface information only. Surface details and features are for conceptual illustration. The proposed structure location is shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contract Documents.

LICENSED PROFESSIONAL ENGINEER
A. G. TEPYLO
100170808
Apr 10, 2018
PROVINCE OF ONTARIO

LICENSED PROFESSIONAL ENGINEER
S. HU
90524232
Apr. 10, 2018
PROVINCE OF ONTARIO

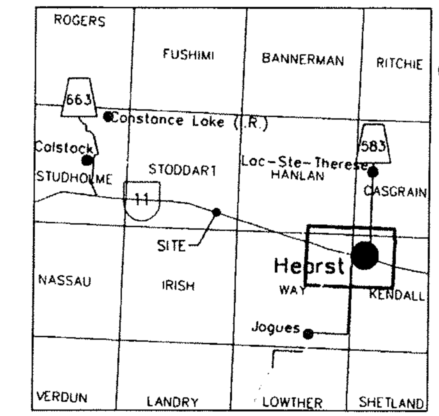
DISTRICT
CONT. No.
GWP No. 5074-16-00

HWY 11 - RYLAND REST AREA
LAT. 49.731635' LON. -83.913612'
TWP. OF STODDART

DRAWING 2

BOREHOLE LOCATIONS AND SOIL STRATIGRAPHY

Englobe



KEY PLAN
N.T.S.

⊕	Monitoring Well in Hydrogeological Borehole
●	Foundation Borehole
N	Blows/0.3 m (Std Pen Test, 475 J/blow)
DCPT	Blows/0.3 m (60° Cone, 475 J/blow)
▼	Water Level at Time of Investigation
A/R	Auger Refusal at Elevation
E/S	End of Sampling
E/B	End of Borehole
	Piezometer

BOREHOLE No.	ELEVATION	O/S	NORTHING	EASTING
1	248.6	--------	5510444.5	311019.8
2	248.5	--------	5510450.7	311027.6
3	248.5	--------	5510471.1	311017.5
4a	248.3	--------	5510469.8	311004.6
4b	248.2	--------	5510468.8	311004.3
5a	249.2	--------	5510409.3	311024.9
5b	249.1	--------	5510409.8	311023.3
6a	248.7	--------	5510486.9	311071.0
6b	248.7	--------	5510485.8	311070.5

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 Planmac Engineering Inc. on January 5, 2018

Coordinates based on MTM Zone 13 NAD83 CSRS

GEOCRES No. 42G-69

REVISIONS			
JAN/18	DM	DRAFT	
APR/18	DM	FINAL	
		DESCRIPTION	

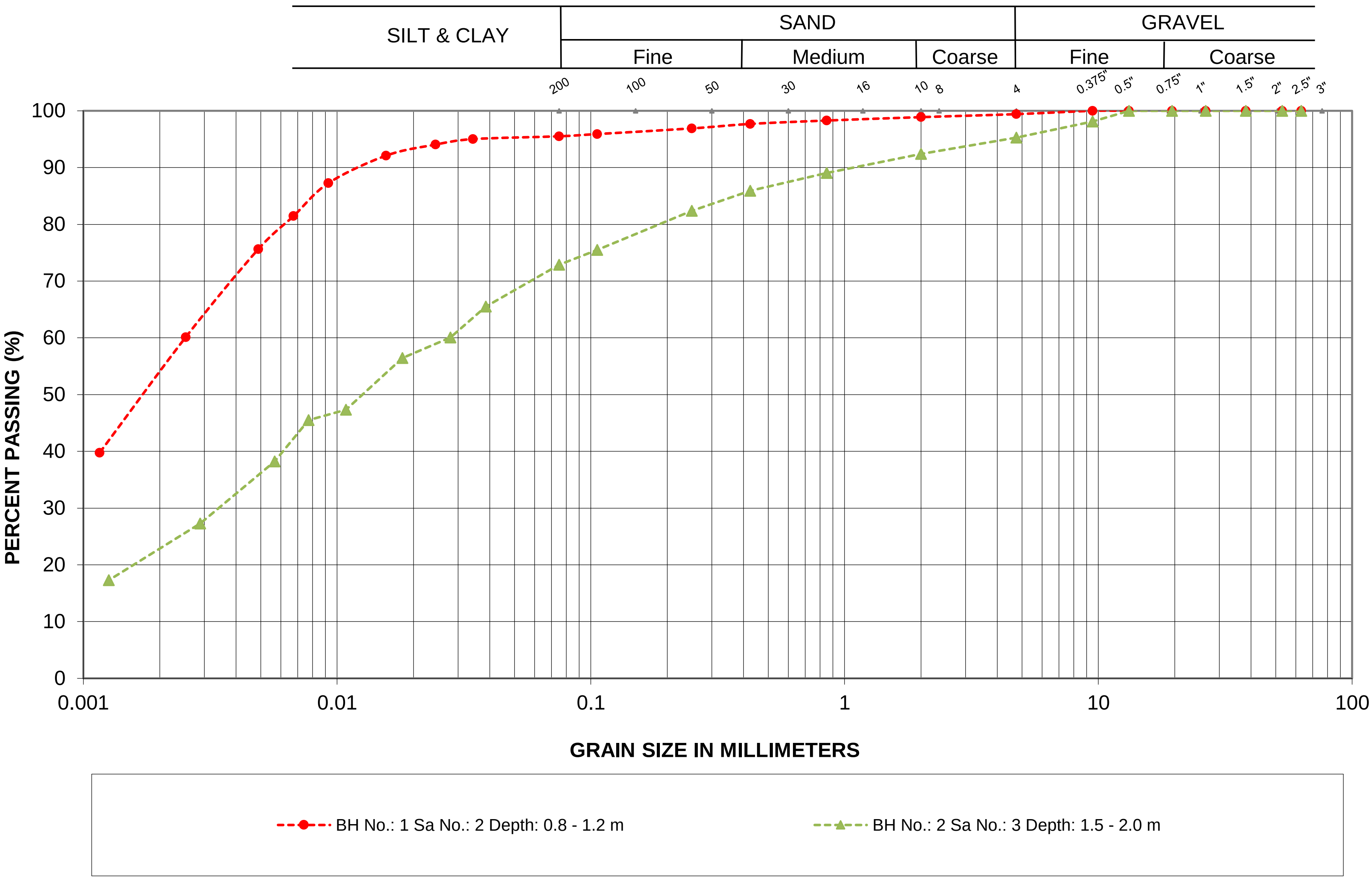
DESIGN	CHK	CODE	LOAD	DATE APR/18
DRAWN DM	CHK AT	SITE	STRUCT	SCHEME DWG 2

CAD FILE LOCATION AND NAME: G:\152\P-0014221\CAD\Working\P-0014221 - PAV & FDN, Hwys 11, 144 (Planmac)\CAD\Working\P-0014221 - Ryland Borehole Location Plan - (18-04-07).dwg
MODIFIED: 4/7/2018 2:17:48 PM BY: MITCOU
DATE PLOTTED: 4/7/2018 2:26:55 PM BY:

MINISTRY OF TRANSPORTATION, ONTARIO

Reference No.: P-0014221-0-00-100-01-F1
Date: December, 2017

GRAIN SIZE ANALYSIS



SILTY CLAY

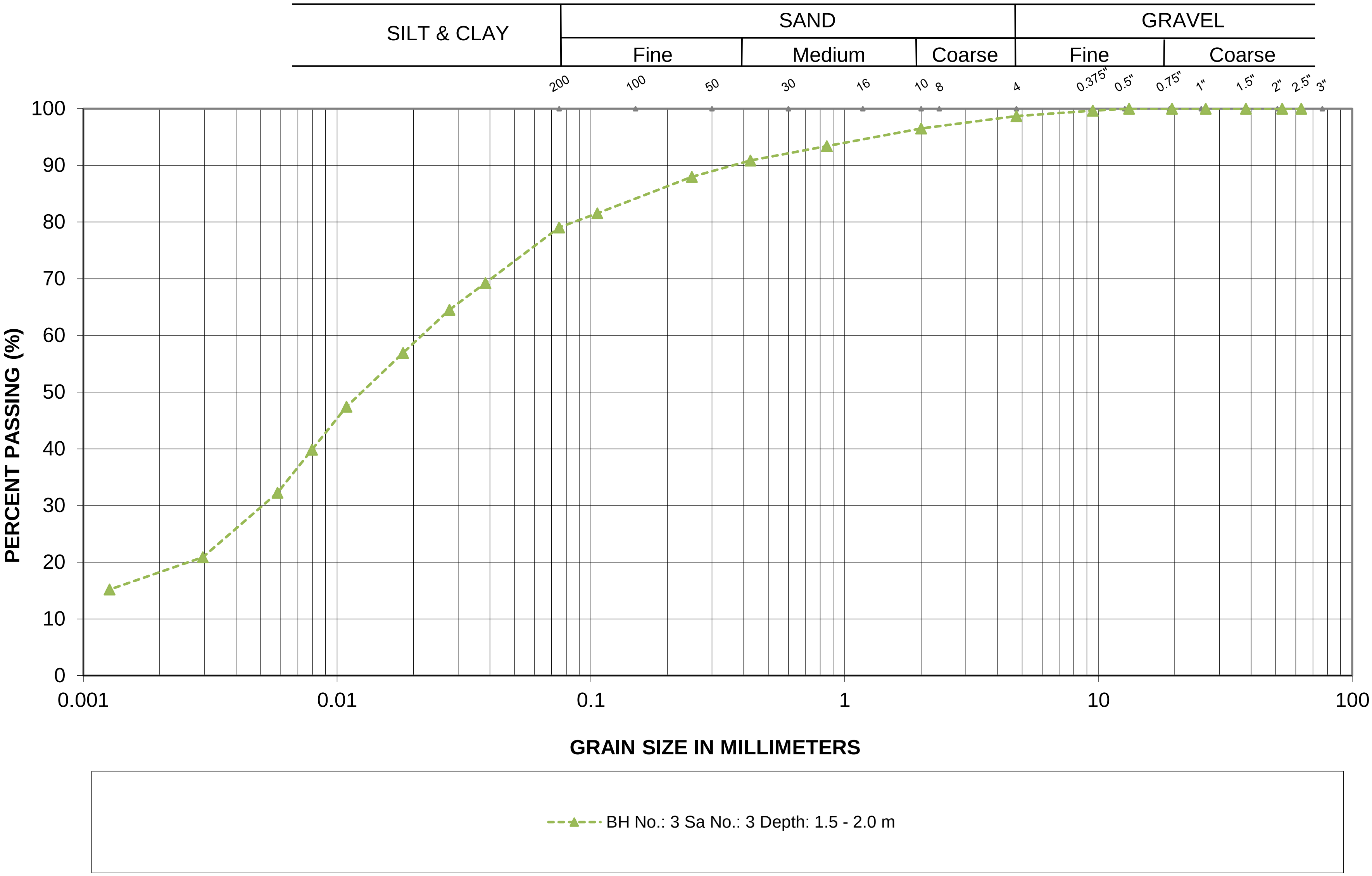
LOCATION: Ryland Rest Area, Hwy 11
GWP 5074-16-00

Englobe Corp.

FIGURE L-1

Reference No.: P-0014221-0-00-100-01-F1
Date: December, 2017

GRAIN SIZE ANALYSIS



CLAYEY SILT

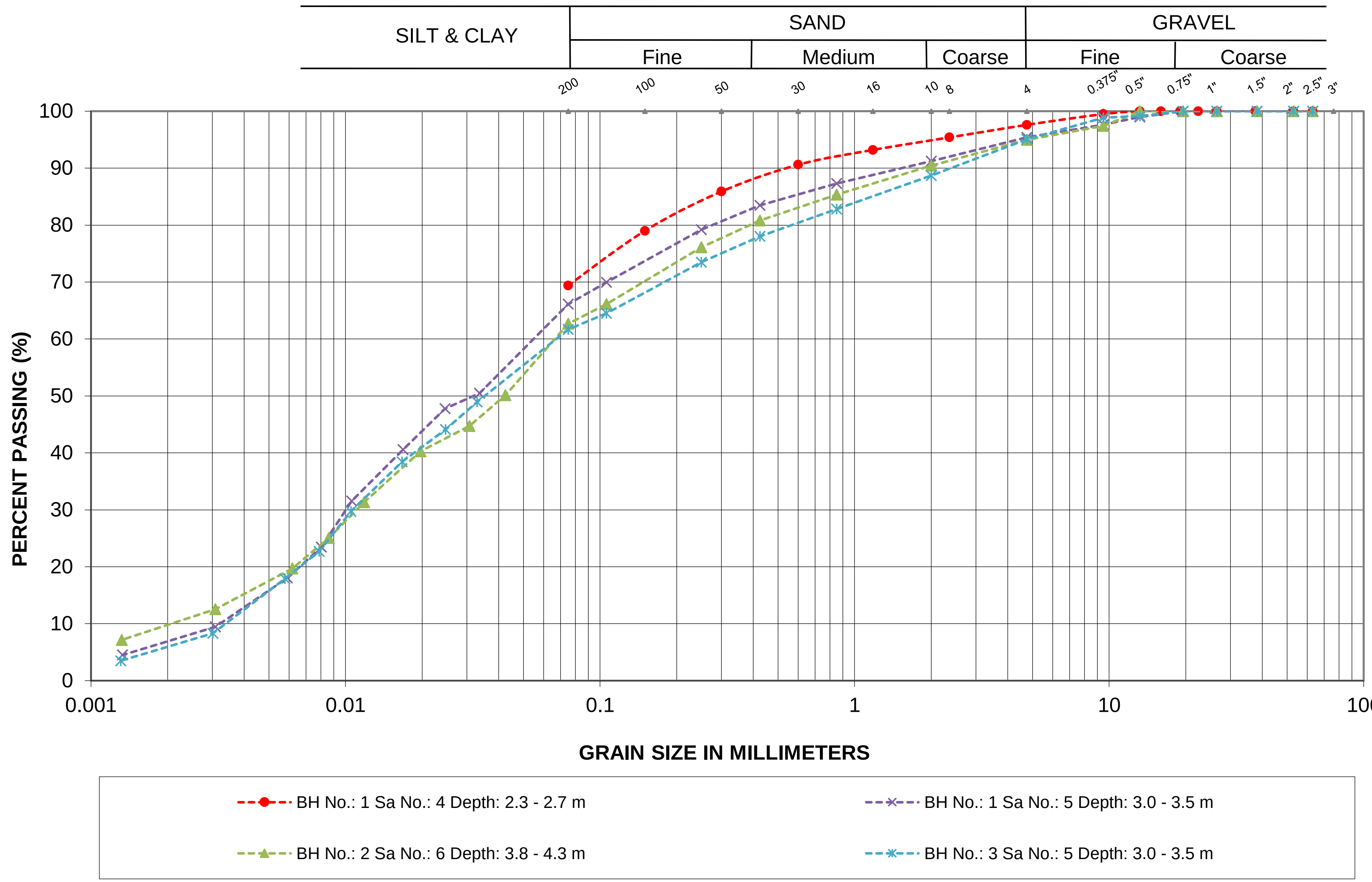
LOCATION: Ryland Rest Area, Hwy 11
GWP 5074-16-00

Englobe Corp.

FIGURE L-2

Reference No.: P-0014221-0-00-100-01-F1
Date: December, 2017

GRAIN SIZE ANALYSIS



SANDY SILT

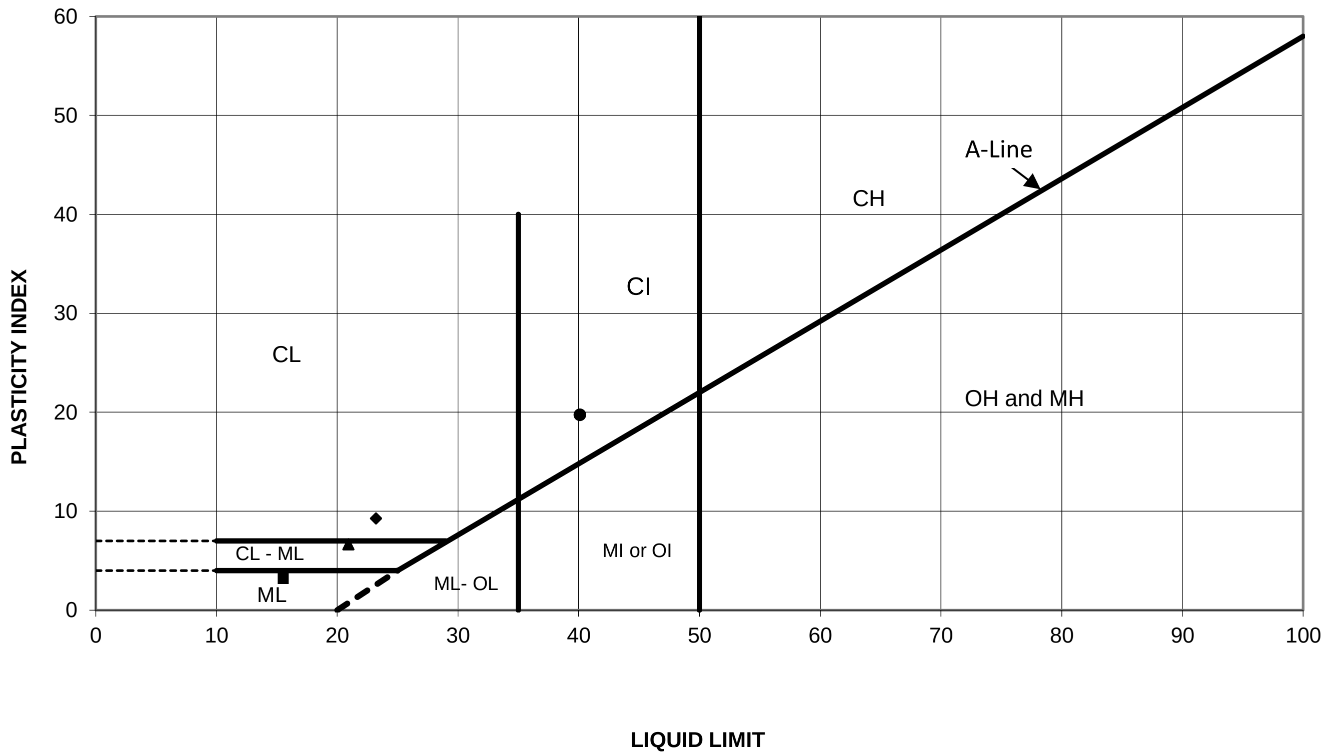
LOCATION: Ryland Rest Area, Hwy 11
GWP 5074-16-00

Englobe Corp.

FIGURE L-3

ATTERBERG LIMITS TEST RESULTS	FIGURE L-4

ATTERBERG INDICES



SYMBOL	BH	Sa. No.	Depth(m)	Elev.(m)	Liquid Limit	Plastic Limit	Plasticity Index	NMC %
●	1	2	1.0	247.6	40.1	20.4	19.7	27.7
◆	2	3	1.8	246.8	23.2	14.0	9.3	16.4
■	2	6	4.0	244.5	15.5	12.3	3.2	9.1
▲	3	3	1.8	246.8	20.9	14.2	6.7	15.3

Date: Jan-18
Project: Hwy 11
Location: Ryland Rest Area

Prep'd: DM
Chkd: AT
Ref. No.: P-0014221-0-00-100-01-F1

Englobe Corp.

Reference No.: P-0014221-0-00-100-01-F1
Date: April 2018

Laboratory Tests - Summary Sheet

Borehole No.	Sample No.	Depth	Grain Size Analysis				NMC	Atterberg Limits			SPT 'N'	USCS	Unit Weight (kN/m3)	Remarks
			Gravel Size (%)	Sand Size (%)	Silt Size (%)	Clay Size (%)		LL (%)	PL (%)	IP (%)				
1	1	0.0					22.0				6			
	2	0.8	1	4	41	54	27.7	40.1	20.4	19.7	7			
	3	1.5					25.6				15			
	4	2.3	2	29	69		4.9				31			
	5	3.1	5	29	60	6	12.3				38			
	6	3.8					10.9				30			
2	1	0.0					35.9				7			
	2	0.8					31.5				8			
	3	1.5	5	22	50	23	16.4	23.2	14.0	9.2	8			
	4	2.3					13.5				18			
	5	3.1					11.9				49			
	6	3.8	5	32	53	10	9.1	15.5	12.3	3.2	47			
	7	4.6					9.5				25/75 mm			
	8	4.7												Rec= 100%, RQD= 99%
	9	5.5												Rec= 100%, RQD= 83%
3	1	0.0					30.0				5			
	2	0.8					23.0				7			
	3	1.5	1	20	61	18	15.3	20.9	14.2	6.7	12			
	4	2.3									19			
	5	3.1	5	33	56	6	14.2				15			
	6	3.8					10.0				36			
	7	4.6					12.4				51			

Project: Hwy 11, Ryland Rest Area
GWP 5074-16-00

Table No. L-5

AGAT Laboratories

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

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

ATTENTION TO: Victoria Steuernol

PROJECT: P-0014221-0-00-100-01

AGAT WORK ORDER: 17T295383

SOIL ANALYSIS REVIEWED BY: Amanjot Bhela, Inorganic Coordinator

DATE REPORTED: Dec 21, 2017

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.

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

AGAT Laboratories

Certificate of Analysis

AGAT WORK ORDER: 17T295383

PROJECT: P-0014221-0-00-100-01

CLIENT NAME: ENGLOBE CORP

ATTENTION TO: Victoria Steuernol

SAMPLING SITE:

SAMPLED BY:Sonya Clelland

Corrosivity Package

DATE RECEIVED: 2017-12-15

DATE REPORTED: 2017-12-21

			SAMPLE DESCRIPTION:	BH: F1 Sa:3	BH: F3 Sa:2
			SAMPLE TYPE:	Soil	Soil
			DATE SAMPLED:	2017-10-26	2017-10-26
Parameter	Unit	G / S	RDL	8977374	8977379
Sulfide (S2-)	%		0.05	<0.05	<0.05
Chloride (2:1)	µg/g		2	10	4
Sulphate (2:1)	µg/g		2	6	<2
pH (2:1)	pH Units		NA	8.12	8.19
Electrical Conductivity (2:1)	mS/cm		0.005	0.133	0.138
Resistivity (2:1)	ohm.cm		1	7520	7250
Redox Potential (2:1)	mV		5	206	214

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

8977374-8977379 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

Certified By: Amanjot Bhela

AGAT Laboratories

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MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
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FAX (905)712-5122
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Quality Assurance

CLIENT NAME: ENGLOBE CORP
AGAT WORK ORDER: 17T295383
PROJECT: P-0014221-0-00-100-01
ATTENTION TO: Victoria Steuernol
SAMPLING SITE:
SAMPLED BY:Sonya Clelland

Soil Analysis

RPT Date: Dec 21, 2017			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper	Recovery	Acceptable Limits Lower	Acceptable Limits Upper
Corrosivity Package															
Sulfide (S2-)	8977374	8977374	< 0.05	< 0.05	NA	< 0.05	99%	80%	120%						
Chloride (2:1)	8977373		489	500	2.2%	< 2	107%	80%	120%	102%	80%	120%	102%	70%	130%
Sulphate (2:1)	8977373		32	33	3.1%	< 2	91%	80%	120%	101%	80%	120%	102%	70%	130%
pH (2:1)	8977373		8.64	8.58	0.7%	NA	101%	90%	110%	NA			NA		
Electrical Conductivity (2:1)	8980919		0.498	0.516	3.6%	< 0.005	99%	90%	110%	NA			NA		
Redox Potential (2:1)	8977373		165	162	1.8%	< 5	103%	70%	130%	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: Amanjot Bhela

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CANADA L4Z 1Y2
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Method Summary

CLIENT NAME: ENGLOBE CORP

PROJECT: P-0014221-0-00-100-01

SAMPLING SITE:

AGAT WORK ORDER: 17T295383

ATTENTION TO: Victoria Steuernol

SAMPLED BY:Sonya Clelland

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Sulfide (S2-)	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

AGAT Laboratories

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

Laboratory Use Only

Work Order #: 17T295383

Cooler Quantity:
Arrival Temperatures: 8.6 | 7.9 | 8.5

Custody Seal Intact: ☐Yes ☐No ☐N/A

Notes:

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 Steuernol
Address: 2-120 Progress Court
North Bay, Ontario
Phone: 705 476 2550 Fax: 705 476 8882
Reports to be sent to:
1. Email: alexander.typelo@englobecorp.com
2. Email:

Regulatory Requirements: ☐ No Regulatory Requirement

(Please check all applicable boxes)

☐Regulation 153/04
Table (Indicate One)
☐Ind/Com
☐Res/Park
☐Agriculture
Soil Texture (Check One)
☐Coarse
☐Fine

☐Sewer Use
☐Sanitary
☐Storm
Region (Indicate One)
☐MISA

☐Regulation 558
☐CCME
☐Prov. Water Quality Objectives (PWQO)
☐Other
(Indicate One)

Turnaround Time (TAT) Required:

Regular TAT ☑ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

For 'Same Day' analysis, please contact your AGAT CPM

Project Information:

Project: P-0014221-0-00-100-01
Site Location: Ryland
Sampled By:
AGAT Quote #: PO: A12781

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

Is this submission for a **Record of Site Condition?** ☐ Yes ☐ No

Report Guideline on *Certificate of Analysis* ☐ Yes ☐ No

Invoice Information:

Bill To Same: Yes ☑ No ☐

Company:
Contact:
Address:
Email:

Sample Matrix Legend

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

Analysis columns: Field Filtered - Metals, Hg, CrVI (Y/N); O. Reg 153: Metals and Inorganics; ☐ All Metals ☑ 153 Metals (excl. Hydrides) ☐ Hydride Metals ☐ 153 Metals (Incl. Hydrides); ORPs: ☐B-HWS ☐Cl ☐CN ☐Cr6+ ☐EC ☐FOC ☐Hg ☐pH ☐SAR; Full Metals Scan; Regulation/Custom Metals; Nutrients: ☐TP ☐NH3 ☐TKN ☐NO3 ☐NO2 ☐NO3+NO2; 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	Corrosivity Package
BH: F1 Sa:3	Oct 26/17		1	S	Corrosivity Package testing:	☑
BH: F3 Sa:2	Oct 26/17		1	S	pH, water soluable sulphate,	☑
					sulfide, chloride, resistivity and	
					electrical conductivity	

Samples Relinquished By (Print Name and Sign)	Date	Time	Samples Received By (Print Name and Sign)	Date	Time
Sonya Clelland [signature]	Dec 14/17	4:30	[signature]	17/12/15	10:28

Page 1 of 1

Nº:

Appendix 4 Photo Essay

Enclosure No. 5 Photo Essay

Ryland Rest Area, West Entrance – Looking East	Photo: 1

Ryland Rest Area, Parking Area – Looking East	Photo: 2

Project: GWP 5074-16-00 - Hwy 11 – Ryland Rest Area	Photos Provided By: Englobe Date: October 2017

Ryland Rest Area, Existing Restroom Structure – Looking North East	Photo: 3

Ryland Rest Area, Wooded Area – Looking North	Photo: 4

Project: GWP 5074-16-00 - Hwy 11 – Ryland Rest Area	Photos Provided By: Englobe Date: October 2017

Rock Cores – Borehole No. 2 (left)	Photos: 5
	
Project: GWP 5074-16-00 - Hwy 11 – Ryland Rest Area	Photos Provided By: Englobe Date: October 2017