Englobe
Soils Materials Environment

Qulliq Energy Corporation

GEOTECHNICAL INVESTIGATION

Proposed Power Plant Location in Zone M
Gjoa Haven, Nunavut – Option 01

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REVISED FINAL REPORT

Englobe

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Property and Confidentiality

Executive Summary

Englobe Corp. (Englobe) was retained by Quilliq Energy Corporation (QEC) to complete environmental site assessments, topographic surveys, and geotechnical investigations in the communities of Cambridge Bay, Igloolik, and Gjoa Haven, to evaluate possible location options for proposed power plants. Written authorization to proceed was received through contract no: 2020084 on August 28, 2020.

This report covers the geotechnical investigation for Gjoa Haven – Site Option 01 (the Site). The information gathered from this investigation will aid in the detailed engineering design for the new power plant.

After obtaining public and private service clearances, eight (8) boreholes were drilled to depths ranging from 9.0 to 12.0 metres below ground surface (mbgs).

The general stratigraphy encountered on the Site was ice-poor sands with trace gravels and fines.

Adfreeze piles with grout and accompanying thermosyphons are considered a feasible foundation option for the Site due to the presence of sand encountered during the investigation and lack of bedrock.

The site classification for seismic site response D (Stiff Soil) must be used for foundation supported on soil for earthquake load and effects in accordance with Table 4.1.8.4.-A of the 2015 National Building Code of Canada.

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1 Introduction

Englobe Corp. (Englobe) was retained by Qulliq Energy Corporation (QEC) to conduct environmental site assessments, topographic surveys, and geotechnical investigations in the communities of Cambridge Bay, Igloolik, and Gjoa Haven to evaluate possible location options for proposed power plants.

Written authorization to proceed was received through contract no: 2020084 on August 26, 2020. This report covers the geotechnical investigation for Gjoa Haven – Site Option 01 (the Site). The information gathered from this investigation will aid in the detailed engineering design for the new power plant.

The geotechnical investigation was required to evaluate and confirm the existing surface and subsoil conditions for the Site so that a suitable location can be selected and suitable foundations for a new power plant can be designed.

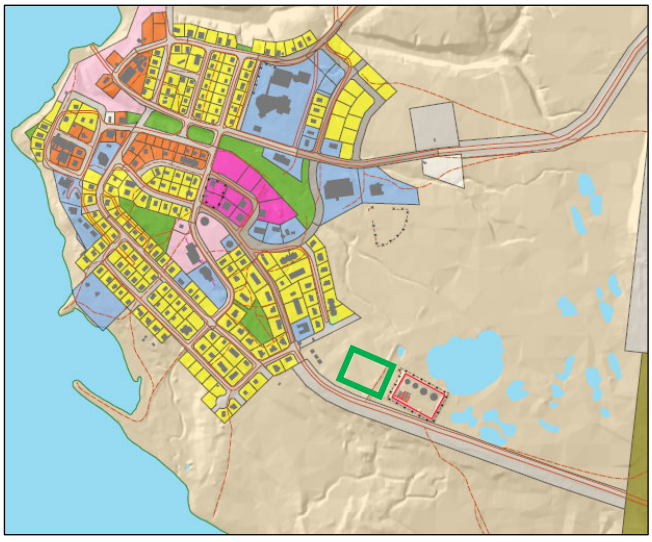
Site Option 01 is located southeast of the community approximately, 150 metres from the intersection of Ibruqrd Street and road R36. The Site is bounded by road R36 to the south, a tank farm to the east, undeveloped land to the north, and residences to the west. The Site surface condition is generally even. Figures are provided in Appendix 1.

The Site has not been previously occupied by any residential, industrial, or commercial buildings. However, the Site is presently used to store construction materials that are stored in seacans and on bulk pallets and is also used as a storage area for equipment and shipping containers. The surface condition appears to be disturbed due to the presence of vehicle traffic and equipment being stored onsite with little vegetation.

The area required for new power plants and the auxiliary components in each community is approximately 6,000 m^2 and it is understood that a one-story building will act as a replacement for an aging diesel power generation facility that is currently located in the center of the community.

The area of the proposed Site Option 01 is shown below.

Area of Proposed Site Option 01



2 Background Information

2.1 Hamlet of Gjoa Haven

The Hamlet of Gjoa Haven (also known as Uqsuqtuuk), is in the Kitikmeot Region of Nunavut, on King William Island. It is bounded by Schwatka Bay to the east, Petersen Bay to the southwest, and relatively flat land to the north comprising mainly of glaciomarine deposits, overall sloping gently toward the south. The population of Gjoa Haven is approximately 1324, as of the 2016 census.

2.2 Permafrost and Climate

Gjoa Haven lies within the zone of continuous permafrost. Areas within zones of continuous permafrost generally have Mean Annual Air Temperatures (MAAT) of less than -8°C with Gjoa Haven having a MAAT of approximately -14.5°C (Climate Atlas of Canada). The active layer thickness is estimated to be approximately 1.25 m. Surface drainage is moderately to well developed, with surface runoff generally flowing through the active layer in the summer to drainage channels, which then drain to Petersen Bay. Table 1 below shows historical and projected climate indices.

Table 1 Climate Indices for Gjoa Haven, Nunavut

Parameter	Historical Average (1976-2005)(1)	Projected Future Average (2051-2080)(1)
Mean Annual Air Temperature (°C)	-14.5	-7.8 to -10.1
Freezing Index (C degree days)	5828	3910 to 4539
Thawing Index (C degree days)	564	866 to 1058
Annual Precipitation (mm)	175	208 to 225

1. Referenced from Climate Atlas of Canada (climateatlas.ca)

2.3 Geology

The bedrock geology of Gjoa Haven generally comprises of Lower Paleozoic sedimentary rocks of the Arctic Platform (dolostone, limestone, sandstone, shale, intraclast conglomerate and breccia). Bedrock outcrops are rare in and around the Hamlet.

The surficial geology of the Gjoa Haven area generally comprises of glacial till, glaciomarine ice contact deposits (sand and gravel) and postglacial marine deposits.

3 Scope of Work

The scope of work for the geotechnical assessment is described in detail in Qulliq Energy Corporation's Contract No.: 2020084. The geotechnical scope of services includes:

- Completion of local service clearances and obtainment of authorization from QEC;

- Drilling a total of eight (8) boreholes;
- Geotechnical and environmental laboratory testing on selected soil samples obtained during the geotechnical investigation;
- Desktop review to determine the suitability of site options for the proposed development;
- Desktop review of local borrow sites for granular materials; and,
- Preparation of a geotechnical report summarizing the results of the geotechnical field and laboratory testing program and providing geotechnical comments and preliminary recommendations for the design of suitable foundations, and general earthworks including soil backfill and compaction, site drainage, and construction considerations.

3.1 Field Investigation

After obtaining public and private service clearances, eight (8) boreholes were drilled to depths ranging from 9.0 to 12.0 metres below ground surface (mbgs). The boreholes were drilled in various vacant areas according to the Borehole Location Plan (Figure 2) in Appendix 1.

All boreholes were advanced between September 28 and 29, 2020; using a track-mounted air rotary drill rig supplied by Canadrill Ltd. and operated under the continuous supervision of qualified Englobe personnel.

Disturbed subsoil samples were collected from the auger cuttings. The recovered subsoil samples were visually examined in the field and then preserved and transported to Englobe's Material Testing laboratory in Edmonton, Alberta for further examination and testing. The Borehole Logs are provided in Appendix 2.

3.2 Laboratory Testing

In the laboratory, each soil sample was examined as to its visual and textural characteristics by the project engineer. Moisture content determinations were carried out on selected recovered samples. In addition, four (4) grain size analysis (ASTM D422), and four (4) Atterberg Limits (ASTM D4318) were conducted for selected soil samples. The geotechnical laboratory results are provided in Appendix 3.

In addition to geotechnical laboratory testing, six (6) soil samples were collected across the two (2) site options and submitted to a chemical laboratory for analysis of soluble sulphate content. The chemical analysis test results are provided in Appendix 4.

The number and type of test conducted are summarized in Table 2.

Table 2 Summary of Laboratory Tests Completed

Name of Test	Number of Tests Completed	Sample Type	Laboratory	ASTMs Completed
Moisture Content	40	Soil	Englobe	-
Grain Size Analysis	4	Soil	Englobe	ASTM D422
Atterberg Limits	4	Soil	Englobe	ASTM D4318
Water Soluble Sulphate	6	Soil	AGAT	-

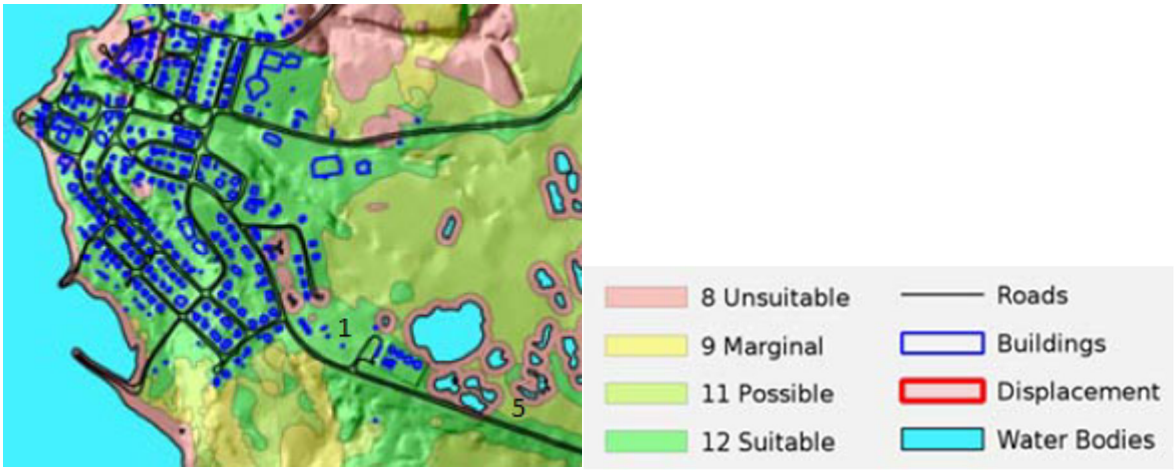
3.3 Site Suitability

In the report "Nunavut Terrain and Soil Analysis" (3vGeomatics Inc. and BCG Engineering, 2011) accessed by Englobe, image processing of radar images on different communities throughout Northern Canada was performed to determine site suitability based on motion layers, slope and aspect, land cover classification and permafrost pictures determined through the image processing.

Based on these factors, maps were produced defining areas by suitability for development from: unsuitable, marginally suitable, possibly suitable, suitable, or built-up.

The figure below roughly shows the locations of the three Gjoa Haven proposed site options for the proposed power plant along with a legend regarding development suitability. With Site Option 01 being overall suitable or in a built-up area, likewise with Site Option 02, and Site Option 03 ranging between possibly suitable to suitable.

- **Suitable for development** – Area that is thought to be stable and available data has indicated little or no evidence of ice-rich and changing permafrost conditions. Generally consisting of terrain with exposed rock, bare soil, low vegetation, less than 4% slope, and aspect not south facing.
- **Possibly suitable for development** – The area is possibly stable for development; ground conditions have limited indicators of changing permafrost conditions. In some cases, due to the lack of quality remote sensing data, the presence of permafrost could not be ruled out. Generally consisting of terrain with exposed rock, bare soil, low vegetation, greater than 4% slope, and aspect not south facing.
- **Marginally suitable for development** – All data indicates that some ground ice is present, and the area is therefore only marginally suitable for future development. Generally consisting of terrain with low vegetation, greater than 4% slope, and includes south facing aspects.
- **Unsuitable for development** – Rugged terrain, evidence of ground ice or subsidence, and surface water identified in the area. Generally consisting of terrain with wet areas, within 25 m of displacement, within 30 m of a water body, and greater than 10% slope.



Site Option 01 is generally considered suitable, however there are existing conditions which could potentially increase the complexity and cost of developments on this Site. The disturbance of the Site from usage as a roadway and storage areas could lead to settlement

issues and increase the active layer thickness which would then in turn increase the depth and/or size of foundations required for this site option.

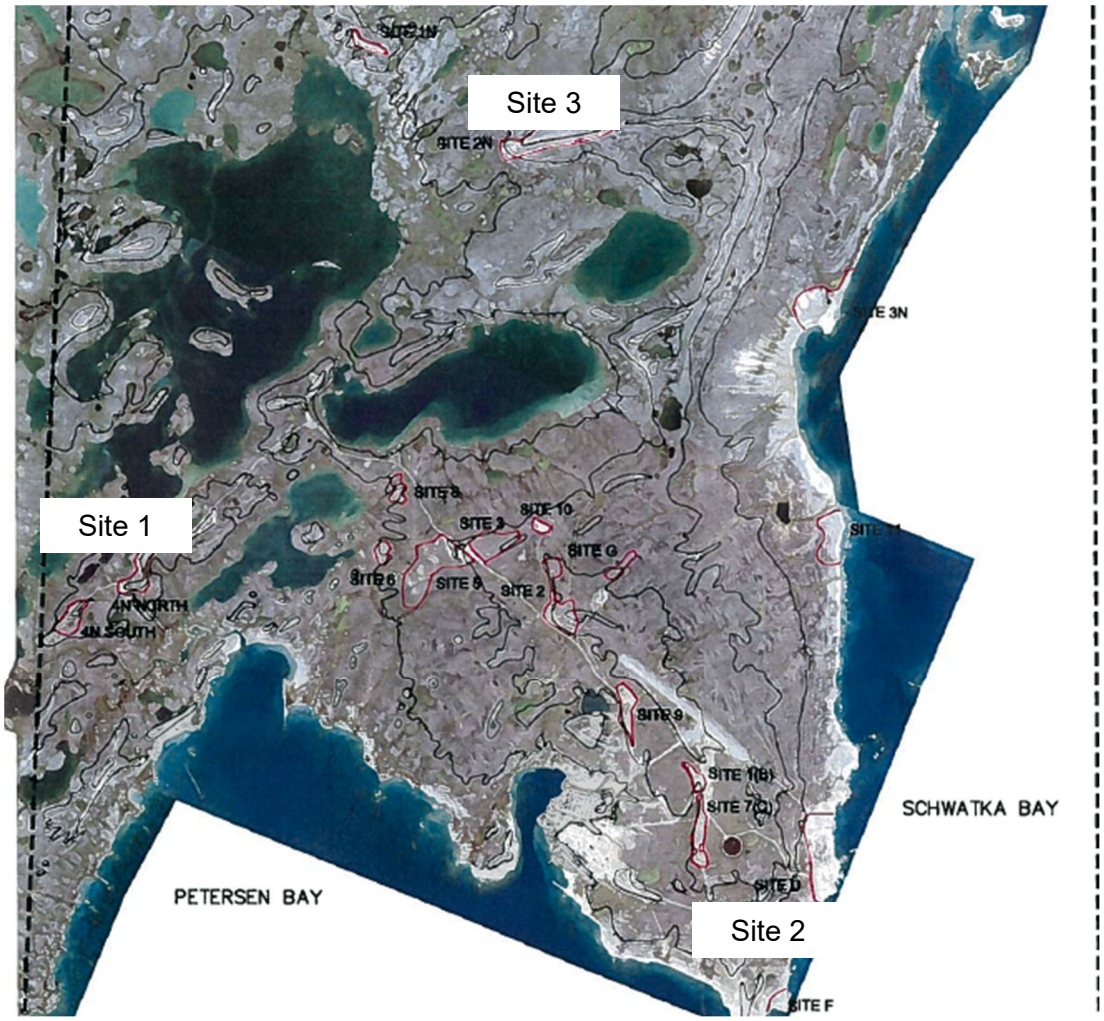
3.4 Borrow Material Sites

Several borrow sites were identified through a review of the following reports:

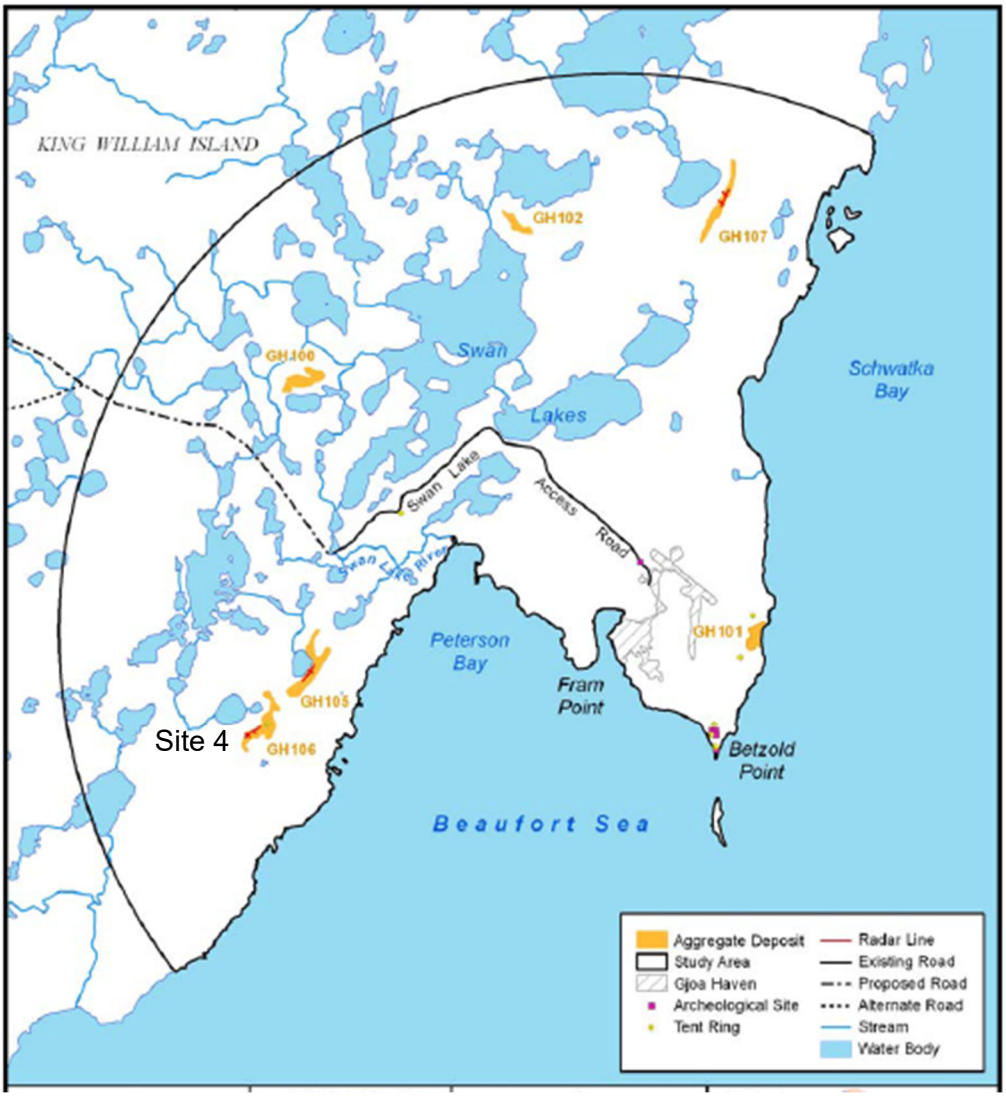
1. "Aggregate Resources Evaluation, Gjoa Haven, Nunavut, Geotechnical Engineering Research and Investigations, Kitikmeot Region, Nunavut", prepared by Nuna Burnside, dated October 2008
2. "Surficial Geology and Aggregate Resource Analysis, Gjoa Haven, NU", prepared by Nunami Stantec, dated March 16, 2011

After a review of these reports, four prospective borrow sites were identified in the figures below.

Aerial view of potential borrow sites (2008)



Aerial view of borrow sites (2011)



The four potential borrow sites are located within a 5 km vicinity of Gjoa Haven.

Site 1 (Site 4N North and South, 2008) – This site is approximately 5 km northwest of the main community and consists of two areas with an estimated volume of aggregate of over 90,000 m^3 from the date of the 2008 report. This aggregate consists of sandy gravel, some cobbles, and boulders, with trace fines, suitable for 75 mm minus gravel, but would require improvement for usage as 25 mm minus gravel.

Site 2 (Site D, 2008 or GH101, 2011) – This site is approximately 2 km east of the main community, with an estimated volume of aggregate of over 120,000 m^3 from the date of the 2008 report. This aggregate consists mainly of sandy gravel and is not quite suitable as 25 mm minus gravel but is suitable as 75 mm minus gravel material.

Site 3 (Site 2N, 2008) – This site is approximately 6.5 km north of the main community, with an estimated volume of aggregate of over 75,000 m^3 from the date of the 2008 report. This aggregate consists mainly of gravelly sand with some fines and inclusions of cobbles and

boulders and is likewise suitable for 75 mm minus gravel but would require improvement for usage as 25 mm minus gravel.

Site 4 (GH106, 2011) – This site is approximately 7 km west of the main community, with an estimated volume of aggregate of 680,000 m^3 from the date of the 2011 report. This aggregate consists mainly of sandy gravel, with some cobbles and trace fines and is likewise suitable for 75 mm minus gravel but would require improvement for usage as 25 mm minus gravel.

Permits are required for the exploration and recovery of material from these borrow pits from the Government of Nunavut and the Hamlet of Gjoa Haven.

4 Results

4.1 Summary of Borehole Coordinates and Depths

The borehole locations were provided through a topographic survey performed by Sub-Arctic Geomatics. Table 3 summarizes borehole coordinates and depths.

Table 3 Summary of Borehole Coordinates and Depths

Borehole No.	Coordinates[1]		Ground Elevation (MAMSL[2])	Borehole Depth (mbgs[3])	Bottom of Borehole Elevation[4] (MAMSL[2])
	Northing	Easting			
BH20-01	7614805.18	383534.41	43.10	12.0	31.10
BH20-02	7614840.22	383568.75	43.31	9.0	34.31
BH20-03	7614814.78	383615.29	43.76	11.4	32.36
BH20-04	7614772.07	383586.08	43.78	12.0	31.78
BH20-05	7614824.28	383571.72	43.59	9.0	34.26
BH20-06	7614809.48	383590.52	43.93	12.0	31.93
BH20-07	7614793.81	383577.38	43.94	9.0	34.94
BH20-08	7614805.18	383534.41	43.10	12.0	31.10

1. NAD 83(CSRS)/UTM Zone 15N
2. Metres above mean sea level (MAMSL)
3. Metres below ground surface (mbgs)
4. Calculated from ground elevations and borehole depths

4.2 Subsoil Conditions

Detailed descriptions of the subsoil conditions encountered in each borehole are presented in the Borehole Log Sheets provided in Appendix 2. The generalized stratigraphy is briefly described in this section. Classification and identification of soils have been based on the commonly accepted methods employed in the practice of geotechnical engineering. The

stratigraphic boundaries shown on the Borehole Log Sheets represent transitions between soil types rather than distinct lithological boundaries. It must be recognized that subsurface conditions often vary both with depth and laterally between individual borehole locations.

The general subsoil conditions are outlined briefly below.

4.2.1 Sand

Ice-poor sands (i.e. with volumetric ice content lower than or equal to 15%) with traces of gravel and fines were encountered at the surface of all borehole locations and extended to the maximum depths of drilling which ranged from 9.0 to 12.0 mbgs. Permafrost was encountered at a depth of approximately 2.25 m during the investigation. The in-situ moisture content of these materials ranged from approximately 8 to 19% but were generally between 9 and 12%.

5 Geotechnical Recommendations and Considerations

The geotechnical recommendations provided in this section are from the interpretation of the geotechnical data obtained during the investigation and recommendations for geotechnical aspects of the design of foundations and general Site development. The recommendations provided are intended to support the design of the development. Where comments are made on construction, they are provided to highlight aspects of construction that could affect the design of the project. It must be noted that information regarding construction must be interpreted to accommodate any change for designs, construction methods, costs, and scheduling.

5.1.1 Limit States Design

The following sections provide geotechnical design parameters in Limit States Design (LSD) format as per the National Building Code of Canada ([NBCC], 2015) and CFEM (2006). The following resistance factors (Φ) have been applied to determine factored design resistance values:

- Shallow Foundations:
  - Resistance to axial load – compression: Φ = 0.5
- Deep Foundations:
  - Resistance to axial load – compression: Φ = 0.4
  - Resistance to axial load – uplift: Φ = 0.3

5.2 Foundation Considerations

Adfreeze piles are considered a feasible foundation type at this Site considering the geotechnical conditions encountered. Having more than one foundation type within the same structure is not recommended.

5.2.1 Deep Foundations

Considering the prevailing subsurface conditions encountered in the exploratory boreholes, adfreeze piles with grout in conjunction with a thermosyphon system are considered a feasible deep foundation option for this project. The usage of sand slurry with adfreeze piles is not recommended due to the salinity conditions and projected warming climate conditions over the lifetime of the proposed facility.

Pile foundation design parameters provided below are based on the soil classification, geotechnical analyses, and Englobe's previous experience with similar formations. Although cobbles and boulders were not encountered during drilling, they may exist on Site and could pose problems during the installation of piles. Therefore, the variability of ground conditions, the suggested pile type, and the installation method must be evaluated by a qualified piling contractor with experience in similar soil conditions and confirmed by Englobe before construction. Although no significant seepage sloughing was encountered during the geotechnical drilling, pile casing is required during the drilling of the piles.

Higher geotechnical resistance factors can be utilized if additional field testing is conducted prior to or during pile installation by qualified geotechnical personnel, such as static load testing.

5.2.1.1 Adfreeze Piles

Adfreeze piles consisting of rounded hollow structural sections (HSS) installed into pre-bored holes and filled with grout are considered a feasible foundation option for the proposed development. Based on the results of the geotechnical investigation, typical end bearing values for the design of adfreeze piles are provided in Table 4. The suggested design values have been estimated based on current conventional engineering practices, as described in Section 18.6.3.3 of the CFEM (2006), by accounting for the ultimate values of frictional resistance along the shaft and end bearing values in soil. A geotechnical resistance factor (ϕ) of 0.4 must be applied for axial compression loading based on static parameters. The geotechnical resistance factor for uplift loading (ϕ) at ULS is 0.3.

Table 4 Suggested Adfreeze Pile Parameters

Soil Description	Approximate Depth of Soil (mbgs)	Unfactored ULS Skin Friction (kPa)
Sand	0 – 5.0	-
Sand	Deeper than 5.0	250

The piles should be grouted up to 1.0 m below the ground surface, with the annulus, the space between the pile and borehole, being at least 25 mm. It is recommended that the side and base of piles be free of water and loose material before placing grout. Inspection by geotechnical engineering personnel during pile installation is required to ensure that the recommended design values are obtained. The inspection must also include the assurance that the as-built pile installations are in accordance with the pile designs as approved by the geotechnical and structural engineers.

The following must be considered in the design of adfreeze piles:

- End-bearing must not be considered in the design.

- Adfreeze piles must be inspected to confirm the removal of loose, disturbed soil and debris prior to placing steel and grout or sand slurry.
- The HSS shall be free of paint, lacquer, oil, grease, dirt, or excessive rust to ensure proper bonding.
- Piles should be installed open-ended in predrilled holes with casing, which shall be at least 50 mm in diameter larger than the pile and be completely clean prior to placement of grout.
- Grout must be placed as soon as practical after boring to minimize seepage and caving problems.
- The grout should be SikaGrout Arctic-100 or an approved substitute.
- The piles should be grouted up to 1.0 m below the ground surface.
- The piles shall be allowed to cure and gain sufficient strength before placement of structural loads.
- The remaining space inside the pile and annular space should be filled with dry sand or drill cuttings with the maximum particle size limited to 1/3 of the annulus spacing.
- The National Building Code of Canada (2015) specifies full-time continuous field review, by a suitably qualified individual, during the installation of all deep foundation elements.

5.2.1.2 Thermosyphons

Consideration must be given to installing a thermosyphon system to preserve permafrost underlying the proposed building to maintain the integrity of the foundation soils in the face of warming climate trends. A thermosyphon system consists of a sealed tubing and/or piping system containing a two-phase system of working fluid (typically carbon dioxide, but propane and ammonia are alternatives). Vapour condensing in the radiator section of the system causes the pressure in the system to drop causing the liquid in the lower portion of the system to boil which extracts heat from the ground. This cycle of condensation and evaporation extracts heat from the soil when the ambient air temperatures are colder than the ground.

A flat loop thermosyphon system is recommended due ease of installation and recent history of successful usage. It consists of evaporator pipes laid in sand bedding on a prepared and level granular base connected to a radiator system above ground, which is filled and pressurized with a working fluid. Carbon dioxide is recommended over alternatives such as ammonia or propane, due to carbon dioxide being generally non-toxic and inert. Consideration must be given to the design to minimize or eliminate vertical bends in the evaporator loops as this can hamper performance due to vapour pockets and reduced efficiency.

Prior to the placement of the granular base, any local soft or loose spots or unsuitable material (organic) of the subgrade must be sub-excavated and replaced with well compacted approved granular material. Duration of subgrade exposure during construction must be limited and in-situ moisture shall be retained to minimise the required moisture conditioning. The crushed gravel leveling course material must be compacted uniformly to 100% of the SPMDD at a water content within 2% of the Optimum Moisture Content (OMC). The subgrade must then be proof rolled to identify weak or soft areas, with problem areas improved to the specification above. The design of the leveling course may be governed by the drainage requirements.

The prepared and level crushed gravel base shall be a 500mm layer of non-frost susceptible granular fill (with a fines contents of less than 10%), compacted to 100% Standard Proctor Maximum Dry Density (SPMDD), within 2% of the Optimum Moisture Content (OMC), in lifts no greater than 150mm.

A light-weight non-woven geotextile (Nilex 4551, Layfield LP6, or equivalent) must be placed immediately overlying the granular base layer to prevent loss of bedding material into the underlying granular base and oversize material into the bedding.

The evaporator pipes shall be envisaged on 150mm of clean sand bedding compacted to 95% SPMDD within 2% of the Optimum Moisture Content (OMC), and after placement of the pipes, another 150mm to the same conditions. Heavy equipment must not be used to compact the upper 150mm portion of bedding immediately overlying the piping system.

A 200mm layer of rigid insulation shall be installed over the top of the bedding and extend outwards at least 1.0m beyond the footprint of the evaporator piping system and building footprint to reduce the infiltration of heat into the soil underlying the building.

Thermistors must be installed to monitor the ground temperatures and performance of the system, which can inform staging of construction. After pile installation, excavation, and placement of engineered fill and thermosyphon evaporator pipe loops, the ground must be allowed to freeze back for at least one winter season before the placement of major structural loads.

Consideration should be given to increasing the overall building elevation such that the grading would allow positive drainage away from proposed structures, reducing water infiltration under the building and thus reducing the potential impact of increased thaw and thaw settlements.

5.2.1.3 Pile Group

Piles must generally be spaced a minimum of 3 times pile diameters (center-to-center) apart to act as a single pile and ultimately minimize group effects. If the piles are spaced closer, pile design parameters must be reduced to account for group effects. The ultimate axial resistance must be reduced by a group factor of 1.0 for piles spaced 3 pile diameters or greater, and 0.85 for piles spaced at 1.25 pile diameters.

Reduction factors for other pile spacings may be interpolated from the values above. These factors are for preliminary design only. Group reduction factors are also affected by ground conditions, pile dimensions and loads, construction method, and pile group layout. Upon request, Englobe would be pleased to assist with pile group design when further information becomes available.

5.2.2 Structural Slab

The structure should be envisaged on a structurally supported floor slab system, and consideration must be given to potential movement of the ground beneath the slab due to the frost action relative to the slab. However, this can lead to problems if piping and other utilities that are connected to the slab are embedded within the ground beneath the slab. All utilities beneath structurally supported ground floor slabs must be protected from the effects of such differential movement and proper care must be taken during installation. This can be accomplished by placing utilities within boxes suspended from the structurally supported slab.

A void form of 100 mm below the slab is required to impede the transfer of heat from inside the building to subgrade.

5.3 Seismic Considerations

The 2015 National Building Code of Canada (the Code) stipulates that a building should be designed to withstand a minimum live load due to an earthquake.

In this regard, due to the shallow depth of the Site, classification for seismic site response D (Stiff Soil) should be used for foundation supported on soil for earthquake load and effects in accordance with Table 4.1.8.4.A of the 2019 National Building Code of Canada.

Ground motion is generally given in terms of probability of exceedance, which is the likelihood of expected horizontal acceleration being exceeded during a particular time period. The probability used in the 2015 National Building Code of Canada is equivalent to a 2% probability of exceedance over 50 years.

Using the 2015 National Building Code Seismic Hazard Calculation online calculator, the Peak Ground Acceleration for the Site is 0.103g, where g is 9.81 m/s^2, and the Peak Ground Velocity is 0.075 m/s for an assumed site Class C and 2% probability of exceedance in 50 years. The seismic hazard is also described by spectral acceleration values at periods of 0.2, 0.5, 1.0, 2.0, 5.0, and 10.0 seconds. Spectral acceleration is a measure of ground motion that takes into account the sustained seismic energy at a particular period. The detailed spectral accelerations are provided in Appendix 5.

6 Site Conditions – Grading and Drainage

6.1 Subgrade Preparation

All organic topsoil, loose fill, and other deleterious materials must be stripped and stockpiled away from the Site. Staining and root intrusion from the overlying organic material and roots may be encountered during excavation within the competent subsurface mineral soils. A representative of the geotechnical consultant must inspect the Site during stripping/excavation to verify the depth of organic soils which must be removed. Any fill placed to fill the Site or replace unsuitable materials must adhere to the requirements provided in Table 5.

Table 5 Compaction Requirements for Site Preparation

Area	Recommended Materials	Compaction Requirement		
		SPMDD(1) (%)	OMC(2) (%)	Maximum Lift Thickness (mm)
Building Areas	Granular materials	98	±2	200
Traffic Areas	Granular materials	98	±2	200
Landscape Area	Granular materials	90	±2	300

1. SPMDD – Standard Proctor Maximum Dry Density
2. OMC – Optimum Moisture Content

Construction is recommended during the thawing season. Care must be taken to not cause excessive disturbance to the subgrade during construction. Backfill materials should not be frozen prior to placement and compaction. In addition, the subgrade must be protected from wetting or drying, both before and after the placement of granular base material or concrete.

Subgrade surfaces that can dry or become wet must be scarified, moisture conditioned, and re-compacted.

Full-time monitoring and compaction testing must be provided during any fill placement or proof-rolling to confirm that the compaction specifications are being achieved.

6.2 Snow Drift and Fencing

Snow drifting and accumulation are a concern for this Site as snow acts as insulation during the winter months reducing the freezing of the active layer thereby increasing its thickness if excess snow is not removed or prevented from accumulating. Due to this, the Site must have snow fences installed around the perimeter of the Site and any excess snow should be removed and stored in a designated location. This snow must be placed where meltwater will not be an issue and must not be placed within 4 m of a building or structure.

6.3 Site Drainage

Excess water must be drained from the Site as quickly as possible both during and after construction. The finished grade must be laid out, so surface water is drained away from the proposed structure by the shortest route. Roof and other drains must discharge well away from the structure, at least 3.0 m from the exterior of the structure.

As the final Site grading is not known at this time, final grades must be sloped so that surface water is directed away from the building footprint and towards existing Site drainage pathways. It is recommended that the final surface grades be sloped no less than 2%. Surface drainage must be controlled by ensuring a minimum grade away from the foundation of 5% for a minimum distance of 5.0 m. Surface water must be directed away from all buildings and structures. Runoff from the roof must be directed a minimum distance of 3.0 m from the perimeter of the building to reduce the potential of excessive moisture near the foundation.

6.3.1 Foundation Drainage

Foundation drains must be provided for all below-grade walls and must consist of a 150 mm diameter continuous, perforated PVC drainpipe, placed in a minimum 300 mm by 300 mm cross-sectional area of 20 mm minus drain rock. Filtration, consisting of a continuous layer of geotextile fabric, must be provided between the drain rock zone and the adjacent native soils. The permanent foundation drainage system must be provided with clean-outs to allow for future maintenance and inspection.

6.4 Excavations

No excavations are permitted in and around the building. The geotechnical engineer must be contacted if any underground structures are to be accommodated.

6.5 Cement Type

Six (6) soil samples were collected across the two (2) site options and submitted to AGAT Laboratories in Edmonton, Alberta for soluble sulphate analyses. The complete test results are presented in Appendix 4 while the results are summarized in Table 6. Refer to CSA A23.1-19 Table 3 for additional requirements.

Table 6 Chemical Analyses Results

Borehole	Depth Below Ground Surface (m)	Sulphate Content (%)	Degree of Exposure[1]	Cement Type[2]
Site Option 1 BH20-02	1.5	0.006	Minimal	GU
Site Option 1 BH20-04	1.5	0.012	Minimal	GU
Site Option 1 BH20-05	1.5	0.006	Minimal	GU
Site Option 1 BH20-08	1.5	0.013	Minimal	GU
Site Option 5 BH20-02	4.5	0.015	Minimal	GU
Site Option 5 BH20-04	3.0	0.078	Minimal	GU

(1) Based on Englobe's review of Table CSA A23.1 - Table 3 (Canadian Standards Association, Concrete Materials, and Methods of Concrete Construction)
(2) Cement Type GU: General Use; MS: Moderate Sulphate resistant; HS: High Sulphate resistant

The results from chemical analysis revealed a "minimal" potential for sulphate attack on concrete in contact with native soils. Therefore, all concrete in contact with the native soils at this Site can be made from GU cement, possessing a minimum 28-day compressive strength of 30 MPa. It must be noted that no concrete batching plant currently exists in this community.

6.6 Design Review and Construction Monitoring

It is recommended that Englobe's geotechnical engineer review the design drawings before they are finalized. The review will identify any deviations from the recommendations which are provided in this report.

Also, it is recommended that a qualified geotechnical engineer or technologist monitors the pile installation. This is a crucial step during construction, as it confirms the pile lengths, depth of competent bedrock, groundwater, and permafrost conditions.

7 Closing Remarks

The comments provided in this report have been developed for the use of Quilliq Energy Corporation. It should be noted that on the borehole logs, the soil boundaries indicated are inferred from non-continuous sampling and observations during drilling and should not be interpreted as exact planes of geological change. These boundaries are intended to reflect approximate transition zones for the purpose of geotechnical design. In addition, the subsoil and groundwater conditions have been determined at the borehole locations only.

The recommended bearing capacity has been calculated by Englobe from the information obtained from the borehole data.

If the soils or permafrost conditions are different from the information provided in this report, Englobe should be contacted immediately and recommendations provided herein will be revised, if necessary.

It is further noted that permafrost active layer depths should be expected to vary, perhaps significantly, from those observed at the time of this investigation.

8 References

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Appendix 1 Figures

Figure 1: Site Location
Figure 2: Aerial Photograph showing Borehole Locations

A	FINAL	2021-02-12	D.W.	K.B.	P.G.
No.	Version	Date	By	Check.	Appr.

Qulliq Energy Corporation
Société d'énergie Qulliq
Qulliq Alruyaktuqtunik Ikumatjutiit

Englobe
16114, 114 Avenue NW
Edmonton, Alberta
T5M 2Z5
780-481-1416

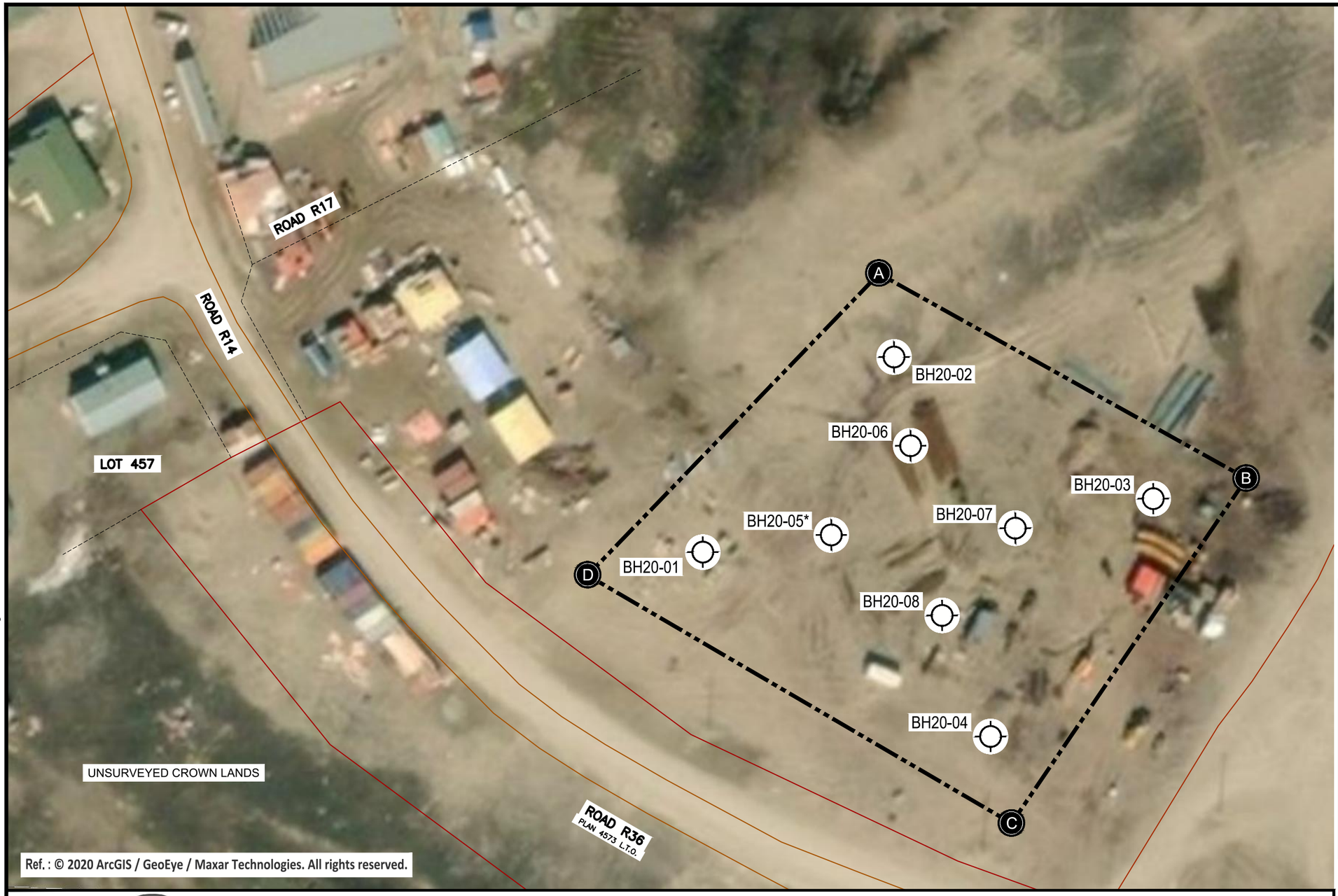
GEOTECHNICAL INVESTIGATION
PROPOSED POWER PLANT LOCATION
Gjoa Haven, Nunavut

SITE LOCATION – OPTION 01

Discipline : Geotechnical		Prepared by : K. BUDD	Checked by : K. BUDD
Scale : 1:10,000		Drawn by : D. WILSON	Approved by : P. GINGRAS
Date : February 2021		Figure no. : FIGURE 1	
Layout : LS-OPTION 01	Paper size : LETTER (8.5" x 11")	Registration no. : ---	

Resp.	Project	Otp	Project/ Disc	Phase/ Type	Electronic ref./ Drawing no.	Rev.
140	P0023273.000-0100-0000	---	---	---	P0023273.000-0100-0000-LS-GEO-GJOA HAVEN.dwg	---

G:\141\CAD\Projects\P0023273.000-0100-0000\P0023273.000-0100-0000-LS-GEO-GJOA HAVEN.dwg



N
W E
S

LEGEND

- Proposed Site (6,045 m^2)
- Borehole
- (A) Geodetic Coordinate (Typical; see table)

Location	Northing	Easting	Elevation (masl)
A	7614855.17	383566.05	22.48
B	7614818.40	383632.03	23.43
C	7614756.48	383589.85	23.29
D	7614801.01	383513.72	22.22
BH20-01	7614805.18	383534.41	43.10
BH20-02	7614840.22	383568.75	43.31
BH20-03	7614814.78	383615.29	43.76
BH20-04	7614772.07	383586.08	43.78
BH20-05*	7614808.26	383557.48	n/a
BH20-06	7614824.28	383571.72	43.59
BH20-07	7614809.48	383590.52	43.93
BH20-08	7614793.81	383577.38	43.94

*Requires Confirmation

Datum is NAD83(CSRS) / Zone 15, Meter; Central Meridian 93d W

No.	Version	Date	By	Check.	Appr.
B	FINAL	2021-02-12	D.W.	K.B.	P.G.
A	PRELIMINARY	2021-01-18	D.W.	K.B.	P.G.

Qulliq Energy Corporation
Société d'énergie Qulliq
Qulliq Alruyaktuqtunik Ikumatjutiit

0 15 30 m
7.5 22.5

1:750

GEOTECHNICAL INVESTIGATION
PROPOSED POWER PLANT LOCATION
Gjoa Haven, Nunavut

Aerial Photograph showing Borehole Locations (Option 01)

Discipline :	Geotechnical
Scale :	1:750
Date :	February 2021
Layout :	OPTION 01
Paper size :	ANSI full bleed B (11.00 x 17.00 Inches)
Prepared by :	K. BUDD
Checked by :	K. BUDD
Drawn by :	D. WILSON
Approved by :	P. GINGRAS
Figure no. :	FIGURE 2
Registration no. :	---

Resp.	Project	Otp	Project/ Disc	Phase/ Type	Electronic ref./ Drawing no.	Rev.
140	P0023273.000-0100-0000	---	---	---	P0023273.000-0100-0000-PL-GEO-GJOA HAVEN.dwg	--

Englobe Corp.
16114, 114 Avenue NW
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780-481-1416

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Appendix 2 Borehole Logs

SYMBOLS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>300	>12
COBBLES	Not Applicable	75 to 300	3 to 12
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
SILT/CLAY	Classified by plasticity	<0.075	<(200)

SAMPLES

AS	Auger sample
BS	Block sample
CS	Chunk sample
SS	Split-spoon
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

MODIFIERS FOR SECONDARY AND MINOR CONSTITUENTS

Percentage by Mass	Modifier
≤ 5	trace
5 to 12	some
12 to 35	Primary soil name prefixed with "gravelly, sandy, SILTY, CLAYEY" as applicable
>35	Use 'and' to combine major constituents (i.e., SAND and GRAVEL, SAND and CLAY)

SOIL TESTS

w	water content
PL	plastic limit
LL	liquid limit
C	consolidation (oedometer test)
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, Gs)
DS	direct shear test
GS	specific gravity
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
Y	unit weight

Note: [1] Tests which are anisotropically consolidated prior to shear are shown as CAD, CAU.

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) drive open sampler for a distance of 300 mm (12 in.).

Piezo-Cone Penetration Test (CPT)

An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (q_t), porewater pressure (u) and sleeve frictions are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance; N_d:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure
PM: Sampler advanced by manual pressure
WH: Sampler advanced by static weight of hammer
WR: Sampler advanced by weight of sampler and rod

NON-COHESIVE (COHESIONLESS) SOILS

Compactness

Term	SPT 'N' (blows/0.3m)*
Very Loose	0 - 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	>50

1. SPT 'N' in accordance with ASTM D 1586, uncorrected for overburden pressure effects or energy transfer.
2. Definition of compactness descriptions based on SPT 'N' ranges from Terzaghi and Peck (1967) and correspond to typical average N_{60} values.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

COHESIVE SOILS

Consistency

Term	Undrained Shear Strength (kPa)	SPT 'N' (blows/0.3m)
Very Soft	<12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	>200	>30

1. SPT 'N' in accordance with ASTM D 1586, uncorrected for overburden pressure effects or energy transfer.

Water Content

Term	Description
w < PL	Material is estimated to be drier than the Plastic Limit.
w ~ PL	Material is estimated to be close to the Plastic Limit.
w > PL	Material is estimated to be wetter than the Plastic Limit.

$\log_{10}$	x or log x, logarithm of x to base 10
g	acceleration due to gravity
t	time
F	factor of safety
V	volume
W	weight

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\sigma$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
υ	poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma - \mu$)
σ'_{vo}	initial effective overburden stress
$\sigma_1, \sigma_2, \sigma_3$	principal stress (major, intermediate, minor)
σ_{OCT}	mean stress or octahedral stress $= (\sigma_1 + \sigma_2 + \sigma_3)/3$
τ	shear stress
μ	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight*)
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma' = \gamma - \gamma_{(w)}$)
D_R	relative density (specific gravity) of solid particles ($D_R = \rho_s / \rho_w$) (formerly G_s)
e	void ratio
n	porosity
S	degree of saturation
$_p$	plastic limit
I_p	plasticity index = $(w_l - w_p)$
w_s	shrinkage limit
I_L	liquidity index = $(w - w_p) / I_p$
I_C	consistency index = $(w_l - w) / I_p$
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index = (emax - e) / (emax - emin) (formerly relative density)

* Density symbol is ρ. Unit weight symbol is γ where $\gamma = \rho g$ (i.e. mass density multiplied by acceleration due to gravity)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	comression index (normally consolidated range)
C_r	recompression index (over-consolidated range)
C_s	swelling index
C_a	coefficient of secondary consolidation
m_v	coefficient of volume change
c_v	coefficient of consolidation
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation stress
OCR	over-consolidation ratio = σ'_p / σ'_{vo}

(d) Shear Strength

T_p, T_r	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction = tan δ
c'	effective cohesion
c_u, s_u	undrained shear strength ($\phi = 0$ analysis)
p	mean total stress $(\sigma_1 + \sigma_3)/2$
p'	mean effective stress $(\sigma'_1 + \sigma'_3)/2$
q	$(\sigma_1 + \sigma_3)/2$ or $(\sigma'_1 + \sigma'_3)/2$
q_u	compressive strength $(\sigma_1 + \sigma_3)$
S_t	sensitivity

Notes:

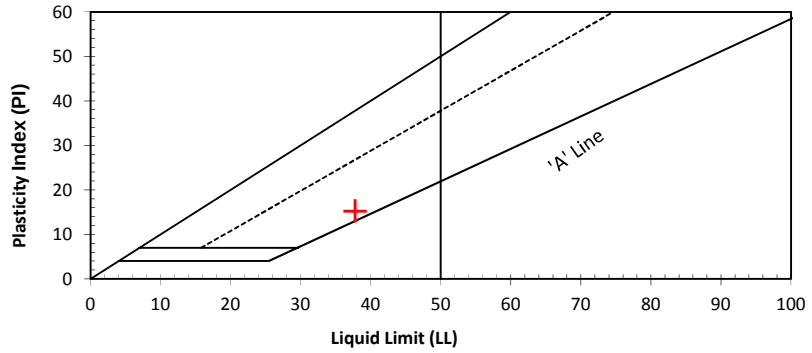
1 $\tau = c' + \sigma' \tan \phi'$

2 shear strength = (compressive strength)/2

Organic or Inorganic	Soil Group	Type of Soil		Gradation or Plasticity	$Cu = \frac{D_{60}}{D_{10}}$	$Cc = \frac{D^2_{30}}{D_{10} \times D_{60}}$	Organic Content	USCS Group Symbol	Group Name
INORGANIC Organic Content <30% by mass)	COARSE-GRAINED SOILS (>50% by mass is larger than 0.075 mm)	GRAVELS (>50% by mass is larger than 4.75 mm)	Gravels with <12% fines (by mass)	Poorly Graded	<4	≤1 or ≥3	<30%	GP	GRAVEL
				Well Graded	≥4	1 to 3		GW	GRAVEL
			Gravels with >12% fines (by mass)	Below A-Line	n/a			GM	SILTY GRAVEL
				Above A-Line	n/a			GC	CLAYEY GRAVEL
		SANDS (>50% by mass is smaller than 4.75 mm)	Sands with <12% fines (by mass)	Poorly Graded	<6	≤1 or ≥3		SP	SAND
				Well Graded	≥6	1 to 3		SW	SAND
			Gravels with >12% fines (by mass)	Below A-Line	n/a			SM	SILTY SAND
				Above A-Line	n/a			SC	CLAYEY SAND

Organic or Inorganic	Soil Group	Type of Soil	Laboratory Tests	Field Indicators				Organic Content	USCS Group Symbol	Group Name
				Dilatancy	Dry Strength	Thread Diameter	Toughness (of 3 mm Thread)			
INORGANIC Organic Content <30% by mass)	FINE-GRAINED SOILS (>50% by mass is larger than 0.075 mm)	SILTS (PI and LL plot below A-Line on Plasticity Chart)	Liquid Limit <50	Rapid	None	>6 mm	N/A (can't roll 3 mm thread)	<5%	ML	SILT
				Slow	None to Low	3 mm to 6 mm	None to Low	<5%	ML	CLAYEY SILT
				Slow to Very Slow	Low to Medium	3 mm to 6 mm	Low	5% to 30%	OL	ORGANIC SILT
			Liquid Limit >50	Slow to Very Slow	Low to Medium	3 mm to 6 mm	Low to Medium	<5%	MH	CLAYEY SILT
				None	Medium to High	1 mm to 3 mm	Medium to High	5% to 30%	OH	ORGANIC SILT
		CLAYS (PI and LL plot above A-Line on Plasticity Chart)	Liquid Limit <35	None	Low to Medium	~3 mm	Low to Medium	0% to 30%	CL	SILTY CLAY
			Liquid Limit 35 to 50	None	Medium to High	1 mm to 3 mm	Medium		CI	SILTY CLAY
			Liquid Limit >50	None	High	<1 mm	High		CH	CLAY
HIGHLY ORGANIC SOILS (Organic Content >30% by mass)		Peat and mineral soil mixtures						30% to 75%	PT	SILTY PEAT, SANDY PEAT
		Predominantly peat, may contain some mineral soil, fibrous or amorphous peat						>75%		PEAT

PLASTICITY CHART



Dual Symbol - A dual symbol is two symbols separated by a hyphen, for example, GP-GM, SW-SC, CL-ML used when the soil has between 5 and 12% fines (i.e. between "clean" sand and "dirty" sand) or when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart.

Borderline Symbol - A borderline symbol is two symbols separated by a slash, for example, CL/CI, GM/SM, CL/ML.

BOREHOLE NO: **01**
PROJECT NO: GH-OP01
ELEVATION: m

N E
MTM ZONE:

DATES: 09/29/2020 - 09/29/2020

SAMPLE STATE: Remoulded | Intact | Core | Lost (no recovery)

SAMPLE TYPE: AS: Auger Sample | ST: Shelby Tube | SS: Split Spoon | MA: Manual Sample | DC: Diamond Rock Core

WET UNIT WEIGHT (kN/m³) ▲ 17 18 19 20 21
WATER CONTENT and LIMITS (%) PLASTIC M.C. LIQUID 20 40 60 80
COMPRESSIVE STRENGTH (kPa) ▲ Pocket Pen ◆ Remoulded □ Intact 100 200 300 400
STANDARD PENETRATION (N) ■ 20 40 60 80

DEPTH (m)	SAMPLE STATE	SAMPLE TYPE and NUMBER	SPT (N)	USC	GROUNDWATER CONDITIONS	ELEVATION - m / DEPTH - m	SOIL SYMBOL	SOIL DESCRIPTION	ELEVATION (m)
0						0.0		SAND some clay and gravel, trace silt, loose, damp, brown, poorly grained Ice-poor soil	
1		AS-01							-1
		AS-02						Sand 74.8%, Clay 11.4%, Gravel 7.2%, Silt 6.6%	
2								Ice-rich soil suspected permafrost	-2
3		AS-03							-3
4		AS-04							-4
5									-5
6		AS-05						clayey sand, wet, grey, frost until end	-6
7									-7
8		AS-06							-8
9		AS-07							-9

Englobe

REMARK: Backfilled with cuttings
LOGGED BY: SS
COMPILED BY: MW
REVIEWED BY: Kiran Chandra Prakash
REPORT DATE: 11/20/2020

BOREHOLE NO: **01**
PROJECT NO: GH-OP01
ELEVATION: m

N E
MTM ZONE:

DATES: 09/29/2020 - 09/29/2020

SAMPLE STATE: Remoulded | Intact | Core | Lost (no recovery)

SAMPLE TYPE: AS: Auger Sample | ST: Shelby Tube | SS: Split Spoon | MA: Manual Sample | DC: Diamond Rock Core

WET UNIT WEIGHT (kN/m³) ▲ 17 18 19 20 21
WATER CONTENT and LIMITS (%) PLASTIC M.C. LIQUID 20 40 60 80
COMPRESSIVE STRENGTH (kPa) ▲ Pocket Pen ◆ Remoulded □ Intact 100 200 300 400
STANDARD PENETRATION (N) ■ 20 40 60 80

DEPTH (m)	SAMPLE STATE	SAMPLE TYPE and NUMBER	SPT (N)	USC	GROUNDWATER CONDITIONS	ELEVATION - m DEPTH - m	SOIL SYMBOL	SOIL DESCRIPTION	ELEVATION (m)
11		AS-08							-11
12						-12.0			-12
						12.0		END OF BOREHOLE	
13									-13
14									-14
15									-15
16									-16
17									-17
18									-18
19									-19

Englobe

REMARK: Backfilled with cuttings
LOGGED BY: SS
COMPILED BY: MW
REVIEWED BY: Kiran Chandra Prakash
REPORT DATE: 11/20/2020

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BOREHOLE NO: **02**
PROJECT NO: GH-OP01
ELEVATION: m

N E
MTM ZONE:

DATES: 09/29/2020 - 09/29/2020

SAMPLE STATE: Remoulded | Intact | Core | Lost (no recovery)

SAMPLE TYPE: AS: Auger Sample | ST: Shelby Tube | SS: Split Spoon | MA: Manual Sample | DC: Diamond Rock Core

WET UNIT WEIGHT (kN/m³) ▲ 17 18 19 20 21
WATER CONTENT and LIMITS (%) PLASTIC M.C. LIQUID 20 40 60 80
COMPRESSIVE STRENGTH (kPa) ▲ Pocket Pen ◆ Remoulded □ Intact 100 200 300 400
STANDARD PENETRATION (N) ■ 20 40 60 80

DEPTH (m)	SAMPLE STATE	SAMPLE TYPE and NUMBER	SPT (N)	USC	GROUNDWATER CONDITIONS	ELEVATION - m DEPTH - m	SOIL SYMBOL	SOIL DESCRIPTION	ELEVATION (m)
0						0.0		SAND some gravel, loose, damp, brown, poorly grained Ice-poor soil	
1		AS-01							-1
2		AS-02						Ice-rich soil suspected frost	-2
3		AS-03						trace clay, grey	-3
4									-4
5		AS-04						some clay	-5
6		AS-05						clayey sand	-6
7									-7
8		AS-06							-8
9		AS-07				-9.0 9.0		some clay, trace gravel END OF BOREHOLE	-9

REMARK: Backfilled with cuttings
LOGGED BY: SS
COMPILED BY: MW
REVIEWED BY: Kiran Chandra Prakash
REPORT DATE: 11/20/2020

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BOREHOLE NO: **03**
PROJECT NO: GH-OP01
ELEVATION: m

N E
MTM ZONE:

DATES: 09/28/2020 - 09/28/2020

SAMPLE STATE: Remoulded | Intact | Core | Lost (no recovery)

SAMPLE TYPE: AS: Auger Sample | ST: Shelby Tube | SS: Split Spoon | MA: Manual Sample | DC: Diamond Rock Core

DEPTH (m)	WET UNIT WEIGHT (kN/m³) 17 18 19 20 21 / WATER CONTENT and LIMITS (%) PLASTIC M.C. LIQUID 20 40 60 80	COMPRESSIVE STRENGTH (kPa) ▲ Pocket Pen ◆ Remoulded □ Intact 100 200 300 400 / STANDARD PENETRATION (N) ■ 20 40 60 80	SAMPLE STATE	SAMPLE TYPE and NUMBER	SPT (N)	USC	GROUNDWATER CONDITIONS	ELEVATION - m DEPTH - m	SOIL SYMBOL	SOIL DESCRIPTION	ELEVATION (m)
0								0.0		SAND trace to some gravel and clay, trace silt, loose, damp, brown, poorly graded Ice-poor soil Sand 81.4%, Gravel 8.8%, Clay 7.1%, Silt 2.1%	0
				AS-01							
1											-1
				AS-02							
2										Ice-rich soil Suspected permafrost	-2
3				AS-03						greyish	-3
4											-4
				AS-04							
5										sloughing at 5m	-5
				AS-05						trace clay	
6											-6
7											-7
				AS-06							
8											-8
9				AS-07						some clay, some gravel, moist	-9

Englobe

REMARK: Backfilled with cuttings
LOGGED BY: SS
COMPILED BY: MW
REVIEWED BY: Kiran Chandra Prakash
REPORT DATE: 11/20/2020

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BOREHOLE NO: **03**
PROJECT NO: GH-OP01
ELEVATION: m

N E
MTM ZONE:

DATES: 09/28/2020 - 09/28/2020

SAMPLE STATE: Remoulded | Intact | Core | Lost (no recovery)

SAMPLE TYPE: AS: Auger Sample | ST: Shelby Tube | SS: Split Spoon | MA: Manual Sample | DC: Diamond Rock Core

WET UNIT WEIGHT (kN/m³) ▲ 17 18 19 20 21
WATER CONTENT and LIMITS (%) PLASTIC M.C. LIQUID 20 40 60 80
COMPRESSIVE STRENGTH (kPa) ▲ Pocket Pen ◆ Remoulded □ Intact 100 200 300 400
STANDARD PENETRATION (N) ■ 20 40 60 80

DEPTH (m)	SAMPLE STATE	SAMPLE TYPE and NUMBER	SPT (N)	USC	GROUNDWATER CONDITIONS	ELEVATION - m DEPTH - m	SOIL SYMBOL	SOIL DESCRIPTION	ELEVATION (m)
11		AS-08				-11.0			-11
						11.4		END OF BOREHOLE	
12									-12
13									-13
14									-14
15									-15
16									-16
17									-17
18									-18
19									-19

Englobe

REMARK: Backfilled with cuttings
LOGGED BY: SS
COMPILED BY: MW
REVIEWED BY: Kiran Chandra Prakash
REPORT DATE: 11/20/2020

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BOREHOLE NO: **04**

N E

PROJECT NO: GH-OP01

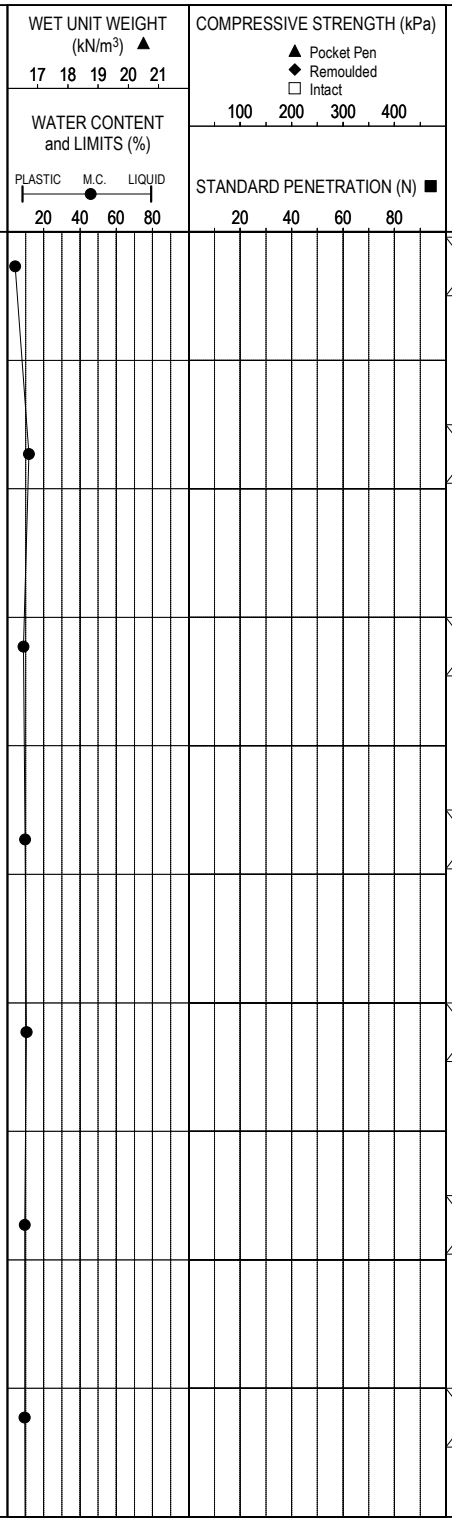
DATES: 09/28/2020 - 09/28/2020

MTM ZONE:

ELEVATION: m

SAMPLE STATE: Remoulded | Intact | Core | Lost (no recovery)

SAMPLE TYPE: AS: Auger Sample | ST: Shelby Tube | SS: Split Spoon | MA: Manual Sample | DC: Diamond Rock Core



DEPTH (m)	SAMPLE STATE	SAMPLE TYPE and NUMBER	SPT (N)	USC	GROUNDWATER CONDITIONS	ELEVATION - m / DEPTH - m	SOIL SYMBOL	SOIL DESCRIPTION	ELEVATION (m)
0						0.0			
		AS-01				0.0		SAND some gravel, loose, damp, brown, poorly graded, organics Ice-poor soil	
1									-1
		AS-02						grey Ice-rich soil Suspected permafrost	
2									-2
		AS-03						trace clay	
3									-3
		AS-04						some clay, wet	
4									-4
		AS-05						Clayey Sand	
5									-5
		AS-06						some clay, trace gravel	
6									-6
		AS-07						no gravel	
7									-7
8									-8
9									-9

Englobe

REMARK: Backfilled with cuttings

LOGGED BY: SS

COMPILED BY: MW

REVIEWED BY: Kiran Chandra Prakash

REPORT DATE: 11/20/2020

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BOREHOLE NO: **04**
PROJECT NO: GH-OP01
ELEVATION: m

N E
MTM ZONE:

DATES: 09/28/2020 - 09/28/2020

SAMPLE STATE: Remoulded | Intact | Core | Lost (no recovery)

SAMPLE TYPE: AS: Auger Sample | ST: Shelby Tube | SS: Split Spoon | MA: Manual Sample | DC: Diamond Rock Core

WET UNIT WEIGHT (kN/m³) ▲ 17 18 19 20 21
WATER CONTENT and LIMITS (%) PLASTIC M.C. LIQUID 20 40 60 80
COMPRESSIVE STRENGTH (kPa) ▲ Pocket Pen ◆ Remoulded □ Intact 100 200 300 400
STANDARD PENETRATION (N) ■ 20 40 60 80

DEPTH (m)	SAMPLE STATE	SAMPLE TYPE and NUMBER	SPT (N)	USC	GROUNDWATER CONDITIONS	ELEVATION - m DEPTH - m	SOIL SYMBOL	SOIL DESCRIPTION	ELEVATION (m)
11		AS-08							-11
		AS-09				-12.0			
12						12.0		END OF BOREHOLE	-12
13									-13
14									-14
15									-15
16									-16
17									-17
18									-18
19									-19

Englobe

REMARK: Backfilled with cuttings
LOGGED BY: SS
COMPILED BY: MW
REVIEWED BY: Kiran Chandra Prakash
REPORT DATE: 11/20/2020

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BOREHOLE NO: **05**
PROJECT NO: GH-OP01
ELEVATION: m

N E
MTM ZONE:

DATES: 09/29/2020 - 09/29/2020

SAMPLE STATE: Remoulded | Intact | Core | Lost (no recovery)

SAMPLE TYPE: AS: Auger Sample | ST: Shelby Tube | SS: Split Spoon | MA: Manual Sample | DC: Diamond Rock Core

WET UNIT WEIGHT (kN/m³) ▲ 17 18 19 20 21
WATER CONTENT and LIMITS (%) PLASTIC M.C. LIQUID 20 40 60 80
COMPRESSIVE STRENGTH (kPa) ▲ Pocket Pen ◆ Remoulded □ Intact 100 200 300 400
STANDARD PENETRATION (N) ■ 20 40 60 80

DEPTH (m)	SAMPLE STATE	SAMPLE TYPE and NUMBER	SPT (N)	USC	GROUNDWATER CONDITIONS	ELEVATION - m DEPTH - m	SOIL SYMBOL	SOIL DESCRIPTION	ELEVATION (m)
0						0.0		SAND trace to some clay and gravel, trace silt, loose, moist, brown grey, poorly grained Ice-poor soil	0
1		AS-01							-1
1.7		AS-02						Sand 82.3%, Clay 8.8%, Gravel, 6.7%, Silt 2.2%	
2								Ice-rich soil Suspected permafrost	-2
3		AS-03						some clay, wet, greyish	-3
4									-4
4.5		AS-04						clayey sand	
5									-5
6		AS-05							-6
7									-7
7.7		AS-06							
8									-8
8.5		AS-07							
9						-9.0 9.0		some clay END OF BOREHOLE	-9

REMARK: Backfilled with cuttings
LOGGED BY: SS
COMPILED BY: MW
REVIEWED BY: Kiran Chandra Prakash
REPORT DATE: 11/20/2020

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BOREHOLE NO: **06**
PROJECT NO: GH-OP01
ELEVATION: m

N E
MTM ZONE:

DATES: 09/29/2020 - 09/29/2020

SAMPLE STATE: Remoulded | Intact | Core | Lost (no recovery)

SAMPLE TYPE: AS: Auger Sample | ST: Shelby Tube | SS: Split Spoon | MA: Manual Sample | DC: Diamond Rock Core

DEPTH (m)	WET UNIT WEIGHT (kN/m³) 17 18 19 20 21 / WATER CONTENT and LIMITS (%) PLASTIC M.C. LIQUID 20 40 60 80	COMPRESSIVE STRENGTH (kPa) ▲ Pocket Pen ◆ Remoulded □ Intact 100 200 300 400 / STANDARD PENETRATION (N) ■ 20 40 60 80	SAMPLE STATE	SAMPLE TYPE and NUMBER	SPT (N)	USC	GROUNDWATER CONDITIONS	ELEVATION - m DEPTH - m	SOIL SYMBOL	SOIL DESCRIPTION	ELEVATION (m)
0								0.0		SAND some gravel, loose, damp, brown, poorly grained Ice-poor soil	
1				AS-01							-1
2				AS-02						Ice-rich soil Suspected permafrost	-2
3				AS-03						trace clay , greyish brown	-3
4											-4
5				AS-04						some clay, grey	-5
6				AS-05						trace gravel	-6
7											-7
8				AS-06						damp	-8
9				AS-07							-9

Englobe

REMARK: Backfilled with cuttings
LOGGED BY: SS
COMPILED BY: MW
REVIEWED BY: Kiran Chandra Prakash
REPORT DATE: 11/20/2020

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BOREHOLE NO: **06**
PROJECT NO: GH-OP01
ELEVATION: m

N E
MTM ZONE:

DATES: 09/29/2020 - 09/29/2020

SAMPLE STATE: Remoulded | Intact | Core | Lost (no recovery)

SAMPLE TYPE: AS: Auger Sample | ST: Shelby Tube | SS: Split Spoon | MA: Manual Sample | DC: Diamond Rock Core

WET UNIT WEIGHT (kN/m³) ▲ 17 18 19 20 21
WATER CONTENT and LIMITS (%) PLASTIC M.C. LIQUID 20 40 60 80
COMPRESSIVE STRENGTH (kPa) ▲ Pocket Pen ◆ Remoulded □ Intact 100 200 300 400
STANDARD PENETRATION (N) ■ 20 40 60 80

DEPTH (m)	SAMPLE STATE	SAMPLE TYPE and NUMBER	SPT (N)	USC	GROUNDWATER CONDITIONS	ELEVATION - m DEPTH - m	SOIL SYMBOL	SOIL DESCRIPTION	ELEVATION (m)
11		AS-08							-11
		AS-09				-12.0			
12						12.0		END OF BOREHOLE	-12
13									-13
14									-14
15									-15
16									-16
17									-17
18									-18
19									-19

Englobe

REMARK: Backfilled with cuttings
LOGGED BY: SS
COMPILED BY: MW
REVIEWED BY: Kiran Chandra Prakash
REPORT DATE: 11/20/2020

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BOREHOLE NO: **07**
PROJECT NO: GH-OP01
ELEVATION: m

N E
MTM ZONE:

DATES: 09/28/2020 - 09/28/2020

SAMPLE STATE: Remoulded | Intact | Core | Lost (no recovery)

SAMPLE TYPE: AS: Auger Sample | ST: Shelby Tube | SS: Split Spoon | MA: Manual Sample | DC: Diamond Rock Core

WET UNIT WEIGHT (kN/m³) ▲ 17 18 19 20 21
WATER CONTENT and LIMITS (%) PLASTIC M.C. LIQUID 20 40 60 80
COMPRESSIVE STRENGTH (kPa) ▲ Pocket Pen ◆ Remoulded □ Intact 100 200 300 400
STANDARD PENETRATION (N) ■ 20 40 60 80

DEPTH (m)	SAMPLE STATE	SAMPLE TYPE and NUMBER	SPT (N)	USC	GROUNDWATER CONDITIONS	ELEVATION - m DEPTH - m	SOIL SYMBOL	SOIL DESCRIPTION	ELEVATION (m)
0						0.0			
0		AS-01				0.0		SAND traces of gravel, loose, dry to damp, brown, poorly grained Ice-poor soil	
1									-1
1		AS-02							
2								Ice-rich soil Suspected permafrost	-2
3		AS-03							-3
4								sloughing at 4m	-4
4		AS-04							
5									-5
6		AS-05						clayey sand, damp, grey, trace gravel	-6
7								sloughing at 7m	-7
7		AS-06							
8									-8
8		AS-07							
9						-9.0			-9
9						9.0		END OF BOREHOLE	

Englobe

REMARK: Backfilled with cuttings
LOGGED BY: SS
COMPILED BY: MW
REVIEWED BY: Kiran Chandra Prakash
REPORT DATE: 11/20/2020

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BOREHOLE NO: **08**
PROJECT NO: GH-OP01
ELEVATION: m

N E
MTM ZONE:

DATES: 09/28/2020 - 09/28/2020

SAMPLE STATE: Remoulded | Intact | Core | Lost (no recovery)

SAMPLE TYPE: AS: Auger Sample | ST: Shelby Tube | SS: Split Spoon | MA: Manual Sample | DC: Diamond Rock Core

WET UNIT WEIGHT (kN/m³) ▲ 17 18 19 20 21
WATER CONTENT and LIMITS (%) PLASTIC M.C. LIQUID 20 40 60 80
COMPRESSIVE STRENGTH (kPa) ▲ Pocket Pen ◆ Remoulded □ Intact 100 200 300 400
STANDARD PENETRATION (N) ■ 20 40 60 80

DEPTH (m)	SAMPLE STATE	SAMPLE TYPE and NUMBER	SPT (N)	USC	GROUNDWATER CONDITIONS	ELEVATION - m DEPTH - m	SOIL SYMBOL	SOIL DESCRIPTION	ELEVATION (m)
0						0.0			
0		AS-01				0.0		SAND some clay, trace silt, loose, moist, grey, poorly grained Ice-poor soil	
1									-1
1		AS-02						Sand 89.4%, Clay 8.2%, Silt 2%, Gravel 0.5%	
2								Ice-rich soil Suspected permafrost	-2
3		AS-03							-3
4									-4
4		AS-04						trace clay	
5									-5
6		AS-05						some clay, trace gravel, wet	-6
7									-7
7		AS-06							
8									-8
9		AS-07							-9

Englobe

REMARK: Backfilled with cuttings
LOGGED BY: SS
COMPILED BY: MW
REVIEWED BY: Kiran Chandra Prakash
REPORT DATE: 11/20/2020

BOREHOLE NO: **08**
PROJECT NO: GH-OP01
ELEVATION: m

N E
MTM ZONE:

DATES: 09/28/2020 - 09/28/2020

SAMPLE STATE: Remoulded | Intact | Core | Lost (no recovery)

SAMPLE TYPE: AS: Auger Sample | ST: Shelby Tube | SS: Split Spoon | MA: Manual Sample | DC: Diamond Rock Core

WET UNIT WEIGHT (kN/m³) ▲ 17 18 19 20 21
WATER CONTENT and LIMITS (%) PLASTIC M.C. LIQUID 20 40 60 80
COMPRESSIVE STRENGTH (kPa) ▲ Pocket Pen ◆ Remoulded □ Intact 100 200 300 400
STANDARD PENETRATION (N) ■ 20 40 60 80

DEPTH (m)	SAMPLE STATE	SAMPLE TYPE and NUMBER	SPT (N)	USC	GROUNDWATER CONDITIONS	ELEVATION - m DEPTH - m	SOIL SYMBOL	SOIL DESCRIPTION	ELEVATION (m)
11		AS-08							-11
		AS-09				-12.0			
12						12.0		END OF BOREHOLE	-12
13									-13
14									-14
15									-15
16									-16
17									-17
18									-18
19									-19

Englobe

REMARK: Backfilled with cuttings
LOGGED BY: SS
COMPILED BY: MW
REVIEWED BY: Kiran Chandra Prakash
REPORT DATE: 11/20/2020

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Appendix 3 Geotechnical Laboratory Results

Englobe
16114 114 Ave NW Edmonton, Alberta Canada, T5M 2Z5 Ph: 780-481-1416

Moisture Content

In Accordance With ASTM D2217

CCIL Canadian Council of Independent Laboratories

Client:	Qulliq Energy Corporation
Project:	Geotechnical Evaluation
Project Location:	Gjoa Haven - Option 1
Sample Source:	Boreholes (Geo)
Reviewed:	Connor C

Date:	28-Sep-20
Project No.:	P-0023273
Sample No.:	1857
Technician:	MW

Test Hole No.:		1	1	1	1	1
Sample No.:		GH OP-01	GH OP-01	GH OP-01	GH OP-01	GH OP-01
Depth:		1.5m	3m	4.5m	6m	7.5m
Container No.:	g	713	708	608	530	103
Tare of Container:	g	6.1	6	6	6	5.4
Wt. of Wet Sample + Tare:	g	446.2	432.8	409.7	406.5	468.1
Wt. of Dry Sample + Tare:	g	401.7	391.2	372.5	369.2	421.1
Wt. of Water:	g	44.5	41.6	37.2	37.3	47.0
Wt. of Dry Soil:	g	395.6	385.2	366.5	363.2	415.7
Moisture Content:	%	**11.2%**	**10.8%**	**10.2%**	**10.3%**	**11.3%**

Test Hole No.:		1	1	2	2	3
Sample No.:		GH OP-01	GH OP-01	GH OP-01	GH OP-01	GH OP-01
Depth:		9m	12m	1.5m	9m	Topsoil
Container No.:	g	522	79	37	67	57
Tare of Container:	g	6.2	5.4	5.6	5.4	6
Wt. of Wet Sample + Tare:	g	447.7	435.9	452.2	426.6	410.3
Wt. of Dry Sample + Tare:	g	394.5	387.4	396.6	387.7	395.5
Wt. of Water:	g	53.2	48.5	55.6	38.9	14.8
Wt. of Dry Soil:	g	388.3	382.0	391.0	382.3	389.5
Moisture Content:	%	**13.7%**	**12.7%**	**14.2%**	**10.2%**	**3.8%**

Test Hole No.:		3	3	3	3	3
Sample No.:		GH OP-01	GH OP-01	GH OP-01	GH OP-01	GH OP-01
Depth:		1.5m	3m	6m	9m	11m
Container No.:	g	8	24	111	18	770
Tare of Container:	g	6	5.4	5.4	5.4	5.5
Wt. of Wet Sample + Tare:	g	424.7	422.6	465.9	444.2	422.4
Wt. of Dry Sample + Tare:	g	391.9	387.5	424.1	402	380.3
Wt. of Water:	g	32.8	35.1	41.8	42.2	42.1
Wt. of Dry Soil:	g	385.9	382.1	418.7	396.6	374.8
Moisture Content:	%	**8.5%**	**9.2%**	**10.0%**	**10.6%**	**11.2%**

Englobe
16114 114 Ave NW Edmonton, Alberta Canada, T5M 2Z5 Ph: 780-481-1416

Moisture Content

In Accordance With ASTM D2217

CCIL Canadian Council of Independent Laboratories

Client:	Qulliq Energy Corporation
Project:	Geotechnical Evaluation
Project Location:	Gjoa Haven - Option 1
Sample Source:	Boreholes (Geo)
Reviewed:	Connor C

Date:	28-Sep-20
Project No.:	P-0023273
Sample No.:	1857
Technician:	MW

Test Hole No.:		4	4	4	4	4
Sample No.:		GH OP-01	GH OP-01	GH OP-01	GH OP-01	GH OP-01
Depth:		Topsoil	1.5m	3m	4.5m	6m
Container No.:	g	23	12	33	49	4
Tare of Container:	g	5.4	5.4	6	6	5.4
Wt. of Wet Sample + Tare:	g	410.7	455.2	477.3	464.3	489.1
Wt. of Dry Sample + Tare:	g	394.1	407.9	438.9	423.9	443.2
Wt. of Water:	g	16.6	47.3	38.4	40.4	45.9
Wt. of Dry Soil:	g	388.7	402.5	432.9	417.9	437.8
Moisture Content:	%	**4.3%**	**11.8%**	**8.9%**	**9.7%**	**10.5%**

Test Hole No.:		4	4	4	4	3
Sample No.:		GH OP-01	GH OP-01	GH OP-01	GH OP-01	GH OP-01
Depth:		7.5m	9m	10.5m	12m	10.5m
Container No.:	g	91	80	64	55	36
Tare of Container:	g	5.4	5.4	5.4	5.4	5.4
Wt. of Wet Sample + Tare:	g	464.1	472.8	438	478.5	453.9
Wt. of Dry Sample + Tare:	g	423.8	432.1	399.4	434.9	413.8
Wt. of Water:	g	40.3	40.7	38.6	43.6	40.1
Wt. of Dry Soil:	g	418.4	426.7	394.0	429.5	408.4
Moisture Content:	%	**9.6%**	**9.5%**	**9.8%**	**10.2%**	**9.8%**

Test Hole No.:		5	5	5	5	6
Sample No.:		GH OP-01	GH OP-01	GH OP-01	GH OP-01	GH OP-01
Depth:		1.5m	3m	7.5m	9m	1.5m
Container No.:	g	17	90	83	52	24
Tare of Container:	g	5.4	5.4	5.4	5.4	5.4
Wt. of Wet Sample + Tare:	g	446.4	472.4	454.8	503.8	447.3
Wt. of Dry Sample + Tare:	g	383.4	413.2	411	456.8	399.1
Wt. of Water:	g	63.0	59.2	43.8	47.0	48.2
Wt. of Dry Soil:	g	378.0	407.8	405.6	451.4	393.7
Moisture Content:	%	**16.7%**	**14.5%**	**10.8%**	**10.4%**	**12.2%**

Englobe
16114 114 Ave NW Edmonton, Alberta Canada, T5M 2Z5 Ph: 780-481-1416

Moisture Content

In Accordance With ASTM D2217

CCIL Canadian Council of Independent Laboratories

Client:	Qulliq Energy Corporation
Project:	Geotechnical Evaluation
Project Location:	Gjoa Haven - Option 1
Sample Source:	Boreholes (Geo)
Reviewed:	Connor C

Date:	28-Sep-20
Project No.:	P-0023273
Sample No.:	1857
Technician:	MW

Test Hole No.:		6	6	6	6	6
Sample No.:		GH OP-01	GH OP-01	GH OP-01	GH OP-01	GH OP-01
Depth:		3m	4.5m	6m	7.5m	9m
Container No.:	g	88	41	101	31	89
Tare of Container:	g	5.4	5.4	5.4	5.5	5.5
Wt. of Wet Sample + Tare:	g	481.2	478.4	434	450.7	502.3
Wt. of Dry Sample + Tare:	g	417.2	435.6	397.3	411.5	457.7
Wt. of Water:	g	64.0	42.8	36.7	39.2	44.6
Wt. of Dry Soil:	g	411.8	430.2	391.9	406.0	452.2
Moisture Content:	%	**15.5%**	**9.9%**	**9.4%**	**9.7%**	**9.9%**

Test Hole No.:		6	7	8m East of BH4	8	8
Sample No.:		GH OP-01	GH OP-01	GH OP-01	GH OP-01	GH OP-01
Depth:		12m	4.5m	0.2m	1.5m	7.5m
Container No.:	g	104	46	93	21	68
Tare of Container:	g	5.4	5.4	5.4	5.4	5.4
Wt. of Wet Sample + Tare:	g	421.8	411.7	418.7	404.8	491.8
Wt. of Dry Sample + Tare:	g	385.8	381.6	392.4	342.5	448.3
Wt. of Water:	g	36.0	30.1	26.3	62.3	43.5
Wt. of Dry Soil:	g	380.4	376.2	387.0	337.1	442.9
Moisture Content:	%	**9.5%**	**8.0%**	**6.8%**	**18.5%**	**9.8%**

Test Hole No.:						
Sample No.:						
Depth:						
Container No.:	g					
Tare of Container:	g					
Wt. of Wet Sample + Tare:	g					
Wt. of Dry Sample + Tare:	g					
Wt. of Water:	g					
Wt. of Dry Soil:	g					
Moisture Content:	%					

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ATTERBERG LIMITS

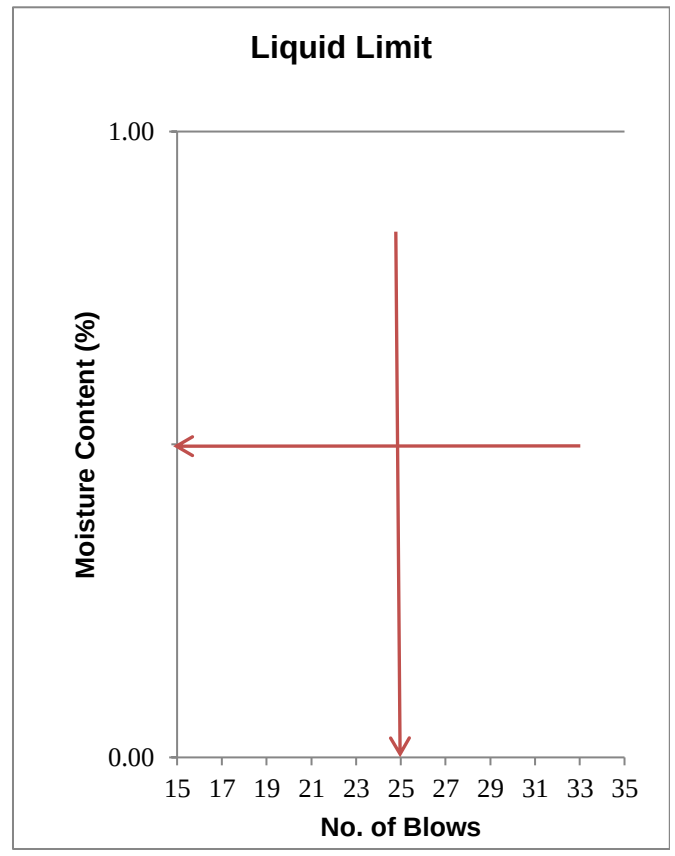
Prep Method: Moist ☐ Dry ☒ Accordance with ASTM D4318

Oversize: Pestle ☒ Grinder ☐

Client:	Qulliq Energy Corporation
Project:	Geotechnical Evaluation
Project Location:	Gjoa Haven - Option 1
Sample Source:	Boreholes (Geo)
Contact:	N/A

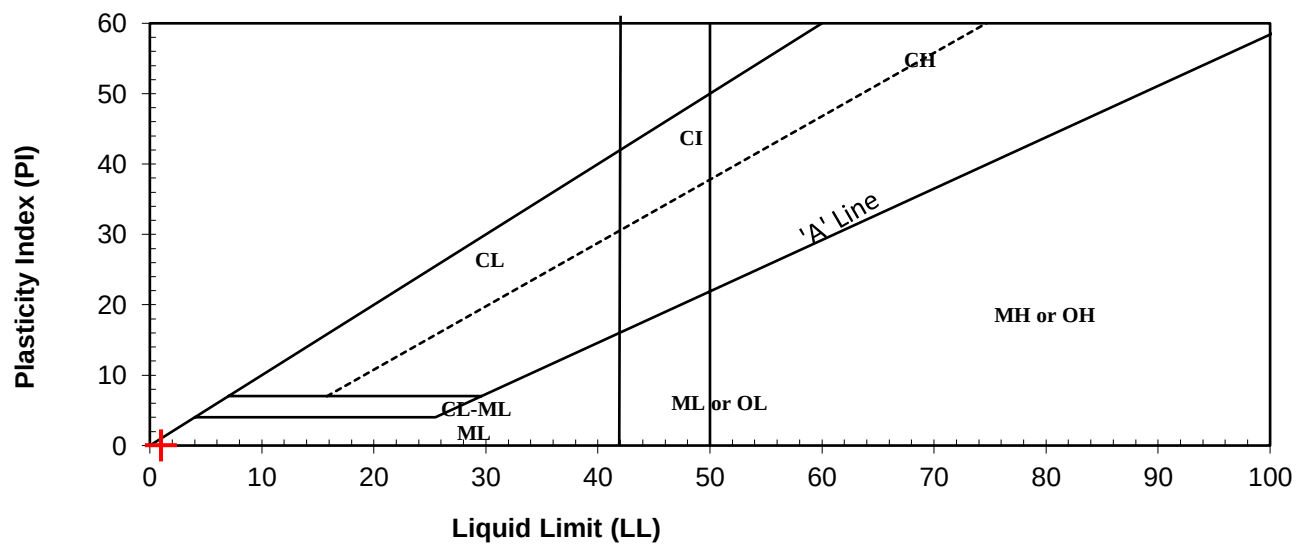
Date:	28-Sep-20
Project No.:	P-0023273
Sample No.:	1857
Technician:	CC / LS

Liquid Limit - Hand Operated Method			
Borehole: 1	**Sample No.** GH OP-01	**Depth:**	1.5m
Container No.			
Mass of Empty Container (grams)	Non Plastic Sand		
Mass of Wet Soil + Container (grams)			
Mass of Dry Soil + Container (grams)			
Mass of Water (grams)			
Mass of Dry Soil (grams)			
% Moisture			
No. of Blows			
Liquid Limit from Flow Curve			



Plastic Limit - Manual Rolling Method		
Container No.	Non Plastic Sand	
Mass of Empty Container (grams)		
Mass of Wet Soil + Container (grams)		
Mass of Dry Soil + Container (grams)		
Mass of Water (grams)		
Mass of Dry Soil (grams)		
% Moisture		
Plastic Limit		

Groving Tool: Plastic ☒ Metal ☐



Summary

Liquid Limit:	N/A
Plastic Limit:	N/A
Plasticity Index:	N/A
Unified Soil Classification:	**S**

Reviewed By: Connor Carlson

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ATTERBERG LIMITS

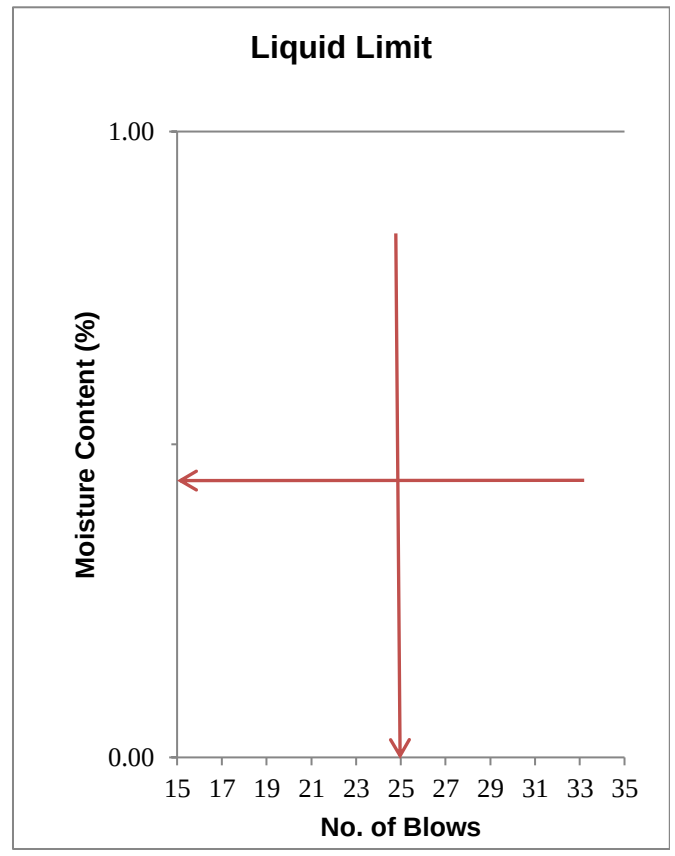
Prep Method: Moist ☐ Dry ☒ Accordance with ASTM D4318

Oversize: Pestle ☒ Grinder ☐

Client:	Qulliq Energy Corporation
Project:	Geotechnical Evaluation
Project Location:	Gjoa Haven - Option 1
Sample Source:	Boreholes (Geo)
Contact:	N/A

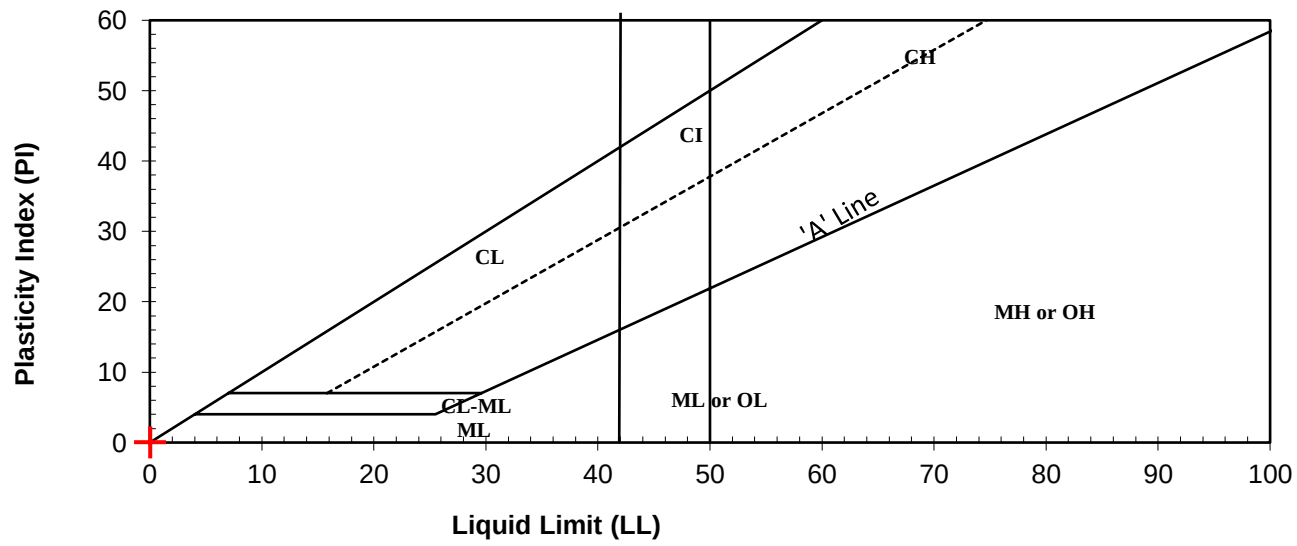
Date:	28-Sep-20
Project No.:	P-0023273
Sample No.:	1857
Technician:	CC / LS

Liquid Limit - Hand Operated Method			
Borehole: 3	**Sample No. GH OP-01**	**Depth:**	**Topsoil**
Container No.			
Mass of Empty Container (grams)	Non Plastic Sand		
Mass of Wet Soil + Container (grams)			
Mass of Dry Soil + Container (grams)			
Mass of Water (grams)			
Mass of Dry Soil (grams)			
% Moisture			
No. of Blows			
Liquid Limit from Flow Curve			



Plastic Limit - Manual Rolling Method		
Container No.	Non Plastic Sand	
Mass of Empty Container (grams)		
Mass of Wet Soil + Container (grams)		
Mass of Dry Soil + Container (grams)		
Mass of Water (grams)		
Mass of Dry Soil (grams)		
% Moisture		
Plastic Limit		

Groving Tool: Plastic ☒ Metal ☐



Summary

Liquid Limit:	
Plastic Limit:	
Plasticity Index:	
Unified Soil Classification:	

Reviewed By: Connor Carlson

16114 114 Ave NW Edmonton, Alberta Canada, T5M 2Z5 Ph: 780-481-1416

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ATTERBERG LIMITS

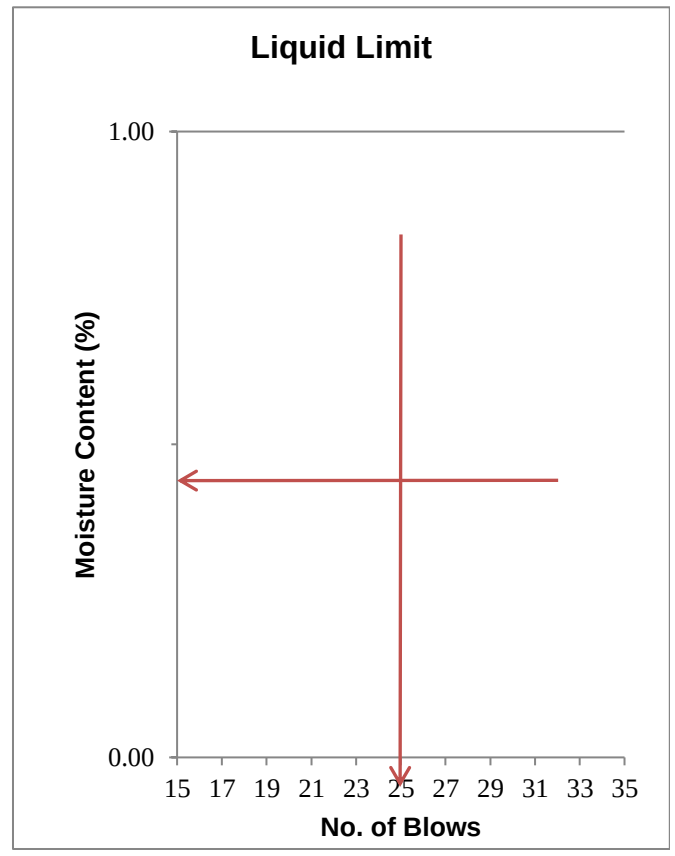
Prep Method: Moist ☐ Dry ☒ Accordance with ASTM D4318

Oversize: Pestle ☒ Grinder ☐

Client:	Qulliq Energy Corporation
Project:	Geotechnical Evaluation
Project Location:	Gjoa Haven - Option 1
Sample Source:	Boreholes (Geo)
Contact:	N/A

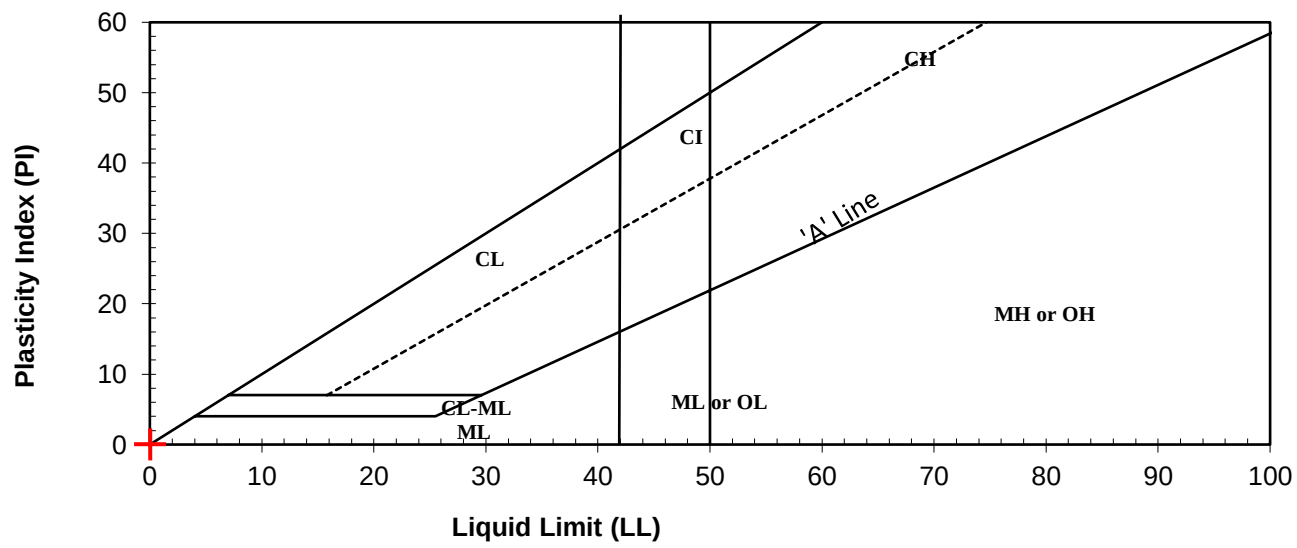
Date:	28-Sep-20
Project No.:	P-0023273
Sample No.:	1857
Technician:	CC / LS

Liquid Limit - Hand Operated Method			
Borehole: 5	**Sample No. GH OP-01**	**Depth:**	**1.5m**
Container No.			
Mass of Empty Container (grams)	Non Plastic Sand		
Mass of Wet Soil + Container (grams)			
Mass of Dry Soil + Container (grams)			
Mass of Water (grams)			
Mass of Dry Soil (grams)			
% Moisture			
No. of Blows			
Liquid Limit from Flow Curve			



Plastic Limit - Manual Rolling Method		
Container No.	Non Plastic Sand	
Mass of Empty Container (grams)		
Mass of Wet Soil + Container (grams)		
Mass of Dry Soil + Container (grams)		
Mass of Water (grams)		
Mass of Dry Soil (grams)		
% Moisture		
Plastic Limit		

Groving Tool: Plastic ☒ Metal ☐



Summary

Liquid Limit:	
Plastic Limit:	
Plasticity Index:	
Unified Soil Classification:	

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ATTERBERG LIMITS

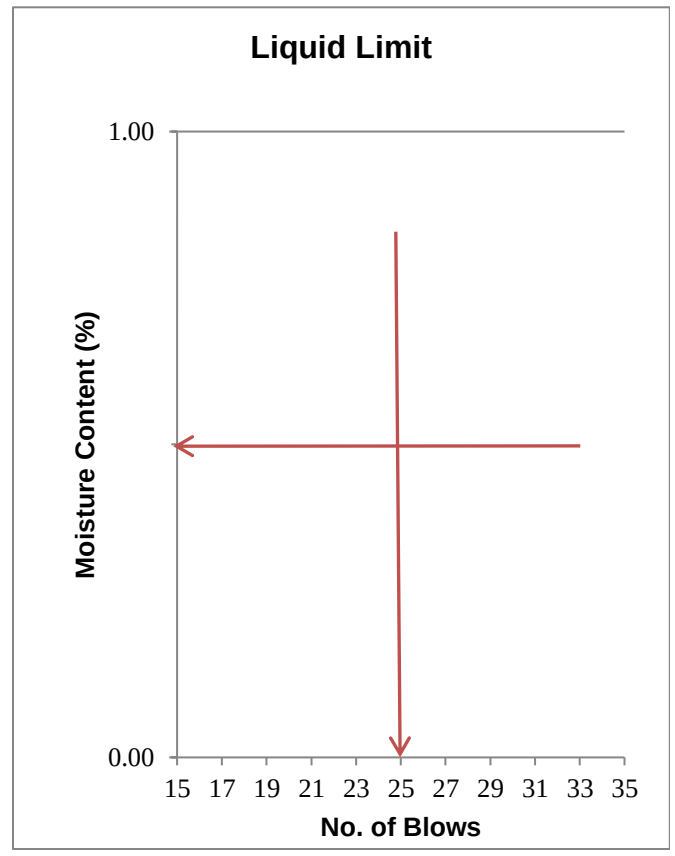
Prep Method: Moist ☐ Dry ☒ Accordance with ASTM D4318

Oversize: Pestle ☒ Grinder ☐

Client:	Qulliq Energy Corporation
Project:	Geotechnical Evaluation
Project Location:	Gjoa Haven - Option 1
Sample Source:	Boreholes (Geo)
Contact:	N/A

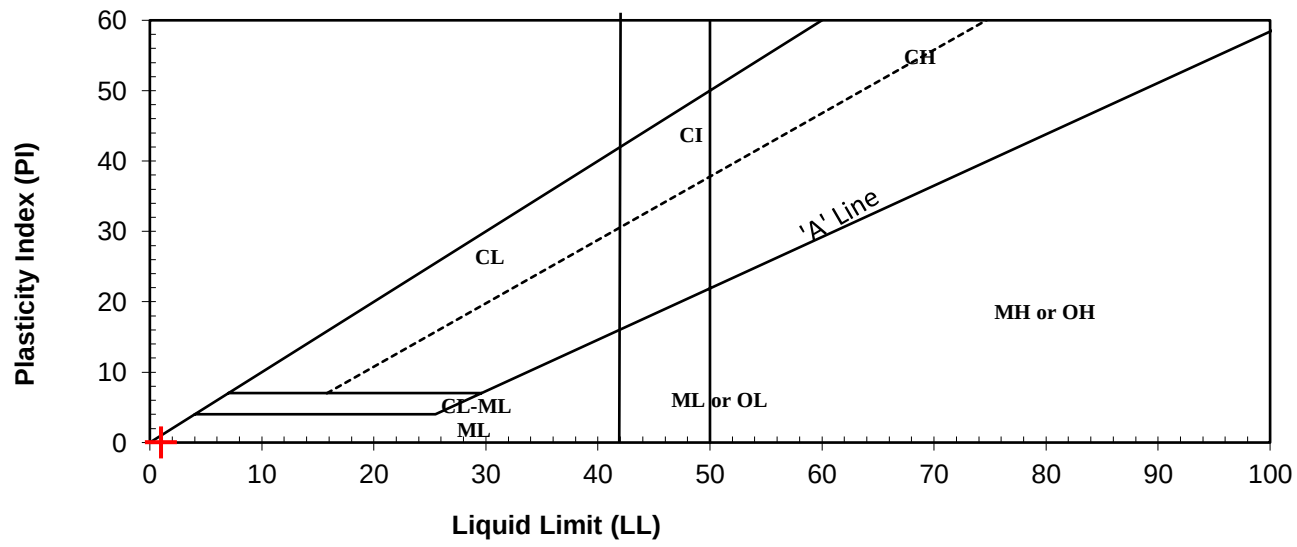
Date:	28-Sep-20
Project No.:	P-0023273
Sample No.:	1857
Technician:	CC / LS

Liquid Limit - Hand Operated Method			
Borehole: 8	**Sample No.** GH OP-01	**Depth:**	1.5m
Container No.			
Mass of Empty Container (grams)	Non Plastic Sand		
Mass of Wet Soil + Container (grams)			
Mass of Dry Soil + Container (grams)			
Mass of Water (grams)			
Mass of Dry Soil (grams)			
% Moisture			
No. of Blows			
Liquid Limit from Flow Curve			



Plastic Limit - Manual Rolling Method		
Container No.	Non Plastic Sand	
Mass of Empty Container (grams)		
Mass of Wet Soil + Container (grams)		
Mass of Dry Soil + Container (grams)		
Mass of Water (grams)		
Mass of Dry Soil (grams)		
% Moisture		
Plastic Limit		

Groving Tool: Plastic ☒ Metal ☐



Summary

Liquid Limit:	N/A
Plastic Limit:	N/A
Plasticity Index:	N/A
Unified Soil Classification:	**S**

Reviewed By: Connor Carlson

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Canada, T5M 2Z5
Ph: 780-481-1416

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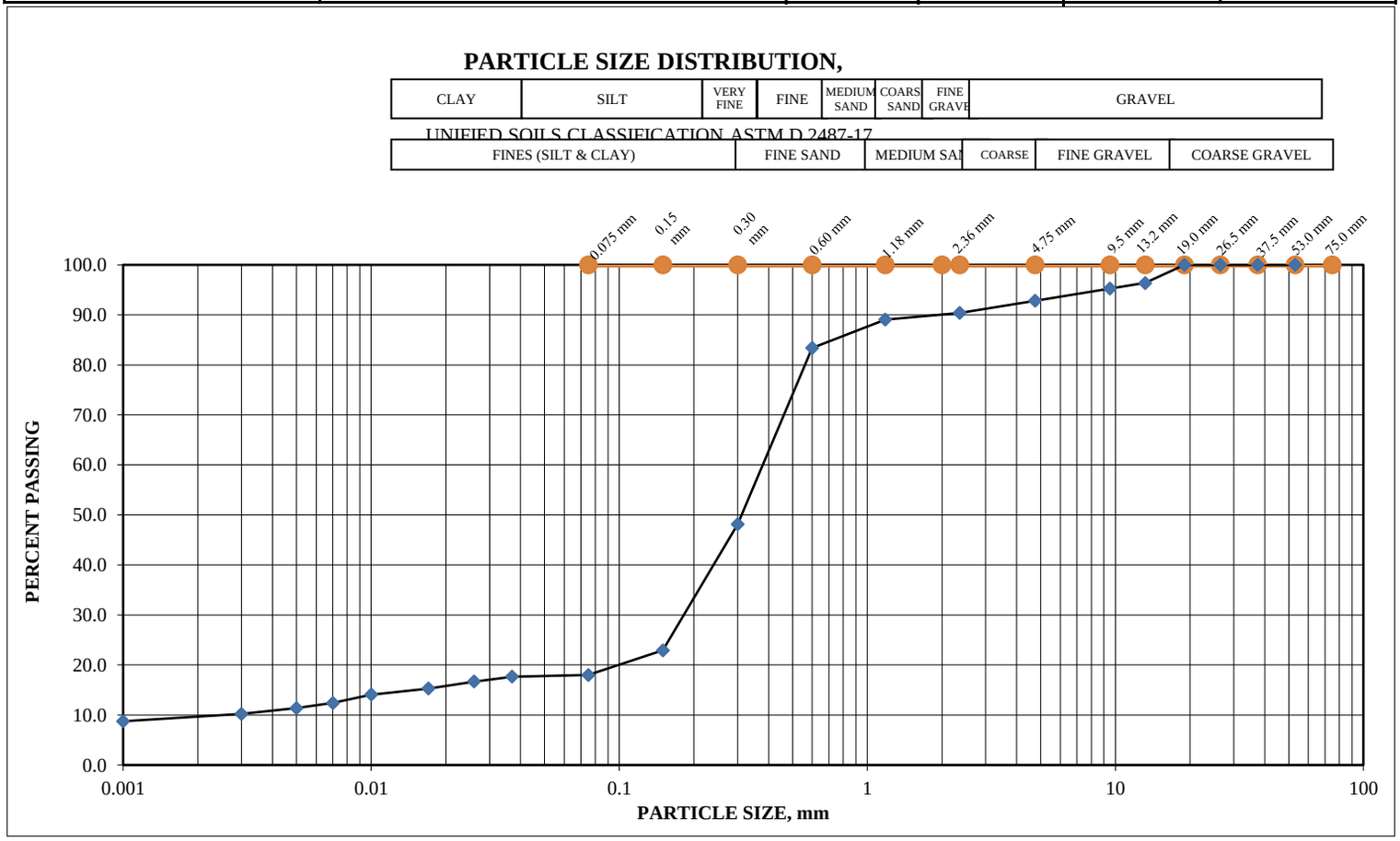
GRAIN SIZE ANALYSIS AND HYDROMETER TEST REPORT

ASTM D422 − 63

PROJECT NO:	P-0023273	**GRAIN SIZE ANALYSIS**		SAMPLE ID:	1857
CLIENT NAME:	Qulliq Energy Corporation				
PROJECT NAME:	Geotechnical Evaluation	SIEVE SIZE mm	% PASSING	JOB NO.:	N/A
PROJECT LOCATION:	Gjoa Haven - Option 1			SAMPLER:	Sharath
SAMPLING LOCATION:	BH 1	53	100.0	TESTER:	Camille
SAMPLING METHOD:	Grab Sample	37.5	100.0	**HYDROMETER ANALYSIS**	
SAMPLE NUMBER:	GH OP-01	26.5	100.0		
SAMPLING DEPTH, m:	1.5m	19	100.0	DIAMETER mm	% PASSING
SAMPLING DATE:	28-Sep-20	13.2	96.4		
GRAIN SIZE PROPORTIONS, %		9.5	95.2	0.037	17.7
		4.75	92.8	0.026	16.7
% GRAVEL (> 4.75 mm):	7.2	2.4	90.4	0.017	15.3
% SAND (75 µm to 4.75 mm):	74.8	1.18	89.0	0.01	14.1
% Silt (5 µm to 75 µm):	6.6	0.60	83.4	0.007	12.4
% Clay (<5 µm):	11.4	0.30	48.1	0.005	11.4
DELIVERED MOISTURE CONTENT:	11.2%	0.15	22.9	0.003	10.2
		0.075	18.0	0.001	8.7



Reviewed by: Connor Carlson

Rev:May 5,2018

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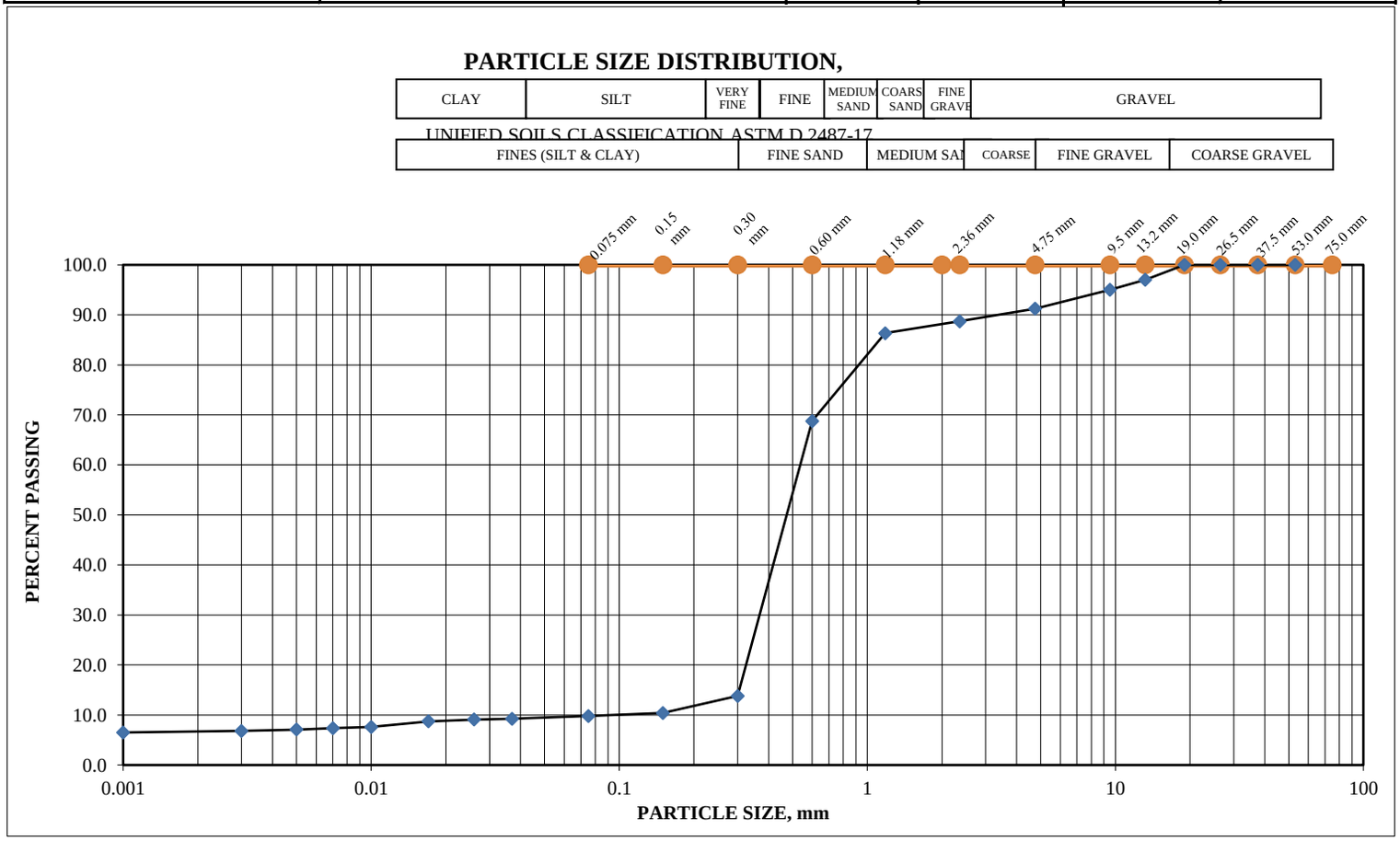
GRAIN SIZE ANALYSIS AND HYDROMETER TEST REPORT

ASTM D422 − 63

PROJECT NO:	P-0023273	**GRAIN SIZE ANALYSIS**		SAMPLE ID:	1857
CLIENT NAME:	Qulliq Energy Corporation				
PROJECT NAME:	Geotechnical Evaluation	SIEVE SIZE mm	% PASSING	JOB NO.:	N/A
PROJECT LOCATION:	Gjoa Haven - Option 1			SAMPLER:	Sharath
SAMPLING LOCATION:	BH 3	53	100.0	TESTER:	Camille
SAMPLING METHOD:	Grab Sample	37.5	100.0	**HYDROMETER ANALYSIS**	
SAMPLE NUMBER:	GH OP-01	26.5	100.0		
SAMPLING DEPTH, m:	Topsoil	19	100.0	DIAMETER mm	% PASSING
SAMPLING DATE:	28-Sep-20	13.2	97.0		
GRAIN SIZE PROPORTIONS, %		9.5	95.0	0.037	9.2
		4.75	91.2	0.026	9.1
% GRAVEL (> 4.75 mm):	8.8	2.4	88.7	0.017	8.7
% SAND (75 µm to 4.75 mm):	81.4	1.18	86.3	0.01	7.6
% Silt (5 µm to 75 µm):	2.7	0.60	68.8	0.007	7.4
% Clay (<5 µm):	7.1	0.30	13.8	0.005	7.1
DELIVERED MOISTURE CONTENT:	3.8%	0.15	10.4	0.003	6.8
		0.075	9.8	0.001	6.5



Reviewed by: Connor Carlson

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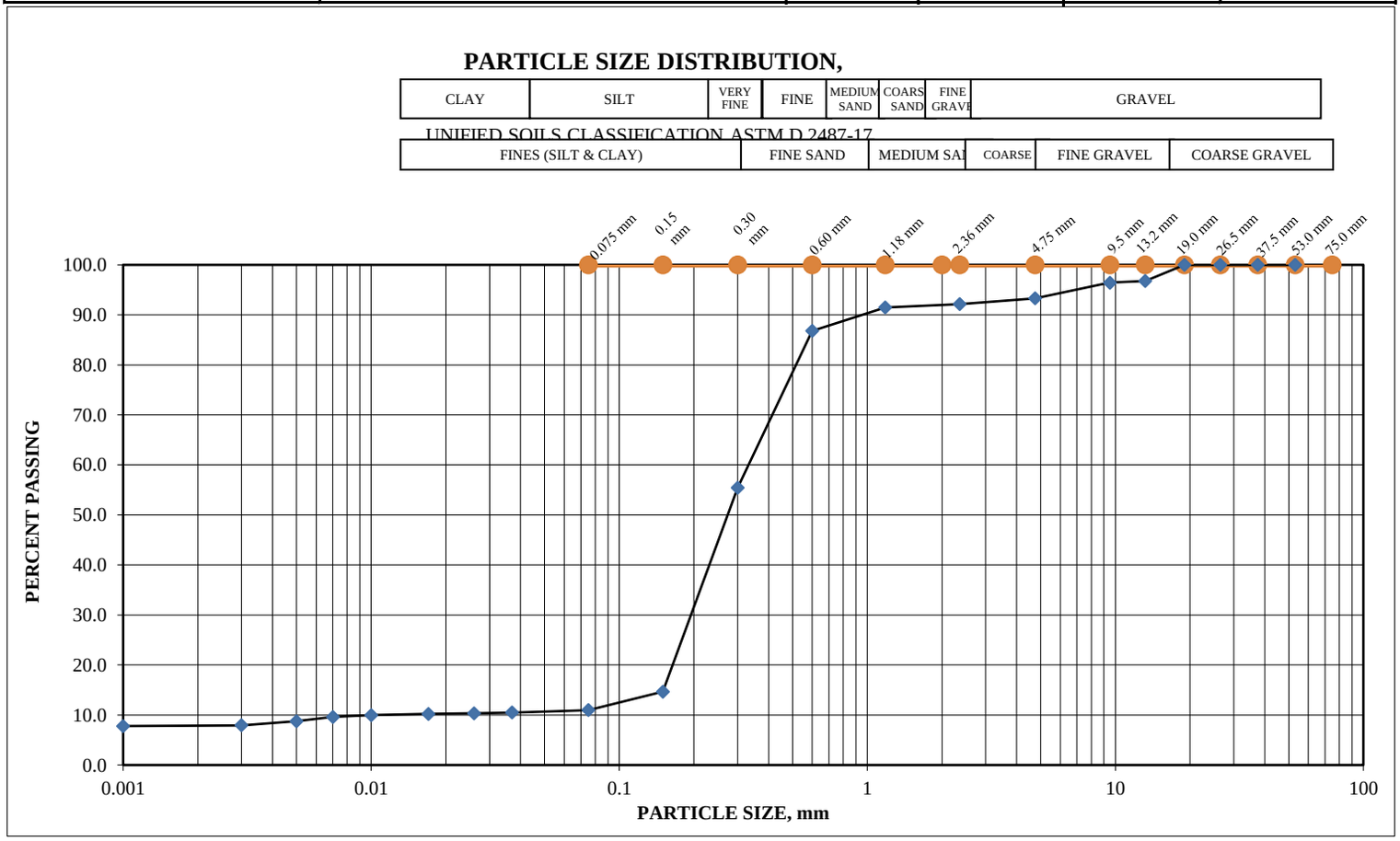
GRAIN SIZE ANALYSIS AND HYDROMETER TEST REPORT

ASTM D422 − 63

PROJECT NO:	P-0023273	**GRAIN SIZE ANALYSIS**		SAMPLE ID:	1857
CLIENT NAME:	Qulliq Energy Corporation				
PROJECT NAME:	Geotechnical Evaluation	SIEVE SIZE mm	% PASSING	JOB NO.:	N/A
PROJECT LOCATION:	Gjoa Haven - Option 1			SAMPLER:	Sharath
SAMPLING LOCATION:	BH 5	53	100.0	TESTER:	Camille
SAMPLING METHOD:	Grab Sample	37.5	100.0	**HYDROMETER ANALYSIS**	
SAMPLE NUMBER:	GH OP-01	26.5	100.0		
SAMPLING DEPTH, m:	1.5m	19	100.0	DIAMETER mm	% PASSING
SAMPLING DATE:	28-Sep-20	13.2	96.8		
GRAIN SIZE PROPORTIONS, %		9.5	96.4	0.037	10.5
		4.75	93.3	0.026	10.4
% GRAVEL (> 4.75 mm):	6.7	2.4	92.1	0.017	10.2
% SAND (75 µm to 4.75 mm):	82.3	1.18	91.5	0.01	10.0
% Silt (5 µm to 75 µm):	2.2	0.60	86.8	0.007	9.6
% Clay (<5 µm):	8.8	0.30	55.4	0.005	8.8
DELIVERED MOISTURE CONTENT:	16.7%	0.15	14.6	0.003	7.9
		0.075	11.0	0.001	7.8



Reviewed by: Connor Carlson

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GRAIN SIZE ANALYSIS AND HYDROMETER TEST REPORT

ASTM D422 − 63

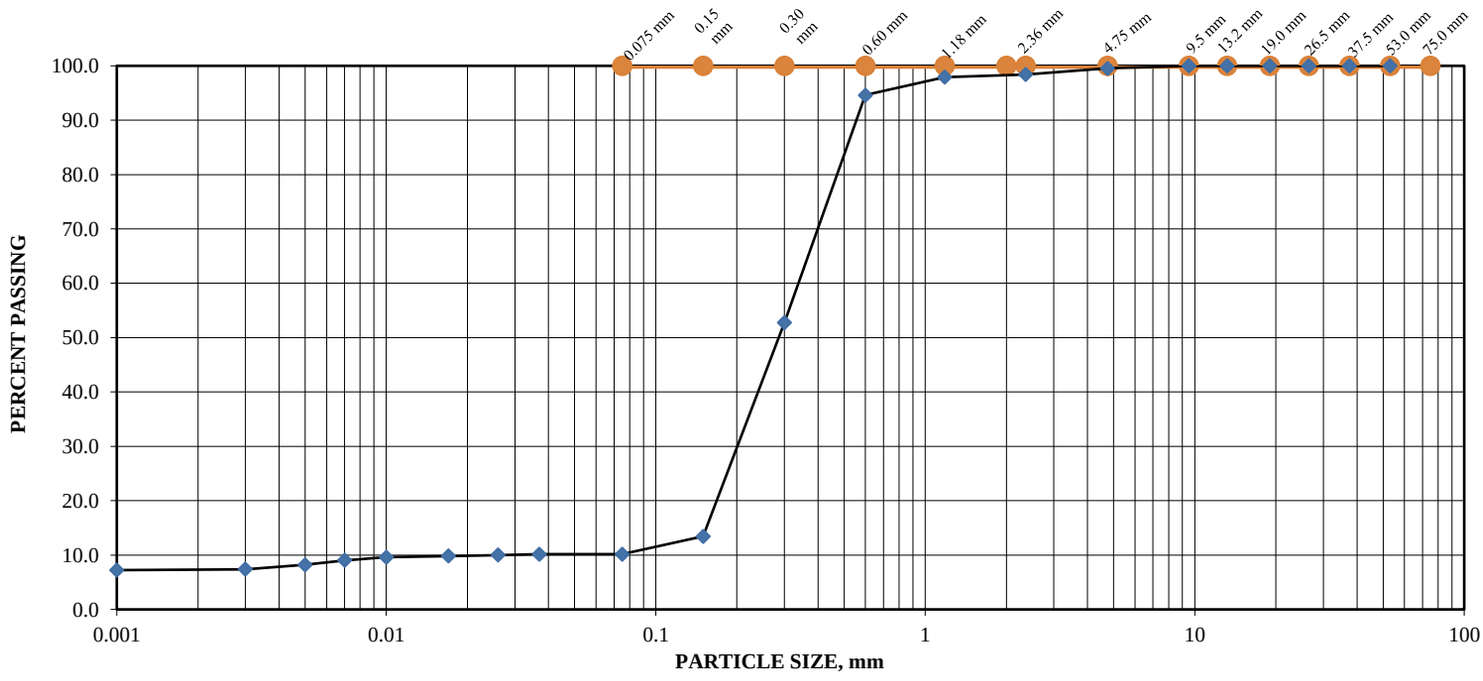
PROJECT NO:	P-0023273	**GRAIN SIZE ANALYSIS**		SAMPLE ID:	1857
CLIENT NAME:	Qulliq Energy Corporation				
PROJECT NAME:	Geotechnical Evaluation	SIEVE SIZE mm	% PASSING	JOB NO.:	N/A
PROJECT LOCATION:	Gjoa Haven - Option 1			SAMPLER:	Sharath
SAMPLING LOCATION:	BH 8	53	100.0	TESTER:	Camille
SAMPLING METHOD:	Grab Sample	37.5	100.0	**HYDROMETER ANALYSIS**	
SAMPLE NUMBER:	GH OP-01	26.5	100.0		
SAMPLING DEPTH, m:	1.5m	19	100.0	DIAMETER mm	% PASSING
SAMPLING DATE:	28-Sep-20	13.2	100.0		
GRAIN SIZE PROPORTIONS, %		9.5	100.0	0.037	10.1
		4.75	99.5	0.026	10.0
% GRAVEL (> 4.75 mm):	0.5	2.4	98.4	0.017	9.8
% SAND (75 µm to 4.75 mm):	89.4	1.18	97.9	0.01	9.6
% Silt (5 µm to 75 µm):	2.0	0.60	94.6	0.007	9.0
% Clay (<5 µm):	8.2	0.30	52.7	0.005	8.2
DELIVERED MOISTURE CONTENT:	18.5%	0.15	13.4	0.003	7.4
		0.075	10.2	0.001	7.2

PARTICLE SIZE DISTRIBUTION,

CLAY	SILT	VERY FINE	FINE	MEDIUM SAND	COARS SAND	FINE GRAVE	GRAVEL

UNIFIED SOILS CLASSIFICATION, ASTM D 2487-17

FINES (SILT & CLAY)	FINE SAND	MEDIUM SA	COARSE	FINE GRAVEL	COARSE GRAVEL



Reviewed by: Connor Carlson

Appendix 4 Chemical Analyses Results

AGAT Laboratories

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CANADA T6B 3P9
TEL (780)395-2525
FAX (780)462-2490
http://www.agatlabs.com

CLIENT NAME: **ENGLOBE CORP**
400, 606 - 4TH STREET S.W.
CALGARY, AB T2P1T1
(403) 699-9990

ATTENTION TO: **Kiran Chandra Prakash**

PROJECT: **P-0023273, QEC, Nunavut**

AGAT WORK ORDER: **20E661575**

SOIL ANALYSIS REVIEWED BY: **Melinda Guay, Technical Reviewer**

TRACE ORGANICS REVIEWED BY: **Jarrod Roberts, Operations Manager**

DATE REPORTED: **Oct 15, 2020**

PAGES (INCLUDING COVER): **12**

VERSION*: **1**

Should you require any information regarding this analysis please contact your client services representative at (780) 395-2525

*Notes

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FAX (780)462-2490
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 20E661575

PROJECT: P-0023273, QEC, Nunavut

CLIENT NAME: ENGLOBE CORP

ATTENTION TO: Kiran Chandra Prakash

SAMPLING SITE:

SAMPLED BY:

CCME / Tier 1 Metals (Soil)

DATE RECEIVED: 2020-10-08

DATE REPORTED: 2020-10-15

SAMPLE DESCRIPTION:				BH20-08, GHOP-1	BH20-04, GHOP-1	BH20-02, GHOP-1	BH20-05, GHOP-1	BH20-04, GHOP-5	BH20-02, GHOP-5
SAMPLE TYPE:				Soil	Soil	Soil	Soil	Soil	Soil
DATE SAMPLED:				2020-10-02	2020-10-02	2020-10-02	2020-10-02	2020-10-01	2020-10-01
Parameter	Unit	G / S	RDL	1549658	1549662	1549663	1549664	1549665	1549666
Antimony	mg/kg	20	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Arsenic	mg/kg	17	0.5	0.9	<0.5	0.6	0.6	2.4	1.2
Barium	mg/kg	750	0.5	6.5	3.7	6.6	5.8	19.8	22.2
Beryllium	mg/kg	5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cadmium	mg/kg	1.4	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	mg/kg	64	0.5	5.9	3.8	5.3	4.3	8.8	5.8
Cobalt	mg/kg	20	0.5	1.0	0.6	0.8	0.8	1.8	1.1
Copper	mg/kg	63	0.5	3.2	1.3	2.9	1.7	8.0	4.2
Lead	mg/kg	70	0.5	1.7	0.8	1.9	1.3	4.9	3.3
Molybdenum	mg/kg	4	0.5	<0.5	<0.5	<0.5	<0.5	1.8	<0.5
Nickel	mg/kg	45	0.5	2.1	1.5	1.8	2.1	3.8	3.0
Selenium	mg/kg	1	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Silver	mg/kg	20	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Thallium	mg/kg	1	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Tin	mg/kg	5	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Uranium	mg/kg	23	0.5	<0.5	<0.5	0.7	<0.5	0.9	<0.5
Vanadium	mg/kg	130	0.5	4.8	2.9	4.8	4.2	9.8	4.9
Zinc	mg/kg	250	1	3	3	4	9	6	5

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to Alberta Tier 1 - Soil - Agricultural - Fine
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

1549658-1549666 Results are based on the dry weight of the sample.

Analysis performed at AGAT Edmonton (unless marked by *)

Certified By:

AGAT Laboratories

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Certificate of Analysis

AGAT WORK ORDER: 20E661575

PROJECT: P-0023273, QEC, Nunavut

CLIENT NAME: ENGLOBE CORP

ATTENTION TO: Kiran Chandra Prakash

SAMPLING SITE:

SAMPLED BY:

Soil Analysis - Salinity (pH Calcium Chloride)

DATE RECEIVED: 2020-10-08

DATE REPORTED: 2020-10-14

SAMPLE DESCRIPTION:				BH20-08, GHOP-1	BH20-04, GHOP-1	BH20-02, GHOP-1	BH20-05, GHOP-1		BH20-04, GHOP-5		BH20-02, GHOP-5
SAMPLE TYPE:				Soil	Soil	Soil	Soil		Soil		Soil
DATE SAMPLED:				2020-10-02	2020-10-02	2020-10-02	2020-10-02		2020-10-01		2020-10-01
Parameter	Unit	G / S	RDL	1549658	1549662	1549663	1549664	RDL	1549665	RDL	1549666
pH (CaCl2 Extraction)	pH Units		N/A	7.77	7.72	7.87	7.84	N/A	8.03	N/A	8.10
Electrical Conductivity (Sat. Paste)	dS/m		0.05	0.98	0.90	0.41	0.82	0.05	8.76	0.05	1.25
Sodium Adsorption Ratio	N/A		0.34	5.41	4.13	1.77	4.81	0.34	20.6	0.34	6.60
Saturation Percentage	%		1	34	54	27	37	1	47	1	26
Chloride, Soluble	mg/L		5	234	178	53	206	5	3100	5	318
Calcium, Soluble	mg/L		1	19	27	22	16	1	88	1	20
Potassium, Soluble	mg/L		2	13	8	6	10	2	104	2	17
Magnesium, Soluble	mg/L		1	13	15	9	11	1	138	1	17
Sodium, Soluble	mg/L		2	125	108	39	102	2	1330	2	166
Sulfate, Soluble	mg/L		2	131	124	64	62	10	782	2	151
Theoretical Gypsum Requirement	tonnes/ha		0.01	<0.01	<0.01	<0.01	<0.01	0.01	9.52	0.01	<0.01
Calcium, Soluble (meq/L)	meq/L		0.05	0.95	1.35	1.10	0.80	0.05	4.39	0.05	1.00
Calcium, Soluble (mg/kg)	mg/kg		1	6	15	6	6	1	41	1	5
Chloride, Soluble (meq/L)	meq/L		0.06	6.60	5.02	1.49	5.81	0.06	87.4	0.06	8.97
Chloride, Soluble (mg/kg)	mg/kg		2	80	96	14	76	2	1460	2	83
Magnesium, Soluble (meq/L)	meq/L		0.08	1.07	1.23	0.74	0.91	0.08	11.4	0.08	1.40
Magnesium, Soluble (mg/kg)	mg/kg		1	4	8	2	4	1	65	1	4
Potassium, Soluble (meq/L)	meq/L		0.05	0.33	0.20	0.15	0.26	0.05	2.66	0.05	0.43
Potassium, Soluble (mg/kg)	mg/kg		2	4	4	<2	4	2	49	2	4
Sodium, Soluble (meq/L)	meq/L		0.09	5.44	4.70	1.70	4.44	0.09	57.9	0.09	7.22
Sodium, Soluble (mg/kg)	mg/kg		2	43	58	11	38	2	625	2	43
Sulfur (as Sulfate), Soluble (meq/L)	meq/L		0.04	2.73	2.58	1.33	1.29	0.04	16.3	0.04	3.14
Sulfur (as Sulfate), Soluble (mg/kg)	mg/kg		2	45	67	17	23	2	368	2	39

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Certificate of Analysis

AGAT WORK ORDER: 20E661575

PROJECT: P-0023273, QEC, Nunavut

CLIENT NAME: ENGLOBE CORP

ATTENTION TO: Kiran Chandra Prakash

SAMPLING SITE:

SAMPLED BY:

Soil Analysis - Salinity (pH Calcium Chloride)

DATE RECEIVED: 2020-10-08

DATE REPORTED: 2020-10-14

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

1549658-1549666 If sodium results in mg/L are less than detection, SAR is non-calculable and is reported as 0.
Sodium Adsorption Ratio is a calculated parameter. The calculated value is the ratio of the sodium concentration in mmol/L over the square rooted sum of the calcium and magnesium concentrations in mmol/L.
Theoretical Gypsum Requirement is a calculated parameter. The calculation is from “A Comparison of Methods for Gypsum Requirement of Brine-Contaminated Soils”, Canadian Journal of Soil Science, 1998.

Analysis performed at AGAT Edmonton (unless marked by *)

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AGAT WORK ORDER: 20E661575

PROJECT: P-0023273, QEC, Nunavut

CLIENT NAME: ENGLOBE CORP

ATTENTION TO: Kiran Chandra Prakash

SAMPLING SITE:

SAMPLED BY:

Petroleum Hydrocarbons (BTEX/F1-F4) in Soil (CWS) (Methanol Field Stabilized)

DATE RECEIVED: 2020-10-08

DATE REPORTED: 2020-10-14

		SAMPLE DESCRIPTION:		BH20-08, GHOP-1	BH20-04, GHOP-1	BH20-02, GHOP-1	BH20-05, GHOP-1	BH20-04, GHOP-5	BH20-02, GHOP-5
		SAMPLE TYPE:		Soil	Soil	Soil	Soil	Soil	Soil
		DATE SAMPLED:		2020-10-02	2020-10-02	2020-10-02	2020-10-02	2020-10-01	2020-10-01
Parameter	**Unit**	**G / S**	**RDL**	**1549658**	**1549662**	**1549663**	**1549664**	**1549665**	**1549666**
Benzene	mg/kg		0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Toluene	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ethylbenzene	mg/kg		0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Xylenes	mg/kg		0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
C6 - C10 (F1)	mg/kg		10	<10	<10	<10	<10	<10	<10
C6 - C10 (F1 minus BTEX)	mg/kg		10	<10	<10	<10	<10	<10	<10
C10 - C16 (F2)	mg/kg		10	10	<10	<10	<10	60	<10
C16 - C34 (F3)	mg/kg		10	130	80	70	20	110	70
C34 - C50 (F4)	mg/kg		10	<10	<10	<10	<10	<10	<10
Gravimetric Heavy Hydrocarbons	mg/kg		1000	N/A	N/A	N/A	N/A	N/A	N/A
Moisture Content	%		1	19	10	12	21	6	16
Surrogate	**Unit**	**Acceptable Limits**							
Toluene-d8 (BTEX)	%	60-140		104	105	104	104	105	104
Ethylbenzene-d10 (BTEX)	%	60-140		137	108	70	136	130	72
o-Terphenyl (F2-F4)	%	60-140		68	69	69	68	70	72

Certified By:

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Certificate of Analysis

AGAT WORK ORDER: 20E661575

PROJECT: P-0023273, QEC, Nunavut

CLIENT NAME: ENGLOBE CORP

ATTENTION TO: Kiran Chandra Prakash

SAMPLING SITE:

SAMPLED BY:

Petroleum Hydrocarbons (BTEX/F1-F4) in Soil (CWS) (Methanol Field Stabilized)

DATE RECEIVED: 2020-10-08

DATE REPORTED: 2020-10-14

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

1549658-1549666

Results are based on the dry weight of the sample.
The C6-C10 (F1) fraction is calculated using toluene response factor.
The C10 - C16 (F2), C16 - C34 (F3), and C34 - C50 (F4) fractions are calculated using the average response factor for n-C10, n-C16, and n-C34.
Gravimetric Heavy Hydrocarbons (F4g) are not included in and cannot be added to the Total C6-C50 and are only determined if the chromatogram of the C34 - C50 hydrocarbons indicates that hydrocarbons >C50 are present.
Total C6 - C50 results are corrected for BTEX and PAH contributions (if requested).
Quality control data is available upon request.
Assistance in the interpretation of data is available upon request.
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
nC6 and nC10 response factors are within 30% of Toluene response factor.
nC10, nC16 and nC34 response factors are within 10% of their average.
C50 response factor is within 70% of nC10 + nC16 + nC34 average.
Linearity is within 15%.
The chromatogram returned to baseline by the retention time of nC50.
Extraction and holding times were met for this sample.
C6 –C10 (F1 minus BTEX) is a calculated parameter. The calculated value is F1 minus BTEX.
Xylenes is a calculated parameter. The calculated value is the sum of m&p-Xylenes + o-Xylene.

Analysis performed at AGAT Edmonton (unless marked by *)

Certified By:

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Quality Assurance

CLIENT NAME: ENGLOBE CORP

AGAT WORK ORDER: 20E661575

PROJECT: P-0023273, QEC, Nunavut

ATTENTION TO: Kiran Chandra Prakash

SAMPLING SITE:

SAMPLED BY:

Soil Analysis

RPT Date:			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
CCME / Tier 1 Metals (Soil)															
Antimony	289	1556027	<0.5	<0.5	NA	< 0.5	91%	70%	130%	92%	80%	120%	93%	70%	130%
Arsenic	289	1556027	0.7	0.7	NA	< 0.5	108%	80%	120%	107%	80%	120%	108%	80%	120%
Barium	289	1556027	29.4	24.5	18.2%	< 0.5	102%	70%	130%	100%	80%	120%	105%	70%	130%
Beryllium	289	1556027	<0.5	<0.5	NA	< 0.5	98%	70%	130%	92%	80%	120%	109%	70%	130%
Cadmium	289	1556027	<0.5	<0.5	NA	< 0.5	96%	70%	130%	97%	80%	120%	98%	70%	130%
Chromium	289	1556027	2.0	1.9	NA	< 0.5	103%	70%	130%	92%	80%	120%	108%	70%	130%
Cobalt	289	1556027	1.1	1.0	NA	< 0.5	104%	70%	130%	89%	80%	120%	102%	70%	130%
Copper	289	1556027	3.5	3.1	12.1%	< 0.5	103%	70%	130%	91%	80%	120%	108%	70%	130%
Lead	289	1556027	1.5	1.3	NA	< 0.5	103%	70%	130%	105%	80%	120%	105%	70%	130%
Molybdenum	289	1556027	<0.5	<0.5	NA	< 0.5	99%	70%	130%	98%	80%	120%	98%	70%	130%
Nickel	289	1556027	2.9	2.4	NA	< 0.5	88%	70%	130%	89%	80%	120%	105%	70%	130%
Selenium	289	1556027	<0.5	<0.5	NA	< 0.5	93%	70%	130%	96%	80%	120%	97%	70%	130%
Silver	289	1556027	<0.5	<0.5	NA	< 0.5	98%	70%	130%	97%	80%	120%	98%	70%	130%
Thallium	289	1556027	<0.5	<0.5	NA	< 0.5	101%	70%	130%	101%	80%	120%	100%	70%	130%
Tin	289	1556027	1.2	0.6	NA	< 0.5	93%	70%	130%	95%	80%	120%	81%	70%	130%
Uranium	289	1556027	<0.5	<0.5	NA	< 0.5	100%	70%	130%	104%	80%	120%	109%	70%	130%
Vanadium	289	1556027	3.0	2.9	3.4%	< 0.5	104%	70%	130%	93%	80%	120%	106%	70%	130%
Zinc	289	1556027	8	7	13.3%	< 1	113%	70%	130%	96%	80%	120%	125%	70%	130%

Comments: If Matrix spike value is NA, the spiked analyte concentration was lower than that of the matrix contribution.
If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated.
With multi element runs, a maximum of 10% for each QC parameter may fail to an absolute maximum of 10%

Soil Analysis - Salinity (pH Calcium Chloride)															
pH (CaCl2 Extraction)	288	1554178	7.57	7.56	0.1%	N/A	100%	90%	110%						
Electrical Conductivity (Sat. Paste)	288	1554178	3.20	3.12	2.5%	< 0.05	107%	80%	120%						
Saturation Percentage	288	1554178	53	54	1.9%	< 1	102%	80%	120%						
Chloride, Soluble	126	1554178	902	901	0.2%	< 5	98%	70%	130%	106%	80%	120%	100%	70%	130%
Calcium, Soluble	288	1555263	346	349	0.8%	< 1	93%	70%	130%	109%	80%	120%	103%	70%	130%
Potassium, Soluble	288	1555263	13	14	1.8%	< 2	90%	70%	130%	99%	80%	120%	111%	70%	130%
Magnesium, Soluble	288	1555263	40	41	1.5%	< 1	94%	70%	130%	93%	80%	120%	121%	70%	130%
Sodium, Soluble	288	1555263	13	13	1.1%	< 2	93%	70%	130%	103%	80%	120%	108%	70%	130%
Sulfate, Soluble	288	1555263	1000	991	1.3%	< 2	90%	70%	130%	102%	80%	120%	75%	70%	130%

Comments: If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated
If Matrix spike value is NA, the spiked analyte concentration was lower than that of the matrix contribution.

Certified By:

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Quality Assurance

CLIENT NAME: ENGLOBE CORP

AGAT WORK ORDER: 20E661575

PROJECT: P-0023273, QEC, Nunavut

ATTENTION TO: Kiran Chandra Prakash

SAMPLING SITE:

SAMPLED BY:

Trace Organics Analysis

RPT Date:			DUPLICATE			Method Blank	REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD		Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Petroleum Hydrocarbons (BTEX/F1-F4) in Soil (CWS) (Methanol Field Stabilized)															
Benzene	2431	1549662	<0.005	<0.005	NA	< 0.005	118%	60%	140%	78%	60%	140%	83%	60%	140%
Toluene	2431	1549662	<0.05	<0.05	NA	< 0.05	119%	60%	140%	81%	60%	140%	91%	60%	140%
Ethylbenzene	2431	1549662	<0.01	<0.01	NA	< 0.01	117%	60%	140%	87%	60%	140%	93%	60%	140%
C6 - C10 (F1)	2431	1549662	<10	<10	NA	< 10	82%	60%	140%	93%	60%	140%	91%	60%	140%
C10 - C16 (F2)	1270	1549662	<10	<10	NA	< 10	103%	60%	140%	82%	60%	140%	81%	60%	140%
C16 - C34 (F3)	1270	1549662	80	80	0.0%	< 10	104%	60%	140%	88%	60%	140%	87%	60%	140%
C34 - C50 (F4)	1270	1549662	<10	<10	NA	< 10	101%	60%	140%	75%	60%	140%	77%	60%	140%
Moisture Content	2431	1549662	9	10	10.5%	< 1									

Comments: If the RPD value is NA, the results of the duplicates are under 5X the RDL and will not be calculated.
The sample spikes and dups are not from the same sample ID.

Certified By:

AGAT Laboratories

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Method Summary

CLIENT NAME: ENGLOBE CORP

AGAT WORK ORDER: 20E661575

PROJECT: P-0023273, QEC, Nunavut

ATTENTION TO: Kiran Chandra Prakash

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Soil Analysis			
Antimony	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Arsenic	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Barium	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Beryllium	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Cadmium	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Chromium	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP/MS
Cobalt	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Copper	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Lead	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Molybdenum	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Nickel	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Selenium	INORG-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Silver	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Thallium	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Tin	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Uranium	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Vanadium	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
Zinc	INOR-171-6006, INOR-171-6202	EPA SW 846-3050; SM 3125 B	ICP-MS
pH (CaCl2 Extraction)	INOR-171-6207	SHEPPARD 2007; HENDERSHOT 2008	PH METER
Electrical Conductivity (Sat. Paste)	INOR-171-6208	SHEPPARD 2007; MILLER 2007	CONDUCTIVITY METER
Sodium Adsorption Ratio	INOR-171-6201 & INOR-171-6002	McKeague 3.26	CALCULATION
Saturation Percentage	INOR-171-6002	MILLER 2007; SHEPPARD 2007	GRAVIMETRIC
Chloride, Soluble	INOR-171-6212	CARTER & GREGORICH 2007, SM 3120B	COLORIMETER
Calcium, Soluble	INOR-171-6201	CARTER & GREGORICH 2007, SM 3120B	ICP/OES
Potassium, Soluble	INOR-171-6201	CARTER & GREGORICH 2007, SM 3120B	ICP/OES
Magnesium, Soluble	INOR-171-6201	CARTER & GREGORICH 2007, SM 3120B	ICP/OES
Sodium, Soluble	INOR-171-6201	CARTER & GREGORICH 2007, SM 3120B	ICP/OES
Sulfate, Soluble	SOIL 0110; SOIL 0120; INST 0140	SHEPPARD 2007; EATON 2005	ICP/OES

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Method Summary

CLIENT NAME: ENGLOBE CORP

AGAT WORK ORDER: 20E661575

PROJECT: P-0023273, QEC, Nunavut

ATTENTION TO: Kiran Chandra Prakash

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Theoretical Gypsum Requirement	INOR-171-6201 & INOR-171-6002	USDA HDBK 60, 22D	CALCULATION
Trace Organics Analysis			
Benzene	ORG-170-5110/5140/5430/5440	EPA SW-846 8260	GC/MS
Toluene	ORG-170-5110/5140/5430/5440	EPA SW-846 8260	GC/MS
Ethylbenzene	ORG-170-5110/5140/5430/5440	EPA SW-846 8260	GC/MS
Xylenes	ORG-170-5110/5140/5430/5440	EPA SW-846 8260	GC/MS
C6 - C10 (F1)	ORG-170-5110/5140/5430/5440	CCME Tier 1 Method	GC/FID
C6 - C10 (F1 minus BTEX)	ORG-170-5110/5140/5430/5440	CCME Tier 1 Method	GC/FID
C10 - C16 (F2)	ORG-170-5120/5300	CCME Tier 1 Method	GC/FID
C16 - C34 (F3)	ORG-170-5120/5300	CCME Tier 1 Method	GC/FID
C34 - C50 (F4)	ORG-170-5120/5300	CCME Tier 1 Method	GC/FID
Gravimetric Heavy Hydrocarbons	ORG-170-5120/5300	CCME Tier 1 Method	GC/FID
Moisture Content	LAB-175-4002	CCME Tier 1 Method	GRAVIMETRIC
Toluene-d8 (BTEX)	ORG-170-5110/5140/5430/5440	EPA SW-846 8260-S	GC/MS
Ethylbenzene-d10 (BTEX)	ORG-170-5110/5140/5430/5440	EPA SW-846 8260-S	GC/MS
o-Terphenyl (F2-F4)	ORG-170-5120/5300	CCME Tier 1 Method	GC/FID

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Calgary, Alberta T2E 7P7
P: 403-735-2005 • F: 403-735-2771
webearth.agatlabs.com

Laboratory Use Only
Arrival Temperature: 9.3°c
AGAT Job Number: 20E661575
Date and Time: 20 OCT 13:24

Chain of Custody Record

Emergency Support Services Hotline 1-855-AGAT 245 (1-855-242-8245)

Report Information
Company: Englobe Corp
Contact: Kiran Chandra Prakash
Address: 16114, 114 Ave NW, Edmonton, AB
Phone: 780 394 5308 Fax:
LSD:
Client Project #: P-0023273, BEC, Nunavut
Sampled By: Sharath Sukrutha

Report Information
1. Name: Kiran Chandra Prakash
Email: kiran.chandra.prakash@englobecorp.com
2. Name:
Email:
3. Name:
Email:

Turnaround Time Required (TAT)
Regular TAT ☑ 5 to 7 Business Days
Rush TAT ☐ <24 Hours (200%) ☐ Two Day / Next Day (100%) ☐ Three Day (50%) ☐ Four Day (25%)
Date Required:

Report Format
☑ Single sample per page
☐ Multiple samples per page
☐ Export

Invoice To Same Yes ☐ / No ☐
Company:
Contact:
Address:
Phone: Fax:
PO/AFE#:
AGAT ID/Quote #:

Requirements *(Selection may impact detection limits)*
☐ CCME ☐ Agricultural ☐ Industrial ☐ Residential/Park ☐ Commercial ☐ FWAL
☐ AB Tier 1 ☐ Agricultural ☐ Industrial ☐ Residential/Park ☐ Commercial ☐ Natural Area
☐ Alberta Surface Water ☐ Chronic ☐ Acute ☐ SK Notice of Site Condition ☐ Drinking Water ☐ Other:
Is this part of the Alberta SRP program? ☐ YES ☐ NO (If yes, please fill below)
Application Number:
Grant Amount:
Well/Facility/Location ID:
UWI:

LABORATORY USE (LAB ID #)		SAMPLE IDENTIFICATION	DEPTH	DATE/TIME SAMPLED	SAMPLE MATRIX	COMMENTS (FILTERED, PRESERVED, HAZARDOUS*) *ADDITIONAL FEE	# OF CONTAINERS VIALS / JARS	BAGS	BOTTLES
1	96058	BH20-08, GH OP-1	1.5	2nd oct	Soil		2		1
2	662	BH20-04, GH OP-1	1.5	"			2		1
3	663	BH20-02, GH OP-1	1.5	"			2		1
4	664	BH20-03, GH OP-1	1.5	"			2		1
5	665	BH20-04, GH OP-5	3m	1st oct			2		1
6	666	BH20-02, GH OP-5	4.5m	"			2		1
7									
8									
9									
10									

Detailed Salinity: ☐ AB ☐ SK ☐ BC ☐ D50
☐ CCME/AB : BTEX/F1-F4 ☐ CCME/AB : BTEX/F1-F2 ☐ BC: BTEXS/VPH/EPH ☐ BC: LEPH/HEPH
SK: BTEX/TVH/C11-C22, C23-C60
Soil Metals: ☐ HWS-B ☐ SP-B ☐ Hg ☐ Cr^{6+}
Water Metals: ☐ Dissolved ☐ Total ☐ Hg ☐ Cr^{6+}
Routine Water Chemistry
Landfill: ☐ AB Class 2 ☐ BC ☐ SK
Coliforms: ☐ Total ☐ Fecal ☐ E.coli
Particle Size: ☐ Sieve (75µm) ☐ Texture

	metals	Salinity	BTEX F1-F4	Hydrocarbons
1	✓	✓	✓	✓
2	✓	✓	✓	✓
3	✓	✓	✓	✓
4	✓	✓	✓	✓
5	✓	✓	✓	✓
6	✓	✓	✓	✓

HOLD FOR 30 DAYS NO ANALYSIS (Additional Fee)
HOLD FOR 30 DAYS AFTER ANALYSIS (Additional Fee)

Samples Relinquished By (Print Name and Sign):	Date/Time	Samples Received By (Print Name and Sign):	Date/Time
SHARATH SUKRUTHA	2nd oct		

Pink Copy - Client
Yellow Copy - AGAT
White Copy- AGAT

Page _____ of _____
N°: AB 146048

AGAT Laboratories

SAMPLE INTEGRITY RECEIPT FORM

RECEIVING BASICS - Shipping

Company/Consultant: ENGLOBE

Courier: C-B / PO — Prepaid Collect

Waybill#: —

Branch: EDM GP FN FM RD VAN LYD FSJ EST SASK Other:

If multiple sites were submitted at once: Yes (No)

Custody Seal Intact: Yes No (NA)

TAT: <24hr 24-48hr 48-72hr (Reg) Other

Cooler Quantity: 1

TIME SENSITIVE ISSUES - Shipping

ALREADY EXCEEDED HOLD TIME? Yes (No)

Inorganic Tests (Please Circle): Mibi , BOD , Nitrate/Nitrite , Turbidity , Color , Microtox , Ortho PO4 , Tedlar Bag , Residual Chlorine , Chlorophyll* , Chloroamines*

Earliest Expiry: —

Hydrocarbons: Earliest Expiry TR

SAMPLE INTEGRITY - Shipping

Hazardous Samples: YES (NO) Precaution Taken:

Legal Samples: Yes (No)

International Samples: Yes (No)

Tape Sealed: Yes (No)

Coolant Used: Icepack Bagged Ice Free Ice Free Water (None)

Temperature (Bottles/Jars only) N/A if only Soil Bags Received

FROZEN (Please Circle if samples received Frozen)

1 (Bottle/Jar) 9.7+9.0+9.3=9.3 °C

2(Bottle/Jar)___+___+___=____ °C

3 (Bottle/Jar)___+___+___=____ °C

4 (Bottle/Jar)___+___+___=____ °C

5 (Bottle/Jar)___+___+___=____ °C

6 (Bottle/Jar)___+___+___=____ °C

7 (Bottle/Jar)___+___+___=____ °C

8 (Bottle/Jar)___+___+___=____ °C

9 (Bottle/Jar)___+___+___=____ °C

10 (Bottle/Jar)___+___+___=____ °C

(If more than 10 coolers are received use another sheet of paper and attach)

LOGISTICS USE ONLY

Workorder No: 20EC061575

Samples Damaged: Yes (No) If YES why?

No Bubble Wrap Frozen Courier

Other:

Account Project Manager: _____ have they been notified of the above issues: Yes No

Whom spoken to: _____ Date/Time: _____

CPM Initial_____

General Comments: _____ **JARS** were packed with **VIALS** _____

* Subcontracted Analysis (See CPM)

Date issued: March 11, 2020

Appendix 5 Seismic Hazard Calculations

2015 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Site: 68.621N 95.863W **User File Reference:** Gjoa Haven 2021-01-08 15:56 UT

Requested by: Englobe

Probability of exceedance per annum	0.000404	0.001	0.0021	0.01
Probability of exceedance in 50 years	2 %	5 %	10 %	40 %
Sa (0.05)	0.147	0.081	0.048	0.012
Sa (0.1)	0.187	0.109	0.067	0.019
Sa (0.2)	0.165	0.100	0.063	0.019
Sa (0.3)	0.130	0.080	0.052	0.016
Sa (0.5)	0.096	0.060	0.038	0.012
Sa (1.0)	0.050	0.031	0.020	0.005
Sa (2.0)	0.024	0.014	0.009	0.002
Sa (5.0)	0.005	0.003	0.002	0.001
Sa (10.0)	0.002	0.001	0.001	0.000
PGA (g)	0.103	0.060	0.036	0.010
PGV (m/s)	0.075	0.044	0.027	0.007

Notes: Spectral (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s^2). Peak ground velocity is given in m/s. Values are for "firm ground" (NBCC2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are highlighted in yellow. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. **These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.**

References

National Building Code of Canada 2015 NRCC no. 56190; Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

Structural Commentaries (User's Guide - NBC 2015: Part 4 of Division B)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File 7893 Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

See the websites www.EarthquakesCanada.ca and www.nationalcodes.ca for more information