



- **Government of Nunavut**

## **Additional Geotechnical Investigation**

**Type of Document**  
Final

**Project Name**  
Proposed Sewage Lagoon Upgrades  
Hall Beach, Nunavut

**Project Number**  
OTT-00220382-A0

**Prepared By:**

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Canada

**Date Submitted**  
September 29, 2014

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## Executive Summary

As requested, **exp** Services Inc. (**exp**) has carried out additional geotechnical investigation of the existing sewage lagoon site in Hall Beach, NU. The additional geotechnical investigation was carried out to further evaluate the presence of debris (garbage) within the proposed expansion footprint of Cell 1. Written authorization to proceed with this investigation was provided by the Government of Nunavut (GN) on June 24, 2014.

The current Hall Beach sewage lagoon comprises of two cells oriented in a north south direction. The south cell and north cell are commonly referred to as Cell 1 and Cell 2, respectively. Despite remedial measures taken in 2010 (partial lining of the inside slopes) Cell 1 has reportedly been leaking noticeably at its southeast corner since 2008. This has led to partial failure of the south berm. **Exp** carried out an initial site visit on June 20, 2013 to make observations on the potential cause(s) of observed leakage through the southern berm of Cell 1. Following the initial site visit, **exp** carried out a geotechnical investigation of the existing sewage lagoon in November 2013 to support preliminary design. The findings and recommendations resulting from the initial geotechnical investigation were provided to the GN in our report entitled Geotechnical Investigation, Sewage Lagoon Upgrades, dated January 22, 2014.

At the time of our initial investigation a total of four options were being explored to rehabilitate and expand the sewage lagoon. Option 1 included rehabilitation and expansion of Cell 1 to the south and into an area reportedly used as a local dump for some time. Buried debris was reported to be present throughout the expansion area and surficial debris was visible during both of the above noted site visits. Therefore, it was recommended that additional investigative work (test pits) be carried out when the active layer is at or near its maximum depth to evaluate the extent of garbage present if Option 1 was selected for final design. It is now understood that Option 1 has been selected; therefore, the additional geotechnical investigation discussed herein focused on the proposed expansion footprint to the south. The findings and recommendations from our initial geotechnical investigation (November, 2013) are repeated herein for information and completeness. Our previous recommendations have not been altered.

The fieldwork for this portion of the investigation was carried out on August 25, 2014 and consisted of fourteen test pits (TP10 to TP23). The test pits were excavated near the inside toe of Cell 1's south berm to confirm our previous test pit findings and throughout the proposed expansion footprint to the south of Cell 1. The test pits were excavated to practical refusal at depths ranging from 1.0 m to 2.0 m using a Komatsu 300 excavator. Soil samples were obtained from each test pit at regular intervals. Each test pit was then left open for at least 1 hour to observe groundwater levels, then backfilled using excavated material and lightly compacted with the excavator bucket.

In general, the investigations have revealed that the overburden soils at the site comprise of surficial silty sandy gravel, underlain by clay and by bedrock. Many of the test pits excavated throughout the current base of Cell 1 encountered less sand and silt in the gravel layer at depth. A layer of debris (pieces of metal, wood, plastic, glass, etc.) intermixed with organic materials and brown to black silty sandy gravel was observed outside the lagoon in test pits TP11, TP12, TP16, TP18 and TP23. The debris was generally encountered throughout the east half of the proposed expansion area footprint and to the south; however, it is possible that debris may also be present throughout the west half of the footprint, between our test pit locations. Based on the test pit findings, the layer of debris is also present directly adjacent to

and beneath portions of the existing outside slope of the south berm of Cell 1. However, it does not appear to extend inside the lagoon.

Bedrock was confirmed in Borehole No. 1 (center of existing Cell 1) of the previous investigation at 2.9 m depth below current grade. Based on previous nearby geotechnical investigations, it is anticipated that bedrock is at a similar depth throughout the entire area of interest to this investigation, likely at about 3 m to 5 m below original grade. The overburden soils were observed to contain very little to no excess ice. Groundwater (primarily comprised of sewage water) was encountered at depths ranging from 1.2 m to 2.3 m in the borehole and most of the test pits located throughout the existing base of Cell 1.

The berm embankments are to be constructed using locally available sand and gravel. It is recommended that the entire zone of influence for the berm expansions and/or liner installations, should be stripped of any existing sludge, garbage, surficial organic/peat layer and/or any other soft saturated materials encountered to expose a structurally stable subgrade of either unfrozen or frozen well-graded soils. Where the existing berms of Cell 1 are to be re-used/raised, any sections of the berms known to have experienced slope failures and/or undermining, should be removed to approved material/subgrade and reconstructed. Any over-excavation should be backfilled to pre-existing grades within one day of the excavation to limit the time of exposure of the underlying permafrost soils. It is recommended that the embankment fill be well-graded sand and gravel having a maximum size of about 150 mm and moisture content within about 2% of the optimum moisture content. Embankment fill should be placed in maximum 300 mm thick lifts and compacted to at least 95 percent Standard Proctor maximum dry density. The synthetic liner should be provided with a suitable bedding (such as sand) as specified by the manufacturer. The upper end of the liner (at the crest of the berm) should be buried in an approximately 0.6 m deep trench and backfilled with well-compacted embankment fill.

Permafrost degradation is expected beneath the lagoon cells and will result in differential thaw settlements of the lagoon and the berms. However, the site soils encountered during our investigation were not observed to be ice-rich, were primarily coarse grained and bedrock is anticipated to be within 3 m to 5 m of the current site grades. Therefore, the use of fully lined lagoon cells is considered feasible at the site.

A slope stability analysis was performed in order to determine if the proposed berm heights and slopes would be stable. The slope stability analysis was performed using the Geoslope computer program and Morgenstern-Price method. For slope stability analysis, the most critical proposed cross-section of the berms was used. It is considered that the results for this location will also be applicable to the other proposed berm cross-sections. The analysis was performed for static as well as seismic loading. It revealed that the required factors of safety of 1.5 in the case of static loading and 1.1 in the case of seismic loading will be satisfied with upstream slopes of 3H:1V and downstream slopes of 3.5H:1V for the reservoir. A slope stability analysis for the rapid drawdown condition was also undertaken using Seep W and Geoslope computer programs. The analysis revealed that the berm slopes will be stable (factor of safety of 1.1) provided that the lagoon is drained in 5 or more days. The slope stability results assume that sufficiently sized toe drains would be provided to prevent the phreatic surface from daylighting at the downstream face of the berms and that over topping of the berms will not occur.

The above and other related considerations have been discussed in greater detail in the report.

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# 1 Introduction

As requested, **exp** Services Inc. (**exp**) has carried out additional geotechnical investigation of the existing sewage lagoon site in Hall Beach, NU. The additional geotechnical investigation was carried out to further evaluate the presence of debris (garbage) within the proposed expansion footprint of Cell 1. Written authorization to proceed with this investigation was provided by the Government of Nunavut (GN) on June 24, 2014.

The comments and recommendations given in this report are based on the assumption that the design concepts discussed herein will proceed into construction. If changes are made either in the design phase or during construction, this office must be retained to review these modifications. The result of this review may be a modification of our recommendations or it may require additional field or laboratory work to check whether the changes are acceptable from a geotechnical viewpoint.

## 1.1 Project Background

**Exp** carried out an initial site visit on June 20, 2013 to make observations on the potential cause(s) of observed leakage through the southern berm of Cell 1. Following the initial site visit, **exp** carried out a geotechnical investigation of the existing sewage lagoon in November 2013 to support preliminary design decisions. The initial investigation comprised of one borehole and nine test pits put down throughout the existing base of Cell 1, one borehole near the center of a proposed expansion area to the north and one borehole near the center of a proposed expansion area to the south. The findings and recommendations resulting from the initial geotechnical investigation were provided to the GN in our report entitled Geotechnical Investigation, Sewage Lagoon Upgrades, dated January 22, 2014.

At the time of our initial investigation a total of four options were being explored to rehabilitate and expand the sewage lagoon. Option 1 included rehabilitation and expansion of Cell 1 to the south and into an area reportedly used as a local dump for some time. Buried debris was reported to be present throughout the area and surficial debris was visible during both of the above noted site visits. Therefore, it was recommended that additional investigative work (test pits) be carried out when the active layer is at or near its maximum depth to evaluate the extent of garbage present if Option 1 was selected for final design. It is now understood that Option 1 has been selected; therefore, the additional geotechnical investigation discussed herein focused on the proposed expansion footprint to the south. The findings and recommendations from our initial geotechnical investigation (November, 2013) are repeated herein for information and completeness. Our current findings support our previous recommendations.

## 2 Procedure

The fieldwork for this portion of the investigation was carried out on August 25, 2014 and consisted of fourteen test pits (TP10 to TP23). The test pits were excavated near the inside toe of Cell 1's south berm to confirm our previous test pit findings and throughout the proposed expansion footprint to the south of Cell 1. The test pit locations from this portion of the investigation, as well as the borehole and test pit locations from the geotechnical investigation carried out in November 2013 are shown on the appended Figure 1.

The test pits were excavated to practical refusal at depths ranging from 1.0 m to 2.0 m using a Komatsu 300 excavator. Soil samples were obtained from each test pit at regular intervals. Each test pit was then left open for at least 1 hour to observe groundwater levels, then backfilled using excavated material and lightly compacted with the excavator bucket.

The fieldwork was supervised on a full-time basis by a technician from **exp**. The samples were visually examined, logged in accordance with the modified MIT soil classification system and ASTM D 2488 (*Standard Practice for Description and Identification of Soils, Visual-Manual Procedure*), and stored in moisture tight containers for transport. On completion of the fieldwork, all samples were transported to the **exp** laboratory in the City of Ottawa where they were examined by a senior geotechnical engineer and further classified. The soils encountered during this portion of the investigation were consistent with our previous findings; therefore, no additional laboratory testing was carried out. The previously reported laboratory test results are repeated herein for information, as noted above.

The new test pit locations were located in the field by **exp** using a commercial grade handheld GPS unit (horizontal accuracy of  $\pm 3$  to 5 m). The elevations of the test pits were established from a contour plan available for the site, and therefore are considered to be approximate. These elevations refer to Geodetic datum.

### 3 Site and Soil Description

The Hamlet of Hall Beach is located on the east shore of the Melville Peninsula at latitude 68°46' N and longitude 81°13'W. The current sewage lagoon (site) is located about 1 km north of the community and about 200 m inland from Foxe Basin.

A detailed description of the subsurface soil and groundwater/ground ice conditions encountered at the previously completed test pit and borehole locations (November 2013), as well as the current test pits are given on the attached Borehole and Test Pit Logs, Figures 2 to 27 (inclusive). The borehole/test pit logs and related information depict subsurface conditions only at the specific locations and times indicated. Subsurface conditions and water levels at other locations may differ from conditions at the locations where sampling was conducted. The passage of time may also result in changes in the conditions interpreted to exist at the locations where sampling was conducted. Boreholes and test pits were carried out to provide representation of subsurface conditions as part of a geotechnical exploration program and are not intended to provide evidence of potential environmental conditions.

It should be noted that the soil boundaries indicated on the test pit logs are intended to reflect approximate transition zones for the purpose of geotechnical design and should not be interpreted as exact planes of geological change. The "Note on Sample Descriptions" preceding the borehole and test pit logs form an integral part of this report and should be read in conjunction with this report.

The principal strata encountered at the site are summarized in Table No. I:

Table No. I: Borehole and Test Pit Summary								
Borehole/ Test Pit No.	Elev. (m)	Total Depth (m)	Soil Stratigraphy Thickness (m)					Depth to Groundwater (m)
			FILL	DEBRIS	FILL/TILL silty sandy gravel	CLAY	BEDROCK	
BH1	5.6	6.1	-	-	2.5	0.4	> 3.6	2.3
BH2	6.7	3.7	-	-	2.4	> 1.3	-	Not Observed
BH3	6.0	3.1	-	-	> 3.1	-	-	Not Observed
TP1	5.6	2.0	-	-	> 2.0	-	-	1.2
TP2	5.7	2.0	-	-	> 2.0	-	-	Not Observed
TP3	5.5	2.0	-	-	> 2.0	-	-	1.4
TP4	5.5	2.3	-	-	> 2.3	-	-	2.0
TP5	5.5	2.1	-	-	> 2.1	-	-	2.0
TP6	5.6	2.5	-	-	1.8	> 0.7	-	1.7
TP7	5.7	2.5	-	-	1.5	> 1.0	-	1.4
TP8	5.7	2.6	-	-	2.0	> 0.6	-	1.7

Table No. I: Borehole and Test Pit Summary								
Borehole/ Test Pit No.	Elev. (m)	Total Depth (m)	Soil Stratigraphy Thickness (m)					Depth to Groundwater (m)
			FILL	DEBRIS	FILL/TILL silty sandy gravel	CLAY	BEDROCK	
TP9	5.6	2.0	-	-	> 2.0	-	-	Not Observed
TP10	7.9	1.5	-	-	> 1.5	-	-	1.4
TP11	5.8	2.0	-	1.0	> 1.0	-	-	0.8
TP12	5.4	1.6	0.8	> 0.8	-	-	-	1.5
TP13	5.5	1.8	-	-	> 1.8	-	-	0.9
TP14	5.4	1.8	-	-	> 1.8	-	-	0.9
TP15	8.0	1.3	-	-	> 1.3	-	-	Not Observed
TP16	6.4	1.0	-	> 1.0	-	-	-	0.9
TP17	5.5	1.2	-	-	> 1.2	-	-	Not Observed
TP18	5.5	1.1	0.5	> 0.6	-	-	-	1.0
TP19	6.5	1.1	-	-	> 1.1	-	-	1.1
TP20	7.0	1.4	-	-	> 1.4	-	-	1.3
TP21	7.1	1.3	-	-	> 1.3	-	-	None Observed
TP22	6.7	1.3	-	-	> 1.3	-	-	None Observed
TP23	5.8	1.4	0.5	> 0.9	-	-	-	1.0

### 3.1 Silty Sandy Gravel to Gravel

A layer of light grey silty sandy gravel to gravel with some silt, and sand fill/till was encountered at the surface in all three boreholes and all twenty-three test pits. In test pits TP11 and TP16 the surficial gravel layer was observed to be intermixed with debris just beneath the surface. In test pits TP12, TP18 and TP23 the surficial gravel layer was observed to be 0.5 m to 0.8 m thick and underlain by debris.

Boreholes BH1 and BH2, and test pits TP6, TP7 and TP8 continued through the entire gravel thickness. The gravel layer thickness was observed to range from 1.5 m to 2.5 m and was underlain by clay at these locations. The remaining boreholes and test pits were terminated within the gravel layer at depths ranging from 1.0 m to 3.1 m. No distinct transition from fill to till was observed during either of our investigations, with the exception of those test pits that encountered debris. The test pits were terminated due to practical refusal in frozen soils, or due to inflow of ground/sewage water. Some cobbles and boulders were observed/interpreted throughout the layer.

In BH1 the clay content of the gravel layer was observed to increase with depth.

In the majority of the test pits put down throughout the current base of Cell 1, the sand and silt content of the gravel layer was observed to decrease drastically below depths ranging from 0.6 m to 2.3 m. Below this depth, the gravel becomes black and contained trace silt and sand interspersed with some organics/sewage.

The majority of the gravel layer was observed to be frozen and poorly to well bonded with no excess ice (Nf to Nbn). An approximately 0.3 m thick portion of the layer in BH1 was observed to be unfrozen from about 2.3 m to 2.5 m depth (directly above the underlying clay layer). An approximately 1.2 m thick portion of the layer in BH2 was observed to contain trace visible ice inclusions (Vx 5% to 10% by volume) from about 1.2 m to 2.4 m depth.

**Previous Laboratory Test Results (November 2013):** Natural moisture contents of samples collected from this layer ranged between 2.5% and 15.1%, with an average value of 6.6% (based on 36 samples). One sample collected from the upper most 1.0 m of this layer in TP1 had an elevated natural moisture content of 33.2%. Grain-size analyses performed on eight samples from this layer yielded 38% to 96% gravel, 3% to 35% sand and 1% to 36% silt and clay size particles based on the modified MIT soil classification system (Figure 28 to 35). The silt and clay sized particles were assessed and determined to be non-plastic.

### 3.2 Debris

A layer of debris (pieces of metal, wood, plastic, glass, etc.) intermixed with organic materials and brown to black silty sandy gravel was observed in test pits TP11, TP12, TP16, TP18 and TP23. Test pits TP12, TP16, TP18 and TP23 were terminated due to practical refusal within the debris layer at total depths of 1.6 m, 1.0 m, 1.1 m and 1.4 m, respectively. The only test pit that could continue through the full thickness of the debris layer was TP11, where the debris layer was observed to be 1.0 m thick and underlain by silty sandy gravel similar to that noted above.

### 3.3 Clay

A layer of green to grey clay with trace to some sand and gravel, some sand was observed below the gravel layer in boreholes BH1 and BH2, and test pits TP6, TP7 and TP8. Borehole BH1 continued through the entire clay thickness, which was observed to be 0.4 m and underlain by bedrock. The remaining borehole and three test pits were terminated within this layer at depths ranging from 2.5 m to 3.7 m.

The layer was observed to be frozen and poorly to well bonded with no excess ice (Nf to Nbn).

**Previous Laboratory Test Results (November 2013):** Natural moisture contents of samples collected from this layer ranged between 11% and 21%, with an average value of 18% (based on 5 samples). Grain-size analyses performed on two samples from this layer yielded 0% to 10% gravel, 3% to 5% sand and 85% to 97% silt and clay size particles (Figures 36 and 37). The silt and clay sized particles were assessed by Atterberg Limits and determined to be low plasticity clay, with a plastic limit (PL) of about 18% and liquid limit (LL) of about 36%.

### 3.4 Bedrock

Bedrock was encountered in Borehole No. 1 at a depth of 2.9 m below the current grade. The bedrock was observed to be grey limestone. Bedrock was not encountered within the depth investigated in any of the remaining boreholes or test pits.

### 3.5 Groundwater

Groundwater levels were not observed in boreholes BH2 and BH3, or test pits TP2, TP9, TP15, TP17, TP21 and TP22. Groundwater levels were observed in the remaining boreholes and test pits, at depths ranging from 0.9 m to 2.3 m. The groundwater observed at the locations within the old sewage lagoon cell was primarily comprised of sewage water.

It should be noted that the groundwater levels reported above are based on our observations over a short period of time (typically one hour or less). The groundwater levels may not have stabilized before the boreholes and test pits were backfilled and additional fluctuations in the level of the groundwater are expected due to seasonal variation such as active layer thaw depth, precipitation, snowmelt, rainfall activities, etc.

### 3.6 Permafrost and Climate

Based on available permafrost mapping, Hall Beach is located well within the zone of continuous permafrost. Based on a review of environment Canada average monthly air temperatures from 1981 to 2010, the Mean Annual Air Temperature (MAAT) is -13.8°C, the freezing index is -5441°C-days and the thawing index is 402°C-days. Based on the test pits carried out during the August 2014 portion of our investigation, the active layer throughout the cleared (gravel surface) areas of the site is estimated to range from 0.9 m to 1.9 m depth below the surface.

## 4 Ground Temperature

A thermistor string was installed in borehole BH1 on November 18, 2013. The thermistor string was installed to 5.0 m depth, with thermistors located at 1 m intervals. Ground temperature readings taken during the previous fieldwork, as well as during the additional fieldwork are given on Table No. II.

Table No. II: Ground Temperature Readings						
Borehole No.	Thermistor Depth (m)	Ground Temperature °C				
		Date & Elapsed Time Since Installation				
		Nov. 19, 2013 1:30 p.m.	Nov. 20, 2013 10:35 a.m.	Nov. 21, 2013 11:00 a.m.	Nov. 22, 2013 11:00 a.m.	Aug. 25, 2014 4:00 p.m.
1	0	-26.5	-24.3	-30.1	-32.5	5.2
	1	-5.9	-8.0	-10.6	-10.8	1.0
	2	-4.5	-5.1	-5.5	-5.1	-2.2
	3	-3.3	-3.9	-4.1	-4.4	-5.3
	4	-4.4	-4.7	-4.9	-5.0	-7.2
	5	-5.5	-5.6	-5.6	-5.7	-8.3

## 5 Recommendations

It is currently understood that the existing south berm of Cell 1 will be removed as part of the lagoon upgrade. Cell 1 will then be expanded by lengthening the east and west berms by about 200 m and a new south berm will be constructed (as shown on the appended Figure 1). It is further understood that the new Cell 1 will be lined throughout the base and up the inside slopes of each berm in accordance with our previous recommendations (January, 2014).

The layer of debris was observed to contain sharp pieces of metal, wood, etc. that would represent considerable risk to the integrity of the liner system if left in place. Furthermore, it is apparent that voids present throughout the debris layer have resulted in the washing out of fines from the silty sandy gravel fill materials used to construct the existing south berm and that this has resulted in the observed leakage of Cell 1 over the years. Therefore, it is recommended that the debris be removed down to approved soils throughout the expansion footprint and replaced with embankment fill as outlined herein.

As noted above, the layer of debris was encountered at or near the surface in five of the twenty-three test pits. The debris was generally encountered throughout the east half of the proposed expansion area footprint and to the south; however, it is possible that debris may also be present throughout the west half of the footprint, between our test pit locations. Furthermore, four of the five test pits that encountered debris could not continue through its full thickness due to excavator refusal in permafrost. Therefore, the full extent of the debris present throughout the proposed expansion footprint will need to be delineated at the time of construction and excavation/replacement may need to be staged such that the debris layer has time to thaw during removal.

Based on the test pits excavated along the outside toe of the existing south berm (TP10, TP11, TP12 and TP21), the layer of debris is present directly adjacent to and beneath portions of the existing outside slope. It is noted that the test pits excavated along the existing slope were extended to just beneath the toe and the full extent of the debris present beneath the berm will also need to be delineated at the time of construction. However, based on the test pits excavated throughout the existing base of Cell 1 (TP01 to TP09, TP13 and TP14) the layer of debris does not appear to extend inside the existing lagoon.

### 5.1 Geothermal Considerations and Thaw Settlement

Detailed geothermal analysis of the lagoon structure was not part of our previous or current scope of work. However, based on past experience with other sewage lagoon designs throughout zones of continuous permafrost, we have made the following assumptions related to permafrost degradation/aggradation that should be considered during design:

- Existing permafrost beneath the interior base of the cells will thaw for tens of meters below finished grade due to the storing of sewage within the cells. This thaw may be shallower but will extend for some distance behind/under the inside toes of all berms.

- Drifting snow along the outside toes of exterior berms will serve as increased insulation during the winter months and result in additional permafrost thaw for some distance in front of and behind/under the outside toes of exterior berms.
- Permafrost thaw will be less approaching the core of each berm due to the increased soil cover.
- The depth of permafrost degradation (thaw) will vary substantially over the sewage lagoon footprint.

Permafrost degradation will result in differential settlements of the lagoon and the berms. The magnitude of thaw settlement is a function of the type of soil, density, ice content and the depth of thaw. Thaw settlement of ice-rich soils present beneath a fully lined lagoon cell can cause the liner to strain beyond its capacity and fail.

The site soils encountered during our investigation were not observed to be ice-rich. Furthermore, the bedrock surface was about 2.9 m below current grade in borehole BH1 (center of existing Cell 1). Other nearby geotechnical investigations encountered similar conditions. It is anticipated that the overburden is not ice-rich and bedrock is within 3 m to 5 m throughout the area of interest. Therefore, the use of fully lined lagoon cells is considered suitable at the site.

## 6 Site Preparation

### 6.1 Excavation

It is recommended that the prepared footprint of new cells and/or berm expansions, extend at least 2 m beyond the toe of the slopes. The expanded footprint should be stripped of any existing sludge, garbage, surficial organic/peat layer and/or any other soft saturated materials encountered to expose a structurally stable subgrade of either unfrozen or frozen well-graded soils approved by qualified geotechnical personnel. Where the existing berms of Cell 1 are to be re-used/raised, any sections of the berms known to have experienced slope failures, undermining and/or surficial sloughing should be removed to approved material/subgrade and reconstructed.

It is recommended that any over-excavation be carried out in stages such that an over-excavated area can be backfilled to pre-existing grades within one day. This is intended to limit the time of exposure for underlying permafrost soils and minimize short-term permafrost thaw and global instability of the berms. If over-excavated areas are not backfilled to at least the current grade the same day, then additional thawing of the frozen soils is anticipated, likely resulting in soft soil conditions throughout the base and requiring over-excavation to remove the soft soils.

### 6.2 Water Control

It is anticipated that controlling surface and groundwater flow through the site may be a challenge given the surrounding wetlands, observed site soils and general tendency of groundwater to travel along the surface of the permafrost during thaw. It is possible that the existing access road running along the west side of the site will considerably limit water inflow from this direction. However, diversion ditches having positive outlet may need to be established up gradient of the site to minimize the amount of surface and groundwater entering the excavation(s).

Any water that does enter the excavation(s) should be gathered via swales/ditches having positive outlet or led to adequately sized sumps equipped with pumps for immediate removal offsite. Discharge of collected water should be conducted and controlled in a manner that does not induce erosion or transport of sediment, and is in accordance with all applicable government requirements.

### 6.3 Embankment Fill

Once the site has been prepared as outlined above, embankment fill should be placed to the desired grades. Embankment fill for the base of each cell and containment berms should comprise of well-graded silty sand and gravel having a maximum size of 150 mm.

The embankment fill shall be placed in maximum of 300 mm lifts and compacted to at least 95% of the standard Proctor maximum dry density (SPMDD) determined for the material. This will typically require that the material be within about 2% of its optimum moisture content at the time of placement.

Depending on the exposed soils, the placement and compaction of the initial lift(s) of material throughout over-excavations may be inhibited by the build-up of excess porewater pressures within the native subgrade. It is recommended that emphasis be placed on covering the permafrost the same day as excavation and returning the area to current grade. Compaction should be monitored by qualified geotechnical personnel, but if the lift begins to exhibit signs that excess porewater pressure exists within the underlying materials (spongy or rolling appearance under traffic), then compaction should be stopped immediately and the next lift placed. Lifts above current grade should be placed and compacted to at least 95% of the SPMDD as outlined above and this may require that the initial lifts be allowed to drain over the course of several days.

Widening/raising the existing berms would require placement of fill against the existing slopes. For this purpose, the surface soils on the existing slopes should be cut/stepped (about 0.6 m vertically) and worked into each lift of new embankment fill placed to create a stable slope for the expanded berm.

## 6.4 Synthetic Liner

Synthetic liners offer advantages to provide primary containment in cold regions. They are useful in locations where fine-grained soils are not available to construct a natural low permeability liner and containment structure. They are also insensitive to climate warming and will be effective in both frozen and unfrozen conditions. They have good performance where the ground is stable and not subject to subsidence due to thawing of permafrost. Most liner materials require burial for several reasons including ultraviolet light protection, traffic protection and ice run-up or gouging protection.

It is noted that a number of liners have been used in the past in permafrost regions to make sewage lagoons constructed with granular materials impervious. These materials include polyvinylchloride (PVC), reinforced polyethylene (RPE), polypropylene (PP) and synthetic clay liners. RPE liners are normally preferred for lining sewage lagoons as they can withstand very low temperatures, have high tear strength and are highly resistant to chemicals.

The liner should be provided with a suitable bedding (such as sand) as specified by the manufacturer. The upper end of the liner (at the crest of the berm) should be buried in an approximately 0.6 m deep key trench and backfilled with well-compacted embankment fill.

## 7 Permanent Slopes

Based on site preparation and embankment fill gradation/placement as outlined above, as well as the slope stability analyses outlined below, the proposed embankment slopes of 3.5H:1V (outside) and 3H:1V (inside) are considered acceptable at the site.

All slopes should be provided with suitable erosion protection. The inside (upstream) face of each berm may be subject to some wave action during the summer months and ice impact/run-up during winter. This should be considered when designing erosion protection. Additionally, the inside and outside slopes will be subject to seasonal freeze/thaw action. Frost susceptible soils placed within this zone may slough as a result, causing slope stability issues over time.

### 7.1 Slope Stability

Although it is understood that a synthetic liner will be installed along the upstream slope to render it impervious, there is potential that a steady-state seepage condition may develop in the berms if the liner is damaged. Therefore, the slope stability analyse presented below was based on unfrozen soils.

The stability of slopes was analyzed using Slope W, Geoslope Office, version 7.2 computer program using Morgenstern-Price Method. One cross-section taken through the proposed east berm of the Cell 1 expansion (near the southeast corner) was analyzed. The cross-section was chosen based on the height of berm being proposed and least favorable surrounding site grades. It is considered to be the most critical berm proposed.

The berm was analysed using effective stress analysis with static loading and total stress analysis with seismic loading. Total stress analysis for static loading conditions was not undertaken since the factors of safety would less than obtained by the effective stress analysis. The following assumptions were made for slope stability analysis:

- 1.) The crest of the berm will be at Elevation 9.8 m whereas the base of the lagoon to the west will be at Elevation 6.0 m and the outside toe of the lagoon will be at Elevation 5.0 m. The crest width of the berm will be 8 m. The upstream and downstream slopes of the berms were analysed for slopes of 3H:1V and 3.5H:1V respectively.
- 2.) The water level in the lagoon will be maintained at Elevation 8.8 m or lower and that the berm will not be overtopped at any time. Overtopping of the berm(s) may be prevented by construction of a proper spillway structure.
- 3.) Sufficiently sized toe drains will be provided along the downstream toe of each berm in order to prevent the phreatic surface from day lighting at the downstream slope of the berm.
- 4.) The berms will be constructed in accordance with the recommendations outlined above.
- 5.) The soils below the berms are unfrozen to the bedrock surface.
- 6.) The engineering properties of the various soil strata were assumed as given on Table No. III based on previous experience in the region and literature research.

<b>Table No. III: Engineering Properties of Soils Used in Slope Stability Analysis</b>			
<b>Soil Type</b>	<b>Unit Weight (kN/m<sup>3</sup>)</b>	<b>Effective Cohesion c' (kPa)</b>	<b>Effective Angle of Internal Friction <math>\phi</math> (degrees)</b>
Silty sandy gravel fill	20	0	33
Silty sandy gravel	21	0	33

The results of the slope stability analysis are given on Table IV.

<b>Table No. IV: Computed Factors of Safety for Outside and Inside Berm Slopes</b>			
<b>Slope Inclination</b>	<b>Slope Identification</b>	<b>Loading Condition</b>	<b>Computed Factor of Safety</b>
3.5H:1V	Downstream slope	Effective stress analysis	1.57
		Total stress analysis + seismic loading	1.13
3H:1V	Upstream slope	Effective stress analysis	1.83
		Total stress analysis + seismic loading	1.18

Based on current practice in the industry, a minimum factor of safety of 1.5 is required for static loading conditions and a factor of safety of 1.1 is required for seismic loading conditions. A review of Table No. IV indicates that a 3H:1V upstream slope and 3.5H:1V downstream slope would satisfy the requisite factors of safety. Therefore, those slopes may be used in the design of the berms.

#### 7.1.1 Rapid Drawdown Condition

The upstream slope of the chosen berm cross-section was also analysed for rapid drawdown condition. The analysis was based on Morgenstern-Price Method coupled with the Seep W computer program to simulate the rapid drawdown condition. The following permeability values were assumed for the analysis:

Silty sandy gravel fill .....	$1 \times 10^{-8}$ m/sec
Silty sandy gravel .....	$3 \times 10^{-8}$ m/sec
Bedrock.....	$5 \times 10^{-8}$ m/sec

The factor of safety of the slope was computed assuming that the lagoon will be emptied over a period of 5 days. The results indicate that the lowest factor of safety for the 3H:1V slope as a result of emptying the lagoon in this way will be 1.15. This factor of safety will be the minimum on emptying of the lagoon and is expected to increase thereafter as the excess pore pressure in the berm dissipates with time. The typical acceptable factor of safety for rapid drawdown condition is 1.1. Therefore, this factor of safety is considered acceptable for the temporary condition.

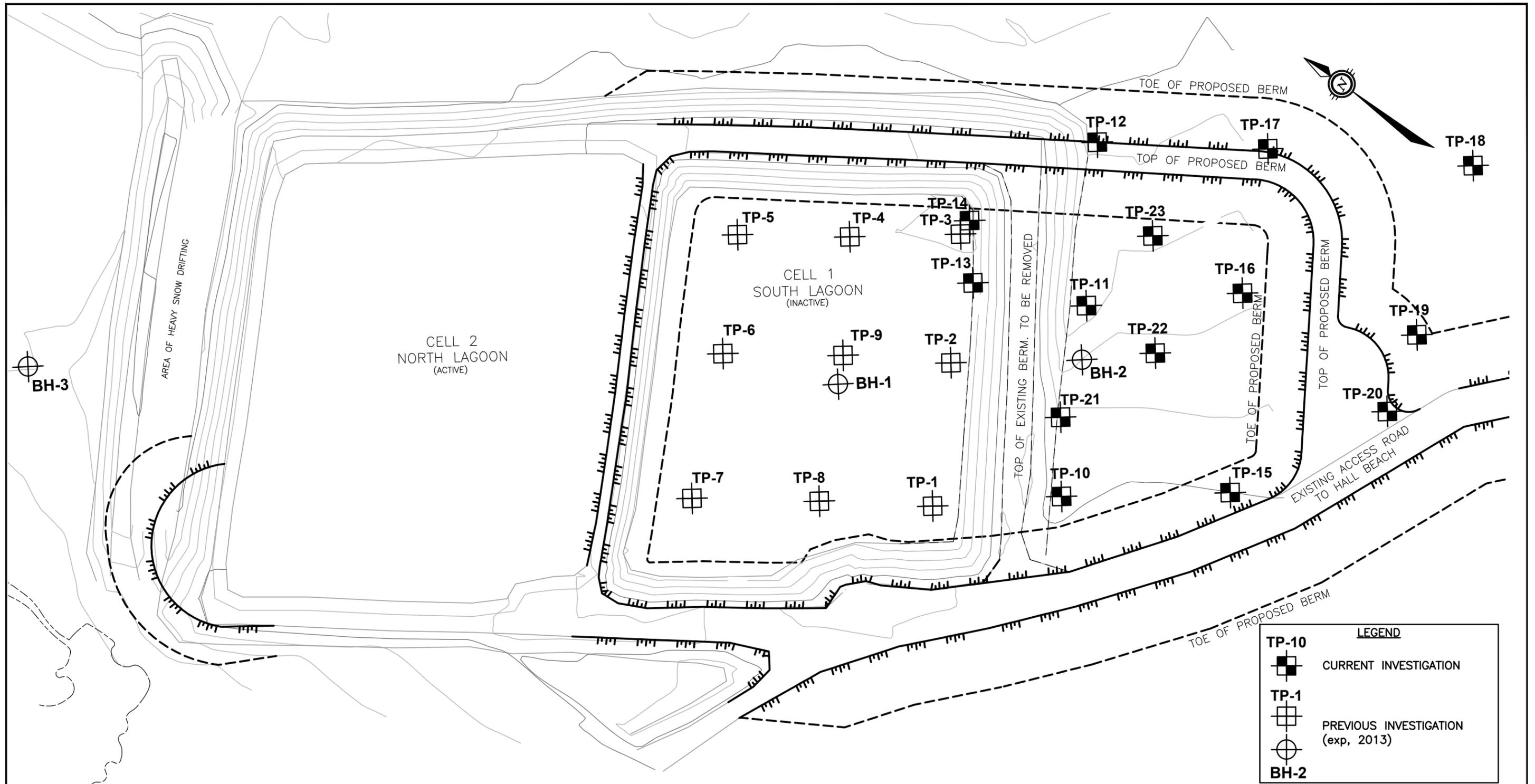
## 8 General Comments

The comments given in this report are intended only for the guidance of design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc., would be much greater than has been carried out for the design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

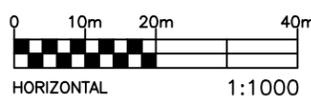
The information contained in this report is not intended to reflect on environmental aspects of the soils. Should specific information be required, including for example, the presence of pollutants, contaminants or other hazards in the soil, additional testing may be required.

We trust that the information contained in this report will be satisfactory for your purposes. Should you have any questions, please do not hesitate to contact this office.

## **Figures**



- NOTES :**
1. THE BOUNDARIES AND SOIL TYPES HAVE BEEN ESTABLISHED ONLY AT TEST PIT AND BOREHOLE LOCATIONS. BETWEEN TEST PIT AND BOREHOLES THEY ARE ASSUMED AND MAY BE SUBJECT TO CONSIDERABLE ERROR.
  2. SOIL SAMPLES WILL BE RETAINED IN STORAGE FOR THREE MONTHS AND THEN DESTROYED UNLESS THE CLIENT ADVISES THAT AN EXTENDED TIME PERIOD IS REQUIRED.
  3. TOPSOIL QUANTITIES SHOULD NOT BE ESTABLISHED FROM THE INFORMATION PROVIDED AT THE TEST PIT AND BOREHOLE LOCATIONS.
  4. TEST PIT AND BOREHOLE ELEVATIONS SHOULD NOT BE USED TO DESIGN BUILDING(S) OR FLOOR SLABS OR PARKING LOT(S) GRADES.
  5. THIS DRAWING FORMS PART OF THE REPORT PROJECT NUMBER AS REFERENCED AND SHOULD BE USED ONLY IN CONJUNCTION WITH THIS REPORT.
  6. BASE PLAN OBTAINED FROM WHYTE, McELMON & ASSOCIATES LTD., PROJECT No 47A-15-1, DATED NOVEMBER 12, 2013.

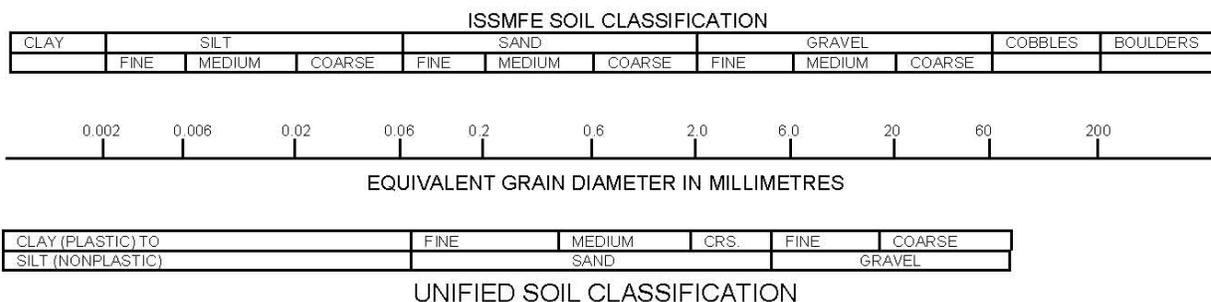


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scale <b>1:1000</b>	CLIENT: <b>GOVERNMENT OF NUNAVUT</b>	project no. <b>OTT-00220382-A0</b>	
date <b>14/09/03</b>	TITLE: <b>TEST PIT LOCATION PLAN, HALL BEACH, NU</b>		<b>FIG. 1.0</b>
drawn by <b>M.C.K.</b>			

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- INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

## Notes On Sample Descriptions

- All sample descriptions included in this report follow the Canadian Foundations Engineering Manual soil classification system. This system follows the standard proposed by the International Society for Soil Mechanics and Foundation Engineering. Laboratory grain size analyses provided by **exp** Services Inc. also follow the same system. Different classification systems may be used by others; one such system is the Unified Soil Classification. Please note that, with the exception of those samples where a grain size analysis has been made, all samples are classified visually. Visual classification is not sufficiently accurate to provide exact grain sizing or precise differentiation between size classification systems.



- Fill:** Where fill is designated on the borehole log it is defined as indicated by the sample recovered during the boring process. The reader is cautioned that fills are heterogeneous in nature and variable in density or degree of compaction. The borehole description may therefore not be applicable as a general description of site fill materials. All fills should be expected to contain obstruction such as wood, large concrete pieces or subsurface basements, floors, tanks, etc., none of these may have been encountered in the boreholes. Since boreholes cannot accurately define the contents of the fill, test pits are recommended to provide supplementary information. Despite the use of test pits, the heterogeneous nature of fill will leave some ambiguity as to the exact composition of the fill. Most fills contain pockets, seams, or layers of organically contaminated soil. This organic material can result in the generation of methane gas and/or significant ongoing and future settlements. Fill at this site may have been monitored for the presence of methane gas and, if so, the results are given on the borehole logs. The monitoring process does not indicate the volume of gas that can be potentially generated nor does it pinpoint the source of the gas. These readings are to advise of the presence of gas only, and a detailed study is recommended for sites where any explosive gas/methane is detected. Some fill material may be contaminated by toxic/hazardous waste that renders it unacceptable for deposition in any but designated land fill sites; unless specifically stated the fill on this site has not been tested for contaminants that may be considered toxic or hazardous. This testing and a potential hazard study can be undertaken if requested. In most residential/commercial areas undergoing reconstruction, buried oil tanks are common and are generally not detected in a conventional geotechnical site investigation.
- Till:** The term till on the borehole logs indicates that the material originates from a geological process associated with glaciation. Because of this geological process the till must be considered heterogeneous in composition and as such may contain pockets and/or seams of material such as sand, gravel, silt or clay. Till often contains cobbles (60 to 200 mm) or boulders (over 200 mm). Contractors may therefore encounter cobbles and boulders during excavation, even if they are not indicated by the borings. It should be appreciated that normal sampling equipment cannot differentiate the size or type of any obstruction. Because of the horizontal and vertical variability of till, the sample description may be applicable to a very limited zone; caution is therefore essential when dealing with sensitive excavations or dewatering programs in till materials.

# Log of Borehole BH1



Project No: OTT-00215839-A0  
 Project: Proposed Sewage Lagoon Upgrades  
 Location: Hall Beach, NU  
 Date Drilled: November 14, 2013  
 Drill Type: \_\_\_\_\_  
 Datum: Geodetic  
 Logged by: RV Checked by: JS

Figure No. 2  
 Page. 1 of 1

- Split Spoon Sample
- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Shear Strength by Vane Test
- Combustible Vapour Reading
- Natural Moisture Content
- Atterberg Limits
- Undrained Triaxial at % Strain at Failure
- Shear Strength by Penetrometer Test

GWL	SOIL	SOIL DESCRIPTION	Geodetic Elevation m	Depth m	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m <sup>3</sup>
					Shear Strength				Natural Moisture Content % Atterberg Limits (% Dry Weight)			
					20	40	60	80	250	500	750	
		<b>FILL/TILL</b> Light grey silty sandy GRAVEL - frozen, N <sub>f</sub> to N <sub>bn</sub> - some cobbles and boulders	5.6	0					X			
		<b>FILL/TILL</b> Light grey sandy GRAVEL and CLAY - frozen, N <sub>f</sub> to N <sub>bn</sub> - some cobbles and boulders - unfrozen black sewage sludge between 2.3 m and 2.6 m	4.1	1					X			
		<b>TILL</b> Green to grey CLAY, some gravel, some sand - frozen, N <sub>f</sub> to N <sub>bn</sub>	3.1	2					X			
		<b>BEDROCK</b> Medium grey bedrock	2.8	3								
				4								
				5								
				6								
		End of Borehole at 6.1 m	-0.5									

LOG OF BOREHOLE OTT-00215839-A0\_BH\_LOGSHALLBEACH\_8JAN2014.GPJ TROW/OTTAWA.GDT 9/29/14

- NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
  2. Thermister was installed upon completion to 5.0 m.
  3. Field work supervised by an exp representative.
  4. See Notes on Sample Descriptions
  5. This Figure is to read with exp. Services Inc. report OTT-00215839-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

# Log of Borehole BH2



Project No: OTT-00215839-A0  
 Project: Proposed Sewage Lagoon Upgrades  
 Location: Hall Beach, NU  
 Date Drilled: November 19, 2013  
 Drill Type: \_\_\_\_\_  
 Datum: Geodetic  
 Logged by: RV Checked by: JS

Figure No. 3  
 Page. 1 of 1

- Split Spoon Sample
- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Shear Strength by Vane Test
- Combustible Vapour Reading
- Natural Moisture Content
- Atterberg Limits
- Undrained Triaxial at % Strain at Failure
- Shear Strength by Penetrometer Test

GWL	SOIL	SOIL DESCRIPTION	Geodetic Elevation m	Depth m	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m <sup>3</sup>
					Shear Strength				Natural Moisture Content % Atterberg Limits (% Dry Weight)			
					20	40	60	80	250	500	750	
		<b>FILL/TILL</b> Light grey GRAVEL, some silt, some sand to silty sand GRAVEL - frozen, N <sub>i</sub> to N <sub>bn</sub> - some cobbles and boulders  - V <sub>x</sub> 5% to 10% below 1.5 m depth	6.7	0								
				1								
				2								
			4.3	3								
		<b>TILL</b> Green to grey CLAY, some gravel, some sand - frozen, N <sub>i</sub> to N <sub>bn</sub>										
		End of Borehole at 3.7 m	3.0									

LOG OF BOREHOLE OTT-00215839-A0\_BH\_LOGSHALLBEACH\_8JAN2014.GPJ TROW/OTTAWA.GDT 9/29/14

- NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
  2. Borehole was backfilled upon completion.
  3. Field work supervised by an exp representative.
  4. See Notes on Sample Descriptions
  5. This Figure is to read with exp. Services Inc. report OTT-00215839-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

# Log of Borehole BH3



Project No: OTT-00215839-A0  
 Project: Proposed Sewage Lagoon Upgrades  
 Location: Hall Beach, NU  
 Date Drilled: November 20, 2013  
 Drill Type: \_\_\_\_\_  
 Datum: Geodetic  
 Logged by: RV Checked by: JS

Figure No. 4  
 Page. 1 of 1

- Split Spoon Sample
- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Shear Strength by Vane Test
- Combustible Vapour Reading
- Natural Moisture Content
- Atterberg Limits
- Undrained Triaxial at % Strain at Failure
- Shear Strength by Penetrometer Test

G W L	S O B Y L	SOIL DESCRIPTION	Geodetic Elevation m	D e p t h m	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m <sup>3</sup>	
					Shear Strength kPa				Natural Moisture Content %				
					20	40	60	80	250	500	750		
		<b>FILL/TILL</b> Light grey silty GRAVEL and SAND to silty sandy GRAVEL - frozen, N, to N <sub>bn</sub> - some cobbles and boulders	6	0									
				1									
				2									
				3									
		End of Borehole at 3.1 m	2.9	3									

LOG OF BOREHOLE OTT-00215839-A0\_BH\_LOGSHALLBEACH\_8JAN2014.GPJ TROW/OTTAWA.GDT 9/29/14

NOTES:  
 1. Borehole/Test Pit data requires Interpretation by exp. before use by others  
 2. Borehole was backfilled upon completion.  
 3. Field work supervised by an exp representative.  
 4. See Notes on Sample Descriptions  
 5. This Figure is to read with exp. Services Inc. report OTT-00215839-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

# Log of Test Pit TP1



Project No: OTT-00215839-A0

Figure No. 5

Project: Proposed Sewage Lagoon Upgrades

Page. 1 of 1

Location: Hall Beach, NU

Date Drilled: November 14, 2013

Split Spoon Sample

Combustible Vapour Reading

Drill Type: \_\_\_\_\_

Auger Sample

Natural Moisture Content

SPT (N) Value

Atterberg Limits

Datum: Geodetic

Dynamic Cone Test

Undrained Triaxial at % Strain at Failure

Shelby Tube

Shear Strength by Penetrometer Test

Logged by: RV Checked by: JS

Shear Strength by Vane Test

G W L	S O B Y L	SOIL DESCRIPTION	Assumed Elevation m	D e p t h	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			S A M P L E S	Natural Unit Wt. kN/m <sup>3</sup>	
					Shear Strength kPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)					
					20	40	60	80	250	500	750			
		<b>FILL/TILL</b> Light grey silty sandy GRAVEL - frozen, N <sub>f</sub> to N <sub>bn</sub>	5.6	0										
		<b>FILL/TILL</b> Black GRAVEL, trace sand, trace silt - intermixed with organics/sewage - frozen, N <sub>f</sub> to N <sub>bn</sub>	4.6	1					X					
		End of Test Pit at 2.0 m - unfrozen seam of sewage water at 1.2 m depth - test pit terminated due to sewage water inflow	3.6	2										

LOG OF TEST PIT OTT-00215839-A0\_BH\_LOGSHALLBEACH\_8JAN2014.GPJ TROW/OTTAWA.GDT 9/29/14

- NOTES:
- Borehole/Test Pit data requires Interpretation by exp. before use by others
  - Test pit was backfilled and lightly compacted upon completion.
  - Field work supervised by an exp representative.
  - See Notes on Sample Descriptions
  - This Figure is to read with exp. Services Inc. report OTT-00215839-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

# Log of Test Pit TP2



Project No: OTT-00215839-A0

Project: Proposed Sewage Lagoon Upgrades

Location: Hall Beach, NU

Date Drilled: November 14, 2013

Drill Type: \_\_\_\_\_

Datum: Geodetic

Logged by: RV Checked by: JS

Figure No. 6

Page. 1 of 1

- Split Spoon Sample
- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Shear Strength by Vane Test
- Combustible Vapour Reading
- Natural Moisture Content
- Atterberg Limits
- Undrained Triaxial at % Strain at Failure
- Shear Strength by Penetrometer Test

GWL	SOIL	SOIL DESCRIPTION	Assumed Elevation m	Depth m	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m <sup>3</sup>	
					20	40	60	80	250	500	750		
					Shear Strength kPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)				
		<b>FILL/TILL</b> Light grey silty sandy GRAVEL - frozen, N <sub>r</sub> to N <sub>bn</sub>	5.7	0									
				1									
			3.7	2									
		End of Test Pit at 2.0 m - due to practical refusal in frozen soil											

LOG OF TEST PIT OTT-00215839-A0\_BH\_LOGSHALLBEACH\_8JAN2014.GPJ TROW/OTTAWA.GDT 9/29/14

- NOTES:
1. Borehole/Test Pit data requires Interpretation by exp. before use by others
  2. Test pit was backfilled and lightly compacted upon completion.
  3. Field work supervised by an **exp** representative.
  4. See Notes on Sample Descriptions
  5. This Figure is to read with exp. Services Inc. report OTT-00215839-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

# Log of Test Pit TP3



Project No: OTT-00215839-A0

Project: Proposed Sewage Lagoon Upgrades

Location: Hall Beach, NU

Date Drilled: November 14, 2013

Drill Type: \_\_\_\_\_

Datum: Geodetic

Logged by: RV Checked by: JS

Figure No. 7

Page. 1 of 1

- Split Spoon Sample
- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Shear Strength by Vane Test
- Combustible Vapour Reading
- Natural Moisture Content
- Atterberg Limits
- Undrained Triaxial at % Strain at Failure
- Shear Strength by Penetrometer Test

G W L	S O B Y L	SOIL DESCRIPTION	Assumed Elevation m	D e p t h	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			S M I L I T I E S	Natural Unit Wt. kN/m <sup>3</sup>	
					20	40	60	80	250	500	750			
					Shear Strength kPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)					
		<b>FILL/TILL</b> Light grey silty sandy GRAVEL - frozen, N <sub>f</sub> to N <sub>bn</sub>	5.5	0										
		<b>FILL/TILL</b> Black GRAVEL, trace sand, trace silt - intermixed with organics/sewage - frozen, N <sub>f</sub> to N <sub>bn</sub>	4.1	1										
		End of Test Pit at 2.0 m - unfrozen seam of sewage water at 1.4 m depth - test pit terminated due to sewage water inflow	3.5	2										

LOG OF TEST PIT OTT-00215839-A0\_BH\_LOGSHALLBEACH\_8JAN2014.GPJ TROW/OTTAWA.GDT 9/29/14

- NOTES:
- Borehole/Test Pit data requires Interpretation by exp. before use by others
  - Test pit was backfilled and lightly compacted upon completion.
  - Field work supervised by an exp representative.
  - See Notes on Sample Descriptions
  - This Figure is to read with exp. Services Inc. report OTT-00215839-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

# Log of Test Pit TP4



Project No: OTT-00215839-A0  
 Project: Proposed Sewage Lagoon Upgrades  
 Location: Hall Beach, NU  
 Date Drilled: November 15, 2013  
 Drill Type: \_\_\_\_\_  
 Datum: Geodetic  
 Logged by: RV Checked by: JS

Figure No. 8  
 Page. 1 of 1

- Split Spoon Sample
- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Shear Strength by Vane Test
- Combustible Vapour Reading
- Natural Moisture Content
- Atterberg Limits
- Undrained Triaxial at % Strain at Failure
- Shear Strength by Penetrometer Test

G W L	S O B O L	SOIL DESCRIPTION	Assumed Elevation m	D e p t h	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			S O I L T E M P E R A T U R E	Natural Unit Wt. kN/m <sup>3</sup>	
					Shear Strength kPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)					
					20	40	60	80	250	500	750			
		<b>FILL/TILL</b> Light grey silty sandy GRAVEL - frozen, N <sub>r</sub> to N <sub>bn</sub>	5.5	0										
		<b>FILL/TILL</b> Black GRAVEL, trace sand, trace silt - intermixed with organics/sewage - frozen, N <sub>r</sub> to N <sub>bn</sub>	3.9	1										
		<b>FILL/TILL</b> Black GRAVEL, trace sand, trace silt - intermixed with organics/sewage - frozen, N <sub>r</sub> to N <sub>bn</sub>	3.2	2										
		End of Test Pit at 2.3 m - unfrozen seam of sewage water at 2.0 m depth - test pit terminated due to sewage water inflow												

LOG OF TEST PIT OTT-00215839-A0\_BH\_LOGSHALLBEACH\_8JAN2014.GPJ TROW/OTTAWA.GDT 9/29/14

- NOTES:
- Borehole/Test Pit data requires Interpretation by exp. before use by others
  - Test pit was backfilled and lightly compacted upon completion.
  - Field work supervised by an exp representative.
  - See Notes on Sample Descriptions
  - This Figure is to read with exp. Services Inc. report OTT-00215839-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

# Log of Test Pit TP5



Project No: OTT-00215839-A0  
 Project: Proposed Sewage Lagoon Upgrades  
 Location: Hall Beach, NU  
 Date Drilled: November 15, 2013  
 Drill Type: \_\_\_\_\_  
 Datum: Geodetic  
 Logged by: RV Checked by: JS

Figure No. 9  
 Page. 1 of 1

- Split Spoon Sample
- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Shear Strength by Vane Test
- Combustible Vapour Reading
- Natural Moisture Content
- Atterberg Limits
- Undrained Triaxial at % Strain at Failure
- Shear Strength by Penetrometer Test

G W L	S O B Y L	SOIL DESCRIPTION	Assumed Elevation m	D e p t h	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			S O I L T E M P E R A T U R E	Natural Unit Wt. kN/m <sup>3</sup>
					Shear Strength kPa				Natural Moisture Content %				
					20	40	60	80	250	500	750		
		<b>FILL/TILL</b> Light grey silty sandy GRAVEL - frozen, N <sub>r</sub> to N <sub>bn</sub>	5.5	0									
		<b>FILL/TILL</b> Black GRAVEL, trace sand, trace silt - intermixed with organics/sewage - frozen, N <sub>r</sub> to N <sub>bn</sub>	4.0	1					X				
		<b>FILL/TILL</b> Black GRAVEL, trace sand, trace silt - intermixed with organics/sewage - frozen, N <sub>r</sub> to N <sub>bn</sub>	3.4	2					X				
		End of Test Pit at 2.1 m - unfrozen seam of sewage water at 2.0 m depth - test pit terminated due to sewage water inflow											

LOG OF TEST PIT OTT-00215839-A0\_BH\_LOGSHALLBEACH\_8JAN2014.GPJ TROW/OTTAWA.GDT 9/29/14

- NOTES:
- Borehole/Test Pit data requires Interpretation by exp. before use by others
  - Test pit was backfilled and lightly compacted upon completion.
  - Field work supervised by an exp representative.
  - See Notes on Sample Descriptions
  - This Figure is to read with exp. Services Inc. report OTT-00215839-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

# Log of Test Pit TP6



Project No: OTT-00215839-A0  
 Project: Proposed Sewage Lagoon Upgrades  
 Location: Hall Beach, NU  
 Date Drilled: November 15, 2013  
 Drill Type: \_\_\_\_\_  
 Datum: Geodetic  
 Logged by: RV Checked by: JS

Figure No. 10  
 Page. 1 of 1

- Split Spoon Sample
- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Shear Strength by Vane Test
- Combustible Vapour Reading
- Natural Moisture Content
- Atterberg Limits
- Undrained Triaxial at % Strain at Failure
- Shear Strength by Penetrometer Test

GWL	SOIL DESCRIPTION	Assumed Elevation m	Depth	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m <sup>3</sup>
				Shear Strength kPa				250	500	750	
				20	40	60	80	Natural Moisture Content % Atterberg Limits (% Dry Weight)			
	<b>FILL/TILL</b> Light grey silty sandy GRAVEL - frozen, N <sub>r</sub> to N <sub>bn</sub>	5.6	0								
	<b>FILL/TILL</b> Black GRAVEL, trace sand, trace silt - intermixed with organics/sewage - frozen, N <sub>r</sub> to N <sub>bn</sub>	4.0	1					X			
	<b>TILL</b> Green to grey CLAY, some gravel, some sand - frozen, N <sub>r</sub> to N <sub>bn</sub>	3.8	2					X			
	<b>TILL</b> Green to grey CLAY, some gravel, some sand - frozen, N <sub>r</sub> to N <sub>bn</sub>	3.1						X			
	End of Test Pit at 2.5 m - unfrozen seam of sewage water at 1.7 m depth - test pit terminated due to sewage water inflow										

LOG OF TEST PIT OTT-00215839-A0\_BH\_LOGSHALLBEACH\_8JAN2014.GPJ TROW/OTTAWA.GDT 9/29/14

**NOTES:**  
 1. Borehole/Test Pit data requires Interpretation by exp. before use by others  
 2. Test pit was backfilled and lightly compacted upon completion.  
 3. Field work supervised by an exp representative.  
 4. See Notes on Sample Descriptions  
 5. This Figure is to read with exp. Services Inc. report OTT-00215839-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

# Log of Test Pit TP7



Project No: OTT-00215839-A0  
 Project: Proposed Sewage Lagoon Upgrades  
 Location: Hall Beach, NU  
 Date Drilled: November 15, 2013  
 Drill Type: \_\_\_\_\_  
 Datum: Geodetic  
 Logged by: RV Checked by: JS

Figure No. 11  
 Page. 1 of 1

- Split Spoon Sample
- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Shear Strength by Vane Test
- Combustible Vapour Reading
- Natural Moisture Content
- Atterberg Limits
- Undrained Triaxial at % Strain at Failure
- Shear Strength by Penetrometer Test

G W L	S O B Y L	SOIL DESCRIPTION	Assumed Elevation m	D e p t h	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			S O I L T E M P E R A T U R E	Natural Unit Wt. kN/m <sup>3</sup>
					Shear Strength kPa				Natural Moisture Content %				
					20	40	60	80	250	500	750		
		<b>FILL/TILL</b> Light grey silty sandy GRAVEL - frozen, N <sub>f</sub> to N <sub>bn</sub>	5.7	0									
		<b>FILL</b> Black sandy GRAVEL intermixed with organics/sewage - frozen - no visible ice	4.4 4.2	1					X				
		<b>TILL</b> Green to grey CLAY, trace sand - frozen, N <sub>f</sub> to N <sub>bn</sub>	3.2	2					X				
		End of Test Pit at 2.5 m - unfrozen seam of sewage water at 1.4 m depth - test pit terminated due to sewage water inflow											

LOG OF TEST PIT OTT-00215839-A0\_BH\_LOGSHALLBEACH\_8JAN2014.GPJ TROW/OTTAWA.GDT 9/29/14

**NOTES:**  
 1. Borehole/Test Pit data requires Interpretation by exp. before use by others  
 2. Test pit was backfilled and lightly compacted upon completion.  
 3. Field work supervised by an exp representative.  
 4. See Notes on Sample Descriptions  
 5. This Figure is to read with exp. Services Inc. report OTT-00215839-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

# Log of Test Pit TP8



Project No: OTT-00215839-A0  
 Project: Proposed Sewage Lagoon Upgrades  
 Location: Hall Beach, NU  
 Date Drilled: November 15, 2013  
 Drill Type: \_\_\_\_\_  
 Datum: Geodetic  
 Logged by: RV Checked by: JS

Figure No. 12  
 Page. 1 of 1

Split Spoon Sample   
 Auger Sample   
 SPT (N) Value   
 Dynamic Cone Test   
 Shelby Tube   
 Shear Strength by Vane Test   
 Combustible Vapour Reading   
 Natural Moisture Content   
 Atterberg Limits   
 Undrained Triaxial at % Strain at Failure   
 Shear Strength by Penetrometer Test

GWL	SOIL DESCRIPTION	Assumed Elevation m	Depth	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m <sup>3</sup>
				Shear Strength kPa				Natural Moisture Content %			
				20	40	60	80	250	500	750	
	<b>FILL/TILL</b> Light grey silty sandy GRAVEL - frozen, N <sub>r</sub> to N <sub>bn</sub>	5.7	0								
	<b>FILL/TILL</b> Black GRAVEL, trace sand, trace silt - intermixed with organics/sewage - frozen, N <sub>r</sub> to N <sub>bn</sub>	4.1	1								
	<b>TILL</b> Green to grey CLAY, some gravel, some sand - frozen, N <sub>r</sub> to N <sub>bn</sub>	3.7	2								
	<b>TILL</b> Green to grey CLAY, some gravel, some sand - frozen, N <sub>r</sub> to N <sub>bn</sub>	3.1									
	End of Test Pit at 2.6 m - unfrozen seam of sewage water at 1.7 m depth - test pit terminated due to sewage water inflow										

LOG OF TEST PIT OTT-00215839-A0\_BH\_LOGSHALLBEACH\_8JAN2014.GPJ TROW/OTTAWA.GDT 9/29/14

NOTES:  
 1. Borehole/Test Pit data requires Interpretation by exp. before use by others  
 2. Test pit was backfilled and lightly compacted upon completion.  
 3. Field work supervised by an exp representative.  
 4. See Notes on Sample Descriptions  
 5. This Figure is to read with exp. Services Inc. report OTT-00215839-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

# Log of Test Pit TP9



Project No: OTT-00215839-A0  
 Project: Proposed Sewage Lagoon Upgrades  
 Location: Hall Beach, NU  
 Date Drilled: November 15, 2013  
 Drill Type: \_\_\_\_\_  
 Datum: Geodetic  
 Logged by: RV Checked by: JS

Figure No. 13  
 Page. 1 of 1

- Split Spoon Sample
- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Shear Strength by Vane Test
- Combustible Vapour Reading
- Natural Moisture Content
- Atterberg Limits
- Undrained Triaxial at % Strain at Failure
- Shear Strength by Penetrometer Test

GWL	SOIL	SOIL DESCRIPTION	Assumed Elevation m	Depth m	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m <sup>3</sup>
					20	40	60	80	250	500	750	
					Shear Strength kPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)			
		<b>FILL/TILL</b> Light grey silty sandy GRAVEL - frozen, N <sub>r</sub> to N <sub>bn</sub>	5.6	0								
				1					X			
		End of Test Pit at 2.0 m - due to practical refusal in frozen soil	3.6	2								

LOG OF TEST PIT OTT-00215839-A0\_BH\_LOGSHALLBEACH\_8JAN2014.GPJ TROW/OTTAWA.GDT 9/29/14

- NOTES:
- Borehole/Test Pit data requires Interpretation by exp. before use by others
  - Test pit was backfilled and lightly compacted upon completion.
  - Field work supervised by an exp representative.
  - See Notes on Sample Descriptions
  - This Figure is to read with exp. Services Inc. report OTT-00215839-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

# Log of Test Pit 10



Project No: OTT-00220382-A0  
 Project: Sewage Lagoon Upgrades - Additional Geotechnical Investigation  
 Location: Hall Beach, Nunavut  
 Date Drilled: 8/25/14  
 Drill Type: \_\_\_\_\_  
 Datum: Geodetic  
 Logged by: MAD Checked by: JAS

Figure No. 14  
 Page. 1 of 1

- Split Spoon Sample
- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Shear Strength by Vane Test
- Combustible Vapour Reading
- Natural Moisture Content
- Atterberg Limits
- Undrained Triaxial at % Strain at Failure
- Shear Strength by Penetrometer Test

GWL	SOIL	SOIL DESCRIPTION	Assumed Elevation m	Depth m	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m <sup>3</sup>
					20	40	60	80	250	500	750	
					Shear Strength kPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)			
		<b>FILL/TILL</b> Light brown to greyish brown silty sandy gravel	7.9	0								
		- frozen, Vx 20% to 40%	6.4	6.5								
		End of Test Pit at 1.5 m - test pit terminated due to practical refusal in permafrost										

LOG OF TEST PIT LOGS OF TESTPITS.GPJ TROW OTTAWA.GDT 9/29/14

**NOTES:**  
 1. Borehole/Test Pit data requires Interpretation by exp. before use by others  
 2. The test pit was backfilled upon completion.  
 3. Field work supervised by an exp representative.  
 4. See Notes on Sample Descriptions  
 5. This Figure is to read with exp. Services Inc. report OTT-00220382-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
completion	1.4	1.5

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

# Log of Test Pit 11



Project No: OTT-00220382-A0  
 Project: Sewage Lagoon Upgrades - Additional Geotechnical Investigation  
 Location: Hall Beach, Nunavut  
 Date Drilled: 8/25/14  
 Drill Type: \_\_\_\_\_  
 Datum: Geodetic  
 Logged by: MAD Checked by: JAS

Figure No. 15  
 Page. 1 of 1

- Split Spoon Sample
- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Shear Strength by Vane Test
- Combustible Vapour Reading
- Natural Moisture Content
- Atterberg Limits
- Undrained Triaxial at % Strain at Failure
- Shear Strength by Penetrometer Test

GWL	SOIL	SOIL DESCRIPTION	Assumed Elevation m	Depth	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m <sup>3</sup>
					kPa				Atterberg Limits (% Dry Weight)			
					20	40	60	80	250	500	750	
	0	<b>FILL</b> Debris (pieces of metal, wood, plastic, glass) and organics intermixed with brown to black silty sandy gravel	5.8	0								
	1	<b>FILL/TILL</b> Light brown to greyish brown silty sandy gravel	4.8	1								
	2	End of Test Pit at 2.0 m - test pit terminated due to heavy groundwater inflow and sloughage	3.8	2								

LOG OF TEST PIT LOGS OF TESTPITS.GPJ TROW OTTAWA.GDT 9/29/14

**NOTES:**  
 1. Borehole/Test Pit data requires Interpretation by exp. before use by others  
 2. The test pit was backfilled upon completion.  
 3. Field work supervised by an exp representative.  
 4. See Notes on Sample Descriptions  
 5. This Figure is to read with exp. Services Inc. report OTT-00220382-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
completion	0.8	2.0

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

# Log of Test Pit 12



Project No: OTT-00220382-A0

Figure No. 16

Project: Sewage Lagoon Upgrades - Additional Geotechnical Investigation

Page. 1 of 1

Location: Hall Beach, Nunavut

Date Drilled: 8/25/14

Split Spoon Sample

Combustible Vapour Reading

Drill Type: \_\_\_\_\_

Auger Sample

Natural Moisture Content

SPT (N) Value

Atterberg Limits

Datum: Geodetic

Dynamic Cone Test

Undrained Triaxial at % Strain at Failure

Shelby Tube

Shear Strength by Penetrometer Test

Logged by: MAD Checked by: JAS

Shear Strength by Vane Test

GWL	SOIL	SOIL DESCRIPTION	Assumed Elevation m	Depth	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m <sup>3</sup>
					20	40	60	80	250	500	750	
					Shear Strength kPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)			
		<b>FILL</b> Brown to grey silty sandy gravel	5.4	0								
		<b>FILL</b> Debris (pieces of metal, wood, plastic, glass) and organics intermixed with brown to black silty sandy gravel - frozen, Vx 20% to 40%	4.6	1								
		End of Test Pit at 1.6 m - test pit terminated due to practical refusal in permafrost	3.8	3.9								

LOG OF TEST PIT LOGS OF TESTPITS.GPJ TROW OTTAWA.GDT 9/29/14

**NOTES:**  
 1. Borehole/Test Pit data requires Interpretation by exp. before use by others  
 2. The test pit was backfilled upon completion.  
 3. Field work supervised by an exp representative.  
 4. See Notes on Sample Descriptions  
 5. This Figure is to read with exp. Services Inc. report OTT-00220382-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
completion	1.5	1.6

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

# Log of Test Pit 13



Project No: OTT-00220382-A0  
 Project: Sewage Lagoon Upgrades - Additional Geotechnical Investigation  
 Location: Hall Beach, Nunavut  
 Date Drilled: 8/25/14  
 Drill Type: \_\_\_\_\_  
 Datum: Geodetic  
 Logged by: MAD Checked by: JAS

Figure No. 17  
 Page. 1 of 1

- Split Spoon Sample
- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Shear Strength by Vane Test
- Combustible Vapour Reading
- Natural Moisture Content
- Atterberg Limits
- Undrained Triaxial at % Strain at Failure
- Shear Strength by Penetrometer Test

GWL	SOIL	SOIL DESCRIPTION	Assumed Elevation m	Depth	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m <sup>3</sup>
									250	500	750	
									Natural Moisture Content % Atterberg Limits (% Dry Weight)			
		<b>FILL/TILL</b> Light brown to greyish brown silty sandy gravel	5.5	0	20	40	60	80	20	40	60	
			4.6	1								
		- frozen, Vx 20% to 40%	3.7									
		End of Test Pit at 1.8 m - test pit terminated due to practical refusal in permafrost										

LOG OF TEST PIT LOGS OF TESTPITS.GPJ TROW OTTAWA.GDT 9/29/14

- NOTES:**
- Borehole/Test Pit data requires Interpretation by exp. before use by others
  - The test pit was backfilled upon completion.
  - Field work supervised by an exp representative.
  - See Notes on Sample Descriptions
  - This Figure is to read with exp. Services Inc. report OTT-00220382-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
completion	0.9	1.8

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

# Log of Test Pit 14



Project No: OTT-00220382-A0  
 Project: Sewage Lagoon Upgrades - Additional Geotechnical Investigation  
 Location: Hall Beach, Nunavut  
 Date Drilled: 8/25/14  
 Drill Type: \_\_\_\_\_  
 Datum: Geodetic  
 Logged by: MAD Checked by: JAS

Figure No. 18  
 Page. 1 of 1

- Split Spoon Sample
- Auger Sample
- SPT (N) Value
- Dynamic Cone Test
- Shelby Tube
- Shear Strength by Vane Test
- Combustible Vapour Reading
- Natural Moisture Content
- Atterberg Limits
- Undrained Triaxial at % Strain at Failure
- Shear Strength by Penetrometer Test

GWL	SOIL	SOIL DESCRIPTION	Assumed Elevation m	Depth m	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m <sup>3</sup>
					20	40	60	80	250	500	750	
					Shear Strength kPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)			
		<b>FILL/TILL</b> Light brown to greyish brown silty sandy gravel	5.4	0								
				4.5								
				3.6								
		End of Test Pit at 1.8 m - test pit terminated due to heavy groundwater inflow and sloughage										

LOG OF TEST PIT LOGS OF TESTPITS.GPJ TROW OTTAWA.GDT 9/29/14

- NOTES:
- Borehole/Test Pit data requires Interpretation by exp. before use by others
  - The test pit was backfilled upon completion.
  - Field work supervised by an exp representative.
  - See Notes on Sample Descriptions
  - This Figure is to read with exp. Services Inc. report OTT-00220382-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
completion	0.9	1.8

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

# Log of Test Pit 15



Project No: OTT-00220382-A0

Figure No. 19

Project: Sewage Lagoon Upgrades - Additional Geotechnical Investigation

Page. 1 of 1

Location: Hall Beach, Nunavut

Date Drilled: 8/25/14

Split Spoon Sample

Combustible Vapour Reading

Drill Type: \_\_\_\_\_

Auger Sample

Natural Moisture Content

SPT (N) Value

Atterberg Limits

Datum: Geodetic

Dynamic Cone Test

Undrained Triaxial at % Strain at Failure

Shelby Tube

Shear Strength by Penetrometer Test

Logged by: MAD Checked by: JAS

Shear Strength by Vane Test

GWL	SOIL	SOIL DESCRIPTION	Assumed Elevation m	Depth	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m <sup>3</sup>
					20	40	60	80	250	500	750	
					Shear Strength kPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)			
		<b>FILL/TILL</b> Light brown to greyish brown silty sandy gravel	8	0								
		- frozen, Vx 20% to 40%	6.7	1								
		End of Test Pit at 1.3 m - test pit terminated due to practical refusal in permafrost										

LOG OF TEST PIT LOGS OF TESTPITS.GPJ TROW OTTAWA.GDT 9/29/14

NOTES:  
 1. Borehole/Test Pit data requires Interpretation by exp. before use by others  
 2. The test pit was backfilled upon completion.  
 3. Field work supervised by an exp representative.  
 4. See Notes on Sample Descriptions  
 5. This Figure is to read with exp. Services Inc. report OTT-00220382-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
completion	Not Observed	1.3

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

# Log of Test Pit 16



Project No: OTT-00220382-A0

Figure No. 20

Project: Sewage Lagoon Upgrades - Additional Geotechnical Investigation

Page. 1 of 1

Location: Hall Beach, Nunavut

Date Drilled: 8/25/14

Split Spoon Sample

Combustible Vapour Reading

Drill Type: \_\_\_\_\_

Auger Sample

Natural Moisture Content

SPT (N) Value

Atterberg Limits

Datum: Geodetic

Dynamic Cone Test

Undrained Triaxial at % Strain at Failure

Shelby Tube

Shear Strength by Penetrometer Test

Logged by: MAD Checked by: JAS

Shear Strength by Vane Test

GWL	SOIL SYMBOL	SOIL DESCRIPTION	Assumed Elevation m	Depth m	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m <sup>3</sup>	
					20	40	60	80	250	500	750		
					Shear Strength kPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)				
					50	100	150	200	20	40	60		
		<b>FILL</b> Debris (pieces of metal, wood, plastic, glass) and organics intermixed with brown to black silty sandy gravel	6.4	0									
		- frozen, Vx 20% to 40%	5.4	5.5									
		End of Test Pit at 1.0 m - test pit terminated due to practical refusal in permafrost											

LOG OF TEST PIT LOGS OF TESTPITS.GPJ TROW OTTAWA.GDT 9/29/14

NOTES:  
 1. Borehole/Test Pit data requires Interpretation by exp. before use by others  
 2. The test pit was backfilled upon completion.  
 3. Field work supervised by an exp representative.  
 4. See Notes on Sample Descriptions  
 5. This Figure is to read with exp. Services Inc. report OTT-00220382-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
completion	1.0	1.0

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

# Log of Test Pit 17



Project No: OTT-00220382-A0

Figure No. 21

Project: Sewage Lagoon Upgrades - Additional Geotechnical Investigation

Page. 1 of 1

Location: Hall Beach, Nunavut

Date Drilled: 8/25/14

Split Spoon Sample

Combustible Vapour Reading

Drill Type: \_\_\_\_\_

Auger Sample

Natural Moisture Content

SPT (N) Value

Atterberg Limits

Datum: Geodetic

Dynamic Cone Test

Undrained Triaxial at % Strain at Failure

Shelby Tube

Shear Strength by Penetrometer Test

Logged by: MAD Checked by: JAS

Shear Strength by Vane Test

G W L	S Y M B O L	SOIL DESCRIPTION	Assumed Elevation m	D e p t h	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			N a t u r a l M o i s t u r e C o n t e n t % A t t e r b e r g L i m i t s (% D r y W e i g h t)	N a t u r a l U n i t W t. k N /m <sup>3</sup>
					20	40	60	80	250	500	750		
					Shear Strength kPa				Atterberg Limits (% Dry Weight)				
		<b>FILL/TILL</b> Light brown to greyish brown silty sandy gravel	5.5	0									
		- frozen, Vx 20% to 40%	4.3	1									
		End of Test Pit at 1.2 m - test pit terminated due to practical refusal in permafrost											

LOG OF TEST PIT LOGS OF TESTPITS.GPJ TROW OTTAWA.GDT 9/29/14

NOTES:  
 1. Borehole/Test Pit data requires Interpretation by exp. before use by others  
 2. The test pit was backfilled upon completion.  
 3. Field work supervised by an exp representative.  
 4. See Notes on Sample Descriptions  
 5. This Figure is to read with exp. Services Inc. report OTT-00220382-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
completion	Not Observed	1.2

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

# Log of Test Pit 18



Project No: OTT-00220382-A0

Figure No. 22

Project: Sewage Lagoon Upgrades - Additional Geotechnical Investigation

Page. 1 of 1

Location: Hall Beach, Nunavut

Date Drilled: 8/25/14

Split Spoon Sample

Combustible Vapour Reading

Drill Type: \_\_\_\_\_

Auger Sample

Natural Moisture Content

SPT (N) Value

Atterberg Limits

Datum: Geodetic

Dynamic Cone Test

Undrained Triaxial at % Strain at Failure

Shelby Tube

Shear Strength by Penetrometer Test

Logged by: MAD Checked by: JAS

Shear Strength by Vane Test

GWL	SOIL	SOIL DESCRIPTION	Assumed Elevation m	Depth m	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m <sup>3</sup>
					20	40	60	80	250	500	750	
					Shear Strength kPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)			
		<b>FILL</b> Brown silty sandy gravel - occasional cobbles	5.5	0								
		<b>FILL</b> Debris (pieces of metal, wood, plastic, glass) and organics intermixed with brown to black silty sandy gravel - frozen, Vx 20% to 40%	5.0									
		End of Test Pit at 1.1 m - test pit terminated due to practical refusal in permafrost	4.4	4.5								

LOG OF TEST PIT LOGS OF TESTPITS.GPJ TROW OTTAWA.GDT 9/29/14

NOTES:  
 1. Borehole/Test Pit data requires Interpretation by exp. before use by others  
 2. The test pit was backfilled upon completion.  
 3. Field work supervised by an exp representative.  
 4. See Notes on Sample Descriptions  
 5. This Figure is to read with exp. Services Inc. report OTT-00220382-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
completion	1.1	1.1

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

# Log of Test Pit 19



Project No: OTT-00220382-A0

Figure No. 23

Project: Sewage Lagoon Upgrades - Additional Geotechnical Investigation

Page. 1 of 1

Location: Hall Beach, Nunavut

Date Drilled: 8/25/14

Split Spoon Sample

Combustible Vapour Reading

Drill Type: \_\_\_\_\_

Auger Sample

Natural Moisture Content

SPT (N) Value

Atterberg Limits

Datum: Geodetic

Dynamic Cone Test

Undrained Triaxial at % Strain at Failure

Shelby Tube

Shear Strength by Penetrometer Test

Logged by: MAD Checked by: JAS

Shear Strength by Vane Test

GWL	SOIL SYMBOL	SOIL DESCRIPTION	Assumed Elevation m	Depth m	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m <sup>3</sup>
					20	40	60	80	250	500	750	
					Shear Strength kPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)			
					50	100	150	200	20	40	60	
		<b>FILL/TILL</b> Light brown to greyish brown silty sandy gravel  - frozen, Vx 20% to 40%	6.5	0								
		End of Test Pit at 1.1 m - test pit terminated due to practical refusal in permafrost	5.4	1								

LOG OF TEST PIT LOGS OF TESTPITS.GPJ TROW OTTAWA.GDT 9/29/14

NOTES:  
 1. Borehole/Test Pit data requires Interpretation by exp. before use by others  
 2. The test pit was backfilled upon completion.  
 3. Field work supervised by an exp representative.  
 4. See Notes on Sample Descriptions  
 5. This Figure is to read with exp. Services Inc. report OTT-00220382-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
completion	Not Observed	1.1

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

# Log of Test Pit 20



Project No: OTT-00220382-A0

Figure No. 24

Project: Sewage Lagoon Upgrades - Additional Geotechnical Investigation

Page. 1 of 1

Location: Hall Beach, Nunavut

Date Drilled: 8/25/14

Split Spoon Sample

Combustible Vapour Reading

Drill Type: \_\_\_\_\_

Auger Sample

Natural Moisture Content

SPT (N) Value

Atterberg Limits

Datum: Geodetic

Dynamic Cone Test

Undrained Triaxial at % Strain at Failure

Shelby Tube

Shear Strength by Penetrometer Test

Logged by: MAD Checked by: JAS

Shear Strength by Vane Test

GWL	SOIL LOG	SOIL DESCRIPTION	Assumed Elevation m	Depth m	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m <sup>3</sup>
					20	40	60	80	250	500	750	
					Shear Strength kPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)			
		<b>FILL/TILL</b> Light brown to greyish brown silty sandy gravel	7	0	50	100	150	200	20	40	60	
		- frozen, Vx 20% to 40%	5.6	5.7								
		End of Test Pit at 1.4 m - test pit terminated due to practical refusal in permafrost										

LOG OF TEST PIT LOGS OF TESTPITS.GPJ TROW OTTAWA.GDT 9/29/14

- NOTES:
- Borehole/Test Pit data requires Interpretation by exp. before use by others
  - The test pit was backfilled upon completion.
  - Field work supervised by an exp representative.
  - See Notes on Sample Descriptions
  - This Figure is to read with exp. Services Inc. report OTT-00220382-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
completion	1.4	1.4

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

# Log of Test Pit 21



Project No: OTT-00220382-A0

Figure No. 25

Project: Sewage Lagoon Upgrades - Additional Geotechnical Investigation

Page. 1 of 1

Location: Hall Beach, Nunavut

Date Drilled: 8/25/14

Split Spoon Sample

Combustible Vapour Reading

Drill Type: \_\_\_\_\_

Auger Sample

Natural Moisture Content

SPT (N) Value

Atterberg Limits

Datum: Geodetic

Dynamic Cone Test

Undrained Triaxial at % Strain at Failure

Shelby Tube

Shear Strength by Penetrometer Test

Logged by: MAD Checked by: JAS

Shear Strength by Vane Test

G W L	S O B O L	SOIL DESCRIPTION	Assumed Elevation m	D e p t h m	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m <sup>3</sup>
					20	40	60	80	250	500	750	
					Shear Strength kPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)			
		<b>FILL/TILL</b> Light brown to greyish brown silty sandy gravel	7.1	0	50	100	150	200	20	40	60	
		- frozen, Vx 20% to 40%	5.8	1								
		End of Test Pit at 1.3 m - test pit terminated due to practical refusal in permafrost										

LOG OF TEST PIT LOGS OF TESTPITS.GPJ TROW OTTAWA.GDT 9/29/14

**NOTES:**  
 1. Borehole/Test Pit data requires Interpretation by exp. before use by others  
 2. The test pit was backfilled upon completion.  
 3. Field work supervised by an exp representative.  
 4. See Notes on Sample Descriptions  
 5. This Figure is to read with exp. Services Inc. report OTT-00220382-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
completion	Not Observed	1.3

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

# Log of Test Pit 22



Project No: OTT-00220382-A0

Figure No. 26

Project: Sewage Lagoon Upgrades - Additional Geotechnical Investigation

Page. 1 of 1

Location: Hall Beach, Nunavut

Date Drilled: 8/25/14

Split Spoon Sample

Combustible Vapour Reading

Drill Type: \_\_\_\_\_

Auger Sample

Natural Moisture Content

SPT (N) Value

Atterberg Limits

Datum: Geodetic

Dynamic Cone Test

Undrained Triaxial at

Shelby Tube

% Strain at Failure

Logged by: MAD Checked by: JAS

Shear Strength by Vane Test

Shear Strength by Penetrometer Test

GWL	SOIL SAMPLE	SOIL DESCRIPTION	Assumed Elevation m	Depth m	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m <sup>3</sup>
					20	40	60	80	250	500	750	
					Shear Strength kPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)			
		<b>FILL/TILL</b> Light brown to greyish brown silty sandy gravel	6.7	0								
		- frozen, Vx 20% to 40%	5.4	1								
		End of Test Pit at 1.3 m - test pit terminated due to practical refusal in permafrost										

LOG OF TEST PIT LOGS OF TESTPITS.GPJ TROW OTTAWA.GDT 9/29/14

- NOTES:
- Borehole/Test Pit data requires Interpretation by exp. before use by others
  - The test pit was backfilled upon completion.
  - Field work supervised by an exp representative.
  - See Notes on Sample Descriptions
  - This Figure is to read with exp. Services Inc. report OTT-00220382-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
completion	Not Observed	1.3

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

# Log of Test Pit 23



Project No: OTT-00220382-A0

Figure No. 27

Project: Sewage Lagoon Upgrades - Additional Geotechnical Investigation

Page. 1 of 1

Location: Hall Beach, Nunavut

Date Drilled: 8/25/14

Split Spoon Sample

Combustible Vapour Reading

Drill Type: \_\_\_\_\_

Auger Sample

Natural Moisture Content

SPT (N) Value

Atterberg Limits

Datum: Geodetic

Dynamic Cone Test

Undrained Triaxial at % Strain at Failure

Shelby Tube

Shear Strength by Penetrometer Test

Logged by: MAD Checked by: JAS

Shear Strength by Vane Test

GWL	SOIL SYMBOL	SOIL DESCRIPTION	Assumed Elevation m	Depth m	Standard Penetration Test N Value				Combustible Vapour Reading (ppm)			Natural Unit Wt. kN/m <sup>3</sup>
					20	40	60	80	250	500	750	
					Shear Strength kPa				Natural Moisture Content % Atterberg Limits (% Dry Weight)			
		<b>FILL</b> Brown silty sandy gravel	5.8	0								
		<b>FILL</b> Debris (pieces of metal, wood, plastic, glass) and organics intermixed with brown to black silty sandy gravel - frozen, Vx 20% to 40%	5.3	1								
		End of Test Pit at 1.4 m - test pit terminated due to practical refusal in permafrost	4.8									
			4.4									

LOG OF TEST PIT LOGS OF TESTPITS.GPJ TROW OTTAWA.GDT 9/29/14

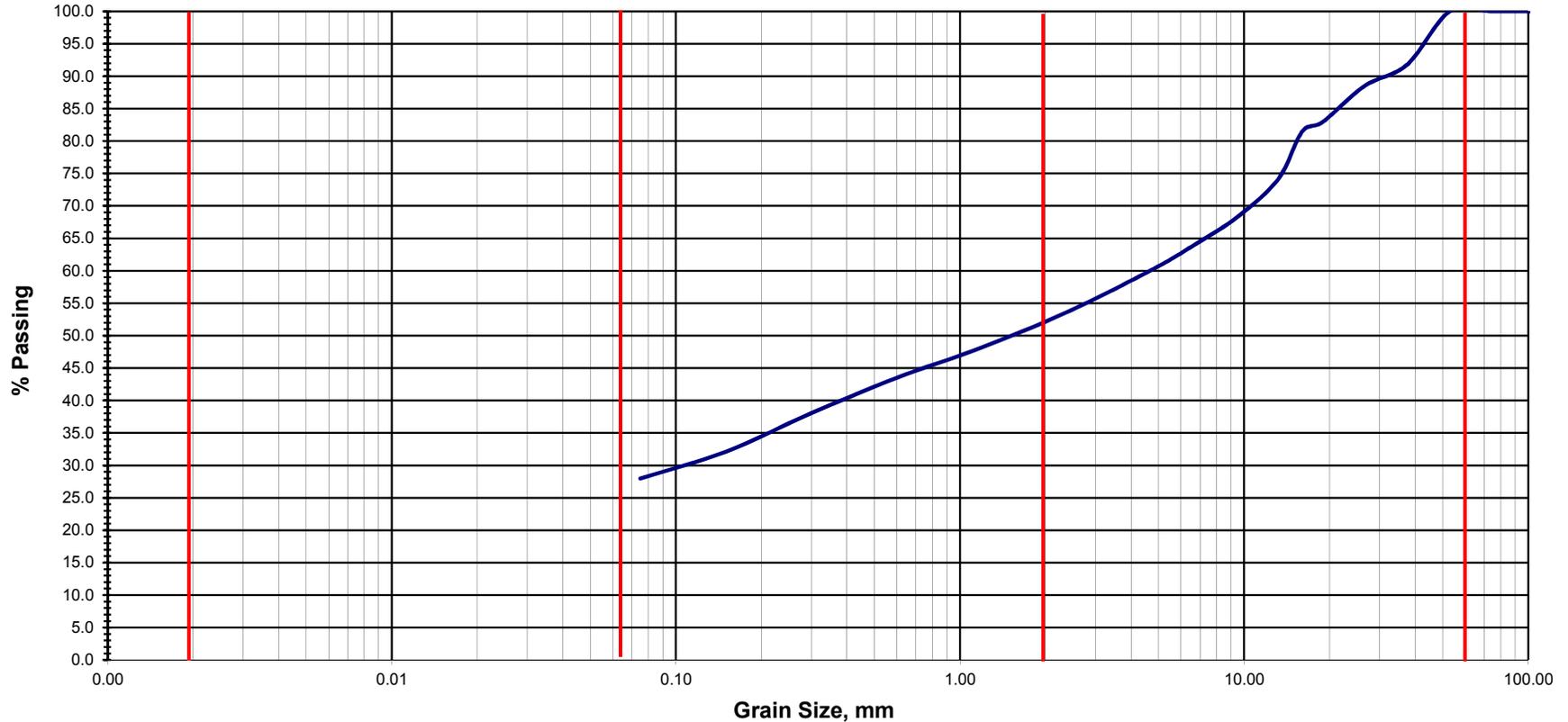
NOTES:  
 1. Borehole/Test Pit data requires Interpretation by exp. before use by others  
 2. The test pit was backfilled upon completion.  
 3. Field work supervised by an exp representative.  
 4. See Notes on Sample Descriptions  
 5. This Figure is to read with exp. Services Inc. report OTT-00220382-A0

WATER LEVEL RECORDS		
Elapsed Time	Water Level (m)	Hole Open To (m)
completion	1.0	1.4

CORE DRILLING RECORD			
Run No.	Depth (m)	% Rec.	RQD %

## Method of Test for Sieve Analysis of Aggregate ASTM C-136 (LS-602)

Grain Size Distribution Curve

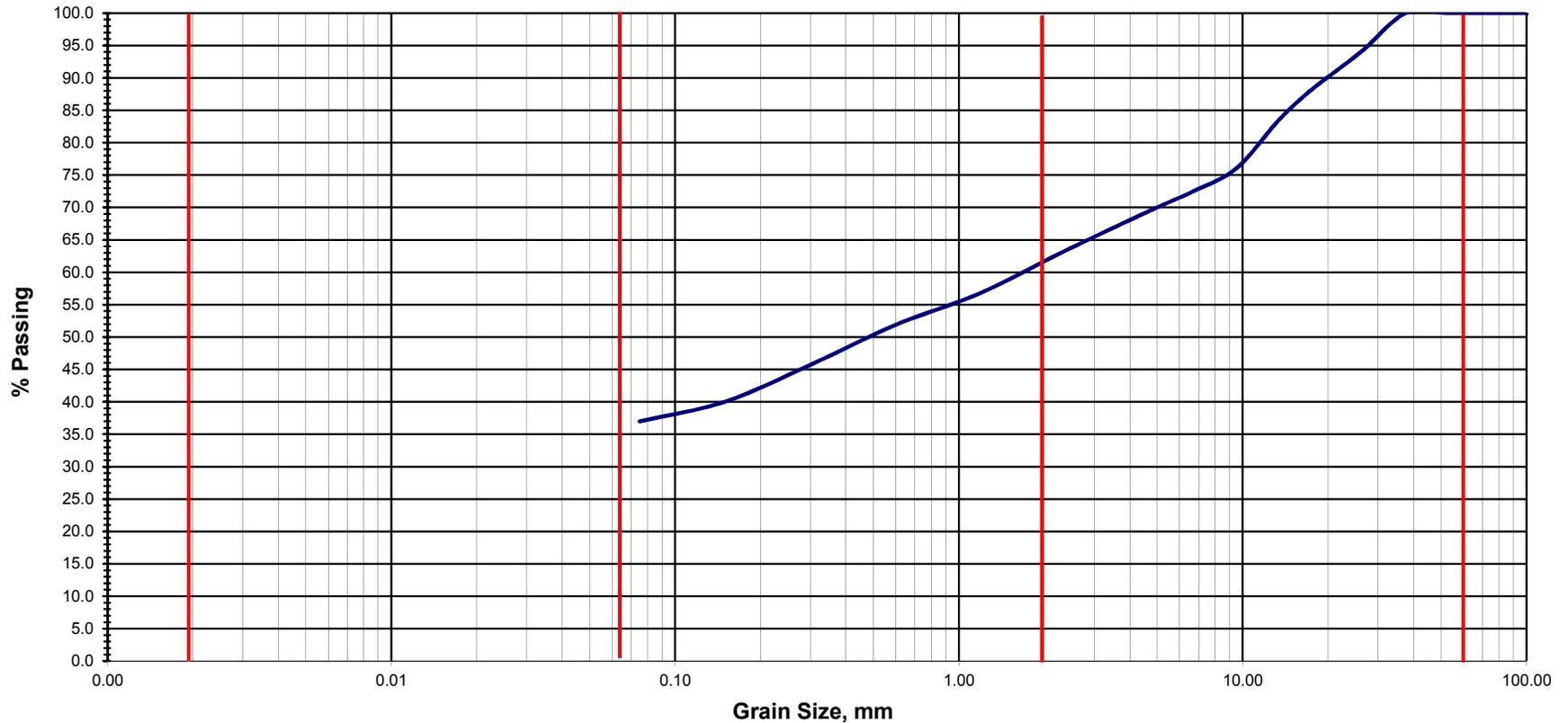


<b>CLAY</b>	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse
	<b>SILT</b>			<b>SAND</b>			<b>GRAVEL</b>		
<b>Modified M.I.T. Classification</b>									

Exp Project No.:	OTT-00215839-A0	Project Name :	Geotechnical Investigation, Proposed Sewage Lagoon Expansion			
Client :	Government of Nunavut	Project Location :	Hall Beach, NU			
Date Sampled :	November 14, 2013	BOREHOLE	1	SAMPLE run 3	Depth (m) :	0.3-0.6
Sample Description :	<b>silty sandy GRAVEL</b>				Figure :	<b>28</b>

## Method of Test for Sieve Analysis of Aggregate ASTM C-136 (LS-602)

Grain Size Distribution Curve

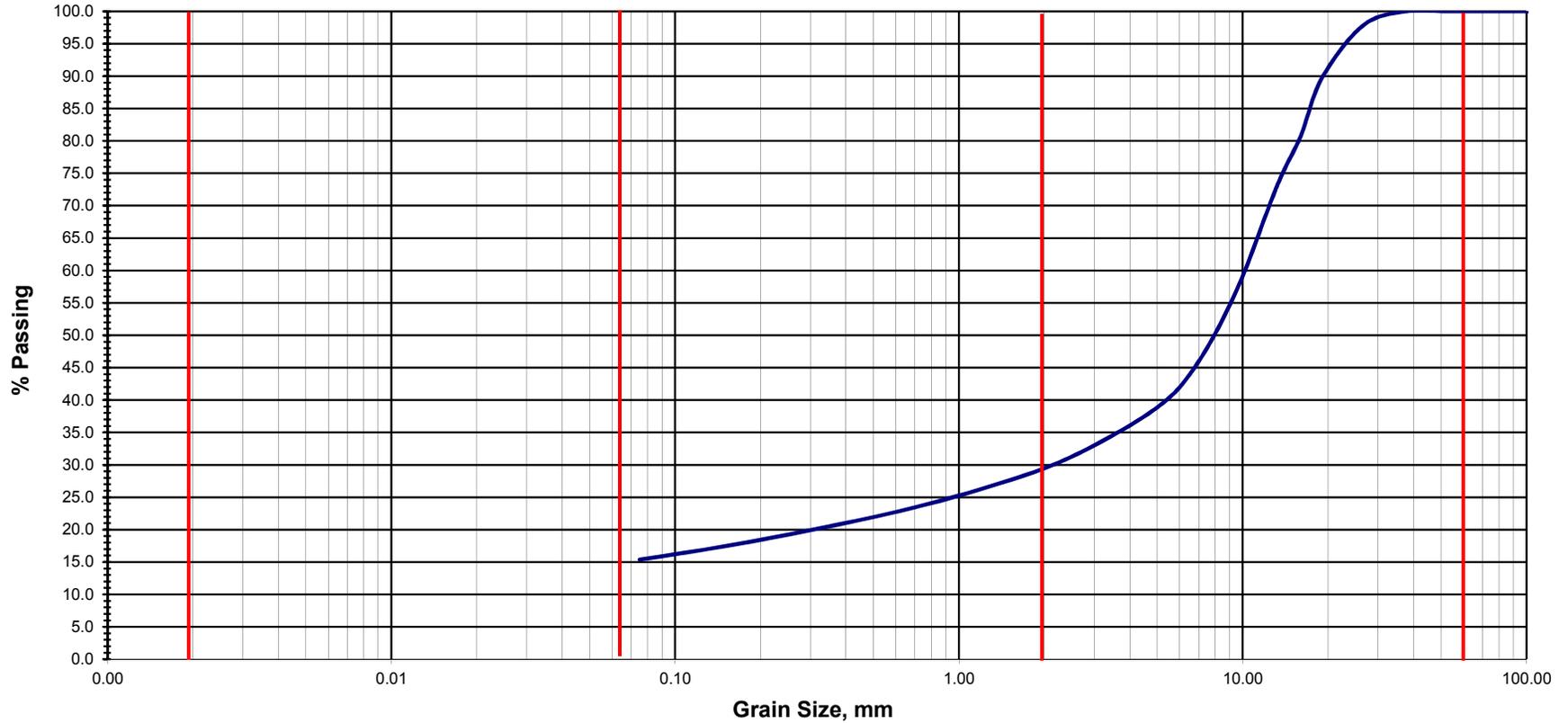


<b>CLAY</b>	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse
	<b>SILT</b>			<b>SAND</b>			<b>GRAVEL</b>		
<b>Modified M.I.T. Classification</b>									

Exp Project No.:	OTT-00215839-A0	Project Name :	Geotechnical Investigation, Proposed Sewage Lagoon Expansion
Client :	Government of Nunavut	Project Location :	Hall Beach, NU
Date Sampled :	November 15, 2013	BOREHOLE	1
		SAMPLE	run 6
Sample Description :	<b>sandy GRAVEL and CLAY</b>		Depth (m) : 1.5-2.4
		Figure :	29

## Method of Test for Sieve Analysis of Aggregate ASTM C-136 (LS-602)

Grain Size Distribution Curve

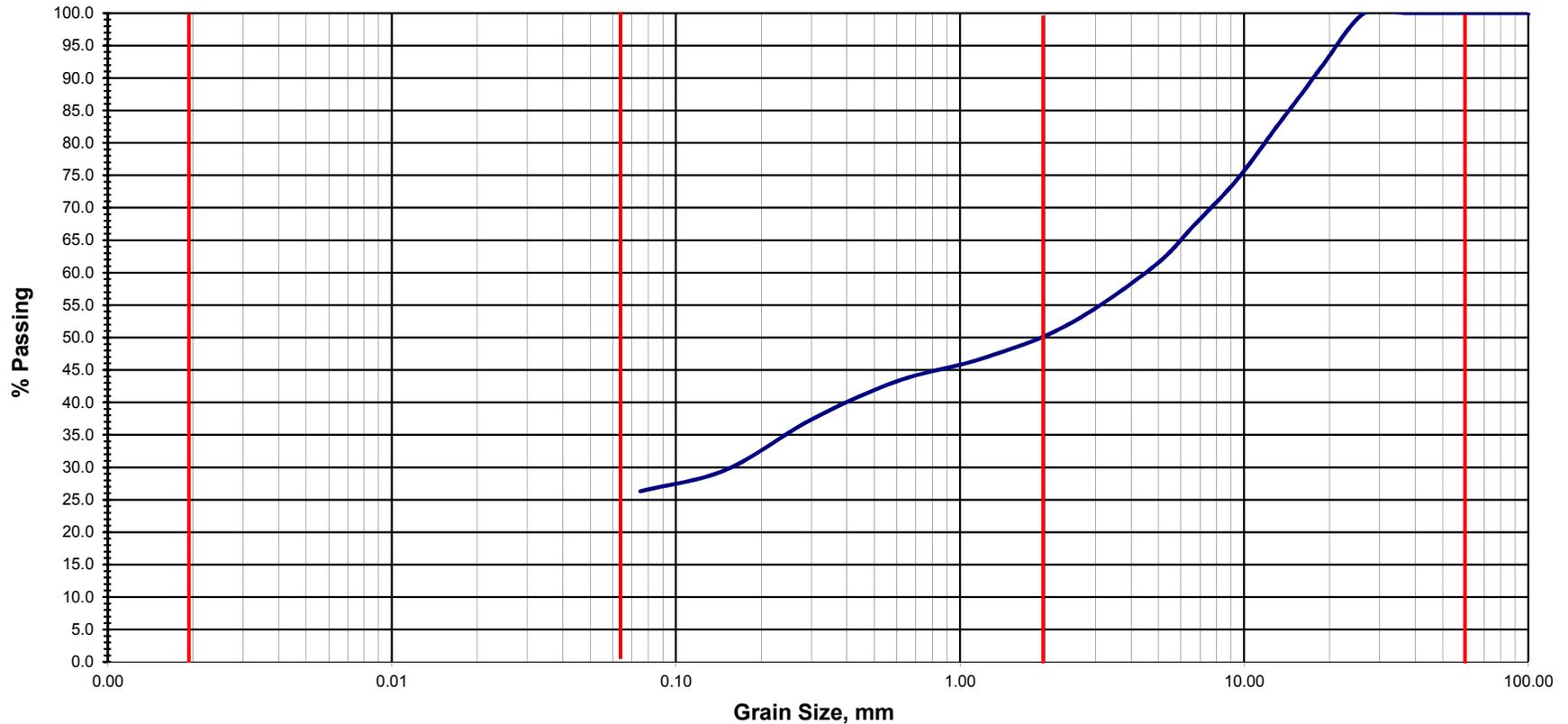


<b>CLAY</b>	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse
	<b>SILT</b>			<b>SAND</b>			<b>GRAVEL</b>		
<b>Modified M.I.T. Classification</b>									

Exp Project No.:	OTT-00215839-A0	Project Name :	Geotechnical Investigation, Proposed Sewage Lagoon Expansion			
Client :	Government of Nunavut	Project Location :	Hall Beach, NU			
Date Sampled :	November 19, 2013	BOREHOLE	2	SAMPLE run 3	Depth (m) :	0.7-1.2
Sample Description :	<b>GRAVEL, some silt, some sand</b>				Figure :	17

## Method of Test for Sieve Analysis of Aggregate ASTM C-136 (LS-602)

Grain Size Distribution Curve

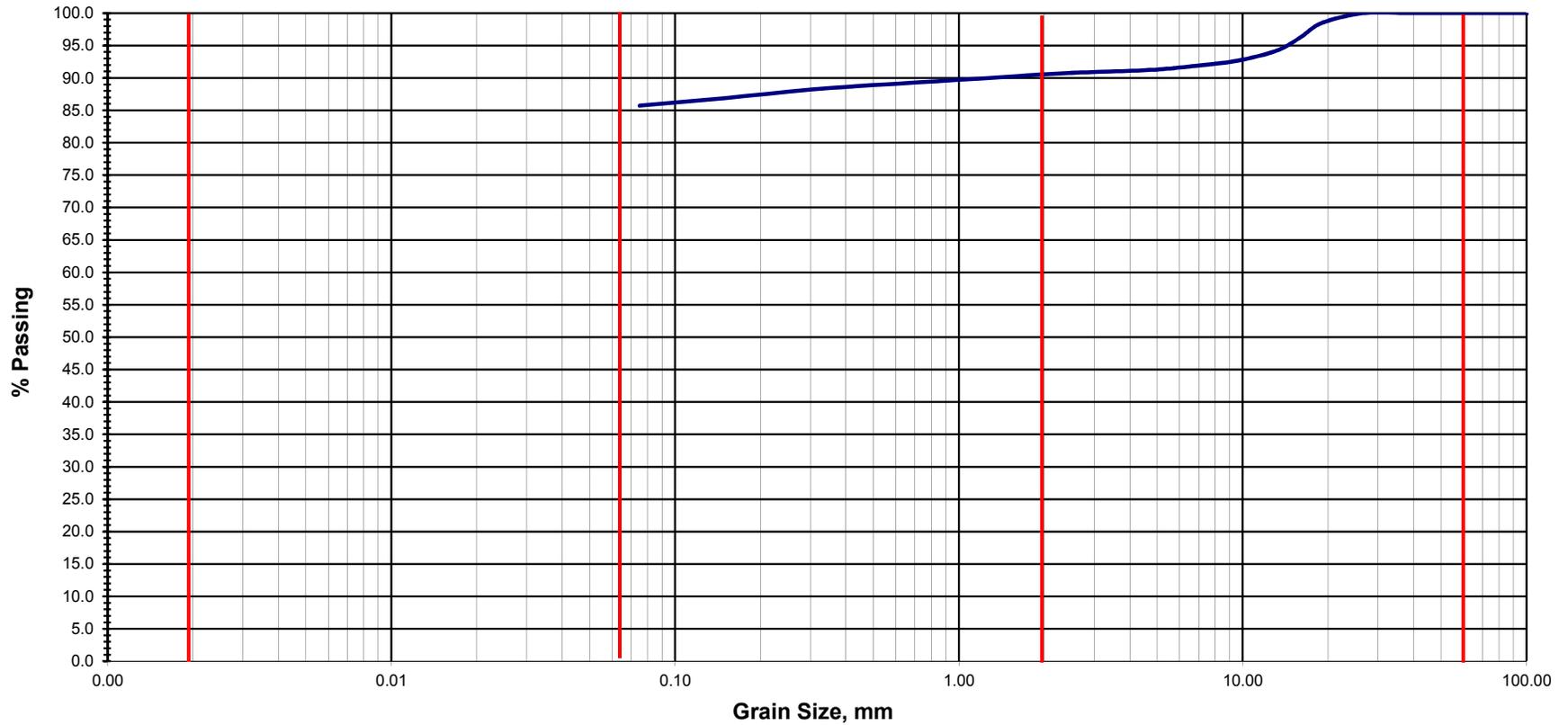


<b>CLAY</b>	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse
	<b>SILT</b>			<b>SAND</b>			<b>GRAVEL</b>		
<b>Modified M.I.T. Classification</b>									

Exp Project No.:	OTT-00215839-A0	Project Name :	Geotechnical Investigation, Proposed Sewage Lagoon Expansion
Client :	Government of Nunavut	Project Location :	Hall Beach, NU
Date Sampled :	November 19, 2013	BOREHOLE	2
		SAMPLE	run 5
Sample Description :	<b>silty sandy GRAVEL</b>		Depth (m) : 2.0-2.4
		Figure :	30

Method of Test for Sieve Analysis of Aggregate  
 ASTM C-136 (LS-602)

Grain Size Distribution Curve

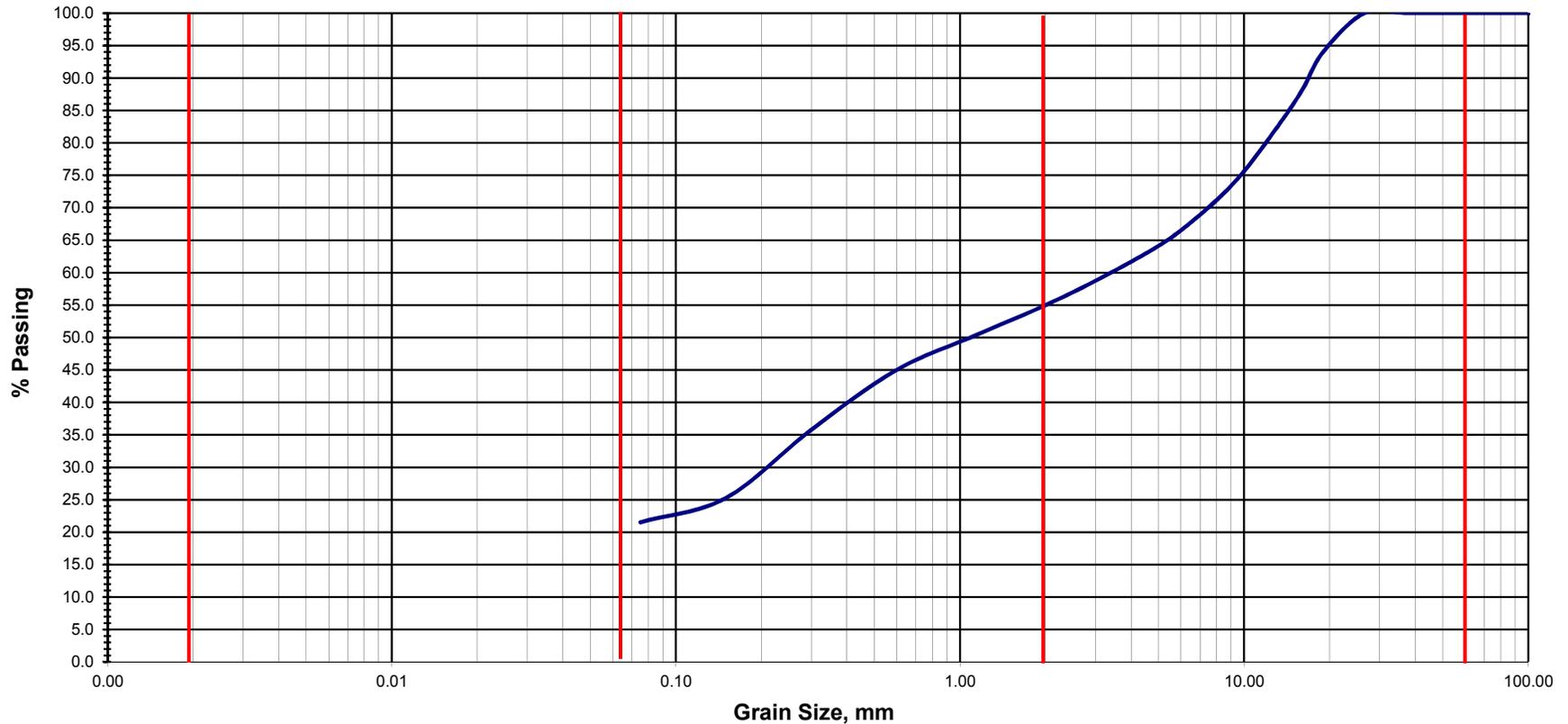


CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse
	SILT			SAND			GRAVEL		
Modified M.I.T. Classification									

Exp Project No.:	OTT-00215839-A0	Project Name :	Geotechnical Investigation, Proposed Sewage Lagoon Expansion						
Client :	Government of Nunavut	Project Location :	Hall Beach, NU						
Date Sampled :	November 19, 2013	BOREHOLE	2	SAMPLE	run 6	Depth (m) :	2.4-3.7		
Sample Description :	CLAY, some gravel, some sand						Figure :	31	

## Method of Test for Sieve Analysis of Aggregate ASTM C-136 (LS-602)

Grain Size Distribution Curve

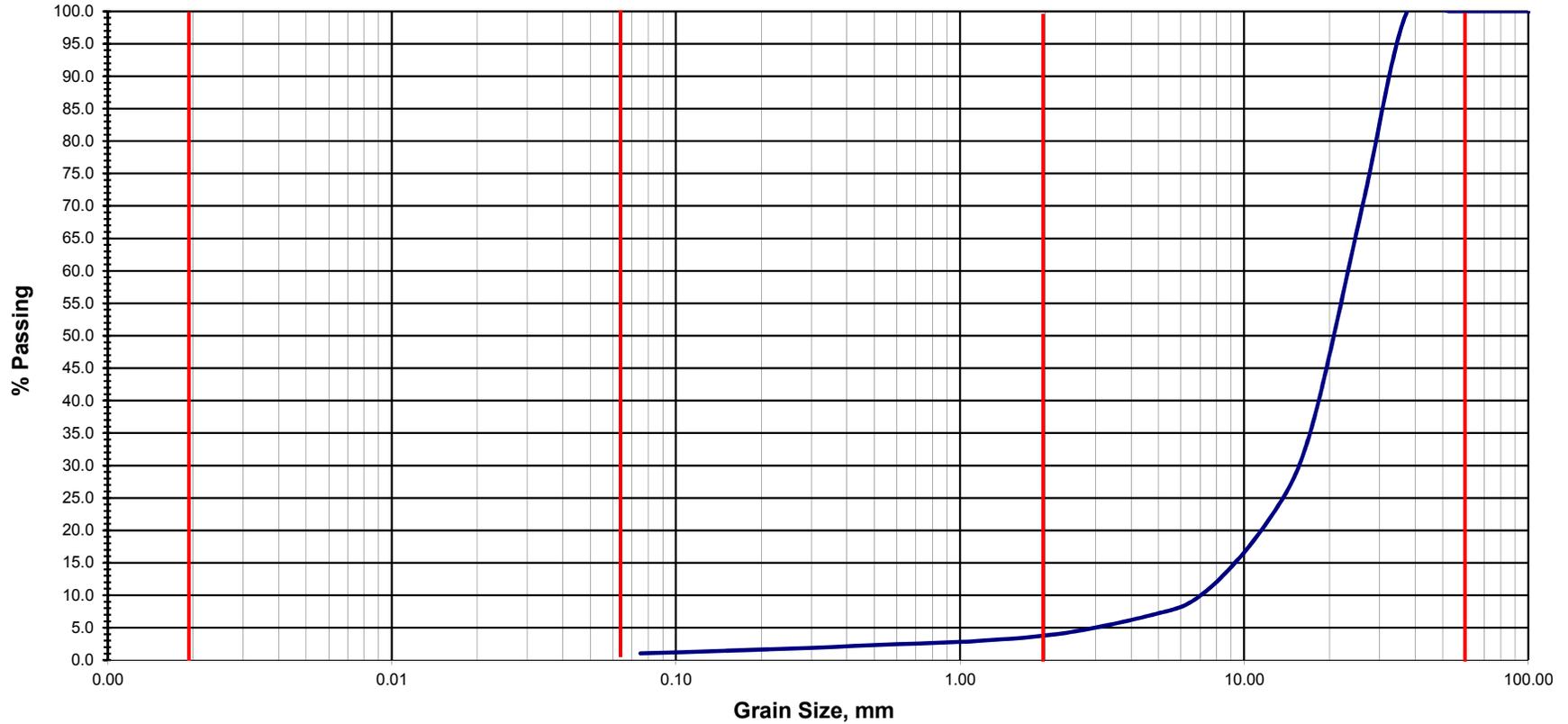


<b>CLAY</b>	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse
	<b>SILT</b>			<b>SAND</b>			<b>GRAVEL</b>		
<b>Modified M.I.T. Classification</b>									

Exp Project No.:	OTT-00215839-A0	Project Name :	Geotechnical Investigation, Proposed Sewage Lagoon Expansion			
Client :	Government of Nunavut	Project Location :	Hall Beach, NU			
Date Sampled :	November 20, 2013	BOREHOLE	3	SAMPLE run 3	Depth (m) :	0.6-1.2
Sample Description :	<b>silty GRAVEL and SAND</b>				Figure :	32

## Method of Test for Sieve Analysis of Aggregate ASTM C-136 (LS-602)

Grain Size Distribution Curve

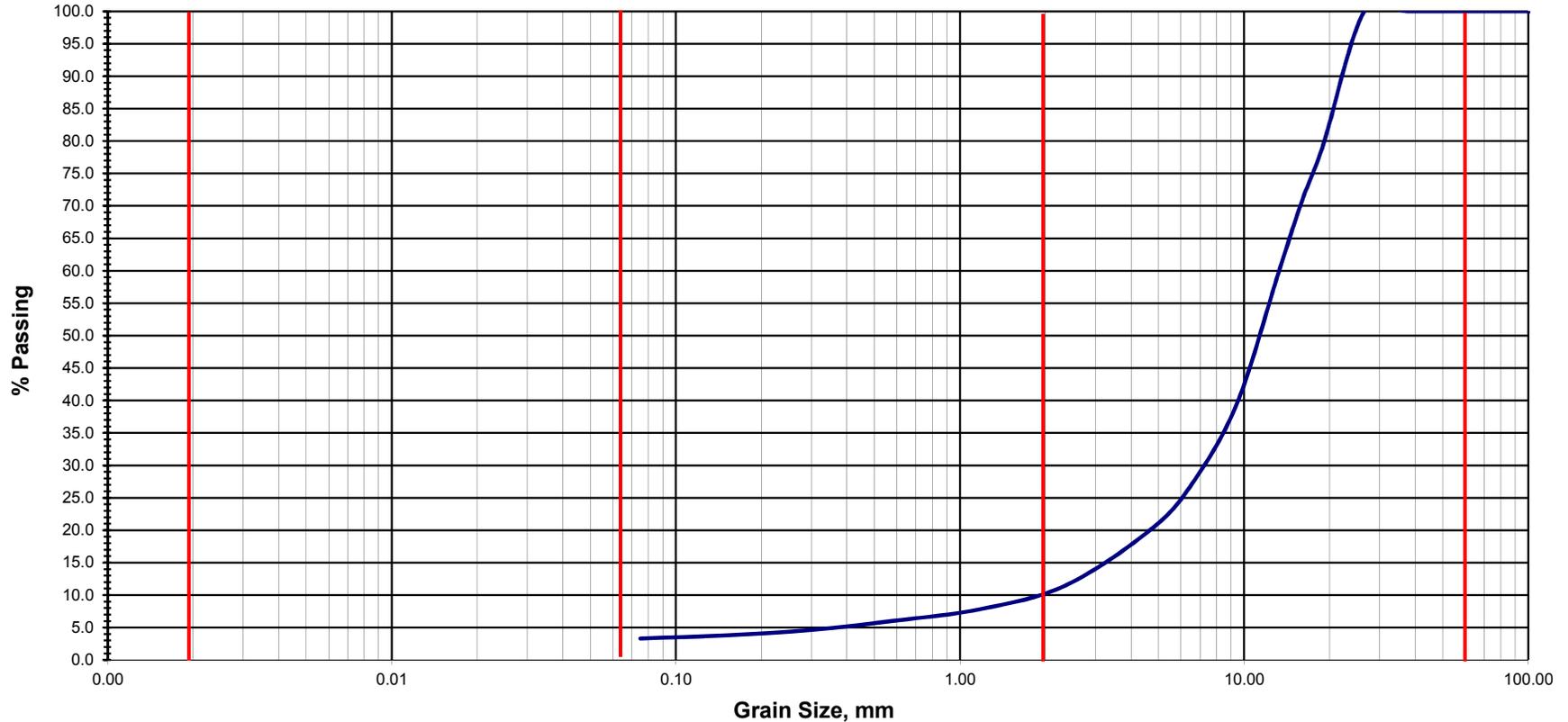


<b>CLAY</b>	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse
	<b>SILT</b>			<b>SAND</b>			<b>GRAVEL</b>		
<b>Modified M.I.T. Classification</b>									

Exp Project No.:	OTT-00215839-A0	Project Name :	Geotechnical Investigation, Proposed Sewage Lagoon Expansion			
Client :	Government of Nunavut	Project Location :	Hall Beach, NU			
Date Sampled :	November 14, 2013	BOREHOLE	TP1	SAMPLE G2	Depth (m) :	0.3-0.5
Sample Description :	<b>GRAVEL, trace sand, trace silt</b>				Figure :	33

## Method of Test for Sieve Analysis of Aggregate ASTM C-136 (LS-602)

Grain Size Distribution Curve

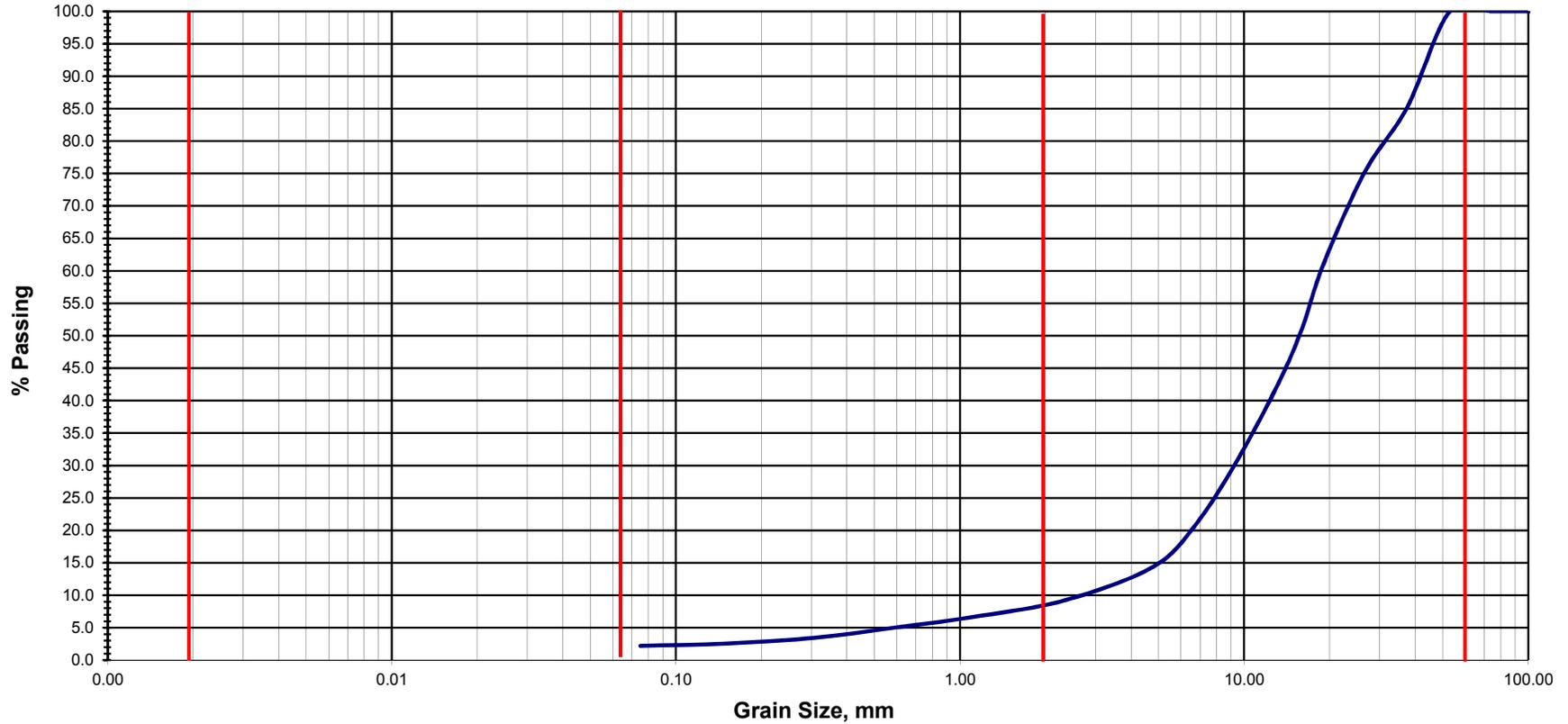


<b>CLAY</b>	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse
	<b>SILT</b>			<b>SAND</b>			<b>GRAVEL</b>		
<b>Modified M.I.T. Classification</b>									

Exp Project No.:	OTT-00215839-A0	Project Name :	Geotechnical Investigation, Proposed Sewage Lagoon Expansion
Client :	Government of Nunavut	Project Location :	Hall Beach, NU
Date Sampled :	November 15, 2013	BOREHOLE	TP5
		SAMPLE	G1
Sample Description :	<b>GRAVEL, trace sand, trace silt</b>		Depth (m) : 0-0.4
			Figure : 34

Method of Test for Sieve Analysis of Aggregate  
 ASTM C-136 (LS-602)

Grain Size Distribution Curve



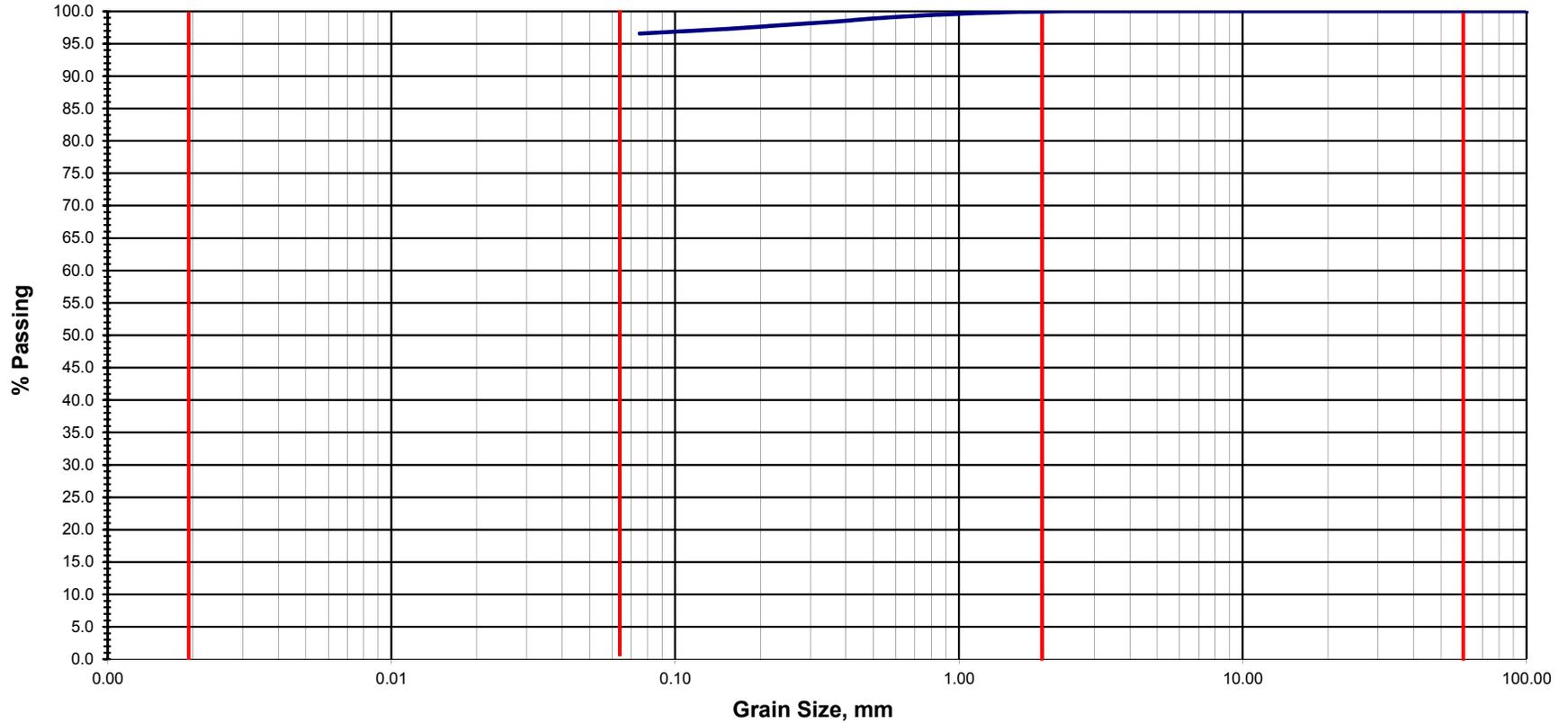
CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse
	SILT			SAND			GRAVEL		
<b>Modified M.I.T. Classification</b>									

Exp Project No.:	OTT-00215839-A0	Project Name :	Geotechnical Investigation, Proposed Sewage Lagoon Expansion						
Client :	Government of Nunavut	Project Location :	Hall Beach, NU						
Date Sampled :	November 15, 2013	BOREHOLE	TP5	SAMPLE	G2	Depth (m) :	0.3-0.5		
Sample Description :	<b>GRAVEL, trace sand, trace silt</b>						Figure :	35	



Method of Test for Sieve Analysis of Aggregate  
 ASTM C-136 (LS-602)

Grain Size Distribution Curve



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse
	SILT			SAND			GRAVEL		
Modified M.I.T. Classification									

Exp Project No.:	OTT-00215839-A0	Project Name :	Geotechnical Investigation, Proposed Sewage Lagoon Expansion						
Client :	Government of Nunavut	Project Location :	Hall Beach, NU						
Date Sampled :	November 15, 2013	BOREHOLE	TP7	SAMPLE	G3	Depth (m) :	0.4-0.7		
Sample Description :	CLAY, trace sand						Figure :	36	

**exp** Services Inc.  
*Client: Government of Nunavut*  
*Re: Additional Geotechnical Investigation – Sewage Lagoon Upgrades*  
*Location: Hall Beach, NU*  
*Project Number: OTT-00202382-A0*  
*Date: September 29, 2014*

## **Appendix A**

### **Photographs of Additional Test Pits**



**Photo 1: August 25, 2014 – TP10**



**Photo 2: August 25, 2014 – TP11**



**Photo 3: August 25, 2014 – TP12**



**Photo 4: August 25, 2014 – TP13**



**Photo 5: August 25, 2014 – TP14**



**Photo 6: August 25, 2014 – TP15**



**Photo 7: August 25, 2014 – TP16**



**Photo 8: August 25, 2014 – TP17**



**Photo 9: August 25, 2014 – TP18**



**Photo 10: August 25, 2014 – TP19**



**Photo 11: August 25, 2014 – TP20**



**Photo 12: August 25, 2014 – TP21**



**Photo 13: August 25, 2014 – TP22**



**Photo 14: August 25, 2014 – TP23**

## List of Distribution

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**Exp** Services Inc. – Steven Burden – [steven.burden@exp.com](mailto:steven.burden@exp.com)