

City of Iqaluit c/o Colliers Project Leaders

Geotechnical Investigation

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Project Name

Geotechnical Investigation Proposed Expansion to City of Iqaluit Public Works Garage Facility Building 1549, Federal Road, Iqaluit, Nunavut

Project Number OTT-00245997-A0

Prepared By:

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Date Submitted May 4, 2018

City of Iqaluit c/o Colliers Project Leaders

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Executive Summary

A geotechnical investigation was undertaken at the site of the proposed expansion to the City of Iqaluit Public Works garage Facility located in the southeast quadrant of the intersection of Federal Road and Qaggamiut Road in the City of Iqaluit, Nunavut. This work was authorized by the City of Iqaluit via service contract SC 000745 dated March 26, 2018.

It is proposed to construct a one storey slab on grade garage building at the site of the existing Public Works Facility at Building 1549 Federal Road, City of Iqaluit, Nunavut. The building will be used as a garage for servicing vehicles and equipment storage. It is understood that two locations are being considered for the proposed expansion. The first option would comprise the construction of an addition on the south side of the existing garage located on the subject property. The alternative is to build a stand-alone facility in the southeast part of the site.

The geotechnical investigation comprised of drilling four boreholes at each of the locations. The boreholes were drilled to a depth of 10 m to 15 m with an air-track drill and representative samples of the soils were obtained for textural classification and laboratory testing. In addition, two test pits which were excavated as part of the Phase II Environmental Site assessment completed by EXP concurrently with the geotechnical investigation were situated in the areas of the proposed expansion. Test Pit No. 2 was excavated adjacent to the existing building to obtain an appreciation of the foundation type of the existing building. The test pit and review of the building specifications available on the site indicate the existing building is likely founded on a concrete slab set on a granular pad and that the building is equipped with air ventilation system. The test pit excavated in the proposed alternative building location, i.e. Test Pit No. 4 revealed the presence of sand and gravel fill, numerous cobbles and boulders to the entire depth investigated.

The investigation indicated that the site contains surficial fill, which extends to 2.5 m to 4.5 m depth, i.e. Elevation 26.1 m to 23.0 m. The fill is underlain by silty sand to sand with gravel and cobbles, which extends to the entire depth investigated, i.e. 10 m to 15 m depth, i.e. Elevation 18.6 m to 12.5 m.

The investigation indicated that the geotechnical conditions at the site at both locations considered are suitable for construction of the proposed building on a concrete mat underlain by extruded polystyrene insulation set on a bed of engineered fill (well compacted, free draining sand and gravel) with thermosyphons incorporated in the granular bed. For this purpose, excavation to a depth of 2 m approximately would be required for the provision of the granular bed and thermosyphons. Adfreeze piles are not considered suitable for a slab-on-grade construction since the heat from the building transmitted to the piles would degrade the permafrost resulting in loss of capacity of the piles over time. End bearing piles are not feasible since bedrock was not encountered to the maximum depth investigated of 15 m. A geothermal analysis is required to assess the feasibility of thermosyphon foundations including thickness and extent of EPS insulation and granular bed required which should be completed as part of the detailed design of the foundation.



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It is recommended that the proposed structure should be constructed as a separate stand-alone building to prevent excavation adjacent to the existing building, which may result in undermining of the existing structure.

The site has been classified as Class C for seismic site classification in accordance with the requirements of the National Building Code of Canada, 2015. The on-site soils are not susceptible to liquefaction during a seismic event.

Chemical testing completed on soil samples has revealed that the subsurface soil south of the existing building (Option I) would have a severe sulphate attack on subsurface concrete. The concrete mix designs for this site would require special considerations and should be designed to meet the National Standard of Canada, CDN/CSA A23.1.

The concentration of sulphates in the soil in the vicinity of the proposed location of the stand-alone building (Option II) are considered to have a negligible potential of attack on subsurface concrete. General Use (GU) cement may be used in the subsurface concrete for this site.

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



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1 Introduction

EXP Services Inc. (EXP) has carried out a geotechnical investigation at the site of the proposed expansion to the City of Iqaluit Public Works Facility to be located at 1549 Federal Road, i.e. at the southeast quadrant of the intersection of Federal Road and Qaggamiut Road in the City of Iqaluit, Nunavut (Figure No.1). This work was authorized by the City of Iqaluit via service contract SC 000745 dated March 26, 2018.

The subject site is approximately 4.6 acres in size and currently occupied by the City of Iqaluit Public Works garage building and used for the servicing of vehicles and for equipment storage and maintenance. It is understood that the proposed new building to be constructed at the site would also be a single-storey warehouse type structure with slab-on-grade floor to be used also as a service garage.

Two locations are considered for the proposed expansion, the first option would consist of the construction of a 21 x 31 m addition on the east site of the existing garage building. The second option would comprise of the construction of 21 x 40 m stand alone building to be located in the southeast corner of the site (Figure No. 2)

The geotechnical investigation was undertaken to:

- Establish geotechnical, groundwater and permafrost conditions at the two proposed locations on the site;
- ii. Determine the active layer thickness (if discernible);
- iii. Make recommendations regarding the most suitable type of foundations, founding depth, and the serviceability limit state (SLS) bearing pressure, and factored geotechnical resistance at ultimate limit state (ULS) of the founding stratum; and
- iv. Comment on subsurface concrete requirements.

The comments and recommendations given in this report are based on the assumption that the above-described design concept 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.



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2 Procedure

The fieldwork for this project was undertaken on April 11 and 12, 2018 using an air-track drill rented from a local drilling company. The fieldwork was supervised on a full-time basis by a senior geotechnician from EXP experienced with permafrost soils and northern construction techniques. The fieldwork consisted of drilling a total of eight boreholes (Borehole Nos. 1 to 8) to 10 m to 15 m depth.

The locations of the boreholes were established in the field by EXP's representative and are shown on the appended Site Plan, Figure 2. Elevations of the boreholes were established by a survey crew from EXP and refer to a geodetic datum.

During drilling, bulk soil samples were obtained from different depths from each borehole. All the soil samples retrieved were visually examined and logged. Each sample was preserved in a watertight plastic bag and weighed on-site to assure accurate moisture content determination. The soil samples were transported to the EXP laboratory in the City of Ottawa, Ontario where they were visually examined in the laboratory by a senior geotechnical engineer and borehole logs prepared. The engineer also assigned the laboratory testing which consisted of performing natural moisture content on all the samples and grain-size analyses, Atterberg Limit, pH, sulphate and electrical conductivity tests on selected soil samples.

In addition to the above fieldwork, six (6) test pits were excavated at the site by EXP as part of the Phase II Environmental Site assessment (ESA) which was completed concurrently with the geotechnical investigation. Test Pit No. 2 was located adjacent to the south wall of the existing building to establish the type of foundations of the existing building. Test Pit No. 4 was excavated at the location of the alternative location to collect samples for environmental testing. Logs of the test pits excavated as part of the Phase II ESA are included in Appendix B.

Multi-bead thermistors were installed in Borehole Nos. 3 and 5 whereas a slotted standpipe was installed in Borehole No. 6. The installation configuration of the thermistors and piezometer are presented on the respective borehole logs.



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3 Site Description

The subject site is located in the southeast quadrant of the intersection of Federal Road and Qaggamiut Road in the City of Iqaluit, Nunavut. The site is approximately 4.6 m acres in area. It is currently occupied by a warehouse-type structure located in the west middle part of the property. The remainder of the land around the building is used for parking and equipment storage. The area east of the building is used to store various construction equipment, drums containing chemicals and tar-like substance, above-ground storage tanks, scrap metal, abandoned vehicles and piles of sand, gravel and snow.

The site is mainly flat lying with the ground surface elevations at borehole locations varying from Elev. 27.5 m to 28.7 m. As indicated previously, two alternative structure locations are being considered for the proposed building. The preferred location is an addition to the existing building to be located south of the existing building. The alternative option is to build a stand-alone building in the southeast part of the site.

Photographs of the site are presented in Appendix A.



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4 Test Pit Investigation

As indicated previously, a total of six test pits were excavated at the site as part of the Phase II Environmental Site Assessment which was completed by EXP concurrently with the geotechnical investigation and presented in a separate cover. Logs of the test pits are presented in Appendix B. Test pits situated within the areas of the proposed construction have been discussed below.

4.1 Test Pit No. 2

Test Pit No. 2 (Figure B2) was excavated adjacent to the south wall of the existing building to determine the type of foundation of the structure since design or as-built drawings are not available. This test pit encountered a concrete slab of 600 mm thickness beneath which 190 mm of pink extruded polystyrene insulation (EPS) was encountered. The insulation was underlain by a 150 mm diameter green PVC pipe. The function of the pipe could not be established. It is unlikely to be an air duct since air ducts normally consist of metal pipes. The pipe was underlain by sand and gravel fill (Photo A3). A summary of the findings in this test pit is presented below:

- 0 − 0.6 m − Concrete
- 0.6 0.79 m Pink Extruded Polystyrene *EPS) Insulation
- 0.70 to 0.94 m 150 mm Diameter Green PVC Pipe (unknow Function)
- 0.94 1.0 m Sand and Gravel Fill

Based on the investigation, it is not known whether the thickness of concrete observed is that of the slab or that of a thickened slab footing of the existing building.

Information received from site personnel indicates that numerous pipes are located under the slab of the existing garage building. The function of the pipe exposed in this test pit could not be established. However, visual observations of the site and review of the specifications available on site revealed the presence of an air blower fan (see Photo A4), which would operate when the outside temperature drops to -5°C and will draw cold air under the floor until the outside temperatures rises above -5°C. (Photo A5 shows the exhaust vents.) It is therefore likely that the existing building is equipped with an air ventilation system with ducts buried within the granular pad to reduce thermal disturbance.

4.2 Test Pit No. 4

Test Pit No. 4 (Figure B4) was excavated in the vicinity of the proposed location of the stand-alone building and revealed that presence of sand and gravel fill containing numerous cobbles and boulders and some debris which extends to the entire depth investigated of 1.4 m.

It is noted that the remaining test pits revealed in general similar subsurface condition findings as Test Pit No. 4.



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5 Soil Description

A detailed description of the subsurface soil and groundwater conditions determined form the boreholes are given on the attached Borehole Logs, Figures 3 to 10 inclusive. The borehole 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 also may result in changes in the conditions interpreted to exist at the locations where sampling was conducted. Boreholes were drilled 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 borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries 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 logs form an integral part of this report and should be read in conjunction with this report.

It is noted that the geotechnical conditions at both the locations being considered on the site are similar. Therefore, the soil stratigraphy discussed below applies to both the sites.

5.1 Fill (SP-GP)

The surficial soil at the site is fill, which extends to 5 m depth in Borehole No. 1 (Elev. 23.7 m) and to a depth of 2.5 m to 3.0 m (Elev. 23.0 m to 26.1 m) in other boreholes. The fill mainly consists of poorly graded to well-graded gravel except in Borehole No. 1 where poorly graded sand fill (SP) was encountered to 3 m depth. The fill is non-frost susceptible (NF) except in Borehole No. 1 below 3 m depth, where it contains ice crystals (V_x). The natural moisture content of the fill varies from 2 to 58 percent. Two grain-size analyses performed on soil samples from this stratum indicate that it contains 1 to 4 percent fines, 34 to 86 percent sand and 10 to 65 percent gravel (Figures 11 and 12).

5.2 Ice

The fill in Borehole No. 1 is underlain by a layer of ice from 5 m to 6 m depth.

5.3 Silty Sand (SM)

The fill in Borehole No. 5 is underlain by silty sand to 7.5 m depth (Elev. 20.0 m). This stratum was also encountered in Borehole No. 1 between 9 m and 15 m depth (Elev. 13.7 m to 19.7 m). The natural moisture content of this stratum varies from 3 to 58 percent.

Three grain-size analyses performed on this stratum revealed a composition of 27 to 50 percent fines, 50 to 73 percent sand and 0 to 2 percent gravel (Figures 13 to 15).



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5.4 Sand (SP-SW)

The silty sand in Borehole No. 5 and the fill in all the other boreholes is underlain by poorly graded to well graded sand, which extends to 9 m in depth in Borehole 1 (Elev. 13.7 m) and to the entire depth investigated in the other boreholes, i.e. 10 m to 15 m depth (Elev. 12.5 m to 18.6 m). The natural moisture content of this stratum varies from 6 to 20 percent.

The results of three grain-size analyses performed on this stratum are given on Figures 16 to 18. A review of these figures indicates that this stratum contains 8 to 25 percent fines, 72 to 90 percent sand and 9 to 20 percent gravel.

5.5 Groundwater

All boreholes remained dry upon completion of drilling. In addition, readings taken in the piezometer installed in Borehole No. 6 on April 13, 2018 did nor reveal the presence of water in this borehole. It should be noted that the groundwater table is subject to seasonal fluctuation and may be at higher levels following thawing of the active layer, i.e. spring and summer.



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6 Ground Temperature

Multi-bead thermistors were installed in Borehole Nos. 3 and 5 to monitor the ground temperature. The readings obtained are shown on Table No. I below.

	Table No. I:	Ground Temperatu	ure Measurements	
Cita Na	Develop No	Thermistor Depth	Ground Temp	perature (°C)
Site No.	Borehole No.	(m)	April 13, 2018	April 15, 2018
1	3	Air	-2.0	-2.0
(Addition to		0.5	-5.7	-10.0
existing building)		1.0	-12.0	-16.4
building)		1.5	-13.1	-13.7
		2.0	-12.2	-12.2
		2.5	-11.4	-11.5
		3.0	-11.1	-11.2
		3.5	-10.7	-10.7
		4.0	-10.5	-10.5
		4.5	-10.1	-10.1
		5.5	-9.6	-9.6
		6.0	-9.2	-9.2
		7.0	-8.2	-8.2
		8.0	-6.3	-6.3
		10.0	-5.5	-5.5
2	5	Air	-2.0	-2.0
(Stand-alone		0.5		-8.2
independent structure-		1.0		-12.1
Northeast		1.5		-13.0
Corner of Site		2.0	-10.9	-11.9
		2.5	-9.7	-10.0
		3.0	-8.6	-8.8
		3.5	-8.0	-8.6
		4.0	-7.5	-7.5
		4.5	-7.0	-7.0
		5.5	-6.4	-6.4
		6.0	-5.7	-4.8
		7.0	-4.7	-4.8
		8.0	-2.6	-2.6
		10.0	-1.3	-1.3



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Graphical presentation of the reading collected to date is presented in Figure No. 19. It is recommended that additional temperature readings should be collected in the spring and summer if feasible.



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7 Soil Salinity

The salinity of the soil at the site was measured by conducting electrical conductivity tests on selected soil samples. The test results are given on Table No. II.

Table No. II: Resi	ults of Salinity	Tests on Soil Sam	nples
Site No.	Borehole No.	Sample Depth (m)	Salinity Parts Per Thousand (ppt)
1	1	9.0 – 10.0	4.19
(Addition to existing structure)	1	11.0 – 13.0	16.9
	4	3.0 – 4.0	1.0
	4	8.0 – 9.0	3.1
2	5	1.0 – 2.0	0.8
(Stand-alone independent structure)	6	6.0 – 7.0	0.8
	7	1.0-2.0	0.33
	8	1.0-2.0	0.27

The above results indicate that the salinity of the soil varies from 0.27 ppt to 16.9 ppt. On the basis of these results, the soil may be classified as of low salinity except for the sample from Borehole No. 1 form 11 to 13 m depth, which has a high salinity.



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8 Foundation Considerations

8.1 Factors Influencing Building Location Selection

The investigation has revealed that the geotechnical conditions at the site are suitable for construction of the proposed building on a concrete mat with provision of EPS insulation and thermosyphons to maintain the soil below the founding level permanently frozen. Since the proposed structure is to have an at-grade floor, adfreeze piles are not feasible because of the loss of heat from the building to the piles will result in degradation of the permafrost adjacent to the piles and resultant loss of pile capacity. End bearing piles are not feasible since bedrock was not encountered at the site to the depth investigated, i.e. to 15 m.

It is understood that two potential locations for the proposed building on the site are being considered. The first option is to build an addition to the existing structure. The second option is to construct a stand-alone structure elsewhere on the site. One of the challenges with construction of an addition to the existing building is that the type of foundations of the existing building and the founding level are not known since design and/or as-built drawings of the structure are not available. An attempt to determine the foundation type of the existing building was made by excavating a test pit (Test Pit No. 2) along the south wall of the existing building. This test pit encountered fill to 0.6 m depth, which was underlain by a layer of pink insulation to 0.79 m depth. The insulation was underlain by 150 mm diameter PVC pipe. It was not possible to advance the test pit further so as not to damage this pipe. Information received from the site personnel indicates that there are numerous buried pipes under the building. However, the purpose of these pipes is not known. Visual observations on site revealed the presence of two exhaust vents and blower fan. It is therefore possible that the existing building is founded on a concrete slab set on a granular pad incorporating a layer of insulation and an air ventilation system by means of pipes buried within the pad to reduce thermal disturbance. The pipe encountered was a plastic pipe, whereas normally metal pipes are used as air ducts. Therefore, it cannot be stated with any degree of confidence that the existing building is equipped with an air ventilation system considering that no information is available regarding the design and/or construction of the foundation system of the existing building.

If, as suspected, the existing building is founded on concrete mat set on the granular pad with insulation and air ventilation ducts, it would present a challenge to construction of an addition to the existing building. The reason for this is that construction of the foundation for the proposed addition would necessitate excavation adjacent to the founding level of the existing building. This would result in exposure of the foundations of the existing building to the environment and may result in degradation of permafrost under the existing building. Therefore, potential exists of undermining the foundation and/or floor of the existing building. For the above reasons, this option is not recommended unless design and/or construction drawings of the existing building can be located and indicate that there will be no potential of undermining the existing building foundation and/or floor slab.

8.2 Recommended Structure Foundations

It is recommended that the proposed structure should be founded on a concrete mat set on an engineered granular fill pad incorporating EPS insulation and thermosyphon system.



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Thermosyphons are two-phase passive refrigeration devices containing a fluid that transmits heat from the ground to the air when appropriate temperature differential exists. Therefore, they help to stabilize permafrost dependent infrastructure.

Thermosyphons extract heat from the ground and discharge it into the atmosphere whenever the air temperature is colder than the ground temperature. A commonly used fluid medium is carbon-dioxide that is contained in a closed 'pipe' pressure vessel. The thermosyphons remove heat from below the building by liquid gas phase change. During the winter, the outside air is colder than the ground temperature causing the gas in the pipe above the ground to condense and flow as a liquid to the base of the pipe. The warmer ground contact with the evaporator drops the pressure in the gas, thereby causing the fluid in the subsurface pipe to evaporate. Heat is extracted from the ground supporting the building and dissipated to the atmosphere throughout the winter. During the summer, the soil is preserved in frozen condition by a layer of insulation located above the horizontal evaporator pipes. Although there are four types of thermosyphons available, the flat loop system is the most commonly used system these days.

A thermosyphon foundation system consists of the following components:

- a.) Evaporator pipes below grade;
- b.) Radiator section on top of vertical conductor pipe;
- c.) Rigid insulation; and
- d.) A layer of non-frost susceptible gravel in which evaporator pipes and insulation are buried.

It is noted that a geothermal analysis would be required for design of the thermosyphon system to establish the thickness and extent of granular pad, the thickness and extent of rigid insulation and the thermosyphon spacing and area required under the building.

The design proposes to place the floor slab of the building at existing site grade. To achieve this, excavation of the native soils to a depth established by the geothermal analysis would be required (likely 2 m approximately). The excavation should extend at least 2 m beyond the perimeter of the structure, or the insulation, whichever is greater, with the sides of the excavation cut back to 2H:1V. The engineered fill pad may be constructed up from the base of the excavation.

From a geotechnical perspective, the requirements would be that the granular bed should comprise thaw stable sand and gravel, preferably conforming to the gradation given on Table No. III. The fill should be placed in 200 mm thick lifts at above freezing temperatures and each lift compacted to at least 98 percent of standard Proctor maximum dry density in accordance with ASTM D698-12e2.

The placement and compaction of the granular fill pad should be undertaken under the supervision of a geotechnician working under the direction of a geotechnical engineer. In place density tests should be performed on each lift to ensure that the specified degree of compaction is being achieved.

The proposed structure should be founded on a concrete mat underlain by EPS insulation set on the engineered fill pad.



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The SLS bearing pressure of the engineered fill pad will be a function of the compressive strength of the insulation used. If EPS insulation having a compressive strength of at least 275 kPa is used, the SLS bearing pressure should be limited to 90 kPa. If EPS insulation having a compressive strength of at least 400 kPa is used, the SLS bearing pressure for design purposes may be assumed as 130 kPa. It is noted that these SLS bearing pressures will be valid only if ice wedges or other massive ice bodies are not present under the building. Ice lenses were encountered in the soil during drilling. Whether ice wedges are also present can be best determined by examining the excavation base during construction. The corresponding subgrade reaction modulus of the engineered pad may be taken as 35 MPa/m and 50 MPa/m for EPS insulation with compressive strengths of 275 kPa and 400 kPa, respectively.

Tak	ole No. III: Physical R	equirements of Engineered Fill
Gradation	ASTM	Requirements
Sieve Size		Percent Passing
100 mm		100
25 mm		50 – 100
4.75 mm	ASTM C-136M	20 – 55
1.18 mm		10 – 40
300 μm		5 – 22
75 μm		0 – 10
Percent Crushed (two faces)		60 % minimum
Plasticity Index	ASTM D4318	0
Flat Elongated	ASTM D4791	Max 15%



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9 Seismic Site Classification

The investigation has revealed that the sites contain surficial fill consisting of sand and gravel with cobbles and boulders, which extends to a depth of 2.5 m to 5 m. It's underlain by sand with some silty sand layers.

It has been recommended that the proposed structure should be founded on a concrete mat set on engineered fill pad containing thermosyphons to maintain the underlying soils in a frozen state. Therefore, the on-site soils below the foundations will be continuously maintained in a frozen state. Hence, the site has been classified as Class C in accordance with the requirements of the National Building Code, 2015.

The on-site frozen soils are not susceptible to liquefaction during a seismic event.



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10 Subsurface Concrete Requirements

Chemical tests limited to pH, sulphates and electrical conductivity were performed on eight soil samples. The results are given on Table No. IV.

	Table No. IV: R	Results of Chen	nical Results o	n Soil Samples	
Site No.	Borehole No.	Depth	рН	Sulphates (%)	Electrical Resistivity (ohm – cm)
381	1	9.0-10.0	7.30	0.167	153
(Addition to	1	11.0-13.0	7.71	0.510	38
Existing Building)	4	3.0 - 4.0	7.35	0.024	621
3,	4	8.0 - 9.0	7.48	0.127	204
2	5	1.0 – 2.0	7.68	0.0203	833
(Stand Alone	6	6.0 - 7.0	7.48	0.0113	833
Independent Structure)	7	1.0 – 2.0	7.31	0.004	1923
2 2.510 3)	8	1.0 – 2.0	7.48	0.0048	2381

The results indicate that the subsurface soils contain 0.024 to 0.510 percent water soluble sulphates in the area south of the existing garage building (Option I). This concentration of sulphates would have a severe sulphate attacks on concrete and therefore the subsurface concrete should be designed to meet the National Standards of Canada CDN/CSA A23.1 and would require sulphate resistant cement, air entrainment, etc.

The results of sulphates in the subsurface soils near the proposed stand-alone building (Option II) varies from 0.004 to 0.203 percent. This concentration of sulphates is considered to have a negligible potential of sulphate attack on subsurface concrete, in such cases, the National Standard of Canada, CDN/CSA A23.1 permit the use of General Use cement (GU) in the subsurface concrete. The concrete should, however, be dense, well compacted and cured. The concrete in all cases should, however be dense, well compacted and cured.

The results of the resistivity tests of the soil samples collected from the south side of the existing garage building (Option I) vary form 38 ohm-cm to 621 ohm-cm which indicates corrosive to very corrosive soils to buried steel. The resistivity of the soil samples collected from the proposed location of the stand-alone building (Option II) varies from 833 ohm-cm to 2381 ohm-cm which is indicative of soils with potential to be mildly corrosive to corrosive to buried steel. It is therefore recommended that a corrosion specialist should be consulted to provide recommendations regarding mitigating measures necessary if steel is to be buried on-site.



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11 Site Grading and Drainage

It is recommended that the finished grade around the building should be sloped away from the structure at a grade of at least two percent to prevent ponding of the surface water around the foundations of the structures.



12 Design Review and Foundation Monitoring

It is recommended that a geotechnical review of the foundation drawings and specifications should be undertaken by this office to ensure that recommendations made in the report have been properly interpreted.

It is recommended that installation of the foundations at the site should be monitored by qualified geotechnical personnel. The monitoring would ensure that the material used in construction of the granular pad meets the specification and its adequately compacted.



Date: May 4, 2018

13 General Closure

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 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 in no way reflects on the environmental aspects of the soils. Should specific information be required, additional testing may be necessary.



EXP Services Inc.

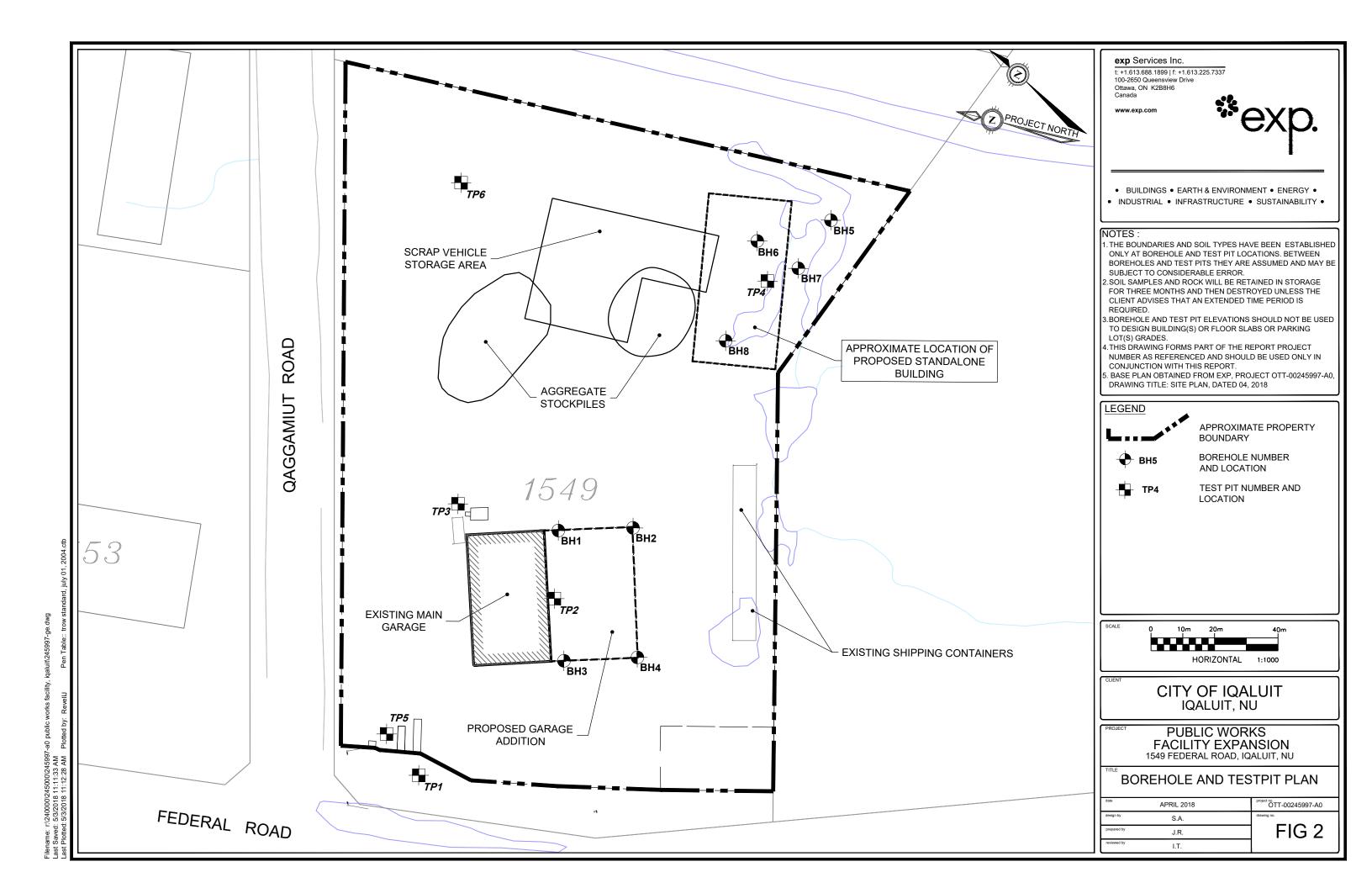
Client: City of Iqaluit c/o Colliers Project Leaders Project Name: Geotechnical Investigation. Proposed Expansion to Public Works Facility Building 1549, Federal Road, Iqaluit, Nunavut EXP Project Number: OTT-00245997-A0 Date: May 4, 2018

Figures



trow standard, july 01, 2004.ctb

Filename: r:\240000\245000\245997-a0 public works facility, iqaluit\245997-ge.dwg Last Saved: 4\27\2018 3:56:07 PM Last Plotted: 4\27\2018 4:31:28 PM Plotted by: RevellJ Pen Table:: trow st



Date: May 4, 2018

Notes On Sample Descriptions

1. 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.

					ISSMF	E SOIL CLA	SSIFICATI	NC				,
CLAY		SILT			SAN	ND.		GRA	VEL		COBBLES	BOULDERS
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CLAY/E	PLASTIC)	TO.		EQUIVA		RAIN DIAME	TER IN MIL	I FINE		RSE	7	
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SILI (IV	ONPLAST	IC)				SAND			GRAVEL		A	

UNIFIED SOIL CLASSIFICATION

- 2. 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.
- 3. 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.



oject: <u>Geo</u>	technical Investigation. Pr	oposed Ex	apnsio	n to	Pub	ic W	orks	s Garaç	ge Fac	ility	Figure I		3	-		ı
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LOG OF BOREHOLE BH LOGS - 244997 - IQALUIT.GPJ TROW OTTAWA.GDT 5/3/18

3. Field work supervised by an EXP representative.

5.Log to be read with EXP Report OTT-00245997-A0

4. See Notes on Sample Descriptions

Project N	lo: <u>OTT-00245997-A0</u>							_					igure	· No			4		7	J	^
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Project No: OTT-00245997-A0 Figure No. Project: Geotechnical Investigation. Proposed Exapnsion to Public Works Garage Facility 1 of <u>1</u> Page. Location: Building 1549 Federal Road, City of Iqaluit, Nunavut Date Drilled: 'April 11, 2018 Split Spoon Sample \boxtimes Combustible Vapour Reading X Auger Sample Natural Moisture Content Drill Type: Air Track SPT (N) Value 0 0 Atterberg Limits Dynamic Cone Test Datum: Undrained Triaxial at Geodetic \oplus % Strain at Failure Shelby Tube Shear Strength by Logged by: B.V. Checked by: S.A. Shear Strength by Penetrometer Test Vane Test Standard Penetration Test N Value Combustible Vapour Reading (ppm) Natural 250 500 750 G W L Geodetic -MBO-SOIL DESCRIPTION Natural Moisture Content % Atterberg Limits (% Dry Weight) Unit Wt. Shear Strength kN/m³ 28.09 FILL (GW) Sand and gravel, frequent cobbles and boulders, brown, frozen, dry, (Nf) 25.6 SAND (SW) Fine to coarse, some gravel, trace silt, light brown, frozen, moist, (Nbn) 23.6 SAND (SP) Fine to medium, some silt, trace gravel, occasional cobbles, frozen, very moist to moist, (Vr) 13.1 Borehole Terminated at 15.0 m Depth WATER LEVEL RECORDS CORE DRILLING RECORD Borehole data requires interpretation by EXP before use by others Elapsed Water Hole Open Run Depth % Rec. RQD % Time Level (m) To (m) No (m) Borehole backfilled with cuttings upon completion of drilling. 3. Field work supervised by an EXP representative. 4. See Notes on Sample Descriptions

244997 - IQALUIT.GPJ TROW OTTAWA.GDT

BH LOGS

5. Log to be read with EXP Report OTT-00245997-A0

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LOG OF BOREHOLE BH LOGS - 244997 - IQALUIT.GPJ TROW OTTAWA.GDT 5/3/18

5.Log to be read with EXP Report OTT-00245997-A0

Project No: OTT-00245997-A0 Figure No. Project: Geotechnical Investigation. Proposed Exapnsion to Public Works Garage Facility 1 of 1 Page. Location: Building 1549 Federal Road, City of Iqaluit, Nunavut Date Drilled: 'April 12, 2018 Split Spoon Sample \boxtimes Combustible Vapour Reading X Auger Sample Natural Moisture Content Drill Type: Air Track SPT (N) Value 0 0 Atterberg Limits Dynamic Cone Test Datum: Undrained Triaxial at Geodetic \oplus % Strain at Failure Shelby Tube Shear Strength by Logged by: B.V. Checked by: S.A. Shear Strength by Penetrometer Test Vane Test Standard Penetration Test N Value Combustible Vapour Reading (ppm) Natural 250 500 750 Geodetic G W L -MBO-SOIL DESCRIPTION Natural Moisture Content % Atterberg Limits (% Dry Weight) Unit Wt. Shear Strength kN/m³ 27.85 FILL (GP) Sand and gravel, frequent cobbles and boulders, brown, frozen, moist, (Nf) 00 25.4 SAND (SP) Fine to coarse, trace silt, occasional gravel and cobbles, light brown, frozen, ice crystals, very moist to moist, (Vx-Vr) 17.9 Borehole Terminated at 10.0 m Depth WATER LEVEL RECORDS CORE DRILLING RECORD Borehole data requires interpretation by EXP before use by others Water Hole Open Run Depth % Rec. RQD % Elapsed Time Level (m) To (m) No (m) A slotted standpipe was installed in the borehole upon completion of drilling, April 13, 2018 NA Dry

244997 - IQALUIT.GPJ TROW OTTAWA.GDT 5/3/18

BH LOGS

3. Field work supervised by an EXP representative.

5. Log to be read with EXP Report OTT-00245997-A0

4. See Notes on Sample Descriptions

Project No:	OTT-00245997-A0		J	CIIC	, I C	<u>, D</u>	<u> </u>		igure N	No.	9		ϵ	X
Project:	Geotechnical Investigation. Proposed	Exapnsio	n te	o Public W	orks	Garage	Fac	ility .	Pag	_	1 of	1		•
Location:	Building 1549 Federal Road, City of Iq	μaluit, Nun	av	rut					ıaţ					
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	with EXP Report OTT-00245997-A0													

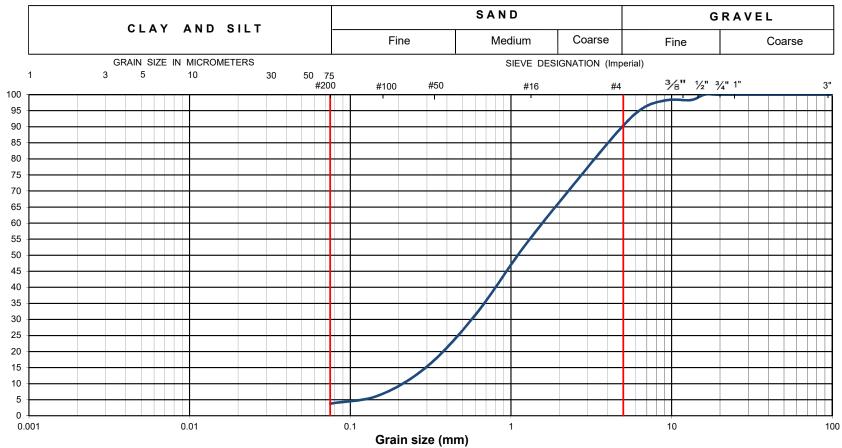
LOG OF BOREHOLE BH LOGS - 244997 - IQALUIT.GPJ TROW OTTAWA.GDT 5/3/18

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55.61														
NOTES:	WAIE				ATER LEVEL RECORDS					CORE DRILLING RECOR				
Borehole data require use by others	res interpretation by EXP before	Elapsed Time		Water _evel (m)	Hole	e Open Run		n Depth		% Rec.			QD %	
drilling.	with cuttings upon completion of ed by an EXP representative.	Timo	_			- \/	110.	(111)	,					
4 See Notes on Semp														

LOG OF BOREHOLE BH LOGS - 244997 - IQALUIT.GPJ TROW OTTAWA.GDT 5/3/18

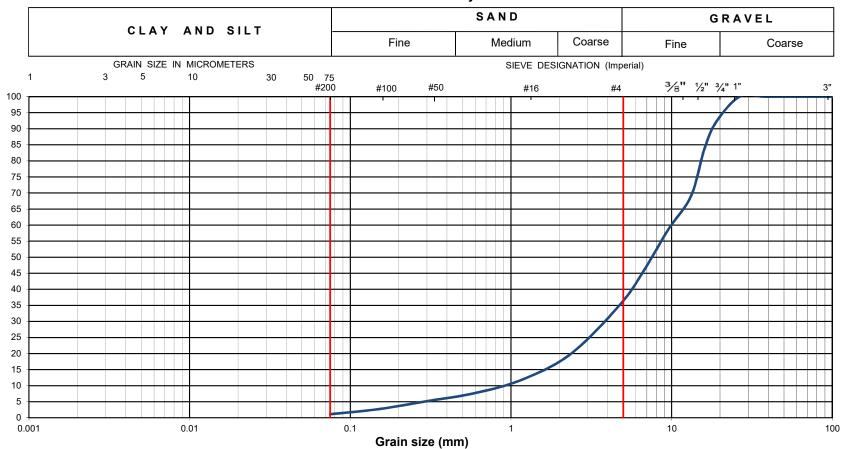
5.Log to be read with EXP Report OTT-00245997-A0

100-2650 Queensview Drive Ottawa, ON K2B 8H6



EXP Project No.:	OTT-00245997-AO	Project Name :		Geotechnical In	vestigat	ion. Expansion to	City of	lqaluit Public W	ork Garage
Client :	City of Iqaluit	Project Location	ı :	Building 1549, F	Federal F	Road, City of Iqalı	uit, Nun	avut	
Date Sampled :	April 11, 2018	Borehole No:		BH1	Sample	: S	1	Depth (m):	1.0-2.0
Sample Composition :		Gravel (%)	11	Sand (%)	85	Silt & Clay (%)	4	Eiguro I	44
Sample Description :	Po	orly Graded Sa	nd (SP), little or no fir	nes			Figure :	"

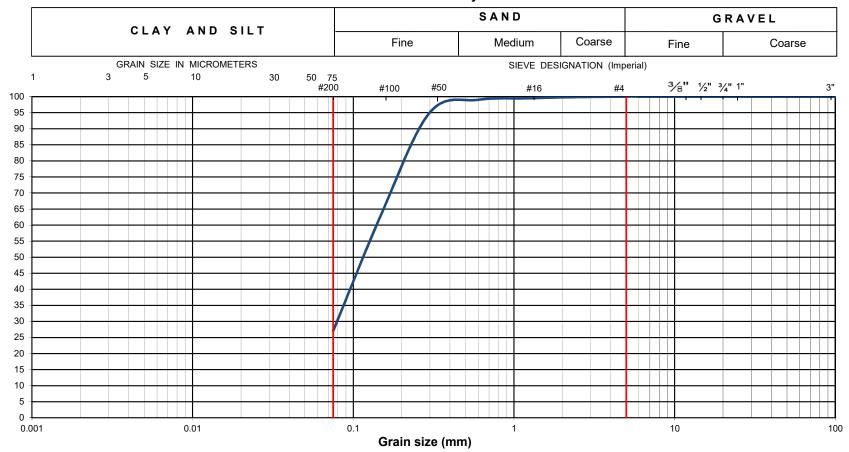
100-2650 Queensview Drive Ottawa, ON K2B 8H6



EXP Project No.:	OTT-00245997-AO	Project Name :		Geotechnical In	vestigat	ion. Expansion	o City o	f Iqaluit Public V	Vork Garage
Client :	City of Iqaluit	Project Location	n :	Building 1549 F	ederal R	oad, Iqaluit, Nun	avut		
Date Sampled :	April 11, 2018	Borehole No:		BH4	Sample	: S	1	Depth (m):	1.0-2.0
Sample Composition :		Gravel (%)	65	Sand (%)	34	Silt & Clay (%)	1	Figure :	12
Sample Description :	Well	Graded Gravel	(GW),	gravel sand mi	xture			rigure .	12

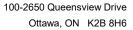
100-2650 Queensview Drive Ottawa, ON K2B 8H6

Unified Soil Classification System



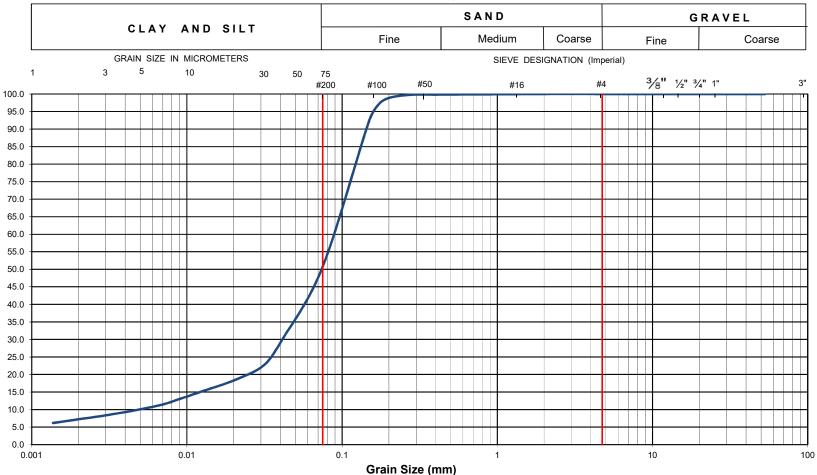
EXP Project No.:	OTT-00245997-AO	Project Name :		Geotechnical In	vestigat	ion. Expansion to	City o	f Iqaluit Public V	Vork Facility
Client :	City of Iqaluit	Project Location	n :	Building 1549 F	ederal R	oad, City of Iqalu	it, Nuna	avut	
Date Sampled :	April 11, 2018	Borehole No:		BH1	Sample	: S	4	Depth (m) :	9.0-10.0
Sample Composition :		Gravel (%)	0	Sand (%)	73	Silt & Clay (%)	27	Figure :	13
Sample Description :		Silty	/ Sand	(SM)				rigure .	13

Percent Passing





Grain-Size Distribution Curve Method of Test For Particle Size Analysis of Soil ASTM C-136/ASTM D422

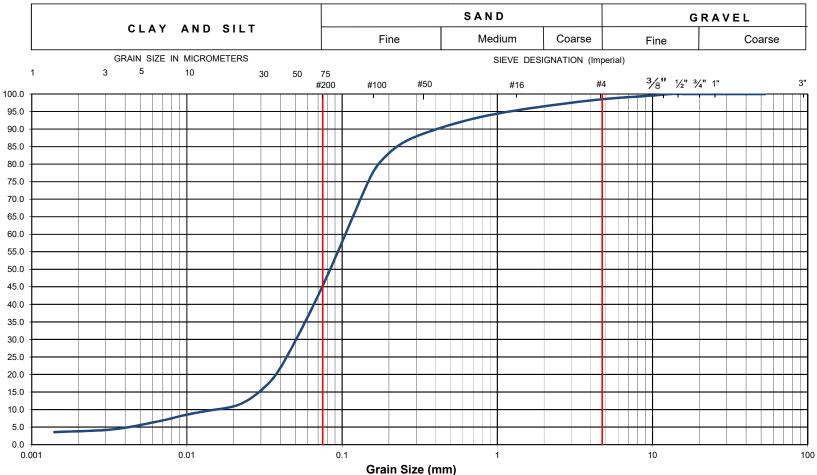


EXP Project No.:	OTT-00245597-AO	Project Name :		Geotechnical In	vestigati	on. Expansio	n to	City of	Iqaluit Public wo	ork Garage
Client :	City of Iqaluit	Project Location	:	Building 1549, F	ederal F	Road, City of	lqalı	uit, NU		
Date Sampled :	April 16, 2018	Project Location : Buil		BH1	San	nple No.:	S	3 5	Depth (m) :	11.0-13.0
Sample Description :		% Silt and Clay	51	% Sand	49	% Gravel		0	Figure :	14
Sample Description :		Silty	/ Sand (SM)					Figure :	14

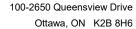


Grain-Size Distribution Curve Method of Test For Particle Size Analysis of Soil ASTM C-136/ASTM D422

100-2650 Queensview Drive Ottawa, ON K2B 8H6

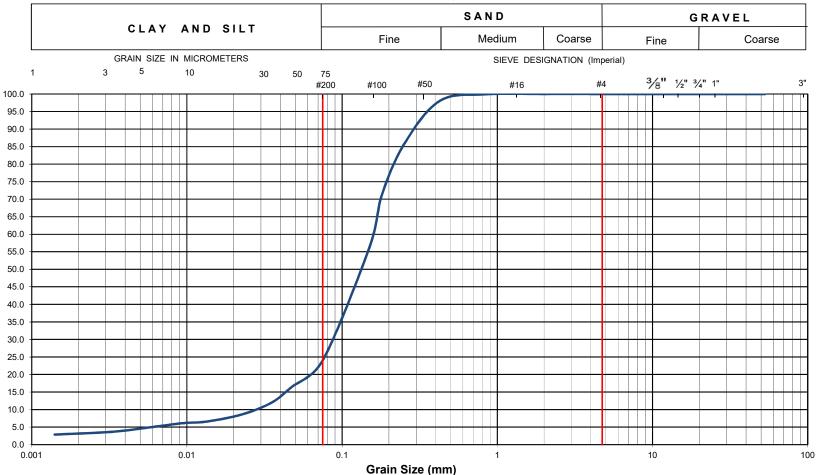


EXP Project No.:	OTT-00245597-AO	Project Name :		Geotechnical Inv	vestigati	on. Expasnio	n to	City of	Iqaluit Public wo	rk Garage
Client :	City of Iqaluit	Project Location	:	Building 1549, F	ederal R	Road, City of I	qalı	ıit, NU		
Date Sampled :	April 12, 2018	Borehole No:		BH5	Sam	ple No.:	S	3	Depth (m):	5.0-6.0
Sample Description :		% Silt and Clay	45	% Sand	53	% Gravel		2	Figure :	15
Sample Description :		Silty	/ Sand (SM)					rigule .	15



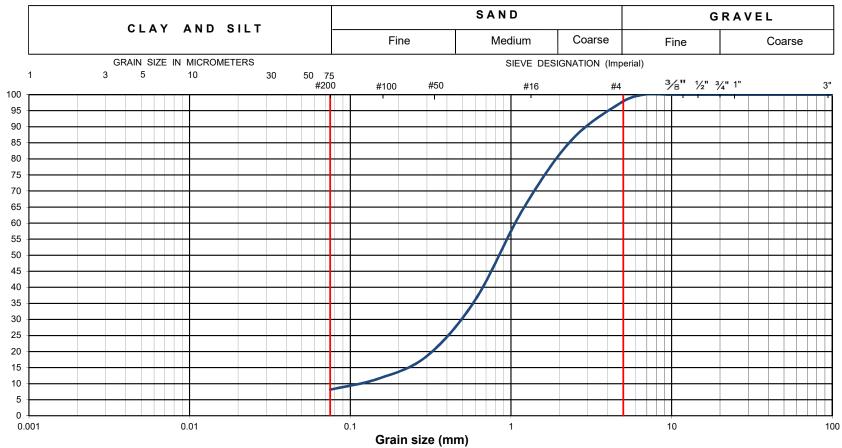


Grain-Size Distribution Curve Method of Test For Particle Size Analysis of Soil ASTM C-136/ASTM D422



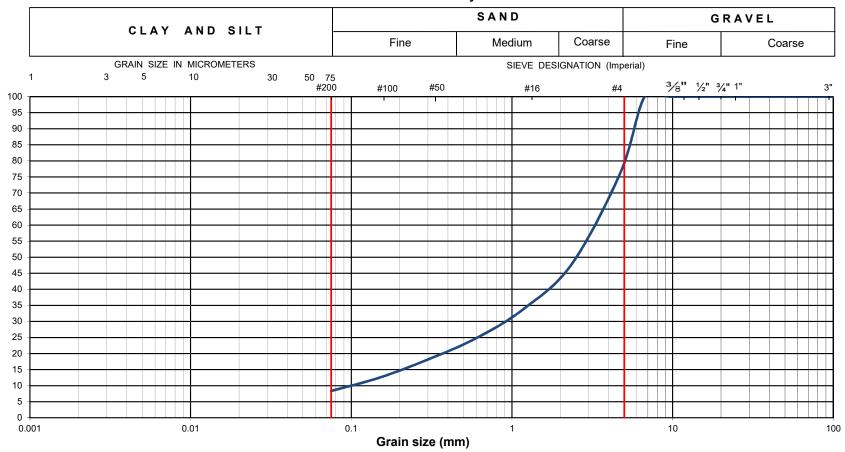
EXP Project No.:	OTT-00245597-AO	Project Name :		Geotechnical Inv	vestigati	on. Expansion	to	City of	lqaluit Public work	Garage
Client :	City of Iqaluit	Project Location	:	Building 1549, F	ederal R	oad, City of Iq	alu	it, NU		
Date Sampled :	April 11, 2018	Borehole No:		BH4	Sam	ple No.:	S	4	Depth (m) :	8.0-9.0
Sample Description :		% Silt and Clay	24	% Sand	76	% Gravel		0	Figure :	16
Sample Description :		S	and (SF	P)					rigule .	10

100-2650 Queensview Drive Ottawa, ON K2B 8H6



EXP Project No.:	OTT-00245997-AO	Project Name :		Geotechnical In	vestigat	ion. Expansion t	o City of	f Iqaluit Public V	Vork Garage
Client :	City of Iqaluit	Project Location	n :	Building 1549, I	Federal F	Road, City of Iqal	uit, Nun	avut	
Date Sampled :	April 11, 2018	Borehole No:		BH5	Sample	: \$	3 5	Depth (m) :	11.0-12.0
Sample Composition :		Gravel (%)	3	Sand (%)	89	Silt & Clay (%)	8	Figure .	47
Sample Description :		Poorly G	raded S	Sand (SP)				Figure :	17

100-2650 Queensview Drive Ottawa, ON K2B 8H6



EXP Project No.:	OTT-00245997-AO	Project Name :		Geotechnical Ir	nvestigat	ion. Expansion to	City of	f Iqaluit Public W	/ork Garage
Client :	City of Iqaluit	Project Location	n :	Building 1549,	City of Fe	ederal Road, Iqal	uit, Nun	avut	
Date Sampled :	April 11, 2018	Borehole No:		ВН6	Sample	: S	3	Depth (m) :	6.0-7.0
Sample Composition :		Gravel (%)	24	Sand (%)	68	Silt & Clay (%)	8	Figure 1	18
Sample Description :		Poorly G	raded	Sand (SP)				Figure :	10



Temperature Collected in Multi-Bead Thermistors Installed in Borehole Nos. 3 and 5

oject No.: oject Name:		Investigatio			City of Iqaluit F	ublic Works	Garage				Figure No. Date Installed:	April 11, 12, 201
ject Location:	Building 1549	Federal Ro	ad, City of Iqa	luit, Nunavut			ı					
	BH April 1:	I-3 3, 2018		1 -3 5, 2018								
Depth (m)	Meter Reading	Temp	Meter Reading	Temp	Meter Reading	Temp	Meter Reading	Temp	Meter Reading	Temp	Meter Reading	Temp
	(kohms)	(°C)	(kohms)	(°C)	(kohms)	(°C)	(kohms)	(°C)	(kohms)	(°C)	(kohms)	(°C)
0.2	Air	-2.0	Air	-2.0								
-0.5	22.0	-5.7	27.6	-10.0								
-1.0 -1.5	30.9 32.8	-12.0 -13.1	39.4 33.9	-16.4 -13.7								
-2.0	31.2	-13.1	31.3	-12.2								
-2.5	29.9	-11.4	30.1	-11.5								
-3.0	29.4	-11.1	29.5	-11.2								
-3.5	28.8	-10.7	28.8	-10.7								
-4.0	28.4	-10.5	28.4	-10.5								
-4.5	27.8	-10.1	27.8	-10.1								
-5.5	27.1	-9.6	27.1	-9.6					+			
-6.0 -7.0	26.5 25.1	-9.2 -8.2	26.5 25.1	-9.2 -8.2								+
-8.0	22.7	-6.3	22.7	-6.3								
-10.0	21.8	-5.5	21.5	-5.3	1		1					
	BH	I-5	BI	1-5								L.
	April 1			5, 2018								
Depth (m)	Meter		Meter		Meter		Meter		Meter		Meter	T _
	Reading	Temp (°C)	Reading	Temp (°C)	Reading	Temp (°C)	Reading	Temp (°C)	Reading	Temp (°C)	Reading	Temp (°C)
	(kohms)		(kohms)		(kohms)	(-0)	(kohms)	(-0)	(kohms)	(-0)	(kohms)	(-0)
0.2	Air	-2.0	Air	-2.0								
-0.5 -1.0			25.1 31.0	-8.2 -12.1								
-1.5			32.6	-13.0								
-2.0	29.1	-10.9	30.7	-11.9								
-2.5	27.3	-9.7	27.6	-10.0								
-3.0	25.7	-8.6	26.0	-8.8								
-3.5	24.8	-8.0	25.6	-8.6								
-4.0	24.2	-7.5	24.2	-7.5								
-4.5	23.5	-7.0	23.5	-7.0								
-5.5 -6.0	22.8 22.0	-6.4 -5.7	22.8 21.0	-6.4 -4.8								
-7.0	20.80	-4.7	20.9	-4.8								
-8.0	18.70	-2.6	18.7	-2.6	1		1					
-10.0	17.50	-1.3	17.5	-1.3								
2.0 ⊤								Zero	Temp Line			
2.0												
0.0	Ground S	urtace						_				
-		-		*		×						
-2.0												
-												
€ -4.0						\Box						
Qebth (m)												
-6.0					-		+					
-												
-8.0						\						
3.0										→ BH-3	Apri	I 13, 2018
-10.0										── BH-3	Apri	l 15, 2018
10.0										——BH-5		113, 2018
-12.0										—BH-5	Apri	I 15, 2018
	.0 -18.0	-16.0	-14.0	-12.0 -1	10.0 -8.0	-6.0	-4.0	-2.0	0.0 2.0	0 4.0	6.0	8.0 10.0
-20												
-20						Tempe	rature (°C)					

EXP Services Inc.

Client: City of Iqaluit c/o Colliers Project Leaders Project Name: Geotechnical Investigation. Proposed Expansion to Public Works Facility Building 1549, Federal Road, Iqaluit, Nunavut EXP Project Number: OTT-00245997-A0 Date: May 4, 2018

Appendix A: Photos





Photo A1: Setting up on BH 5 , looking North, Apr 12, 2018 (Note Snow Piles)





Photo A2: Drilling BH 8, looking North, Apr 12, 2018





Photo A3: Test Pit adjacent to Existing Building, i.e. TP-2 (Note Green PVC Pipe and Insulation)





Photo A4: Showing Utility Blower





Photo A5: Showing Exhaut Vent



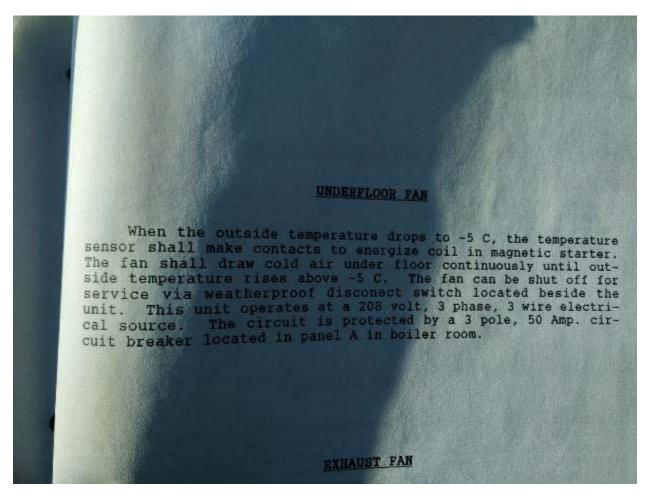


Photo A6: Underfloor Fan Operation (Extracted from on-site Manual)



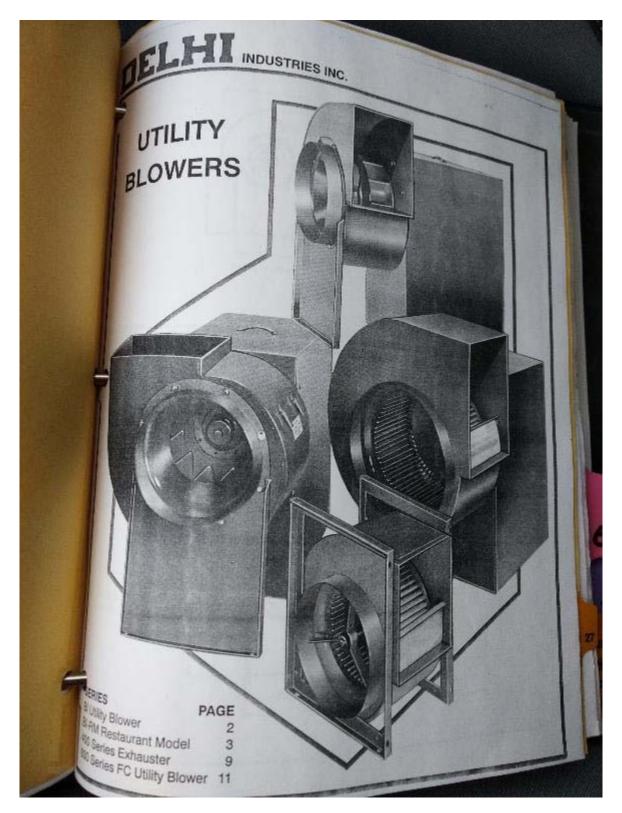


Photo A7: Utility Blower Brochure (Extracted from on-site Manual)



EXP Services Inc.

Client: City of Iqaluit c/o Colliers Project Leaders Project Name: Geotechnical Investigation. Proposed Expansion to Public Works Facility Building 1549, Federal Road, Iqaluit, Nunavut EXP Project Number: OTT-00245997-A0 Date: May 4, 2018

Appendix B: Logs of Test Pits



Project:	Partial Phase II Environmental Si	te Assessmen	t. C	ity of Iqal	uit P	ublic W	orks F	F acility	igure l	_	<u> </u>	-		
ocation:	Building 1549, Federal Road, Iqa								Pa	ge	1_ of			
ate Drilled:	April 13th, 2018			Split Spoon	Sampl	e.	\square		Combus	tible Var	oour Readi	na		
	320 DL Cat Excavator / XR 30 Xc	entric Ripper	-	Auger Samp	ole		Ī		Natural	Moisture	Content	9		×
	Geodetic		-	SPT (N) Val Dynamic Co		st			Atterber Undrain	- ed Triaxi		F		→ ⊕
	MAD Checked by: RF	₹	-	Shelby Tube Shear Stren			=		% Strain Shear S	trength b	у			→
33 7				Vane Test	9 2)		+ s		Penetro	meter Te	est			
S Y M B O	SOIL DESCRIPTION	Geodetic	Den				est N Val	lue 30	2	50		50	SAMP.	Natura Unit W
L		27.68	p t h	Shear Stre	ength			kPa !00	1	perg Limi 20	sture Conte ts (% Dry V 40 6	Veight) 80	LES	kN/m
BOUL	SAND AND GRAVEL WITH LDERS AND COBBLES													
Froze	en, brown with some dark brown, leum odour started at 0.6 m depth								20 · · · · ·				. m	S1
	·													
		+									1		\vdash	
									25				- kus	S2
														32
		_	1								: : : : : : : : : : : : : : : : : : :			
									40				m	S3
														33
T	Testpit Terminated at 1.4 m Depth	26.3			##			 		 	+			
OTES:	aguires interpretation by EVD before	WATE	RL	EVEL REC	ORDS	3			СО	RE DR	ILLING R	ECORD)	
use by others	equires interpretation by EXP before	Elapsed Time	L	Water evel (m)		Hole Op To (m)		Run No.	Dep (m		% Re	C.	R	QD %
	ed upon completion. supervised by an EXP representative.			-										
3. Field work was s														

	L	og of I	E	est	2	It	: <u> </u>	<u> P</u>	<u>2</u>						Vr
Project No:	OTT-00245997-A0									-: •	.1.	<u>B-2</u>			: /
Project:	Partial Phase II Environmental	Site Assessmen	t. C	ity of Iq	aluit	Pι	ıblic W	orks F		Figure I	_		1		- 1
Location:	Building 1549, Federal Road, I	qaluit, Nunavut								Pa	ge	of			
Date Drilled:	April 13th, 2018		_	Split Spoo	on Sar	mple)	×		Combus	stible Va	pour Readi	ng		
Drill Type:	320 DL Cat Excavator / XR 30	Xcentric Ripper		Auger Sa SPT (N) \						Natural Atterber		Content			×
Datum:	Geodetic		_	Dynamic	Cone	Test	t			Undrain % Strair	ed Triaxi				Φ
Logged by:	MAD Checked by:	RR		Shelby Tu Shear Str Vane Tes	rength	by		+ \$	-	% Strair Shear S Penetro	trength I	by			A
G W B O L	SOIL DESCRIPTION	Geodetic m	D e p t h	2 Shear S	20 Strengt	40 h		0	80 kPa	Nat Attert	50 tural Moi perg Lim	sture Conte its (% Dry V	50	l A	Natural Unit Wt. kN/m³
FILL: BOU	: SAND AND GRAVEL WITH LDERS AND COBBLES en, brown, no odour.	28.8	0	5	60	10	0 15	0 2	200	25	20	_40€	00	S Constitution	S1
FILL	: SAND AND GRAVEL	28.3													
	en, brown, no odour.									25					
- Cor	cal Profile of Exterior Wall ncrete was found from 0.0 to 0.6					-								: M	S2
- A 1	rofoam was found from 0.61 to 0 50 mm diameter PVC pipe was	found / 27.8	1											-	
	to 0.94 m underlying the styrofo Testpit Terminated at 1.0 m Dep														
NOTES:		WATE	R L	EVEL RE	ECOF	RDS				CO	RE DR	ILLING R	ECOF	 RD	
Borehole data r use by others	requires interpretation by EXP before	Elapsed Time		Water evel (m)			lole Ope	en	Run No.	Dep (m	th	% Re			QD %
	ed upon completion. supervised by an EXP representative.			\/			(/			\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\					
	Sample Descriptions														
5.Log to be read	with EXP Report OTT-00245997-A0														

LOG OF BOREHOLE LOGS OF BOREHOLES - 1549 IQALUIT.GPJ TROW OTTAWA.GDT 5/1/18

Project No: OTT-00245997-A0 <u>B-3</u> Figure No. Project: Partial Phase II Environmental Site Assessment. City of Iqaluit Public Works Facility Page. 1_ of _1_ Location: Building 1549, Federal Road, Iqaluit, Nunavut Date Drilled: April 13th, 2018 Split Spoon Sample \boxtimes Combustible Vapour Reading × Auger Sample Natural Moisture Content Drill Type: 320 DL Cat Excavator / XR 30 Xcentric Ripper SPT (N) Value 0 0 Atterberg Limits Dynamic Cone Test Datum: Geodetic Undrained Triaxial at \oplus Shelby Tube % Strain at Failure Shear Strength by Logged by: MAD Checked by: RR Shear Strength by + s Penetrometer Test

					Vane	e Tes	st					S				netro								
	S			D		Sta	ındaı	d Pe	netra	tion 7	Test I	V Val	lue		Co	ombu:	stible 50		our F		ing (p 750	opm)	S	Natu
G W L	S Y M B O	SOIL DESCRIPTION	Geodetic	e p t h	- Ch		20 Stron		40	6	30	8	30	_r Do	F	Nat Atterb	tural	Moist	ture (Conte	ent %	ht\	SAMPLES	Unit \
-	6		28.57		Sn	ear S	stren 50	-	100	1	50	2	00	kPa			20 20		s (% 40		rveigi 60	111)	ES	kN/n
		FILL: SAND AND GRAVEL WITH BOULDERS AND COBBLES Frozen, brown, no odour.	50.07	0											15 									S
		-													25									S2
		_		1											20									Sã
		Testpit Terminated at 2.0 m D	26.6	,											15 									S4
				- 1	1 1 1		1 : :	: : :	1:	: : :	1::	: :	133	: :	1:	: : :	1 : :	: :	1::	: :	1:	: : :		
					L		<u> </u>		<u> </u>		<u> </u>	_::			<u> </u>									
NOTE		e data requires interpretation by EXP before	WATE	_l ER LI	EVE	L RI	ECC	ORD	s	-	1::	 7			<u> </u>	СО	RE	DRII	LLIN	IG F	REC	ORE)	

NOTES:

LOG OF 1

- Borehole data requires interpretation by EXP before use by others
- 2. Test Pit backfilled upon completion.
- 3. Field work was supervised by an EXP representative.
- 4. See Notes on Sample Descriptions
- 5.Log to be read with EXP Report OTT-00245997-A0

WATER LEVEL RECORDS											
Elapsed Time	Water Level (m)	Hole Open To (m)									
Time	Lever (III)	10 (111)									

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

Log of Test Pit TP4 Project No: OTT-00245997-A0 Figure No. Project: Partial Phase II Environmental Site Assessment. City of Iqaluit Public Works Facility Page. 1 of 1 Location: Building 1549, Federal Road, Iqaluit, Nunavut Date Drilled: April 13th, 2018 Split Spoon Sample \boxtimes Combustible Vapour Reading × Auger Sample Natural Moisture Content Drill Type: 320 DL Cat Excavator / XR 30 Xcentric Ripper SPT (N) Value 0 0 Atterberg Limits Dynamic Cone Test Datum: Undrained Triaxial at Geodetic \oplus % Strain at Failure Shelby Tube Shear Strength by Logged by: MAD Checked by: RR Shear Strength by Penetrometer Test Vane Test Standard Penetration Test N Value Combustible Vapour Reading (ppm) Natural 250 500 750 G W L Geodetic -MBO-SOIL DESCRIPTION Natural Moisture Content % Atterberg Limits (% Dry Weight) Unit Wt Shear Strength kN/m³ 27.87 FILL: SAND AND GRAVEL WITH **BOULDERS AND COBBLES** Frozen, trace debris (garbage bag pieces), brown, slight pretroleum odour. S1 S2 26.5 Testpit Terminated at 1.4 m Depth 5/1/18 BOREHOLES - 1549 IQALUIT.GPJ TROW OTTAWA.GDT

NOTES:

LOGS OF

LOG OF

- Borehole data requires interpretation by EXP before use by others
- 2. Test Pit backfilled upon completion.
- 3. Field work was supervised by an EXP representative.
- 4. See Notes on Sample Descriptions
- 5.Log to be read with EXP Report OTT-00245997-A0

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

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

	Log	of T	•	est Pit <u>TP5</u>			\bigcirc	vn
Project No:	OTT-00245997-A0				_	B-5		
Project:	Partial Phase II Environmental Site Asse	essment	:. C	City of Iqaluit Public Works Facil		igure No.		- 1
Location:	Building 1549, Federal Road, Iqaluit, Nu	unavut				Page. <u>1</u> of <u>1</u>		
Date Drilled:	April 13th, 2018		_	Split Spoon Sample		Combustible Vapour Reading		
Drill Type:	320 DL Cat Excavator / XR 30 Xcentric F	Ripper	-	Auger Sample SPT (N) Value O		Natural Moisture Content Atterberg Limits		X ⊕
Datum:	Geodetic		_	Dynamic Cone Test Shelby Tube		Undrained Triaxial at % Strain at Failure		\oplus
Logged by:	MAD Checked by: RR	<u> </u>		Shear Strength by + Vane Test S		Shear Strength by Penetrometer Test		A
G X M B O L	SOIL DESCRIPTION	Geodetic m	D e p t h	20 40 60 80	kPa	Combustible Vapour Reading (ppm) 250 500 750 Natural Moisture Content % Atterberg Limits (% Dry Weight) 20 40 60	SAMPLES	Natural Unit Wt. kN/m³
BOU	: SAND AND GRAVEL WITH LDERS AND COBBLES en, brown, no odour.	127.04	0			20	, en	S1

26.6

Testpit Terminated at 1.3 m Depth

LOG OF BOREHOLE LOGS OF BOREHOLES - 1549 IQALUIT.GPJ TROW OTTAWA.GDT 5/1/18

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

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

S2

S3

Borehole data requires interpretation by EXP before use by others

- 2. Test Pit backfilled upon completion.
- $3. \mbox{{\it Field}}$ work was supervised by an EXP representative.
- 4. See Notes on Sample Descriptions
- 5.Log to be read with EXP Report OTT-00245997-A0

Project No:	OTT-00245997-A0	og of I	€	98	it	ŀ	' l'	t	-	<u> </u>							B	-6			E	xp
Project:	Partial Phase II Environmental	Site Assessmen	t. C	ity c	of Ic	qalu	iit P	ublic	: W	orks	Fa	acility	Fiç	gure			_		<u>'</u>			ı
Location:	Building 1549, Federal Road, Id	qaluit, Nunavut												Pa	age	٠ –	1	of	_1			
Date Drilled:	April 13th, 2018			Split	Spo	on S	ampl	e		1	⊠		c	Combu	ıstibl	e Var	oour	Read	lina			
Drill Type:	320 DL Cat Excavator / XR 30 >	Centric Ripper	_	Auge	er Sa	ample	Э			ĺ			Ν	latura	l Moi	isture			3			×
Datum:	Geodetic		-	SPT Dyna	. ,		e e Tes	st			0		L	tterbe Jndraii	ned ⁻	Triaxi				ŀ		→) ⊕
Logged by:	MAD Checked by: F	RR	-	She	-		th by			1	+		S	6 Strai Shear	Strer	ngth b	у					→
55 ,				Vane			,				+ s		F	Penetro	ome	ter Te	est					_
SY MBOL	SOIL DESCRIPTION	Geodetic m 28.75	t h	Sh	ear S	indar 20 Stren 50	4 gth	netrati 0 00	on T 6 15		81 20	0 kPa	┢	Combi Na Atte	250		500	Cont Dry	750		OAMP-IES	Natural Unit Wt. kN/m ³
│ 🎇 <u>BOU</u>	: SAND AND GRAVEL WITH LDERS AND COBBLES en, brown, no odour.	20.73	0	-0.0									15		Ĩ						· · ·	• S1
		20.2											; :- -								.	
	: DEBRIS WITH SANDY, VELLY BOULDERS AND COBBL	28.3											+						<u> </u>		+	1
Debr	ris (metal, crushed drums and wo en with loose pockets, brown, no	od),											:. . :: .		-						.	
	it with loose pockets, brown, no	ododi.																· • · · · · · · · · · · · · · · · · · ·				
		-	1	1 1	<u>: :</u>								15			: : :	+	<u> </u>	╬	: : :	_m	S2
													: - - : . .									
													: :- -						. .		.	
		27.3											; . . .									
BOREHOLES - 1549 IQALUIT.GPJ TROW OTTAWA.GDT 5/1/18	Testpit Terminated at 1.5 m Dept																					
NOTES:] [WATE	R I	FVF	l Ri	ECC)RD9	 3			⊥⊥] [ORF	DR	 	NG F	RFC	ORI	<u> </u>	
	requires interpretation by EXP before	Elapsed		Wat	er			Hole		en	$\frac{1}{1}$	Run		De	pth	אכ		% Re				QD %
2. Test Pit backfill 3. Field work was 4. See Notes on S	ed upon completion. supervised by an EXP representative. Sample Descriptions with EXP Report OTT-00245997-A0	Time	L	<u>.evel</u>	<u>(111)</u>	•		10	<u>(m)</u>			No.		<u>(r</u>	<u>n)</u>							

EXP Services Inc.

Client: City of Iqaluit c/o Colliers Project Leaders Project Name: Geotechnical Investigation. Proposed Expansion to Public Works Facility Building 1549, Federal Road, Iqaluit, Nunavut EXP Project Number: OTT-00245997-A0 Date: May 4, 2018

Appendix C: AGAT Laboratories Certificate





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

CLIENT NAME: EXP SERVICES INC

2650 QUEENSVIEW DRIVE, UNIT 100

OTTAWA, ON K2B8H6

(613) 688-1899

ATTENTION TO: SURINDER AGGARWAL

PROJECT: OTT-245997

AGAT WORK ORDER: 18Z330448

SOIL ANALYSIS REVIEWED BY: Jennifer Liu, Analyst, Qualified Person

DATE REPORTED: May 03, 2018

PAGES (INCLUDING COVER): 7

VERSION*: 1

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

NOTES			

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

AGAT Laboratories (V1)

*NOTE O

Page 1 01 7

Member of: Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Western Enviro-Agricultural Laboratory Association (WEALA) Environmental Services Association of Alberta (ESAA) AGAT Laboratories is accredited to ISO/IEC 17025 by the Canadian Association for Laboratory Accreditation Inc. (CALA) and/or Standards Council of Canada (SCC) for specific tests listed on the scope of accreditation. AGAT Laboratories (Mississauga) is also accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA) for specific drinking water tests. Accreditations are location and parameter specific. A complete listing of parameters for each location is available from www.cala.ca and/or www.scc.ca. The tests in this report may not necessarily be included in the scope of accreditation.



SAMPLING SITE: City of Iqaluit - Public Works Facility

CLIENT NAME: EXP SERVICES INC

Certificate of Analysis

AGAT WORK ORDER: 18Z330448

PROJECT: OTT-245997

ATTENTION TO: SURINDER AGGARWAL

SAMPLED BY:Exp

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

5835 COOPERS AVENUE

Soil Analysis - Salinity (AB Tier 1 - pH Calcium Chloride)

DATE RECEIVED: 2018-04-18							DA	ATE REPOR	TED: 2018-05-03	
	;	SAMPLE DESCRIPTION:	BH1 S4 9-10m		BH1 S5 11-13m		BH4 S4 8-9m		BH6 S3 6-7m	BH5 S1 1-2m
		SAMPLE TYPE:	Soil		Soil		Soil		Soil	Soil
		DATE SAMPLED:	2018-04-11		2018-04-11		2018-04-11		2018-04-12	2018-04-12
Parameter	Unit	G/S RDL	9190162	RDL	9190163	RDL	9190165	RDL	9190167	9190169
pH (CaCl2 Extraction)	pH Units	N/A	7.37	N/A	7.71	N/A	7.48	N/A	7.48	7.68
Electrical Conductivity (Sat. Paste)	dS/m	0.05	6.55	0.05	26.4	0.05	4.89	0.05	1.20	1.20
Sodium Adsorption Ratio	N/A		11.6		23.9		10.7		14.4	3.33
Saturation Percentage	%	1	34	1	33	1	28	1	29	31
Chloride, Soluble	mg/L	40	1030	200	6980	25	663	5	148	178
Calcium, Soluble	mg/L	1	255	3	865	1	145	1	12	77
Potassium, Soluble	mg/L	2	50	7	120	2	42	2	13	16
Magnesium, Soluble	mg/L	1	161	3	935	1	117	1	5	12
Sodium, Soluble	mg/L	2	965	7	4260	2	716	2	235	119
Sulfur (as Sulfate), Soluble	mg/L	2	1670	7	5100	2	1270	2	113	203
Calcium, Soluble (meq/L)	meq/L	0.05	12.7	0.05	43.2	0.05	7.24	0.05	0.60	3.84
Calcium, Soluble (mg/kg)	mg/kg	1	87	1	285	1	41	1	3	24
Chloride, Soluble (meq/L)	meq/L	0.14	29.1	0.14	197	0.14	18.7	0.14	4.17	5.02
Chloride, Soluble (mg/kg)	mg/kg	2	350	2	2300	2	186	2	43	55
Magnesium, Soluble (meq/L)	meq/L	0.08	13.2	0.08	76.9	0.08	9.63	0.08	0.41	0.99
Magnesium, Soluble (mg/kg)	mg/kg	1	55	1	309	1	33	1	1	4
Potassium, Soluble (meq/L)	meq/L	0.05	1.28	0.05	3.07	0.05	1.07	0.05	0.33	0.41
Potassium, Soluble (mg/kg)	mg/kg	2	17	2	40	2	12	2	4	5
Sodium, Soluble (meq/L)	meq/L	0.09	42.0	0.09	185	0.09	31.1	0.09	10.2	5.18
Sodium, Soluble (mg/kg)	mg/kg	2	328	2	1410	2	200	2	68	37
Sulfur (as Sulfate), Soluble (meq/L)	meq/L	0.04	34.8	0.04	106	0.04	26.4	0.04	2.35	4.23
Sulfur (as Sulfate), Soluble (mg/kg)	mg/kg	2	568	2	1680	2	356	2	33	63
Theoretical Gypsum Requirement	tonnes/ha	0.01	2.62	0.01	70.8	0.01	1.07	0.01	0.16	<0.01

Certified By:

Gh-



Certificate of Analysis

AGAT WORK ORDER: 18Z330448

PROJECT: OTT-245997

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

CLIENT NAME: EXP SERVICES INC SAMPLING SITE:City of Iqaluit - Public Works Facility

ATTENTION TO: SURINDER AGGARWAL SAMPLED BY:Exp

Soil Analysis - Salinity (AB Tier 1 - pH Calcium Chloride)

DATE RECEIVED: 2018-04-18								DATE REPORTED: 2018-05-03
			RIPTION: LE TYPE: AMPLED:	BH4 S2 3-4m Soil 2018-04-11		BH7 S1 1-2m Soil 2018-04-12	BH8 S1 1-2m Soil 2018-04-12	
Parameter	Unit	G/S	RDL	9199919	RDL	9199920	9199921	
pH (CaCl2 Extraction)	pH Units		N/A	7.35	N/A	7.31	7.48	
Electrical Conductivity (Sat. Paste)	dS/m		0.05	1.61	0.05	0.52	0.42	
Sodium Adsorption Ratio	N/A			4.21		2.32	1.09	
Saturation Percentage	%		1	27	1	27	26	
Chloride, Soluble	mg/L		10	246	5	65	39	
Calcium, Soluble	mg/L		1	92	1	36	45	
Potassium, Soluble	mg/L		2	17	2	11	8	
Magnesium, Soluble	mg/L		1	29	1	5	5	
Sodium, Soluble	mg/L		2	181	2	56	29	
Sulfur (as Sulfate), Soluble	mg/L		2	241	2	40	48	
Calcium, Soluble (meq/L)	meq/L		0.05	4.59	0.05	1.80	2.25	
Calcium, Soluble (mg/kg)	mg/kg		1	25	1	10	12	
Chloride, Soluble (meq/L)	meq/L		0.14	6.94	0.14	1.83	1.10	
Chloride, Soluble (mg/kg)	mg/kg		2	66	2	18	10	
Magnesium, Soluble (meq/L)	meq/L		0.08	2.39	0.08	0.41	0.41	
Magnesium, Soluble (mg/kg)	mg/kg		1	8	1	1	1	
Potassium, Soluble (meq/L)	meq/L		0.05	0.43	0.05	0.28	0.20	
Potassium, Soluble (mg/kg)	mg/kg		2	5	2	3	2	
Sodium, Soluble (meq/L)	meq/L		0.09	7.87	0.09	2.44	1.26	
Sodium, Soluble (mg/kg)	mg/kg		2	49	2	15	8	
Sulfur (as Sulfate), Soluble (meq/L)	meq/L		0.04	5.02	0.04	0.83	1.00	
Sulfur (as Sulfate), Soluble (mg/kg)	mg/kg		2	65	2	11	12	
Theoretical Gypsum Requirement	tonnes/ha		0.01	<0.01	0.01	<0.01	<0.01	

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

9190162-9199921 If sodium results in mg/L are less than detection, SAR is non-calculable and is reported as 0.

Certified By:



SAMPLING SITE: City of Iqaluit - Public Works Facility

CLIENT NAME: EXP SERVICES INC

Certificate of Analysis

AGAT WORK ORDER: 18Z330448

PROJECT: OTT-245997

ATTENTION TO: SURINDER AGGARWAL

SAMPLED BY:Exp

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

Soil Analysis - Soluble Sulfate

DATE RECEIVED: 2018-04-18								[DATE REPORTE	ED: 2018-05-03	
		SAMPLE DES	CRIPTION:	BH1 S4 9-10m		BH1 S5 11-13m		BH4 S4 8-9m	BH6 S3 6-7m	BH5 S1 1-2m	BH4 S2 3-4m
		SAM	IPLE TYPE:	Soil		Soil		Soil	Soil	Soil	Soil
DATE SAMPLED: 2018-04-11						2018-04-11			2018-04-12	2018-04-12	2018-04-11
Parameter	Unit	G/S	RDL	9190162	RDL	9190163	RDL	9190165	9190167	9190169	9199919
Sulfate, Soluble	mg/L		2	1670	7	5100	2	1270	113	203	241
Sulfur (as Sulfate), Soluble (mg/kg)	mg/kg		2	568	2	1680	2	356	33	63	65
Sulfur(as Sulfate), Soluble	% w/w		0.0002	0.0568	0.0002	0.168	0.0002	0.0356	0.0033	0.0063	0.0065

		SAM	CRIPTION: PLE TYPE: SAMPLED:		BH8 S1 1-2m Soil 2018-04-12	
Parameter	Unit	G/S	RDL	9199920	9199921	
Sulfate, Soluble	mg/L		2	40	48	
Sulfur (as Sulfate), Soluble (mg/kg)	mg/kg		2	11	12	
Sulfur(as Sulfate), Soluble	% w/w		0.0002	0.0011	0.0012	

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

Certified By:



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Quality Assurance

CLIENT NAME: EXP SERVICES INC

AGAT WORK ORDER: 18Z330448

PROJECT: OTT-245997

ATTENTION TO: SURINDER AGGARWAL

SAMPLING SITE:City of Iqaluit - Public Works Facility

SAMPLED BY:Exp

				Soi	l Ana	alysis	5								
RPT Date: May 03, 2018			DUPLICATE				REFEREN	NCE MA	TERIAL	METHOD	BLANK	SPIKE	MAT	KE	
PARAMETER	Batch	Sample	Dup #1	Dup #2	RPD	Method Blank	Measured	Acceptable Limits		Recovery	1 1 1 1 1	ptable nits	Recovery		ptable nits
		ld	.				Value	Lower	Upper		l .	Upper		Lower	Upper
Soil Analysis - Salinity (AB Tier 1	- pH Calc	ium Chlori	de)												
pH (CaCl2 Extraction)	3118	9919	7.35	7.51	2.2%	N/A	100%	90%	110%						
Electrical Conductivity (Sat. Paste)	9199921	9199921	0.42	0.42	0.0%	< 0.05	100%	90%	110%						
Saturation Percentage	9199921	9199921	26	27	3.6%	< 1	101%	80%	120%						
Chloride, Soluble	9199921	9199921	39	42	6.5%	< 5	101%	80%	120%						
Calcium, Soluble	9199921	9199921	45	46	1.5%	< 1	107%	80%	120%						
Potassium, Soluble	9199921	9199921	8	7	NA	< 2	117%	80%	120%						
Magnesium, Soluble	9199921	9199921	5	5	0.0%	< 1	107%	80%	120%						
Sodium, Soluble	9199921	9199921	29	29	0.3%	< 2	95%	80%	120%						
Sulfur (as Sulfate), Soluble	9199921	9199921	48	49	2.0%	< 2	103%	80%	120%						

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

Soil Analysis - Soluble Sulfate

Sulfate, Soluble 9199921 9199921 48 49 2.1% <2 103% 80% 120%

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

Certified By:

GA.



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Method Summary

CLIENT NAME: EXP SERVICES INC

PROJECT: OTT-245997

AGAT WORK ORDER: 18Z330448
ATTENTION TO: SURINDER AGGARWAL

SAMPLING SITE: City of Iqaluit - Public Works Facility

SAMPLED BY:Exp

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE				
Soil Analysis							
pH (CaCl2 Extraction)	SOIL 0110; SOIL 0120; INST 0104	CARTER & GREGORICH 2007-pH	PH METER				
Electrical Conductivity (Sat. Paste)	SOIL 0110; SOIL 0120; INST 0120	SHEPPARD 2007; MILLER 2007-S	CONDUCTIVITY METER				
Sodium Adsorption Ratio	SOIL 200	CARTER & GREGORICH 2007-SAR	CALCULATION				
Saturation Percentage	SOIL 0140; SOIL 0110; SOIL 0120	CARTER & GREGORICH 2007	GRAVIMETRIC				
Chloride, Soluble	SOIL 0110; SOIL 0120; INST 0330	Carter & Gregorich 2007; SM 4500E	COLORIMETER				
Calcium, Soluble	SOIL 0110; SOIL 0120; SOIL 0140; INST 0140	CARTER & GREGORICH 2007, SM 3120B-S	ICP/OES				
Potassium, Soluble	SOIL 0110; SOIL 0120; SOIL 0140; INST 0140	CARTER & GREGORICH 2007, SM 3120B-S	ICP/OES				
Magnesium, Soluble	SOIL 0110; SOIL 0120; SOIL 0140; INST 0140	CARTER & GREGORICH 2007, SM 3120B-S	ICP/OES				
Sodium, Soluble	SOIL 0110; SOIL 0120; SOIL 0140; INST 0140	CARTER & GREGORICH 2007, SM 3120B-S	ICP/OES				
Sulfur (as Sulfate), Soluble	SOIL 0110; SOIL 0120; SOIL 0140; INST 0140	CARTER & GREGORICH 2007, SM 3120B-S	ICP/OES				
Sulfate, Soluble	SOIL 0110; SOIL 0120; INST 0140	SHEPPARD 2007; EATON 2005	ICP/OES				



AGAT Laboratories

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

Laboratory	Use Only
Work Order #: _	187330448
Cooler Quantity:	one noice.
Arrival Temperatu	res: 12912291230

Chain of Custody Reco	ord If this is	a Drinking Wa	ter sample, p	lease u	se Drinking Water Chain o	f Custody Form	potable s	water consu	ned by hur	ians)		10000		Quant Tempe	uty: eratur	-			122		23.0
Report Information: Company: Exp Service					Regulatory Requirements: No Regulatory Requirement People check all applicable bases:						Custody Seal Intact: Yes No Notes:										
Contact: Address: ICO-2450 Ouernaview drive OHawa, OU K2R 8HG Phone: Reports to be sent to: 1. Email: Surinder. Aggarwal @exp. com 2. Email: Project Information: Project: Sampled By: AGAT Quote #: Program note. # questation recorder record provinced data across for analysis. Invoice Information: Company: Contact: Address:					□ Regulation 153/04 Table Agricult One □ Ind/Oom □ Res/Park □ Agriculture Soil Texture (Oeck One) □ Coorse		situity em.	0	Regulati CCME Prov. Wa Objectiv Other	ter Qua	ility	Tu	irna egula ish T	AT (B) 3 Bus Days	T wsh Surc Liness	charges A] 5 to	to 7 Bi Busine	lusines	as Days	Next Busine Day
Project Information: Project: OTT- 7 Site Location: Tealurit Pub	tic Work	Cac: 1: 14	, Winas	a.t	Is this submission Record of Site Co			Repor Certific	t Guide		sis			Ple TAT is	ease p	provide usive of	prior i	notific kends	cation and st	for rus	
AGAT Quate #: Peans note # questation hum Invoice Information: Company: Contact: Address: Email:	market the forest control of the last		- /		Sample Matrix Le B Biota GW Ground Water O Oil P Paint S Soil SD Sediment SW Surface Water	gend	Fleid Fittered - Metals, Hg, Orvi	and Inorganics In D153 Mean (exc. Hydrides)	DB-HWS Did DCN Memory DCN DCN	Scan	Regulation/Custom Metals Nutrients: CITE CINH, CITHN	J NOC	- F4			Total Dividions Districtions Pesticides	Was CLVOCs CLABNS CB(a)P CPC)) 9	10	to Coductivity	2,
Sample Identification	Date Sampled	Time Sampled	# of Containers	Samp		(100 to 100 to 1	Y/N	Metals a	P 40	Full Metals	Reguist Nutrient	201	PHCs FI.	ABNs		PCBs: [] 7 Organoch	TC.P. []	Sewer	t d	Sketo	18
BH 4 52 3-4m BH 7 SI 1-2m BH 8 SI 1-7m	Ap 11/18 Ap 12/18 Ap 12/18																		// /		
Samples Reginalisted By (Print Name and Sign) Von DG: <					Scopping Control (1) (8) Scopping Received (1)	heldt	Bu	ш	u	2	чАр	15	3	ime 	2	5		Page	. 1	of	1

Sampton Received By (Print Name and Sign)

Sumples Retinguished By (Print Name and Sign):

Client: City of Iqaluit c/o Colliers Project Leaders Project Name: Geotechnical Investigation. Proposed Expansion to Public Works Facility Building 1549, Federal Road, Iqaluit, Nunavut EXP Project Number: OTT-00245997-A0

Date: May 4, 2018

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