

## • City of Iqaluit

## **Geotechnical Investigation Northwest Granular Deposit, Iqaluit, Nunavut**

Type of Document FINAL

**Project Name:** 

Geotechnical Investigation - Northwest Granular Deposit

Project Number OTT-00219428-A0

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Date Submitted January 29, 2016

## City of Iqaluit

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January 29, 2016

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### **Executive Summary**

**Exp** Services Inc. (**exp**) has carried out a geotechnical investigation of the Northwest Granular Deposit (Northwest Deposit), located approximately 6 km northwest from the nearest existing road within the City of Iqaluit, NU. The purpose of the geotechnical investigation was to quantify and classify the quality of granular material present is support of general decisions on the viability of the deposit for development.

In 2005, Indian and Northern Affairs Canada (now Aboriginal and Northern Development of Canada (AANDC)) had a granular aggregate assessment carried out to identify potential borrow sources within a 10 km radius of the City of Iqaluit. The assessment consisted of air photo interpretation and preliminary site reconnaissance. Two distinct areas were identified northwest of the city: the Trail Area Deposit and the Northwest Deposit. The current area of interest within the Northwest Deposit begins at the south end of the overall deposit, extends approximately 3 km north and is approximately 0.5 km to 1 km wide. It is understood that the granular deposit is expected to extend a considerable distance further north/northwest based on the initial air photo interpretation carried out in 2005. To date however, only the current area of interest has been evaluated beyond that initial air photo interpretation to date.

Between May 7, 2015 and May 23, 2015 a total of twenty-five (25) boreholes were drilled throughout the south end of the Northwest Deposit using an air-track drill rig. A senior geotechnician from **exp** was on site to observe the drilling activities and log the subsurface conditions encountered. Disturbed samples of the soils encountered were obtained at 1 m intervals from the drill cuttings circulated to the surface during drilling. The boreholes were spaced approximately 100 m apart and drilled to depths ranging from 3.0 m to 7.0 m depth below current grade. Bulk samples were also gathered from the surface of the deposits during the investigation. The quality of the granular material encountered in the boreholes has been classified in accordance with Table 2 herein, which is intended to roughly categorize the materials encountered into suggested uses based on gradation and material strength.

It is noted that the drill method used is highly disruptive and larger gravels, cobbles and boulders have been broken down during drilling and show as smaller gravels, sand and possibly fines within the gradations presented and discussed herein. However, it is expected that this represents a level of conservatism with the results, as one of the primary intentions of the program is to confirm the presence of deposits rich with coarse aggregates and containing little to no fines (Class 1 and Class 2). Such deposits would be considered suitable for use in production of materials such as concrete aggregates, asphalt aggregates, surface coarse granulars, base coarse granulars, sub-base coarse granulars, winter sand, etc. It is expected that the actual gradations encountered in the field will be coarser and possibly contain less fines than presented herein, which should only be better for feeding production of such materials. The same would be true for the material identified as being appropriate for use as general subgrade and backfill material (Class 3); however, it is expected that these materials have been altered much less by the drilling method than the cobble and boulder rich granular layers above.

Observations made of the area without snow cover during previous site visits revealed that t is generally barren with little to no overburden. Based on our observations during drilling and our laboratory test results, the upper 1.0 m to 6.0 m of material throughout the areas investigated can be classified as



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Class 1 – Excellent Quality Granular (less than 5 percent fines) and/or Class 2 – Good Quality Granular (less than 10 percent fines). It is estimated that this upper layer of excellent to good quality granular contains 20 percent to 40 percent cobbles and boulders (crushable rock) to potentially help fill gaps in gradation during crushing/processing. The layer of Class 1 and Class 2 granular was observed to be underlain by either Class 3 – Fair Quality Granular (less than 25 percent fines) or bedrock. The in-situ moisture content of the Class 3 material encountered was quite variable, with some ice-rich zones apparently present throughout the deposit. These zones of ice-rich Class 3 material may require excessive dry times to become usable. Additionally, massive ice lenses/wedges (pure ice) were encountered at depth within the Class 3 material in four of the twenty-five boreholes (16%). Therefore, care will be required during Pit Development as outlined below. At the time of the investigation the active layer was completely frozen. It is anticipated that the maximum active layer thickness throughout the area (late September to early October) would be in the range of 1.5 m to 2.5 m, depending on sun exposure, in-situ moisture of upper materials, etc.

Based on the above, the Northwest Deposit is recommended for development as a borrow source capable of meeting the City of Iqaluit requirements for the next 10 years and beyond. Class 1 and/or Class 2 material was encountered directly at the surface in twenty-four of the twenty-five boreholes. Similar material is visible throughout the majority of the remaining deposit as indicated by Aboriginal and Northern Development of Canada (AANDC) in 2005. The boreholes have verified the thickness of these surficial deposits is significant with an average thickness of 3.8 m throughout the area explored. Furthermore, additional material usable as general subgrade fill (Class 3 material) and/or blending with Class 1 and Class 2 to create desired gradations is present in mass quantities directly beneath the Class 1 and Class 2 layers.

The total estimated volume of usable borrow material within the area investigated by boreholes is between 834,854 m<sup>3</sup> to 1,063,000 m<sup>3</sup>. It is noted that the estimated volumes presented above:

- Do not include the above-noted zones of ice-rich Class 3 material encountered, which represent another 125,660 m³ to 160,000 m³ of potentially usable material depending on the actual in-situ moisture contents encountered.
- Do not include the full thickness of Class 2 or Class 3 material encountered at many of the borehole locations, as drilling was ceased due to time constraints.
- Represents the area investigated by boreholes, which is approximately 25% of the total area investigated by EBA Engineering Ltd. (EBA) in 2006 and estimated to contain 7,941,000 m<sup>3</sup> of usable granular based on their GPR results.

Therefore, it is anticipated that the Northwest Deposit will easily provide access to over 1,000,000 m<sup>3</sup> of usable granular material and it is likely to provide access to over 1,000,000 m<sup>3</sup> of Class 1 Excellent Quality Granular and/or Class 2 Good Quality Granular material as defined herein.

With regards to Pit Development, care will be required during planning and excavation to assure that sufficient room is available within each individual section to allow for alternate site access if/when ice-rich Class 3 materials and/or zones of pure ice lenses/wedges are encountered at depth and exposed.



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Exposing such materials will limit or eliminate site access through that area as the materials thaw and destabilize. This is understood to have been a major issue during development of the Trail Area Deposit. How to deal with such areas will depend on the topography of the individual deposits being excavated and surrounding area, as well as the thickness of the problem soils encountered. Therefore, it will require real time assessment and decision by qualified people with knowledge on quarrying permafrost soils successfully. In general, we would anticipate many possible scenarios with various potential solutions. We have outlined two possible scenarios and our envisioned solutions herein.

Although two distinct zones of buried ice lenses/wedges are discussed herein, it is anticipated that other such zones exist throughout the Northwest Deposit due to the nature of deposition and presence of permafrost. Therefore, monitoring and maintenance of site access roads will be required throughout the duration of Pit Development and must account for potential thawing of underlying ice-rich soils/pure ice and possible weakening/failure of road embankment side slopes. Problem areas must be addressed quickly once warning signs present themselves (i.e. development of soft ground, rutting, longitudinal tension cracks along embankment crests/slopes, sloughing of embankment slopes, etc.) to limit the effects of the issue as much as possible. Thawing of ice-rich soils and/or buried ice is expected to result in development of excess surface water, which will need to be dealt with constantly and quickly removed. Surface water should not be allowed to flow or pond over or adjacent to areas where access is required, as the presence of this warm water will exhilarate permafrost degradation and exacerbate the situation.

Further discussion on how best to deal with this potential issue during Pit Development will be required at the planning stage and considering the interests of all parties (owner, engineering team, contractor, etc.). However, this is considered more of a contractual and planning issue, and should not affect the ability of the City of Iqaluit to extract well over 10 years supply of excellent to fair quality granular material from the Northwest Deposit.

The above and other related recommendations 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 of the Northwest Granular Deposit (Northwest Deposit), located approximately 6 km northwest from the nearest existing road within the City of Iqaluit, NU. The purpose of the geotechnical investigation is to quantify and classify the quality of granular material present to support general decisions on the viability of the deposit for development.

The current area of interest within the Northwest Deposit begins at the south end of the overall deposit, extends approximately 3 km north and is approximately 0.5 km to 1 km wide. It is understood that the granular deposit is expected to extend a considerable distance further north/northwest based on the initial air photo interpretation carried out in 2005. However, only the current area of interest has been evaluated beyond that initial air photo interpretation, as outlined below.

The terms of reference for the geotechnical investigation outlined herein were as follows:

- i. Review of available information.
- ii. Confirm the presence of 10 year supply of suitable borrow material within the deposit, estimated at 10,000 m<sup>3</sup> of borrow material per year, or 100,000 m<sup>3</sup> of borrow material total.
- iii. Carry out laboratory testing program to classify the quality of the material for various potential uses and estimate the volume of materials present within the deposit.
- iv. Provide a geotechnical investigation report summarizing the laboratory test results, approximate material quality classifications, approximate volumes available throughout the area investigated and preliminary comments and recommendations regarding potential development of the deposit.



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### 2 Project Background

#### 2.1 Previous Investigation of the Northwest and Trail Area Deposits

In 2005, Indian and Northern Affairs Canada (now Aboriginal and Northern Development of Canada (AANDC)) had a granular aggregate assessment carried out to identify potential borrow sources within a 10 km radius of the City of Igaluit. The assessment consisted of air photo interpretation and preliminary site reconnaissance. Two distinct areas were identified northwest of the city: the Trail Area Deposit and the Northwest Deposit. In 2006, further evaluation of the two deposits was carried out by AANDC and EBA Engineering Ltd. (EBA). Representatives from AANDC visited the deposits to carry out surficial mapping and excavate a series of shallow hand dug test pits (less than 0.6 m deep) using a shovel. The test pits were excavated at an approximate spacing of 100 m along each deposit and samples recovered for laboratory testing. Representatives from EBA then visited the areas to carry out ground penetrating radar (GPR) throughout the same deposits. Based on the GPR findings, EBA provided preliminary volume estimates for a well sorted fluvial gravel and sand layer, and underlying glacial till layer. The GPR survey carried out by EBA covered an overall area of about 128,000 m<sup>2</sup> within the Trail Area Deposit and 1,000,000 m<sup>2</sup> within the Northwest Deposit. Based on their assessment EBA estimated the Trail Area Deposit contained 599,000 m<sup>3</sup> of well-sorted gravel and sand, underlain by 3,248,000 m<sup>3</sup> of unsorted till material. EBA's estimates for the Northwest Deposit included 4,631,000 m<sup>3</sup> of well-sorted gravel and sand, underlain by 3,310,000 m<sup>3</sup> of unsorted till material.

Additionally, a borehole drill program was carried out and reported by Naviq Consulting Inc. (Naviq) in 2011 to assess an apparent massive ice body (or bodies) at the Trail Area deposit, as discussed below.

#### 2.2 Buried Ice in the Trail Area Deposit

Development of the Trail Area Deposit began in 2010. During development, it was discovered that ice lenses/wedges were present at depth throughout portions of the deposit. The buried ice created access issues and combined with the setbacks between leased areas, resulted in the usable volume being much less than anticipated based on the above-noted preliminary investigation. Therefore, a geotechnical borehole program was undertaken by Naviq in 2011 to further assess the extent of buried ice within the deposit. Given the history with the Trail Area Deposit, it was considered necessary to carry out a similar geotechnical investigation and confirm the viability of the Northwest Deposit as a long-term source before the road is extended to this location.



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#### 3 Procedure

#### 3.1 Drill Program

Between May 7, 2015 and May 23, 2015 a total of twenty-five (25) boreholes were drilled throughout the south end of the Northwest Deposit using an air-track drill rig. The boreholes were spaced approximately 100 m apart and drilled to depths ranging from 3.0 m to 7.0 m depth below current grade.

A senior geotechnician from **exp** was on site to observe the drilling activities and log the subsurface conditions encountered. Disturbed samples of the soils encountered were obtained at 1 m intervals from the drill cuttings circulated to the surface during drilling. The collected soil samples were evaluated by our senior geotechnician and logged in accordance with ASTM D2488 (*Standard Practice for Description and Identification of Soils* (*Visual-Manual Procedure*)) and ASTM D4083 (*Standard Practice for Description of Frozen Soils* (*Visual Manual Procedure*)).

Following the initial visual assessment, each soil sample was sealed in plastic bags, weighed to determine the initial wet weight (to facilitate accurate moisture content determination later on) and stored for transport to **exp**'s laboratory in Ottawa. All boreholes were backfilled using soil cuttings upon completion and the approximate borehole locations were determined by handheld GPS. Final survey of the borehole locations and elevations was outside our current scope of work. Elevations were determined based on available topographic survey and are therefore, considered approximate.

During the drill program, our geotechnical representative also collected a total of three large composite samples from the surface of the various deposits using a shovel. The purpose of these composite samples was to provide bulk material for Los Angeles (LA) Abrasion testing and Petrographic analyses to further classify the soils encountered. The composite samples collected in the field consisted predominantly of cobbles and large gravels present across the surface of the various deposits, as well as portions taken from the drill cuttings that remained from the upper most 1.0 m of the boreholes. Therefore, the samples are considered to be representative of the upper most 1.0 m of each deposit, which was typically coarser material more probable for use in production of concrete aggregates, granular surface courses, granular base course, etc. where durability is more of a factor.

#### 3.2 Laboratory Testing

Upon arrival at the **exp** laboratory, each sample was assessed visually by a senior geotechnical engineer (the author) to confirm or alter the field classification in a more controlled environment. Laboratory testing was then assigned, consisting of; moisture content determinations on all recovered samples and grain size analyses on select samples. During the visual assessment, it was determined that all fines were non-plastic; therefore, Atterberg limit determinations were not required.

In the laboratory, we compiled four additional composite samples from the various borehole samples, which were intended to represent the various materials encountered. These composite samples were



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submitted for total sulphur and sulphate sulphur content determination, in order to determine if the aggregates have potential to be acid producing based on their sulphide content. The boreholes and defined polygons represented by the four composite samples submitted for acid producing potential testing are summarized as follows:

- Composite Sample 1: Represents Polygons 19, 22, 115 and 116 (BH's 1 to 10 inclusive)
- Composite Sample 2: Represents Polygons 107, 113 and 114 (BH's 14 to 20 inclusive)
- Composite Sample 3: Represents Polygon 21 (BH's 11, 12, 13)
- Composite Sample 4: Represents Polygons 16A and 18 (BH's 21 to 25 inclusive)

The above-noted composite samples collected from the surface or near surface drill cuttings of each deposit were submitted for petrographic number analysis and LA abrasion testing. The boreholes and defined polygons represented by these three composite samples are summarized as follows:

- Composite Sample 5: Represents Polygons 19, 22, 115 and 116 (BH's 1 to 10 inclusive)
- Composite Sample 6: Represents Polygons 107, 113 and 114 (BH's 14 to 20 inclusive)
- Composite Sample 7: Represents Polygons 16A, 18 and 21 (BH's 11, 12, 13 and 21 to 25 inclusive)

#### 3.3 Material Quality Classification

It is noted that the drill method used is highly disruptive and larger gravels, cobbles and boulders have been broken down during drilling and show as smaller gravels, sand and possibly fines within the gradations presented and discussed herein. However, it is expected that this represents a level of conservatism with the results, as one of the primary intentions of the program is to confirm the presence of deposits rich with coarse aggregates and containing little to no fines (Class 1 or Class 2 below). Such deposits would be considered suitable for use in production of materials such as concrete aggregates, asphalt aggregates, surface coarse granulars, base coarse granulars, sub-base coarse granulars, winter sand, etc., with fines introduced through blending with more fine grained deposits as required. It is expected that the actual gradations encountered in the field will be coarser and possibly contain less fines than presented herein, which should only be better for feeding production of such materials. The same would be true for the material identified as being appropriate for use as general subgrade and backfill material (Class 3 below); however, it is expected that these materials have been altered much less by the drilling method than the cobble and boulder rich granular layers above.

The gradation test results for samples collected from each borehole are presented graphically in the appended Grain Size Distribution Curve figures that immediately follow each Borehole Log. The gradation test results have been compared against typical specifications for Granular A, Granular B and Select Subgrade Material as summarized in Table 1 below.



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| Table 1: Assumed Gradat                  | ion Requirem        | ents for Granu       | lar A, Granular E        | 3 and Subgrade     |
|--|---------------------|----------------------|--------------------------|--------------------|
| Property                                 | ASTM Test<br>Method | Granular A<br>(Base) | Granular B<br>(Sub-Base) | Select<br>Subgrade |
| Gradation (sieve/% passing)              |                     |                      |                          |                    |
| 150 mm                                   | C136                | -                    | -                        | 100                |
| 75 mm                                    | C136                | -                    | 100                      | -                  |
| 37.5 mm                                  | C136                | -                    | -                        | -                  |
| 25.0 mm                                  | C136                | 100                  | 50-100                   | 50-100             |
| 19.0 mm                                  | C136                | 75-100               | -                        | -                  |
| 9.5 mm                                   | C136                | 50-85                | -                        | -                  |
| 4.75 mm                                  | C136                | 35-65                | 20- 55                   | 20-100             |
| 2.0 mm                                   | C136                | 25-50                | -                        | -                  |
| 0.425 mm                                 | C136                | 15-30                | 5-35                     | -                  |
| 0.300 mm                                 | C136                | -                    | -                        | 5-95               |
| 0.150 mm                                 | C136                | -                    | -                        | 2-65               |
| 0.075 mm                                 | C117                | 5-8                  | 0-8                      | 0-25               |
| Crushed Content (%) min. (2)             | -                   |                      |                          |                    |
| 50 to 37.5 mm                            | -                   | 60                   | 60                       | -                  |
| 37.5 to 19.0 mm                          | -                   | 60                   | 60                       | -                  |
| 19.0 to 4.75 mm                          | -                   | 60                   | 60                       | -                  |
| Plasticity Index (%) max.                | D4318               | NP                   | NP                       | -                  |
| Abrasion Loss (%) max.                   | C131                | 45                   | 50                       | -                  |
| Flat or Elongated Particles (%) Max. (3) | D4791               | 15                   | 15                       | -                  |

Additionally, the quality of the granular material encountered in the boreholes has been classified in accordance with Table 2 below. Similar classification criteria have been used to evaluate potential borrow sources throughout the Northwest Territories since the 1980's (reportedly developed by AANDC (formerly INAC)). The classification system is intended to roughly categorize the materials encountered into suggested uses based on gradation and material strength.



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|                                  | Table 2: Quality  | Classification of Granular Mate  | erials  |
|----------------------------------|---|--|---|
| Source<br>Quality<br>Description | General Description of<br>Material  | Minimum Technical<br>Identification Parameters   | Suggested Uses of<br>Materials  |
| 1 – Excellent                    | Well-graded gravels and sands suitable for use as aggregates with a minimum of processing (<5% fines passing the 80µm sieve).                             | Petrographic Number = 160 (max).<br>LA Abrasion Loss = 35% (max).  | Portland Cement Concrete,<br>Asphaltic Concrete,<br>Masonry Sand, Concrete<br>Block, Surface Treatment,<br>and Roofing Aggregate. |
| 2 – Good                         | Graded sands and gravels with varying quantities of silt (<10% fines passing the 80µm sieve).   | Petrographic Number = 200 (max).  LA Abrasion Loss = 60% (max).  Fines greater than10% passing the 80µm sieve can be removed with a minimum of processing. | Granular base and sub-<br>base. Winter sand backfill<br>for trenches and slabs.<br>Pads for construction.                         |
| 3 – Fair                         | Poorly graded sands and gravels with or without substantial silt content (<25% fines passing the 80µm sieve).   | Petrographic Number = 250 (max). Can be processed to meet local frost susceptibility criteria.   | Granular sub-base, general backfill material, pads for equipment.   |
| 4 – Poor                         | Poorly graded granular soils of high silt content, possibly containing very weak particles and deleterious materials (>25% fines passing the 80µm sieve). | Nil  | General non-structural fill.  |

#### 3.4 Volume Estimates

Material volumes for each material Class presented herein have been estimated based on the following assumptions:

- The upper boundary of our volume estimation is based on each borehole representing a 100 m by 100 m square (10,000 m²) and assumes that any desirable material present above buried ice lenses/wedges can be removed through proper planning and development. However, the ice-rich Class 3 material encountered has not been included as it is expected that this material will require excessive dry times to become usable in construction.
- The lower boundary of our volume estimation is based on each borehole representing a 100 m diameter circle (7,854 m²) which represents an overall 22% reduction of material volume to account for zones of unsuitable material and/or loss of material during processing or to site access road maintenance as discussed in Section 6 Additionally we have removed the boreholes/areas where buried ice lenses/wedges were encountered and assumed these areas will not be developed. Therefore, the lower bound value is considered to be a very conservative value at this time.



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• The subsurface layers in a given borehole extend in a horizontal manner over the surrounding circular area, at the elevation encountered in the borehole, such that the base of each soil unit was a horizontal circular plane.

It should be recognized that the above-mentioned assumptions were made in order to provide a consistent and measurable approach for determining the viability of the Northwest Deposit. Subsurface conditions will vary both with depth and laterally, and a high degree of variability in the material composition, thicknesses and ice-content should be expected between the borehole locations.

It should also be noted that only six of the twenty-five boreholes (24%) were terminated in bedrock and the remaining boreholes were terminated due to time constraints. Therefore, it is anticipated that an unknown volume of additional usable granular material is available beyond the estimated volumes presented herein. Due to time constraints, we attempted to focus on and prove out the vertical extent of granular rich Class 1 and Class 2 materials present throughout the area investigated. Boreholes were typically terminated once we either encountered; possible Class 3 material, bedrock or massive ice/snow.



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#### 4 Subsurface Conditions and Material Classification

A detailed description of the subsurface soil and groundwater/ground ice conditions encountered in the boreholes are given on the appended Borehole Log Figures followed immediately by Gradation Test Result Figures for samples from that borehole. The Borehole Logs and related information depict subsurface conditions only at the specific locations and times indicated. Subsurface conditions, ice content and potential water levels at other locations may differ from conditions at the locations where sampling was conducted. It should be noted that the soil boundaries indicated on the borehole 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 logs form an integral part of this report and should be read in conjunction with this report.

Furthermore, as noted above the method of drilling has affected the gradation of the material and returned altered samples to the surface. Therefore, the gradation and classifications outlined below should be interpreted carefully by qualified personnel.

#### 4.1 General

The surface of the area investigated was covered with snow at the time of the investigation. However, we have observed the area without snow cover during previous site visits and it is generally barren with little to no overburden. Based on our observations during drilling and our laboratory test results, the upper 1.0 m to 6.0 m of material throughout the areas investigated can be classified as Class 1 – Excellent Quality Granular (less than 5 percent fines) and/or Class 2 – Good Quality Granular (less than 10 percent fines). It is estimated that this upper layer of excellent to good quality granular contains 20 percent to 40 percent cobbles and boulders (crushable rock) to potentially help fill gaps in gradation during crushing/processing.

The layer of Class 1 and Class 2 granular was observed to be underlain by either Class 3 — Fair Quality Granular (less than 25 percent fines) or bedrock. The in-situ moisture content of the Class 3 material encountered was quite variable, with some ice-rich zones apparently present throughout the deposit. These zones of ice-rich Class 3 material may require excessive dry times to become usable. Additionally, massive ice lenses/wedges were encountered at depth within the Class 3 material in four of the twenty-five boreholes (16%). Therefore, care will be required during Pit Development as outlined below. At the time of the investigation the active layer was completely frozen. It is anticipated that the maximum active layer thickness throughout the area (late September to early October) would be in the range of 1.5 m to 2.5 m.

A summary of the borehole stratigraphy classified in accordance with Table 2 above is included in Table 3 below. The subsurface conditions encountered are further outlined within the following subsections.



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|      | Table 3 | : Boreh      | ole Sumn   | nary Table | e, Materia | Classific  | ation as per Secti        | ion 3.4    |
|------|---------|--------------|------------|------------|------------|------------|---------------------------|------------|
| вн   | Elev.   | Total        |            | Stratigra  | aphy (m)   |            | Ice-Rich Soil             | Bedrock    |
| No.  | (m)     | Depth<br>(m) | Class 1    | Class 2    | Class 3    | Class 4    | and/or Massive<br>Ice (m) | (m)        |
| BH01 | 159     | 4.0          | -          | -          | 0.0 to 2.5 | -          | 1.0 to 2.5                | 2.5 to 4.0 |
| BH02 | 155     | 6.0          | -          | 0.0 to 3.0 | 3.0 to 6.0 | -          | 3.0 to 4.5                | -          |
| BH03 | 155     | 6.0          | 0.0 to 5.0 | -          | -          | -          | -                         | 5.0 to 6.0 |
| BH04 | 157     | 7.0          | -          | 0.0 to 2.0 | 2.0 to 7.0 | -          | 4.0 to 7.0                | -          |
| BH05 | 168     | 6.0          | -          | 0.0 to 3.0 | 3.0 to 6.0 | -          | 3.0 to 6.0                | -          |
| BH06 | 166     | 6.0          | 0.0 to 2.0 | -          | 2.0 to 6.0 | -          | 2.0 to 6.0                | -          |
| BH07 | 170     | 6.0          | 0.0 to 4.0 | -          | 4.0 to 6.0 | -          | -                         | -          |
| BH08 | 170     | 6.0          | 0.0 to 4.0 | 4.0 to 6.0 | -          | -          | -                         | -          |
| BH09 | 168     | 6.0          | 0.0 to 1.5 | 1.5 to 4.0 | 4.0 to 6.0 | -          | 4.0 to 6.0                | -          |
| BH10 | 170     | 6.0          | 0.0 to 4.0 | -          | 4.0 to 6.0 | -          | -                         | -          |
| BH11 | 170     | 4.0          | -          | 0.0 to 4.0 | -          | -          | -                         | -          |
| BH12 | 172     | 6.0          | 0.0 to 1.5 | 1.5 to 4.0 | -          | 4.0 to 6.0 | -                         | -          |
| BH13 | 170     | 6.0          | 0.0 to 1.5 | -          | 1.5 to 6.0 | -          | -                         | -          |
| BH14 | 205     | 4.0          | 0.0 to 1.0 | -          | 1.0 to 4.0 | -          | -                         | 4.0        |
| BH15 | 194     | 5.0          | -          | 0.0 to 5.0 | -          | -          | -                         | 5.0        |
| BH16 | 185     | 3.0          | -          | 0.0 to 3.0 | -          | -          | -                         | 3.0        |
| BH17 | 180     | 3.0          | -          | 0.0 to 3.0 | -          | -          | -                         | 3.0        |
| BH18 | 186     | 3.0          | 0.0 to 3.0 | -          | -          | -          | -                         | -          |
| BH19 | 183     | 4.0          | -          | 0.0 to 4.0 | -          | -          | -                         | -          |
| BH20 | 183     | 6.0          | 0.0 to 4.0 | 4.0 to 6.0 | -          | -          | -                         | -          |
| BH21 | 174     | 4.3          | 0.0 to 1.5 | 1.5 to 3.0 | 3.0 to 4.3 | -          | -                         | -          |
| BH22 | 167     | 4.5          | 0.0 to 3.0 | 3.0 to 4.5 | -          | -          | -                         | -          |
| BH23 | 168     | 4.0          | 0.0 to 4.0 | -          | -          | -          | -                         | -          |
| BH24 | 174     | 5.0          | 0.0 to 3.0 | 3.0 to 5.0 | -          | -          | -                         | -          |
| BH25 | 174     | 6.0          | 0.0 to 3.0 | 3.0 to 6.0 | -          | -          | 5.0 to 6.0                | -          |

#### 4.2 Class 1 Material

Class 1 material was encountered directly at the surface in sixteen of the twenty-five boreholes (64%) distributed throughout the area investigated (not isolated to one specific area). The Class 1 material ranged in thickness from 1.0 m (BH14) to 5.0 m (BH03), with an average thickness of 2.9 m. Based on the USCS, the Class 1 material comprised of light brown sand and gravel with trace silt, to light brown gravel with sand and trace silt, to dark brown sand with gravel and trace silt. The in-situ moisture content of the Class 1 samples ranged between 1.0 percent and 11.0 percent with an average value of 3.8



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percent, based on 32 samples. The percentage of gravel, sand and silt for each Class 1 gradation test result are summarized below in Table 4. A review of the table indicates that the average gradation for the 32 samples tested is 35% gravel, 62% sand and 3% silt. Based on drill progress, we estimate the Class 1 material contains 20% to 40% cobbles and boulders (crushable rock).

The petrographic number for the three of the above-noted Bulk Samples 5, 6 and 7 were all determined to be 100, which is well below the maximum value of 160 required for the Class 1 classification. The LA Abrasion test results for Bulk Samples 5, 6 and 7 were 36%, 38% and 40%, respectively, which is slightly higher than the maximum value of 35% required for the Class 1 classification. However, it is noted that the laboratory had to crush down some of the larger particles to get enough of the specified particle sizes required to run the test. It is anticipated that this resulted in mechanical fractures within the particles used to run the test and increased the percent wear. Therefore, any gradation test result meeting the maximum 5% fines criteria has been tentatively assigned the Class 1 classification herein.

It is noted that the laboratory test results presented herein are intended to provide a means of assessing the deposits potential suitability for various applications. The actual material produced from any one or combination of these deposits or material types will have to meet project specific criteria based on laboratory testing carried out at the time of production.

#### 4.3 Class 2 Material

Class 2 material was encountered directly at the surface or directly beneath the above-noted Class 1 material in sixteen of the twenty-five boreholes (64%) distributed throughout the area investigated (also not isolated to one specific area). The Class 2 material ranged in thickness from 1.5 m (BH21 and BH22) to 5.0 m (BH15), with an average thickness of 2.8 m; however, nine boreholes were terminated within the Class 2 material due to time constraints. Therefore, an unknown amount of additional Class 2 material is present at these locations. Based on the USCS, the Class 2 material comprised of dark brown sand with gravel and trace silt, to light brown sand with silt and gravel, to light brown.

The in-situ moisture content of the Class 2 ranged between 1.0% and 20.0% with an average value of 6.6% based on 28 samples. The percentage of gravel, sand and silt for each Class 2 gradation test result are summarized below in Table 5. A review of the table indicates that the average gradation based on the 28 samples is 16% gravel, 76% sand and 7% silt. It is also noted that based on observations of drill progress we estimate the Class 2 material contains 20% to 40% cobbles and boulders (crushable rock).

As noted above, the petrographic number and LA Abrasion test results for the above-noted Bulk Samples 5, 6 and 7 were well below the maximum petrographic number of 200 and maximum LA Abrasion wear of 60%. Therefore, any gradation test result meeting the maximum 10% fines criteria and failing the Class 1 criteria of less than 5% has been assigned the Class 2 classification herein.



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#### 4.4 Class 3 Material

Class 3 material was encountered directly at the surface in BH01 and beneath the above-noted Class 1 or Class 2 material in ten of the remaining twenty-four boreholes (44%). The Class 3 material ranged in thickness from 1.3 m (BH21) to 4.5 m (BH13), with an average thickness of 2.8 m; however, nine boreholes were terminated within the Class 3 material due to time constraints and without encountering bedrock. Therefore, an unknown amount of additional Class 3 material is present at these locations. Based on the USCS, the Class 3 material comprised of medium brown silty sand with gravel, to grey silty sand with trace to some gravel, to light brown predominantly fine-grained silty sand.

The in-situ moisture content of the Class 3 ranged between 3.0 and 66.0 with an average value of 21.4 based on 14 samples. The elevated moisture contents reflect the presence of excess ice and/or ice lenses/wedges within the layer. The percentage of gravel, sand and silt for each Class 3 gradation test result are summarized below in Table 6 below. A review of the table indicates that the average gradation based on the 14 samples tested is 11% gravel, 73% sand and 16% silt. It is also noted that based on observations of drill progress we estimate the Class 3 material contains 0% to 20% cobbles and boulders (crushable rock).

The Class 3 material is considered suitable for use as general subgrade fill (fill pads, roadway embankments, etc.) provided the moisture content of the material allows for proper placement and compaction. Generally, this will require that the material be within 2 percent of the optimum moisture content determined by standard Proctor test. As noted above, zones of the Class 3 material encountered were determined to have elevated moisture contents, likely due to the presence of excess ice and/or ice lenses within the soil matrix.

#### 4.5 Class 4 Material

Class 4 material was only encountered in BH12, directly beneath the Class 2 material present at that location. The borehole was terminated within the Class 4 material at a thickness of 2.0 m and without encountering bedrock. Based on the USCS, the Class 4 material comprised of grey silty sand with gravel.

The in-situ moisture content of the Class 4 sample tested was 16.0% and the gradation test indicated it comprised 17% gravel, 54% sand and 29% silt.

#### 4.6 Buried Ice Lenses/Wedges

Buried ice lenses/wedges were encountered beneath about 3 m to 5 m of gravel and sand at four of the twenty-five borehole locations (16% of the area investigated by **exp**). The buried ice lenses/wedges were encountered within two distinct zones investigated. The first zone was encountered in the north half of Poly 116 and south end of Poly 22 (BH4, BH5 and BH6) at depths of 3.0 m and 5.0 m below existing grade. The second zone was encountered in the south half of Poly 18B (BH25) at a depth of 5.0 m below existing grade. These ice lenses/wedges were present well within the Class 3 material layer at each borehole location.



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|         |           | Та         | ble 4: Clas | s 1 Labora  | tory Test R | esults   |                |
|---------|-----------|------------|-------------|-------------|-------------|----------|----------------|
| ВН      | Sample    | Depth      | Pe          | ercentage ( | %)          | Moisture | Material       |
| No.     | No.       | (m)        | Gravel      | Sand        | Fines       | (%)      | Classification |
| ВН3     | S1        | 0 – 1.0    | 23          | 72          | 5           | 3        | Class 1        |
| вн3     | S3        | 2.0 – 3.0  | 30          | 65          | 5           | 7        | Class 1        |
| ВН3     | S4        | 3.0 – 4.0  | 23          | 72          | 5           | 7        | Class 1        |
| BH6     | S1        | 0 – 1.0    | 33          | 65          | 2           | 3        | Class 1        |
| BH7     | S1        | 0 – 1.0    | 24          | 72          | 4           | 3        | Class 1        |
| BH7     | S3        | 2.0 – 3.0  | 46          | 51          | 3           | 4        | Class 1        |
| BH7     | S4        | 3.0 – 4.0  | 25          | 71          | 4           | 9        | Class 1        |
| BH8     | S1        | 0 – 1.0    | 45          | 53          | 2           | 1        | Class 1        |
| ВН8     | S3        | 2.0 – 3.0  | 58          | 40          | 2           | 5        | Class 1        |
| BH8     | S4        | 3.0 – 4.0  | 31          | 65          | 4           | 10       | Class 1        |
| ВН9     | S1        | 0 – 1.0    | 55          | 43          | 2           | 1        | Class 1        |
| BH10    | S1        | 0 – 1.0    | 52          | 47          | 1           | 1        | Class 1        |
| BH10    | S3        | 2.0 – 3.0  | 24          | 73          | 3           | 5        | Class 1        |
| BH10    | S4        | 3.0 – 4.0  | 40          | 54          | 6           | 11       | Class 1        |
| BH12    | S1        | 0 – 1.0    | 58          | 41          | 1           | 2        | Class 1        |
| BH13    | S1        | 0 – 1.0    | 16          | 82          | 2           | 3        | Class 1        |
| BH14    | S1        | 0 – 1.0    | 33          | 62          | 5           | 3        | Class 1        |
| BH18    | S1        | 0 – 1.0    | 50          | 48          | 2           | 2        | Class 1        |
| BH18    | S3        | 2.0 – 3.0  | 13          | 84          | 3           | 1        | Class 1        |
| BH20    | S1        | 0 – 1.0    | 20          | 77          | 3           | 3        | Class 1        |
| BH20    | S3        | 2.0 – 3.0  | 14          | 83          | 3           | 1        | Class 1        |
| BH20    | S4        | 3.0 – 4.0  | 14          | 82          | 4           | 9        | Class 1        |
| BH21    | S1        | 0 – 1.0    | 51          | 47          | 2           | 3        | Class 1        |
| BH22    | S1        | 0 – 1.0    | 38          | 58          | 4           | 5        | Class 1        |
| BH22    | S3        | 2.0 – 3.0  | 28          | 70          | 2           | 1        | Class 1        |
| BH23    | S1        | 0 – 1.0    | 19          | 76          | 5           | 3        | Class 1        |
| BH23    | S3        | 2.0 – 3.0  | 72          | 27          | 1           | 1        | Class 1        |
| BH23    | S4        | 3.0 – 4.0  | 33          | 66          | 1           | 1        | Class 1        |
| BH24    | S1        | 0 – 1.0    | 27          | 70          | 3           | 3        | Class 1        |
| BH24    | S3        | 2.0 – 3.0  | 33          | 63          | 4           | 6        | Class 1        |
| BH25    | S1        | 0 – 1.0    | 37          | 59          | 4           | 3        | Class 1        |
| BH25    | S3        | 2.0 – 3.0  | 45          | 52          | 3           | 3        | Class 1        |
| Overall | Average R | esults (%) | 35          | 62          | 3           | 4        |                |



|  |      |      | -   |     |     |      |
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|            |             | Table     | 5: Class | 2 Labor  | atory Test | Results  |                |
|------------|-------------|-----------|----------|----------|------------|----------|----------------|
| ВН         | Sample      | Depth     | Pe       | rcentage | (%)        | Moisture | Material       |
| No.        | No.         | (m)       | Gravel   | Sand     | Fines      | (%)      | Classification |
| BH2        | S3          | 2.0 – 3.0 | 19       | 73       | 8          | 13       | Class 2        |
| BH4        | S1          | 0 – 1.0   | 15       | 78       | 7          | 8        | Class 2        |
| BH5        | S1          | 0 – 1.0   | 26       | 69       | 5          | 1        | Class 2        |
| BH5        | S3          | 2.0 – 3.0 | 2        | 90       | 8          | 14       | Class 2        |
| BH8        | S5          | 4.0 – 5.0 | 1        | 93       | 6          | 14       | Class 2        |
| BH9        | S3          | 2.0 – 3.0 | 3        | 90       | 7          | 11       | Class 2        |
| ВН9        | S4          | 3.0 – 4.0 | 7        | 86       | 7          | 14       | Class 2        |
| BH11       | S1          | 0 – 1.0   | 36       | 58       | 8          | 3        | Class 2        |
| BH11       | S3          | 2.0 – 3.0 | 15       | 82       | 3          | 1        | Class 2        |
| BH11       | S4          | 3.0 – 4.0 | 11       | 86       | 3          | 1        | Class 2        |
| BH12       | S3          | 2.0 – 3.0 | 6        | 84       | 10         | 20       | Class 2        |
| BH12       | S4          | 3.0 – 4.0 | 49       | 39       | 12         | 7        | Class 2        |
| BH15       | S1          | 0 – 1.0   | 7        | 85       | 8          | 4        | Class 2        |
| BH15       | S3          | 2.0 – 3.0 | 10       | 87       | 3          | 1        | Class 2        |
| BH15       | S4          | 3.0 – 4.0 | 2        | 91       | 7          | 3        | Class 2        |
| BH16       | S1          | 0 – 1.0   | 23       | 69       | 8          | 4        | Class 2        |
| BH16       | S3          | 2.0 – 3.0 | 30       | 63       | 7          | 2        | Class 2        |
| BH17       | S1          | 0 – 1.0   | 12       | 80       | 8          | 3        | Class 2        |
| BH17       | S3          | 2.0 – 3.0 | 3        | 86       | 11         | 1        | Class 2        |
| BH19       | S1          | 0 – 1.0   | 24       | 69       | 7          | 5        | Class 2        |
| BH19       | S3          | 2.0 – 3.0 | 25       | 71       | 4          | 2        | Class 2        |
| BH19       | S4          | 3.0 – 4.0 | 17       | 76       | 7          | 2        | Class 2        |
| BH21       | S3          | 2.0 – 3.0 | 27       | 66       | 7          | 4        | Class 2        |
| BH22       | S4          | 3.0 – 4.0 | 23       | 71       | 6          | 3        | Class 2        |
| BH24       | S4          | 3.0 – 4.0 | 20       | 74       | 6          | 12       | Class 2        |
| BH25       | S4          | 3.0 – 4.0 | 12       | 81       | 7          | 9        | Class 2        |
| BH25       | S5          | 4.0 – 5.0 | 17       | 74       | 9          | 14       | Class 2        |
| Overall Av | verage Resu | ılts (%)  | 16       | 76       | 7          | 7        |                |



|         |           | Та         | ble 6: C | lass 3 Lab | oratory T | est Results |                |
|---------|-----------|------------|----------|------------|-----------|-------------|----------------|
| ВН      | Sample    | Depth      | Pe       | ercentage  | (%)       | Moisture    | Material       |
| No.     | No.       | (m)        | Gravel   | Sand       | Fines     | (%)         | Classification |
| BH1     | S1        | 0 – 1.0    | 15       | 66         | 19        | 10          | Class 3        |
| BH1     | S2        | 2.0 – 2.5  | 4        | 78         | 18        | 20          | Class 3        |
| BH2     | S4        | 3.0 – 4.0  | 10       | 72         | 18        | 25          | Class 3        |
| BH4     | S3        | 2.0 – 3.0  | 22       | 66         | 12        | 10          | Class 3        |
| BH4     | S4        | 3.0 – 4.0  | 16       | 65         | 19        | 19          | Class 3        |
| BH5     | S4        | 3.0 – 4.0  | 0        | 81         | 19        | 43          | Class 3        |
| BH6     | S3        | 2.0 – 3.0  | 23       | 65         | 12        | 34          | Class 3        |
| BH6     | S4        | 3.0 – 4.0  | 40       | 50         | 10        | 66          | Class 3        |
| BH9     | S5        | 4.0 – 5.0  | 2        | 87         | 11        | 26          | Class 3        |
| BH10    | S6        | 5.0 – 6.0  | 3        | 76         | 21        | 16          | Class 3        |
| BH13    | S3        | 2.0 – 3.0  | 3        | 80         | 17        | 10          | Class 3        |
| BH13    | S4        | 3.0 – 4.0  | 3        | 76         | 21        | 19          | Class 3        |
| BH14    | S3        | 2.0 – 3.0  | 3        | 83         | 14        | 3           | Class 3        |
| BH14    | S4        | 3.0 – 4.0  | 18       | 68         | 14        | 5           | Class 3        |
| BH21    | S4        | 3.0 – 4.0  | 13       | 75         | 12        | 3           | Class 3        |
| Overall | Average R | esults (%) | 11       | 73         | 16        | 21          |                |



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#### 5 Estimated Volumes

Material volumes for each Class were estimated based on the borehole logs and laboratory testing results, and the areas of influence for each borehole as per Section 3.4. As noted above, the drill method used is highly disruptive and larger gravels, cobbles and boulders have been broken down during drilling and show as smaller gravels, sand and even fines within the gradations presented and discussed herein. Additionally, the level of processing required to crush/blend the available materials into specified gradations has yet to be determined and cannot be estimated based on the available information. The volume calculations are summarized below in Table 7.

|  | Table 7: | Estimated | Material    | Volumes |  |                                  |
|--|----------|-----------|-------------|---------|--|----------------------------------|
|  |          |           | Stratigraph | y (m)   |  |                                  |
|  | Class 1  | Class 2   | Class 3     | Class 4 | Ice-Rich Soil<br>and/or<br>Massive Ice |                                  |
| Total Thickness of Usable<br>Granular Encountered in All<br>Boreholes Combined (m) | 46.0     | 45.0      | 31.3        | N/A     | - 16.0                                 | Total Usable<br>Granular<br>(m³) |
| Upper Boundary – Est. Total<br>Volume Usable Granular<br>Encountered (m³)          | 460,000  | 450,000   | 313,000     | N/A     | - 160,000                              | 1,063,000                        |
| Lower Boundary – Est. Total<br>Volume Usable Granular<br>Encountered (m³)          | 361,273  | 353,419   | 245,822     | N/A     | - 125,660                              | 834,854                          |

A review of Table 7 indicates the total volume of usable borrow materials (Class 1, Class 2 and Class 3) available throughout the area investigated by boreholes is estimated to be between 834,854 m³ to 1,063,000 m³. For the purpose of this assessment we have assumed any Class 3 material having in-situ moisture content greater than 20% is too wet for immediate use, deemed it ice-rich and removed it from the estimated total usable volume above. Class 3 material having in-situ moisture contents less than 20% may also be deemed too wet for immediate use at the time of quarrying, depending on the actual gradation of the material.

Note that subsurface conditions are expected to vary both with depth and laterally, and based on the findings of this investigation a high degree of variability in the materials and thicknesses of the strata should be expected throughout the deposit. Therefore, these estimates may be high or low dependent on the actual stratigraphy encountered between boreholes. Additionally, although we have attempted to remove those materials that appear to require excessive dry times before they would be usable, it is expected that the in-situ moisture content will be highly variable across the deposits and this will affect the projected volumes.



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#### 6 Overall Assessment

Based on the above, the Northwest Deposit is recommended for development as a borrow source capable of meeting the City of Iqaluit requirements for the next 10 years and beyond. Class 1 and/or Class 2 material was encountered directly at the surface in twenty-four of the twenty-five boreholes. Similar material is visible throughout the majority of the remaining deposit as indicated by AANDC in 2006. The boreholes have verified the thickness of these surficial deposits is significant, ranging from 1.0 m to 6.0 m with an average thickness of 3.8 m throughout the area explored. Furthermore, Class 3 material suitable for use as general subgrade fill and/or blending with Class 1 and Class 2 to create desired gradations is present in mass quantities directly beneath the Class 1 and Class 2 layers.

The total estimated volume of usable borrow material within the area investigated by boreholes is between 834,854 m³ to 1,063,000 m³. It is noted that the estimated volumes presented above:

- Do not include the above-noted identified zones of ice-rich Class 3 material encountered, which represent another 125,660 m³ to 160,000 m³ of potentially usable material depending on the actual in-situ moisture contents present at the time of quarrying.
- Do not include the full thickness of Class 2 or Class 3 material encountered at many of the borehole locations, as drilling was ceased due to time constraints.
- Only represent the portion of the deposit investigated by boreholes, which is approximately 25% of the total area investigated by EBA in 2006 and estimated to contain 7,941,000 m<sup>3</sup> of usable granular based on their GPR results.

Therefore, based on all the available information, it is anticipated that the Northwest Deposit will easily provide access to over 1,000,000 m³ of usable granular material and it is likely to provide access to over 1,000,000 m³ of Class 1 (Excellent Quality Granular) and/or Class 2 (Good Quality Granular) material as defined herein.

It should be noted that we estimate the usable granular material contains 20% to 40% cobbles and boulders by volume, with some boulders being up to 2 m in size or larger, which will need to be processed or set aside. Additionally, the level of processing required to crush/screen/blend the available materials into specified gradations has not been determined and cannot be determined based on the available information. Furthermore, although the active layer was completely frozen at the time of drilling, we would estimate the maximum active layer thickness (late September or early October) would be approximately 1.5 m to 2.5 m depth depending on sun exposure, in-situ moisture of the upper materials, etc. and the permafrost soils extend for 100's of meters beneath the deposits.

With regards to Pit Development, care will be required during planning and excavation to assure that sufficient room is available within each individual section to allow for alternate site access if/when ice-rich Class 3 materials and/or zones of pure ice lenses/wedges are encountered at depth and exposed. Exposing such materials will limit or eliminate site access through that area as the materials thaw and destabilize. This is understood to have been a major issue during development of the Trail Area Deposit. How to deal with such areas will depend on the topography of the individual deposits being excavated



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and surrounding area, as well as the thickness of the problem soils encountered. Therefore, it will require real time assessment and decision by qualified people with knowledge on quarrying permafrost soils successfully. In general, we would anticipate many possible scenarios and potential solutions; however, we have outlined two possible scenarios and our envisioned solutions below for context:

**Scenario 1:** The ice-rich soils and/or pure ice layers are relatively thin and can be removed down to stable soils or bedrock without affecting positive drainage from the area. In this situation we would expect the problem soils could be fully excavated, stockpiled separately to thaw/drain out (may require many seasons) and site access re-established to continue quarrying. The stockpiled soils may be usable as general site grading material during site reclamation (i.e. infilling low spots to promote proper drainage) or may even become suitable for use as Class 3 depending on how wet the material is and how long it can be left to dry.

**Scenario 2:** The ice-rich soils and/or pure ice layers are thought to be thick and depth to bedrock too deep to fully excavate. In this scenario, one course of action would be to quickly remove any thawed soft soils (stockpile separately as outlined above) and cover the area immediately with 0.75 m to 2.0 m of suitable fill capable of supporting construction traffic to re-establish site access. The intention would be to mitigate the issue by providing an insulating layer of good quality material to stop thaw of the ice-rich soils or pure ice layers below. Therefore, the thickness of fill material required for such a scenario will depend on the amount of warm weather remaining and site access requirements. Ongoing maintenance of affected areas should be anticipated (i.e. regrading, infilling depressions, etc.).

Although two distinct zones of buried ice lenses/wedges are discussed herein, it is anticipated that other such zones exist throughout the Northwest Deposit due to the nature of deposition and presence of permafrost. Therefore, monitoring and maintenance of site access roads will be required throughout the duration of Pit Development and must account for potential thawing of underlying ice-rich soils/pure ice and possible weakening/failure of road embankment side slopes. Problem areas must be addressed quickly once warning signs present themselves (i.e. development of soft ground, rutting, longitudinal tension cracks along embankment crests/slopes, sloughing of embankment slopes, etc.) to limit the effects of the issue as much as possible. Thawing of ice-rich soils and/or buried ice is expected to result in development of excess surface water, which will need to be dealt with constantly and quickly removed. Surface water should not be allowed to flow or pond over or adjacent to areas where access is required, as the presence of this warm water will exhilarate permafrost degradation and exacerbate the situation.

Further discussion on how best to deal with this potential issue during Pit Development will be required at the planning stage and considering the interests of all parties (owner, engineering team, contractor, etc.). However, this is considered more of a contractual and planning issue, and should not affect the ability of the City of Iqaluit to extract well over 10 years supply of excellent to fair quality granular material from the Northwest Deposit.

The above comments are provided for information and are intended to provide a basis for decision on development of the Northwest Deposit as a quarry. A separate Pit Development Plan will be required to address excavation and operations procedures, including any environmental constraints that may be present within or adjacent to the Northwest Deposit.



exp Services Inc.

Client: City of Iqaluit Project Name: Geotechnical Investigation, Northwest Granular Deposit

Location: Iqaluit, Nunavut Project Number: OTT-00219428-A0 Date: January 29, 2016

## **Figures**



NORTHWEST DEPOSIT IQALUIT NV

LOCATION PLAN

OTT-00219428-A0

FIG

DRAWING No.

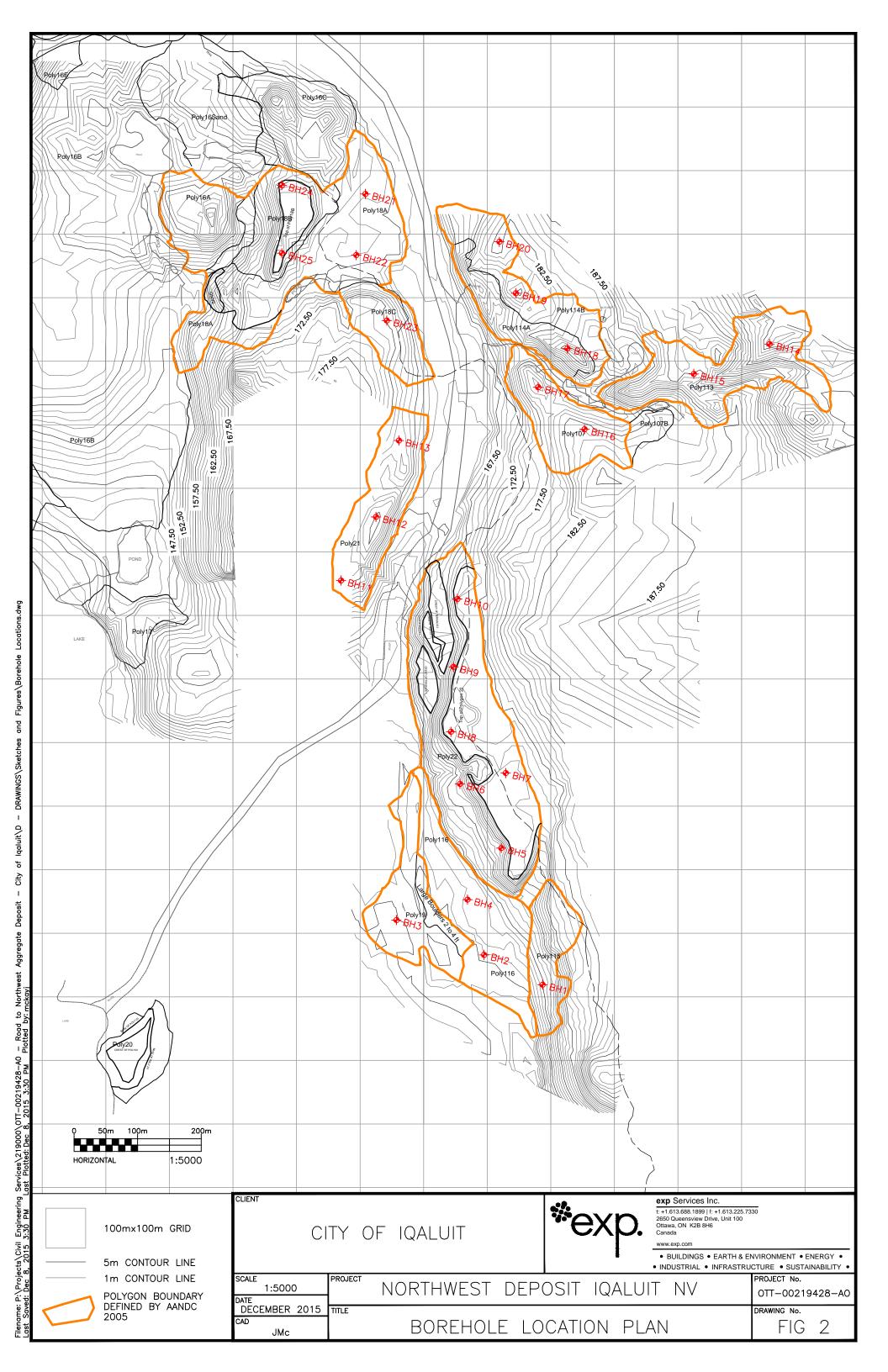
Filename: P.\Projects\Civil Engineering Services\219000\0TT-00219428-A0 - Road to Northwest Aggregate Deposit - City of Iqaluit\D - DRAWINGS\Sketches and Figures\Location Plan.dwg Last Saved: Dec 8, 2015 3:35 PM Last Plotted: Dec 8, 2015 3:35 PM Last Plotted by: mckayj

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DECEMBER 2015

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TITLE



Location: Iqaluit, Nunavut Project Number: OTT-00219428-A0

Date: January 29, 2016

#### **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.

|  | 610      |        |               |                     | ISSMFE S              | OIL CLASS           | SIFICATION             | ٧                  |        |                |         |          |
|--|----------|--------|---------------|---------------------|-----------------------|---------------------|------------------------|--------------------|--------|----------------|---------|----------|
| CLAY   |          | SILT   |               |                     | SAND                  |                     |                        | GRAVEI             | 3      |                | COBBLES | BOULDERS |
|  | FINE     | MEDIUM | COARSE        | FINE                | MEDIUM                | COARS               | E FINE                 | MEDIUN             | 1 CO   | ARSE           |         |          |
| 0.0  | 002<br>  | 0.006  | 0.02<br> <br> | 0.06<br>I<br>QUIVAL | 0.2<br> <br>ENT GRAIN | 0.6<br>I<br>DIAMETE | 2.0<br>I<br>R IN MILLI | 6.0<br>L<br>METRES | 20<br> | 60<br><b>I</b> | 20<br>  | 0        |
| CLAY (PLAS   | STIC) TO |        |               | FINE                |                       | MEDIUM              | CRS.                   | FINE               | COAR   | SE             | ]       |          |
| FINE   MEDIUM   COARSE   FINE   MEDIUM   COARSE   FINE   MEDIUM   COARSE |          |        |               |                     |                       |                     |                        |                    |        |                |         |          |
|  |          |        |               |                     | A MARK IVA DAMAKT     | SAND                |                        |                    |        | SE.            | 1       |          |

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.



### og of Borobola BU01

| Project No:                            | OTT-00219428-A0   | Log of Borehole BH01 |                             |                       |                |                       |          |            |                 |          |                 | 3                       | '     |                                       |
|--|---|----------------------|-----------------------------|-----------------------|----------------|-----------------------|----------|------------|-----------------|----------|-----------------|-------------------------|-------|---------------------------------------|
| Project:                               | GEOTECHNICAL INVESTIGATION - 1  | NORTHWEST DEPOSIT    |                             |                       |                |                       |          |            | -               |          |                 | 1 of                    | 1     |                                       |
| _ocation:                              | IQALUIT, NU   | 1/45                 |                             |                       |                |                       |          |            |                 |          |                 | _                       |       |                                       |
| Date Drilled:                          | 5/7/15  |                      | -                           | Split Spo             |                | ole                   |          | ⊠<br>∎n    |                 |          |                 | our Readi<br>Content    | ng    | ×                                     |
| Orill Type:                            | AIR TRACK   |                      | Auger Sample  SPT (N) Value |                       |                |                       | Atterb   | erg Lii    | mits            |          | ŀ               | — <u> </u>              |       |                                       |
| Datum:                                 | GEODETIC  |                      | -                           | Dynamic<br>Shelby To  |                | est                   |          | _          | Undra<br>% Stra | ain at I | Failure         | 9                       |       | $\oplus$                              |
| ogged by:                              | SB Checked by: JAS  |                      |                             | Shear Str<br>Vane Tes |                | у                     | -        | +<br>s     | Shear<br>Penet  |          |                 |                         |       | <b>A</b>                              |
| SY MBO L                               | SOIL DESCRIPTION  | GEODETIC<br>m        | D<br>e<br>p<br>t<br>h       | Shear S               | 20<br>Strength | enetration 40         | Test N \ | 80<br>kPa  |                 | 250      | Moist<br>Limits | ure Conte<br>s (% Dry V | 50    | Natura<br>P Unit W<br>L kN/m          |
| occ                                    | um brown, silty sand with gravel assional cobbles visible ice content gravel, 66% sand, 19% fines | 159                  | 0                           |                       | 60             | 100                   | 150      | 200        | ×               |          |                 |                         |       |                                       |
| ြွှံ့ို့ို့ - son                      | e gravel below 1.0 m depth<br>ne visible ice, Vx (10% to 20%) below<br>n depth                    | _                    | 1                           |                       |                |                       |          |            |                 | *        |                 |                         |       | · · · · · · · · · · · · · · · · · · · |
| °°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°°° | gravel, 78% sand, 18% fines   | 156.5                | 2                           |                       |                |                       |          |            |                 | ×        |                 |                         |       |                                       |
|  | -   |                      | 3                           |                       |                |                       |          |            |                 |          |                 |                         |       |                                       |
|  | -   | 155.0                |                             |                       |                |                       |          |            |                 |          |                 |                         |       | <u>-</u>                              |
| End                                    | of Borehole at 4.0 m Depth  |                      |                             |                       |                |                       |          |            |                 |          |                 |                         |       |                                       |
|  |   |                      |                             |                       |                |                       |          |            |                 |          |                 |                         |       |                                       |
|  |   |                      |                             |                       |                |                       |          |            |                 |          |                 |                         |       |                                       |
|  |   |                      |                             |                       |                |                       |          |            |                 |          |                 |                         |       |                                       |
|  |   |                      |                             |                       |                |                       |          |            |                 |          |                 |                         |       |                                       |
|  |   |                      |                             |                       |                |                       |          |            |                 |          |                 |                         |       |                                       |
| NOTES:                                 |   |                      | _                           |                       |                | 1::::                 |          |            | :1:::           |          |                 |                         |       |                                       |
| .Borehole data re use by others        | orehole data requires interpretation by exp. before WAT   |                      |                             |                       | ECORI          | ORDS Hole Open To (m) |          | Run<br>No. |                 |          |                 |                         | RQD % |                                       |

LOG OF BOREHOLE NORTHWESTDEPOSITBOREHOLELOGS.GPJ TROW OTTAWA.GDT 1/29/16

5. This Figure is to read with exp. Services Inc. report OTT-00219428-A0

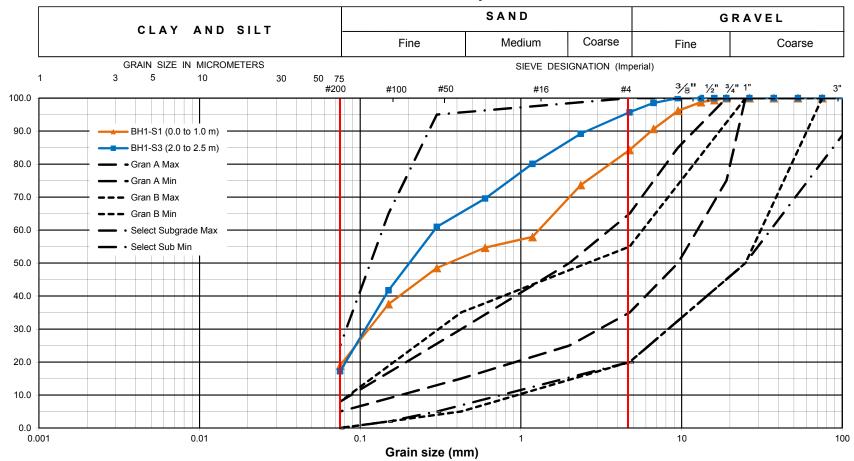


Percent Passing

100-2650 Queensview Drive Ottawa, ON K2B 8H6

## Method of Test for Sieve Analysis of Aggregate ASTM C-136

#### **Unified Soil Classification System**



| Exp Project No.:     | OTT-00219428-A0 | Project Name :       | Geotechnical In  | vestigation - N | Northwest Deposit                              |            |              |
|----------------------|-----------------|----------------------|------------------|-----------------|--|------------|--------------|
| Client :             | City of Iqaluit | Project Location :   | lqaluit, NU      |                 |  |            |              |
| Date Sampled :       | May 7, 2015     | Borehole:            | 1                | Sample:         | S1 & S3  | Depth (m): | as indicated |
| Sample Description : |                 | silty SAND with grav | el to silty SAND |                 | ple: S1 & S3 Depth (m): as indicated Figure: 4 |            |              |

### Log of Borehole BH02

| - inferred bedrock                          | rred bedrock   |  |               |                                 |      |                     |       |   |             |      |    |   |  |            |  |   |          |   |         |  |  |             |    |
|---|----------------|--|---------------|---------------------------------|------|---------------------|-------|---|-------------|------|----|---|--|------------|--|---|----------|---|---------|--|--|-------------|----|
|   | End o          | of Borehole at 6.0 m Depth                                       | 149.0         | 6                               | 1000 | - 1 - 2 - 1         |       |   |             |      |    |   |  |            |  |   |          |   |         |  |  |             | _  |
|   |                |  |               |                                 |      |                     |       |   |             |      |    |   |  |            |  | ×                                       |          |   |         |  |  | m           |    |
|   |                |  |               | 5                               |      |                     |       |   |             |      |    |   |  |            |  |   |          |   |         |  |  |             |    |
|   |                | ne visible ice, Vx (10% to 20%)<br>% gravel, 72% sand, 18% fines |               |                                 |      |                     |       |   |             |      |    |   |  |            |  |   |          |   |         |  |  | 40N         | -2 |
|   | - som<br>- 10% |  |               |                                 |      |                     |       |   |             | 3 () |    | ( · ) · ( · ) |  |            |  | 1 | ×        | ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) |         |  |  |             |    |
|   | - trac         | silty sand<br>e gravel   |               | 3                               |      |                     | 1 1 2 |   |             |      |    |   |  |            |  |   | V        |   |         |  |  | 800         |    |
|   | - 19%          | % gravel, 73% sand, 8% fines                                     | 152.0         |                                 | -3.6 |                     |       | 4: 1:<br>4: 1:<br>4: 1:<br>4: 1:<br>4: 1: |             |      |    | 1 - 1 - 1<br>1 - 1 - 1<br>1 - 1 - 1<br>1 - 1 - 1  | - ( - )<br>- ( - )<br>- ( - )<br>- ( - ) |            | 61   | ×                                       |          |   |         | 3 6 - 1<br>3 6 - 1<br>3 6 - 1<br>3 6 - 1 | -1 -1 -1 -<br>-3 -6 -1 -<br>-3 -6 -1 -<br>-3 -6 -1 - | -100        | ,  |
|   | •—-<br>•<br>•  |  | -             | 2                               |      |                     |       |   |             |      |    |   |  |            |  |   |          |   |         |  |  |             |    |
|   |                |  | -             |                                 |      |                     |       |   |             |      |    |   |  |            |  | ×                                       |          |   |         |  |  | - 1979      |    |
|   | •<br>•<br>•    |  | -             | 1                               |      |                     |       |   |             |      |    |   |  |            |  |   |          |   |         |  |  |             |    |
|   |                | e silt<br>asional cobbles and boulders<br>visible ice content    | _             |                                 |      |                     |       |   |             |      |    |   |  |            |  | <b>-</b> >                              | <b>(</b> |   |         |  |  | m           | 2  |
|   |                | brown, sand with gravel  | 155           | h<br>0                          | -    |                     | 60    | 1(  | 00          | 15   | 50 | 2   | 00                                       | - <b>3</b> | 61   |   | 0        |   | 0       | 60                                       |  | L<br>E<br>S | ŀ  |
| S<br>Y<br>M<br>B                            |                | SOIL DESCRIPTION   | GEODETIC<br>m | D<br>e<br>p                     |      |                     | 20    | 4   | etrati<br>0 | on T |    |   | 0  | :Pa        |  | 2                                       | 50       | 50                                      | 00      | 75                                       | g (ppm<br>0<br>it %<br>eight)                        | <b>−</b> ₩  | N  |
| ogge  | d by:          | SB Checked by: JA  | AS            |                                 | She  |                     | rengt | h by                                      |             |      |    | +<br>s  |  |            |  |   |          | th by<br>Tes                            |         |  |  |             | 4  |
| atum  |                | GEODETIC   |               |                                 |      | (N) \amic<br>lby Ti | Con   | e Tes                                     | st          |      |    | <u> </u>  |  |            | Atterberg Limits Undrained Triax % Strain at Failu |   |          | iaxial                                  | kial at |  | I  |             | -( |
| Date Drilled: 5/7/15  Drill Type: AIR TRACK |                |  |               | Split Spoon Sample Auger Sample |      |                     |       |   |             |      |    |   | Combustible Va                           |            |  |   | -        |   | g       |  | [  |             |    |
| ocati                                       |                |  |               |                                 |      |                     |       |   |             |      |    |   |  |            |  |   |          |   |         |  |  |             |    |

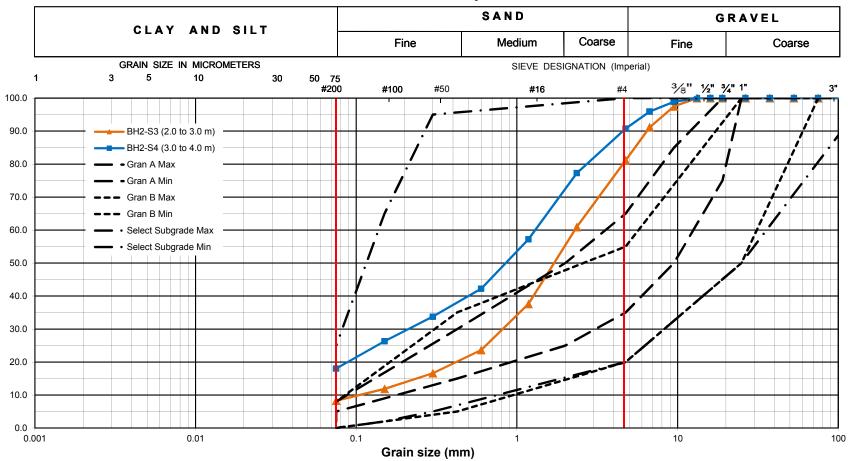


Percent Passing

100-2650 Queensview Drive Ottawa, ON K2B 8H6

## Method of Test for Sieve Analysis of Aggregate ASTM C-136

#### **Unified Soil Classification System**



| Exp Project No.:     | OTT-00219428-A0 | Project Name :        | Geotechnical Ir   | vestigation - | Northwest Deposit |            |              |
|----------------------|-----------------|-----------------------|-------------------|---------------|-------------------|------------|--------------|
| Client :             | City of Iqaluit | Project Location :    | Iqaluit, NU       |               |                   |            |              |
| Date Sampled :       | May 7, 2015     | Borehole:             | 2                 | Sample:       | S3 & S4           | Depth (m): | as indicated |
| Sample Description : | Ş               | SAND with silt and gr | avel to silty SAN | ID            |                   | Figure :   | 6            |

| Drain at Na   |   | g of B                        | Ol     | reho                                      | le                                      | <u>B</u>            | <u> </u>  | <u>)3</u>   |                                  |                      |   |               | $\in$  | XC                  |
|---|---|-------------------------------|--------|---|---|---------------------|-----------|---|----------------------------------|----------------------|---|---------------|--|---------------------|
| Project No:   | OTT-00219428-A0   | TION NODTUM                   | ,,,    |   |   |                     |           | F   | igure N                          | lo                   | 7                                       | -             |  |                     |
| Project:<br>Location:   | GEOTECHNICAL INVESTIGA IQALUIT, NU                              | TION - NORTHY                 | VES    | ST DEPUS                                  | 11                                      |                     |           | _   | Pag                              | ge                   | 1_ of                                   | 1_            |  |                     |
| Date Drilled:   |   |                               |        | Split Spoon S                             | amal                                    | •                   | Ø         |   | Combust                          | tible Var            | our Readir                              |               |  |                     |
| Drill Type:   | AIR TRACK   |                               | -      | Auger Sample                              |   | e                   |           |   | Natural N                        |                      |   | ig            |  | ×                   |
| Datum:  | GEODETIC  |                               | -      | SPT (N) Value<br>Dynamic Con-             |   | st —                | 0         |   | Atterberg<br>Undraine            |                      | al at                                   |               | <del>                                     </del> | <b>→</b>            |
| Logged by:  | SB Checked by:  | JAS                           | _      | Shelby Tube<br>Shear Strengt<br>Vane Test | h by                                    |                     | +<br>s    |   | % Strain<br>Shear St<br>Penetron | at Failu<br>rength b | re<br>Dy                                |               |  | ⊕<br><b>▲</b>       |
| S Y M B B O   | SOIL DESCRIPTION  | GEODETIC                      |        |   |   | netration Test N    | Valu<br>8 |   | 25                               | 50                   |   | 50            | i) SA  | Natural<br>Unit Wt. |
| L   |   | 155                           | t<br>h | Shear Streng                              | -                                       | 00 150              | 20        | kPa<br>00   | Atterb                           |                      | sture Conte<br>ts (% Dry W<br>40 6      | /eight)<br>i0 | E  | kN/m <sup>3</sup>   |
| ુંઃ≎ં∙ - trac   | SS 1 brown, sand with gravel se silt quent cobbles and boulders |                               |        |   | 6 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 |                     |           | - 8 - 8 - 8 - 8 -<br>- 8 - 8 - 8 - 8 -<br>- 8 - 8 | ×                                |                      |   |               | m  | 2                   |
| ູ່ ເຂົ້າ - no າ   | visible ice content<br>6 gravel, 72% sand, 5% fines             |                               | 1      |   |   |                     |           |   |                                  |                      |   |               |  |                     |
|   |   | _                             |        |   |   |                     |           |   | ×                                |                      |   |               |  | 3                   |
|   |   | _                             | 2      |   |   |                     |           |   |                                  |                      |   |               |  |                     |
| :::<br>::::: - 30%  | % gravel, 65% sand, 5% fines                                    | -                             |        |   |   |                     |           |   | ×                                |                      |   |               |  | 3                   |
|   |   | -                             | 3      |   |   |                     |           |   |                                  |                      |   |               |  | -                   |
| ::::::<br>:::::::::::::::::::::::::::::::                         | % gravel, 72% sand, 5% fines                                    | -                             |        |   |   |                     |           |   | ×                                |                      | 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 |               |  | 2                   |
|   |   | -                             | 4      |   |   |                     |           |   |                                  |                      |   |               |  | -                   |
|   |   | -                             |        |   |   |                     |           |   | ×                                |                      |   |               |  | 2                   |
| BED   | ROCK  | 150.0                         | 5      |   |   |                     |           |   |                                  |                      |   |               |  | -                   |
|   |   | 149.0                         |        |   |   |                     |           |   |                                  |                      |   |               |  |                     |
| End   | of Borehole at 6.0 m Depth                                      | 145.0                         | 6      |   |   |                     |           |   |                                  |                      |   |               |  |                     |
|   |   |                               |        |   |   |                     |           |   |                                  |                      |   |               |  |                     |
|   |   |                               |        |   |   |                     |           |   |                                  |                      |   |               |  |                     |
|   |   |                               |        |   |   |                     |           |   |                                  |                      |   |               |  |                     |
| NOTES:<br>1. Borehole data re                                     | equires interpretation by exp. before                           | WATE                          | RL     | EVEL RECO                                 | RDS                                     | 3                   | ] [       |   | COI                              | RE DR                | ILLING R                                | ECOR          | D  |                     |
| use by others   | vised by an exp representative.                                 | Elapsed<br>Time<br>Completion |        | Water<br>_evel (m)<br>Frozen              |   | Hole Open<br>To (m) | †         | Run<br>No.  | Dept<br>(m)                      |                      | % Re                                    | C.            | F  | RQD %               |
| <ul><li>3. Borehole backfill</li><li>4. See Notes on Sa</li></ul> | led with drill cuttings upon completion. ample Descriptions     | 2 3                           |        |   |   |                     |           |   |                                  |                      |   |               |  |                     |

LOG OF BOREHOLE NORTHWESTDEPOSITBOREHOLELOGS.GPJ TROW OTTAWA.GDT 1/29/16

5. This Figure is to read with exp. Services Inc. report OTT-00219428-A0

#### **Grain-Size Distribution Curve**

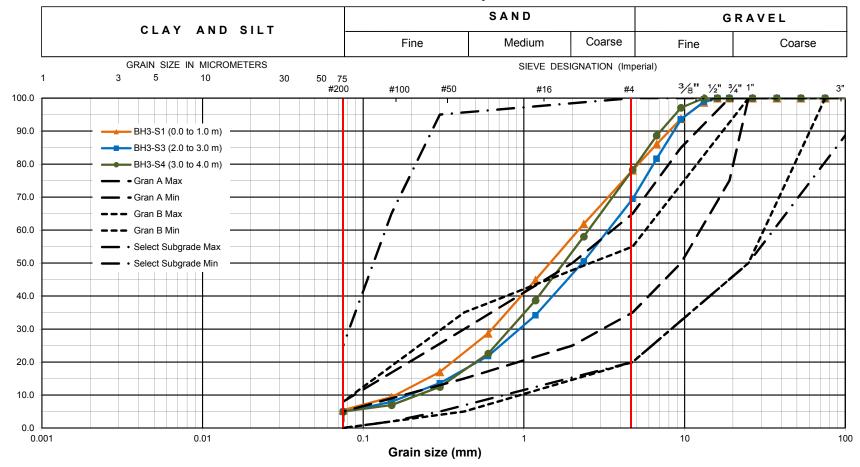


Percent Passing

100-2650 Queensview Drive Ottawa, ON K2B 8H6

## Method of Test for Sieve Analysis of Aggregate ASTM C-136

#### **Unified Soil Classification System**



| Exp Project No.:     | OTT-00219428-A0 | Project Name :     | Geotechnical II | nvestigation - N | lorthwest Deposit |             |              |
|----------------------|-----------------|--------------------|-----------------|------------------|-------------------|-------------|--------------|
| Client :             | City of Iqaluit | Project Location : | lqaluit, NU     |                  |                   |             |              |
| Date Sampled :       | May 7, 2015     | Borehole:          | 3               | Sample:          | S3 & S4           | Depth (m) : | as indicated |
| Sample Description : |                 | SAND with          | gravel          |                  |                   | Figure :    | 8            |

## Log of Borehole BH04

| .ocati                          | ion:                   | IQALUIT, NU   |                      |   |   |       |   |      |              |                   |  |  | Page.    |                    |  | of _     | 1  |                 |                   |                 |
|---------------------------------|------------------------|---|----------------------|---|---|-------|---|------|--------------|-------------------|--|--|----------|--------------------|--|----------|--|-----------------|-------------------|-----------------|
| ate D                           | Orilled:               | 5/7/15  |                      |   | Split   | Spoo  | n San                                   | nple |              |                   | $\boxtimes$                                  |  |          | Combu              | ıstible V                              | apour F  | Readin   | ng              |                   |                 |
| rill Ty                         | уре:                   | AIR TRACK   |                      | Auger Sample  SPT (N) Value                   |   |       |   |      |              |                   |  | Natural Moisture C<br>Atterberg Limits |          |                    | Content                                |          |  | ×<br>⊕          |                   |                 |
| atum                            | 1:                     | GEODETIC  |                      | -   | Dyna  | mic ( | Cone <sup>-</sup>                       | Гest |              | _                 |  |  |          | Undrair<br>% Strai | ned Tria                               | ixial at |  | -               |                   | $\oplus$        |
| Logged by: SB Checked by:       |                        | JAS   |                      | Shelby Tube  Shear Strength by +  Vane Test S |   |       |   |      |              | -                 |  | Shear S<br>Penetro                     | Strength | n by               | у                                      |          |  | •               |                   |                 |
| S Y M B O L                     |                        | SOIL DESCRIPTION  | GEODETIC<br>m<br>157 | t<br>h  |   | 20    | )<br>trength                            | 40   | tration      | Test<br>60<br>150 |  | 80                                     | кРа      | Na<br>Atter        | ustible V<br>250<br>atural Morberg Lir | 500      | 75   | nt %<br>/eight) | SAMPLES           | Na<br>Uni<br>kN |
|                                 | - occ                  | brown, sand with silt and gravel asional cobbles and boulders   |                      | 0   | -5-6-   |       |   |      |              |                   |  | 1 1 1 1                                |          |                    | Ī                                      |          | 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -                          |                 |                   |                 |
|                                 |                        | visible ice content<br>6 gravel, 78% sand, 7% fines   |                      |   | -5.0  |       |   |      |              |                   | 1. 2. 3                                      |  |          | X                  |  |          | 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -                          |                 |                   |                 |
|                                 | •                      |   |                      | 1   |   |       |   |      |              |                   |  |  |          | <b>Y</b>           |  |          |  |                 |                   |                 |
|                                 |                        | 20.0  | 155.0                | 2   |   |       |   |      |              |                   |  |  |          |                    |  |          |  |                 |                   |                 |
|                                 | - som                  | silty sand<br>ne gravel<br>ne visible ice, Vx (20% to 30%)  |                      |   |   |       |   |      |              |                   |  |  |          | ×                  |  |          |  |                 | - 6P              |                 |
|                                 | - 22%                  | 6 gravel, 66% sand, 12% fines   |                      | 3   | 13 6-<br>13 6-<br>13 6-<br>13 6-<br>13 6-<br>13 6-<br>13 6- |       |   |      |              |                   |  |  |          |                    |  |          | 2 - 12 - 12 - 12 - 12 - 12 - 12 - 12 -                           |                 |                   |                 |
|                                 | -<br>- 16%             | 6 gravel, 65% sand, 19% fines   | _                    |   | 10.00   |       | · i · i · i · i · i · i · i · i · i · i |      |              |                   |  |  | -0.0     |                    | ×                                      |          |  |                 | - <sub>(M)</sub>  |                 |
|                                 | -                      |   | _                    | 4   | 10.00   |       |   |      |              |                   |  | 1.5.3                                  |          |                    |  |          |  |                 |                   |                 |
|                                 |                        |   | -                    |   |   |       |   |      |              |                   |  |  |          |                    | ×                                      |          |  |                 | m2                |                 |
|                                 | - laye                 | ers of massive ice below 5.0 m o  | depth _              | 5   |   |       |   |      |              |                   |  |  |          |                    |  |          |  |                 |                   |                 |
|                                 | -                      |   | -                    |   | 10.0  |       | . 1 . 1 . 5                             |      |              |                   |  |  |          | ×                  |  |          | 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -                          |                 | - <sub>(17)</sub> |                 |
|                                 |                        |   |                      | 6   | -0.0  |       |   |      |              |                   | 2- 6 - 3<br>2- 6 - 3<br>2- 6 - 3<br>2- 6 - 3 |  | -0-1-    | ×                  |  |          | 3 - 3 - 6 - 1<br>3 - 3 - 6 - 1<br>3 - 3 - 6 - 1<br>3 - 3 - 6 - 1 |                 | _m                |                 |
|                                 | F                      | of Davahala of 7.0 or Davids  | 150.0                | 7   | -5-6-   |       |   |      |              |                   |  |  |          |                    |  |          |  |                 |                   |                 |
|                                 | End                    | of Borehole at 7.0 m Depth  |                      |   |   |       |   |      |              |                   |  |  |          |                    |  |          |  |                 |                   |                 |
| OTES:<br>Boreho                 | ole data re            | quires interpretation by exp. before  | WATER                | ]<br>   | EVEL  | RE    | COR                                     | DS   |              |                   | : : : :<br>                                  |  |          | CC                 | ORE D                                  | RILLIN   | IG RE  | ECORI           |                   |                 |
| use by                          | others                 |   | Elapsed              |   | Wat   | er    |   | Н    | ole O        |                   |  | Ru                                     |          | De                 | pth                                    |          | % Rec  |                 |                   | QD              |
| .Boreho<br>.See No<br>.This Fig | ole backfillotes on Sa | vised by an exp representative.  ed with drill cuttings upon completion.  Imple Descriptions  read with exp. Services Inc. report | Time<br>Completion   |   | <u>evel</u><br>Froze  |       |   |      | <u>To (n</u> | 1)                |  | N                                      | D.       | <u>(n</u>          | n)                                     |          |  |                 |                   |                 |

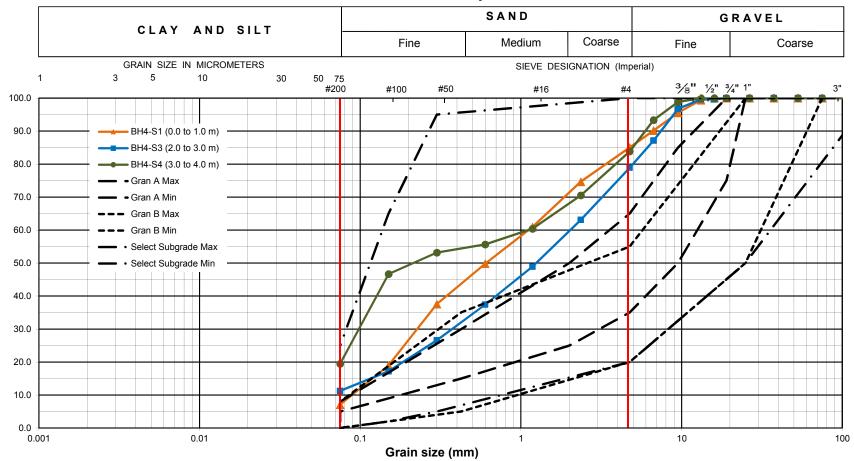
### **Grain-Size Distribution Curve**



Percent Passing

100-2650 Queensview Drive Ottawa, ON K2B 8H6

# Method of Test for Sieve Analysis of Aggregate ASTM C-136



| Exp Project No.:     | OTT-00219428-A0 | Project Name :          | Geotechnical   | Investigation - | Northwest Deposit |            |              |
|----------------------|-----------------|-------------------------|----------------|-----------------|-------------------|------------|--------------|
| Client :             | City of Iqaluit | Project Location :      | Iqaluit, NU    |                 |                   |            |              |
| Date Sampled :       | May 7, 2015     | Borehole:               | 4              | Sample:         | S1, S3 & S4       | Depth (m): | as indicated |
| Sample Description : | SAND            | with silt and gravel to | o silty SAND w | ith gravel      |                   | Figure :   | 10           |

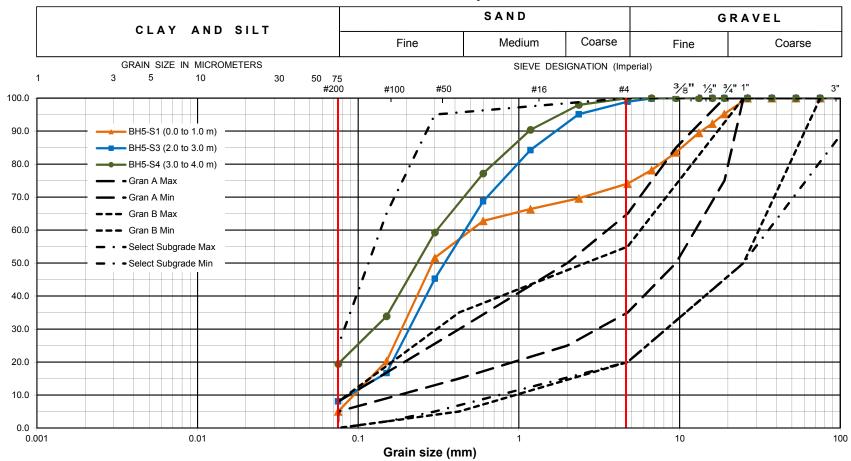
| <ul><li>2.0 m depth</li><li>2% gravel, 90% sand, 8% fines</li></ul>   | _     |   |   |   |   |                                     |  | × |   |          |  |     | 3        |
|---|-------|---|---|---|---|-------------------------------------|--|---|---|----------|--|-----|----------|
|   | 165.0 | 3 | -3 (-1)                                   | 0 0 1 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 | 3   13<br>3   13<br>4   13<br>4   13      | 0 ( ) ( )<br>0 ( ) ( )<br>0 ( ) ( ) |  |   |   |          | 3 ( · i<br>3 ( · i<br>3 ( · i<br>1 ( · i |     |          |
| CLASS 3 Light brown, predominantly fine-grained silty sand  |       |   | -3 -5 -5 -5 -5 -5 -5 -5 -5 -5 -5 -5 -5 -5 |   | 0   0<br>0   0<br>0   0<br>0   0<br>0   0 |                                     |  |   |   |          | 3 ( · · · · · · · · · · · · · · · · · ·  | nn, |          |
| <ul> <li>trace to no gravel</li> <li>trace cobbles and boulders</li> <li>some visible ice, Vx (10% to 20%)</li> </ul> |       |   |   |   |   |                                     |  |   |   | <b>×</b> |  |     | <i>b</i> |
| - 0% gravel, 81% sand, 19% fines  | +     | 4 |   |   |   |                                     |  |   |   |          |  |     | 1        |
|   | -     |   |   |   |   |                                     |  |   | × |          |  |     | 3        |
| - layers of massive ice below 5.0 m depth   |       | 5 |   |   |   |                                     |  |   |   |          |  |     | -        |
|   |       |   |   |   |   |                                     |  |   | × |          |  |     | 3        |
|   | 162.0 |   |   |   |   |                                     |  |   |   |          |  |     |          |
| End of Borehole at 6.0 m Depth  |       | 6 |   |   |   |                                     |  |   |   |          |  |     |          |
|   |       |   |   |   |   |                                     |  |   |   |          |  |     |          |
|   |       |   |   |   |   |                                     |  |   |   |          |  |     |          |
|   |       |   |   |   |   |                                     |  |   |   |          |  |     |          |
|   |       |   |   |   |   |                                     |  |   |   |          |  |     |          |





100-2650 Queensview Drive Ottawa, ON K2B 8H6

# Method of Test for Sieve Analysis of Aggregate ASTM C-136



| Exp Project No.:     | OTT-00219428-A0 | Project Name :     | Geotechnical II | nvestigation - | Northwest Deposit |            |              |
|----------------------|-----------------|--------------------|-----------------|----------------|-------------------|------------|--------------|
| Client :             | City of Iqaluit | Project Location : | lqaluit, NU     |                |                   |            |              |
| Date Sampled :       | May 8, 2015     | Borehole:          | 5               | Sample:        | S1, S3 & S4       | Depth (m): | as indicated |
| Sample Description : |                 | SAND with gravel   | to silty SAND   |                |                   | Figure :   | 12           |

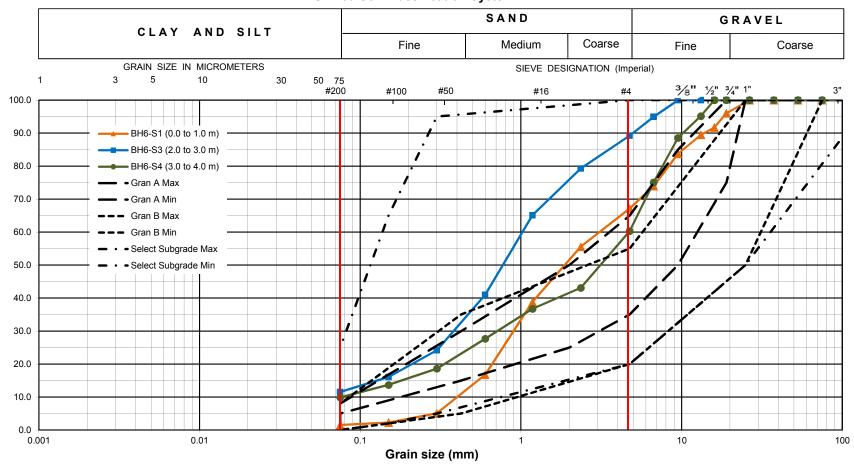
| Project No:               |  | TION NODEL "A"  |                  | \T -                     |                 | 00                            | ıŦ                                      |        |   |   |                               |       | F                       | igu  | re N                                | ۱o.             | _               | 1   | 3_                 |     |                                       |             |
|---------------------------|--|-----------------|------------------|--------------------------|-----------------|-------------------------------|---|--------|---|---|-------------------------------|-------|-------------------------|------|-------------------------------------|-----------------|-----------------|---|--------------------|-----|---------------------------------------|-------------|
| Project:                  | GEOTECHNICAL INVESTIGA   | HON - NORTHW    | ES               | ) I E                    | ıΕΡ             | US                            | 11                                      |        |   |   |                               |       |                         |      | Pa                                  | ge.             | _1              | of  | f <u>1</u>         | _   |                                       |             |
| Location:                 | IQALUIT, NU  |                 |                  |                          |                 |                               |   |        |   |   |                               | _     |                         |      |                                     |                 |                 |   |                    |     |                                       |             |
| Date Drilled              |  |                 |                  |                          | Spoo<br>er Sa   |                               | ample                                   | 9      |   |   |                               |       |                         |      |                                     |                 | •               | ur Rea  | -                  |     |                                       | ×           |
| Drill Type:               | AIR TRACK  |                 |                  | SPT                      | (N) \           | /alue                         | )                                       |        |   |   | 0                             |       |                         | Atte | rber                                | g Lim           | its             |   |                    | ⊢   |                                       | 0           |
| Datum:                    | GEODETIC   |                 |                  |                          | amic<br>by Tu   |                               | e Tes                                   | ι      |   |   | _                             |       |                         | % S  | train                               | ed Tri<br>at Fa | ailure          |   |                    |     |                                       | $\oplus$    |
| Logged by:                | SB Checked by:   | JAS             |                  |                          | ar Str<br>e Tes |                               | h by                                    |        |   |   | +<br>s                        |       |                         |      |                                     | reng<br>neter   |                 |   |                    |     |                                       | •           |
| s Y                       |  | GEODETIC        | D                |                          | Star            | ndar                          | d Pen                                   | etrat  | ion T                                     | est N                                   | l Val                         | ue    |                         | Co   |                                     | stible<br>50    | Vapo<br>50      |   | ading (p           | pm) | S<br>A<br>M<br>P                      | Natu        |
| G M B O L                 | SOIL DESCRIPTION   | m               | e<br>p<br>t<br>h | Sh                       | ear S           | tren                          | -                                       |        | 6   |   |                               |       | Pa                      | Α    | Nat<br>tterb                        | ural N<br>erg L | Noistu<br>imits | re Cor<br>(% Dr                                   | ntent %<br>y Weigh | nt) | PLES                                  | Unit<br>kN/ |
| CL/                       | <u>ASS 1</u>   | 166             | 0                | -3-3                     | 5               | 0                             | 10                                      | 00     | 15  | 50                                      | 2                             | 00    |                         |      | 2                                   | 20              | 4               | 0   | 60                 |     | S                                     |             |
| ૂંઃઃ ્ધ - tra             | k brown, sand with gravel<br>ace silt                          |                 |                  |                          |                 |                               |   |        |   |   | 1-3-                          |       |                         |      |                                     |                 |                 |   |                    |     |                                       |             |
| ုံႏို္င္ငံ - no           | casional cobbles and boulders visible ice content              | 7               |                  | -2.5                     |                 |                               |   |        |   |   |                               |       | ÷ †                     | ×    |                                     |                 |                 |   |                    |     |                                       |             |
| - 33<br>      - 33        | % gravel, 65% sand, 2% fines                                   |                 | 1                |                          |                 |                               |   |        |   |   |                               |       | 11.5                    |      |                                     |                 |                 |   |                    |     |                                       |             |
|                           |  |                 |                  |                          |                 |                               |   |        |   |   |                               |       |                         |      |                                     |                 |                 |   |                    |     |                                       |             |
|                           |  | -               |                  |                          |                 |                               |   |        |   |   | :::                           |       |                         | ×    |                                     |                 |                 |   |                    |     | m                                     |             |
|                           |  | 164.0           |                  |                          |                 |                               |   |        |   |   |                               |       |                         |      |                                     |                 |                 |   |                    |     |                                       |             |
|                           | ASS 3<br>nt brown, silty sand with gravel                      | 104.0           | 2                |                          |                 |                               |   |        |   |   |                               |       |                         |      |                                     |                 |                 |   |                    |     | П                                     |             |
| - fre                     | equent cobbles and boulders<br>me visible ice, Vx (10% to 20%) |                 |                  |                          |                 | - 1 - 2                       |   |        |   |   |                               |       |                         |      |                                     |                 | X               |   |                    |     | ens,                                  |             |
| - 80<br>- 23              | % gravel, 65% sand, 12% fines                                  |                 |                  | 43 d<br>  43 d<br>  43 d |                 | - 1 - 5<br>- 1 - 5<br>- 1 - 5 | 0.1.<br>0.1.<br>0.1.                    |        | . 5 . 5 . 1<br>. 5 . 5 . 1<br>. 5 . 5 . 1 | - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 | ( - ) -<br>( - ) -<br>( - ) - |       | -0-4-<br>-0-4-<br>-0-4- | 01   | - 3 - 0 -<br>- 3 - 0 -<br>- 3 - 0 - |                 |                 | - 4 - 1 - 5<br>- 4 - 1 - 5<br>- 4 - 1 - 5         |                    |     |                                       |             |
|                           | vers of massive ice below 3.0 m                                | depth           | 3                |                          |                 |                               |   |        |   |   |                               | 1 1 1 | <u> </u>                |      |                                     |                 |                 |   |                    |     | $\mathbb{H}$                          |             |
|                           |  |                 |                  |                          |                 |                               |   |        |   |   | 1.3                           |       |                         |      |                                     |                 |                 | - (- 1 - 1)<br>- (- 1 - 1 - 1)<br>- (- 1 - 1 - 1) |                    |     |                                       |             |
| - 40                      | % gravel, 50% sand, 10% fines                                  | -               |                  |                          |                 |                               |   |        |   |   |                               |       |                         |      | 111                                 |                 |                 |   | ×                  |     | m                                     |             |
|                           |  |                 | _                |                          |                 |                               |   |        |   |   |                               |       |                         |      |                                     |                 |                 |   |                    |     |                                       |             |
|                           |  |                 | 4                |                          |                 |                               |   |        |   |   |                               |       |                         |      |                                     |                 |                 |   |                    |     | П                                     |             |
|                           |  | _               |                  |                          |                 |                               |   | - :: : |   |   |                               |       | -: ::                   |      |                                     |                 |                 | ×   |                    |     | m3                                    |             |
|                           |  |                 |                  |                          |                 |                               |   |        |   |   |                               |       |                         |      |                                     |                 |                 |   |                    |     |                                       |             |
|                           |  | -               | 5                |                          |                 |                               |   |        |   |   |                               |       |                         |      |                                     |                 |                 |   |                    |     | H                                     |             |
|                           |  |                 |                  |                          |                 |                               |   |        |   |   |                               |       |                         |      |                                     |                 |                 |   |                    |     |                                       |             |
|                           |  | 7               |                  | 1.3.2                    |                 |                               |   |        |   |   |                               |       |                         |      |                                     |                 | ×               |   |                    |     | · · · · · · · · · · · · · · · · · · · |             |
|                           |  | 160.0           | 6                |                          |                 | - 1 - 3                       | - i - i - i - i - i - i - i - i - i - i |        |   |   |                               |       | -0-4-<br>-0-4-          |      |                                     |                 |                 |   |                    |     |                                       |             |
| End                       | of Borehole at 6.0 m Depth                                     |                 |                  |                          |                 |                               |   |        |   |   |                               |       |                         |      |                                     |                 |                 |   |                    |     |                                       |             |
|                           |  |                 |                  |                          |                 |                               |   |        |   |   |                               |       |                         |      |                                     |                 |                 |   |                    |     |                                       |             |
|                           |  |                 |                  |                          |                 |                               |   |        |   |   |                               |       |                         |      |                                     |                 |                 |   |                    |     |                                       |             |
|                           |  |                 |                  |                          |                 |                               |   |        |   |   |                               |       |                         |      |                                     |                 |                 |   |                    |     |                                       |             |
|                           |  |                 |                  |                          |                 |                               |   |        |   |   |                               |       |                         |      |                                     |                 |                 |   |                    |     |                                       |             |
|                           |  |                 |                  |                          |                 |                               |   |        |   |   |                               |       |                         |      |                                     |                 |                 |   |                    |     |                                       |             |
|                           |  |                 |                  |                          |                 |                               |   |        |   |   |                               |       |                         |      |                                     |                 |                 |   |                    |     |                                       |             |
| NOTES:<br>I.Borehole data | requires interpretation by exp. before                         | WATER           | R LI             | EVE                      | L RE            | CO                            | RDS                                     | 3      |   |   |                               |       |                         |      | СО                                  | RE [            | RIL             | LING  | RECO               | DRD |                                       |             |
| use by others             | ervised by an exp representative.                              | Elapsed<br>Time |                  | Wa<br>evel               |                 |                               | ŀ                                       |        | Ope<br>(m)                                |   |                               | Ru    |                         |      | Dep<br>(m                           |                 |                 | % F   | Rec.               |     | RC                                    | QD 9        |
|                           | filled with drill cuttings upon completion.                    | Completion      |                  | Froz                     |                 |                               |   |        |   |   |                               |       | 7                       |      |                                     |                 |                 |   |                    |     |                                       |             |
|                           | Sample Descriptions  |                 |                  |                          |                 |                               |   |        |   |   |                               |       |                         |      |                                     |                 |                 |   |                    |     |                                       |             |
|                           | o read with exp. Services Inc. report                          | 1               |                  |                          |                 |                               | 1                                       |        |   |   | 1 1                           |       |                         |      |                                     |                 | - 1             |   |                    | - 1 |                                       |             |





100-2650 Queensview Drive Ottawa, ON K2B 8H6

# Method of Test for Sieve Analysis of Aggregate ASTM C-136



| Exp Project No.:     | OTT-00219428-A0 | Project Name :      | Geotechnical Ir | vestigation - | Northwest Deposit |            |              |
|----------------------|-----------------|---------------------|-----------------|---------------|-------------------|------------|--------------|
| Client :             | City of Iqaluit | Project Location :  | lqaluit, NU     |               |                   |            |              |
| Date Sampled :       | May 8, 2015     | Borehole:           | 6               | Sample:       | S1, S3 & S4       | Depth (m): | as indicated |
| Sample Description : |                 | SAND with gravel to | SAND with silt  |               |                   | Figure :   | 14           |

|                  | - trac           | ce visible ice, Vx (<10%)   |  |   |   |  |  |  |   |  |   |  |  |   |   |   |  |  |  |
|------------------|------------------|---|--|---|---|--|--|--|---|--|---|--|--|---|---|---|--|--|--|
|                  | - trac<br>- freq | e gravel<br>quent cobbles and boulders  | _  |   |   |  |  |  |   |  |   |  | ×  |   |   |   |  |  | 3  |
|                  | CLAS<br>Grev     | SS 3<br>. silty sand  | 166.0  | 4   |   |  |  |  |   |  |   |  |  |   |   |   |  |  |  |
|                  | - 25%            | % gravel, 71% sand, 4% fines  |  |   | -5.5  |  |  |  |   |  |   |  |  |   |   |   |  |  |  |
|                  | _                |   |  |   |   |  |  |  |   | - 1 - 2 -  |   |  |  |   |   | - 6 - 8 - 6 - 6<br>- 6 - 8 - 6 - 6<br>- 6 - 8 - 6 - 6   |  | 800x   | 2  |
|                  | _                |   |  | 3   |   |  |  |  |   |  |   |  |  |   |   | . 6. 3 - 3. 6   |  |  |  |
|                  | _<br>- 46%       | % gravel, 51% sand, 3% fines  | -  |   |   |  |  |  |   |  |   | ×  |  |   |   | - 6 - 3 - 3 - 5   |  |  | 3  |
|                  | _                |   |  | 2   |   |  |  |  |   |  |   |  |  |   |   |   |  |  |  |
|                  |                  |   |  |   |   |  |  |  |   |  |   |  |  |   |   |   |  |  |  |
|                  | _                |   |  |   |   |  |  |  |   | - : : : : : : : : : : : : : : : : : : :  |   | *  |  |   |   |   |  | - M  | 3  |
|                  | - 24%<br>-       | o graver, 1∠7o sanū, 47o πnes   | -  | 1   |   |  |  |  |   |  |   |  |  |   |   |   |  |  | $\frac{1}{1}$  |
|                  | - freq<br>- no \ | quent cobbles and boulders visible ice content  |  |   |   |  |  |  |   |  |   | ×  |  |   |   |   |  |  | 3  |
|                  | Dark             | brown, sand with gravel   |  |   | 10.0  |  |  |  | 0   0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0   |  |   |  |  |   | 6 - 1 - 1<br>6 - 1 - 1<br>6 - 1 - 1<br>2 - 1 - 1  | - 6- 3-3- 6<br>- 6- 3-3- 6<br>- 6- 3-3- 6   |  |  |  |
| M<br>B<br>O<br>L | - 01.44          | SOIL DESCRIPTION  | GEODETI  | t<br>h  | Sh  | ear S  | trength  |  | 150   |  | kPa   | - /  | Nat<br>Atterb  | ural M<br>erg L   | loistu<br>imits   | re Cont<br>(% Dry   | ent %<br>Weight)   | P L ES   | Üi   |
| S<br>Y           |                  |   | OFORET   | D   |   |  |  | netratio   | n Test N  |  | ıe  | Co   |  |   |   |   |  | 1) S   | N  |
|                  |                  |   | S  | _   | Shea  | ar Str   | ength by   | ,  |   | +  |   | She  | ar S   | trengt  | h by  |   |  |  | 4  |
|                  |                  |   |  | -   |   |  |  | st   | _   | 0  |   | Und  | Iraine   | ed Tria   | axial   | at  |  | <u> </u>   | —∈<br>A  |
|                  |                  |   |  | -   |   |  |  | le   |   |  |   |  |  |   |   |   | ling   |  | >  |
| catio            |                  | IQALUIT, NU   |  |   |   |  |  |  |   |  | _   |  | . u  | <b>J</b> C.   |   | of  | <u> </u>   |  |  |
| i                | te D II Ty tum:  | te Drilled: Il Type: tum: gged by:  CLA: - trac - no - 249 - 469 - 469 - trac - frec - trac | te Drilled: 5/9/15  Il Type: AIR TRACK  tum: GEODETIC  gged by: SB Checked by: JA  SOIL DESCRIPTION  CLASS 1 Dark brown, sand with gravel - trace silt - frequent cobbles and boulders - no visible ice content - 24% gravel, 72% sand, 4% fines  - 46% gravel, 51% sand, 3% fines | te Drilled: 5/9/15  Il Type: AIR TRACK tum: GEODETIC gged by: SB Checked by: JAS  SOIL DESCRIPTION  CLASS 1 Dark brown, sand with gravel - trace silt - frequent cobbles and boulders - no visible ice content - 24% gravel, 72% sand, 4% fines  - 46% gravel, 51% sand, 3% fines  CLASS 3 Grey, silty sand - trace gravel - frequent cobbles and boulders - 25% gravel, 71% sand, 4% fines  CLASS 3 Grey, silty sand - trace gravel - frequent cobbles and boulders - trace visible ice, Vx (<10%) | te Drilled: 5/9/15  Il Type: AIR TRACK tum: GEODETIC gged by: SB Checked by: JAS  SOIL DESCRIPTION  CLASS 1 Dark brown, sand with gravel - trace silt - frequent cobbles and boulders - no visible ice content - 24% gravel, 72% sand, 4% fines  - 46% gravel, 51% sand, 3% fines  CLASS 3 Grey, silty sand - trace gravel - frequent cobbles and boulders - trace visible ice, Vx (<10%) | te Drilled: 5/9/15  Il Type: AIR TRACK  tum: GEODETIC  gged by: SB Checked by: JAS  Soll DESCRIPTION  CLASS 1 Dark brown, sand with gravel - trace silt - frequent cobbles and boulders - no visible ice content - 24% gravel, 72% sand, 4% fines  CLASS 3 Grey, silty sand - trace gravel - frequent cobbles and boulders - 1  CLASS 3 Grey, silty sand - trace gravel - frequent cobbles and boulders - trace visible ice, Vx (<10%) | te Drilled: 5/9/15  Il Type: AIR TRACK tum: GEODETIC gged by: SB Checked by: JAS  SOIL DESCRIPTION  Solid Description  CLASS 1 Dark brown, sand with gravel - trace silt - frequent cobbles and boulders - no visible ice content - 24% gravel, 72% sand, 4% fines  - 25% gravel, 71% sand, 4% fines  CLASS 3 Grey, silty sand - trace gravel - frequent cobbles and boulders - trace yisible ice, Vx (<10%)  CLASS 3 Grey, silty sand - trace gravel - frequent cobbles and boulders - trace visible ice, Vx (<10%) | te Drilled: 5/9/15  Il Type: AIR TRACK tum: GEODETIC gged by: SB Checked by: JAS  Soll DESCRIPTION  CLASS 1 Dark brown, sand with gravel - trace silt - frequent cobbles and boulders - no visible ice content - 24% gravel, 72% sand, 4% fines  CLASS 3 Grey, silty sand - trace gravel - frequent cobbles and boulders - a compared to the same and the same and the same are size a | te Drilled: 5/9/15  Il Type: AIR TRACK  GEODETIC  gged by: SB Checked by: JAS  Solit Spoon Sample Auger Sample SPT (N) Value  Dynamic Cone Test Shelby Tube Shear Strength by Vane Test  Solit Description  GEODETIC  The shear Strength by Vane Test  CLASS 1  Dark brown, sand with gravel 170  CLASS 1  Dark brown, sand with gravel 170  Trace silt 1 - frequent cobbles and boulders 1 - no visible ice content 24% gravel, 72% sand, 4% fines  CLASS 3  Grey, silty sand 1 - trace gravel 1 - frequent cobbles and boulders 1 - trace wisible ice, Vx (<10%)  CLASS 3  Grey, silty sand 166.0 | te Drilled: 5/9/15  Il Type: AIR TRACK turn: GEODETIC gged by: SB Checked by: JAS  Soll DESCRIPTION  SOIL DESCRIPTION  CLASS 1 Dark brown, sand with gravel - trace silt - frequent cobbles and boulders - no visible ice content - 24% gravel, 72% sand, 4% fines  CLASS 3 Grey, silty sand - trace gravel - frace gravel - frequent cobbles and boulders - na compared to the same of th | te Drilled: 5/9/15  Il Type: AIR TRACK  tum: GEODETIC  gged by: SB Checked by: JAS  Solit Spoon Sample Auger Sample SPT (N) Value  Dynamic Cone Test Shebyr Tube  Shear Strength by Vane Test  CLASS 1  Dark brown, sand with gravel  - trace silt  - frequent cobbles and boulders - no visible ice content - 24% gravel, 72% sand, 4% fines  CLASS 3  Grey, silty sand - trace gravel - frequent cobbles and boulders - frequent cobbles and boulders - trace gravel - frequent cobbles and boulders - trace yisible ice, Vx (<10%) | te Drilled: 5/9/15  Il Type: AIR TRACK tum: GEODETIC gged by: SB | te Drilled: 5/9/15  Il Type: AIR TRACK tum: GEODETIC gged by: SB Checked by: JAS  Solit Description  Solit Description  GEODETIC  Shear Strength by Shear Strength by And East Shear St | te Drilled: 5/9/15  Il Type: AIR TRACK  Tum: GEODETIC  gged by: SB Checked by: JAS  Solit DESCRIPTION  CLASS 1  Dark brown, sand with gravel - trace silt - frequent cobbles and boulders - no visible ice content - 24% gravel, 71% sand, 4% fines  CLASS 3  Grey, silty sand - trace gravel - frequent cobbles and boulders - no visible ice content - 25% gravel, 71% sand, 4% fines  CLASS 3  Grey, silty sand - trace gravel - frequent cobbles and boulders - race gravel - frequent cobbles and boulders - 166.0  LASS 3  Grey, silty sand - trace gravel - frequent cobbles and boulders - frequent cobbles and boulders - trace sit - 1  LASS 3  Grey, silty sand - trace gravel - frequent cobbles and boulders - frequent cobbles and boulders - trace is frequent cobbles and boulders - trace yisible ice, Vx (<10%) | te Drilled: 5/9/15  Il Type: AIR TRACK tum: GEODETIC gged by: SB Checked by: JAS  Solit Description  Solit Description  Solit Description  Solit Description  Solit Description  CLASS 1  Dark brown, sand with gravel - trace site - no visible ice content - 24% gravel, 71% sand, 4% fines  - 25% gravel, 71% sand, 4% fines  CLASS 3  Grey, silty sand - trace gravel - frequent cobbles and boulders - trace gravel - frequent cobbles and boulders - trace site - frequent cobbles and boulders - trace visible ice, Vx (<10%) | te Drilled: 5/9/15  Il Type: AIR TRACK tum: GEODETIC gged by: SB Checked by: JAS  Solit Description  Solit Description  Solit Description  GEODETIC  Trace siti  - trace siti - requent cobbles and boulders - no visible ice content - 24% gravel, 71% sand, 4% fines  CLASS 3  Grey, sitiy sand - trace gravel - frequent cobbles and boulders - trace visible ice, Vx (<10%)  CLASS 3  Grey, sitiy sand - trace visible ice, Vx (<10%)  Spit Spoon Sample Auger Sample Spit (N) Value - Spr (N) Value - Spr (N) Value - Alterberg Limits - | te Drilled: 5/9/15  Il Type: AIR TRACK tum: GEODETIC gged by: SB Checked by: JAS  Solit Description  GEODETIC  Shelby Tube Shear Strength by Shear Str | te Drilled: 5/9/15  Il Type: AIR TRACK  GEODETIC  SB Checked by: JAS  Soli DESCRIPTION  CLASS 1  Dark brown, sand with gravel - trace sitl - request cooles and boulders - request cooles and boulders - trace gravel - trace gravel - trace visible ice, Vx (<10%)  CLASS 3  Gray Silly sand - trace gravel - trace visible ice, Vx (<10%)  Spill Spoon Sample   SA Auger Sample   ST (N) Value   SPT (N) Val | te Drilled: 5/9/15  Il Type: AIR TRACK thum: GEODETIC gged by: SB Checked by: JAS  Solit DESCRIPTION  CEASS 1 Dark brown, sand with gravel - trace slit - requent cobbles and boulders - 24% gravel, 72% sand, 4% fines  CLASS 3 Grey Silly sand - trace gravel - frequent cobbles and boulders - trace visible ice, Vx (<10%)  CLASS 3  CLASS 3  Grey Silly sand - trace gravel - frequent cobbles and boulders - frequent cobbles and boulders - trace gravel - frequent cobbles and boulders - frequent cobbles and boulder |

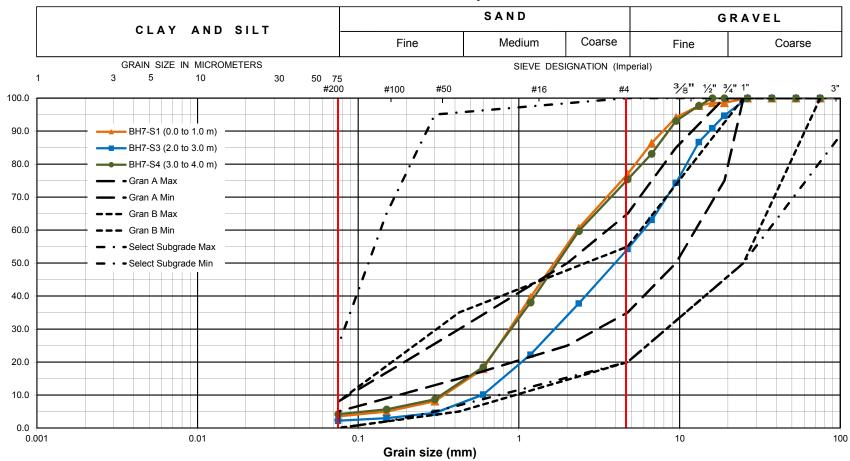
### **Grain-Size Distribution Curve**



Percent Passing

100-2650 Queensview Drive Ottawa, ON K2B 8H6

# Method of Test for Sieve Analysis of Aggregate ASTM C-136



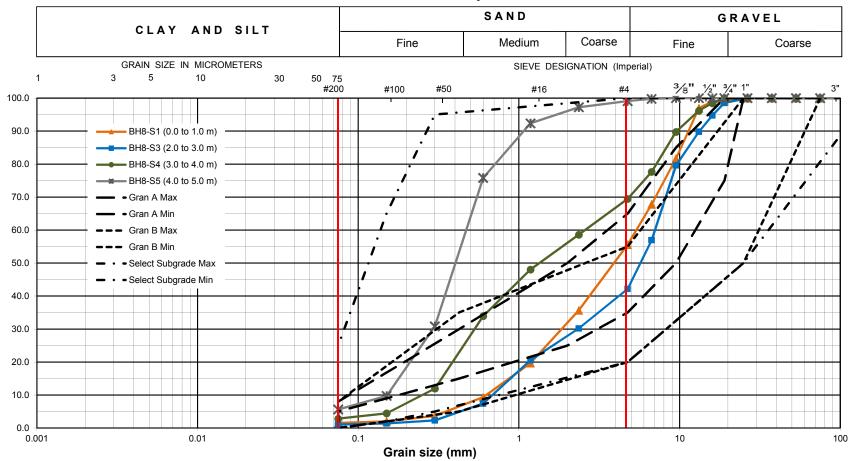
| Exp Project No.:     | OTT-00219428-A0 | Project Name :     | Geotechnical | Investigation - | Northwest Deposit |            |              |
|----------------------|-----------------|--------------------|--------------|-----------------|-------------------|------------|--------------|
| Client :             | City of Iqaluit | Project Location : | Iqaluit, NU  |                 |                   |            |              |
| Date Sampled :       | May 9, 2015     | Borehole:          | 7            | Sample:         | S1, S3 & S4       | Depth (m): | as indicated |
| Sample Description : |                 | SAND with          | gravel       |                 |                   | Figure :   | 16           |

| Proje                     | ect No:  | OTT-00219428-A0  | J. D.            |           | . •  | •     | <b>O</b> .                                  |      | _      | <u> </u>           |             |    |      | igui     | ro N          | J.C              |  | 1                      | 7   | (                                |          | X                    |
|---------------------------|--|--|------------------|-----------|--|-------|---|------|--------|--------------------|-------------|----|------|----------|---------------|------------------|--|------------------------|---|----------------------------------|----------|----------------------|
| Proje                     | ect:   | GEOTECHNICAL INVESTIGATION   | - NORTHW         | /E        | ST DE  | EΡ    | OSIT  | -    |        |                    |             |    | r    | •        |               |                  | _  |                        | <u>/_</u><br>f 1  | 1                                |          |                      |
| Loca                      | ition:   | IQALUIT, NU  |                  |           |  |       |   |      |        |                    |             | _  |      |          | r-d(          | y€.              | _'   | _ 0                    | ''  | <u>'</u>                         |          |                      |
| Date                      | Drilled:   | 5/12/15  |                  | _         | Split S  | роо   | n San                                       | nple |        |                    | $\boxtimes$ |    |      | Con      | nbus          | tible \          | /apo   | ur Rea                 | ading   |                                  |          |                      |
| Drill <sup>-</sup>        | Туре:  | AIR TRACK  |                  | _         | Auger<br>SPT (I                                    |       |   |      |        |                    |             |    |      |          |               | Moistu<br>g Limi |  | onten                  | t   | H                                |          | X<br>⊕               |
| Datu                      | m:   | GEODETIC   |                  | _         | Dynan  | nic ( | Cone T                                      | Гest |        | _                  |             |    |      | Und      | raine         | ed Tria<br>at Fa | axial  |                        |   | •                                |          | $\oplus$             |
| Logg                      | ed by:   | SB Checked by: JAS   |                  |           | Shear<br>Vane                                      | Stre  | ength                                       | by   |        |                    | +<br>s      |    |      | She      | ar St         | trengt           | h by   |                        |   |                                  |          | •                    |
| G M B O L                 | 1 3 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5          | SOIL DESCRIPTION   | GEODETIC<br>m    | D e p     | Shea   | 20    | )<br>trength                                | 40   |        | Test N<br>60<br>50 | 8           | 30 | Pa   |          | Nati<br>tterb | 50               | 50   | oo<br>ire Cor<br>(% Dr | ading (<br>750<br>ntent %<br>y Weig                         |                                  |          | Natu<br>Unit<br>kN/i |
| ,                         | 🐫 sand   | brown, sand with gravel to gravel with   |                  |           | 0 01   |       |   |      |        | 12.0               |             |    |      |          |               |                  | 6 - 3 - 1<br>6 - 3 - 1<br>6 - 3 - 1<br>6 - 3 - 1 |                        |   | 6-1-5<br>6-1-5<br>6-1-5<br>6-1-5 |          |                      |
|                           | - ireq   | uent cobbles and boulders<br>visible ice content   |                  |           | -2-0-1   |       |   |      |        | 1000               |             |    |      |          |               |                  |  |                        |   |                                  | 700      | 1                    |
|                           | • - 45%<br>• • • • • • • • • • • • • • • • • • • | 6 gravel, 53% sand, 2% fines   |                  | 1         |  |       |   |      |        |                    |             |    |      |          |               |                  |  |                        |   |                                  | - 20s    | 1                    |
|                           |  |  |                  |           |  |       |   |      |        |                    |             |    |      | <b>*</b> |               |                  |  |                        |   |                                  | 100      | 1                    |
|                           |  |  |                  | 2         |  |       |   |      |        |                    |             |    |      |          |               |                  |  |                        |   |                                  | SW.      |                      |
|                           | - 58%<br>- 58%                                   | 6 gravel, 40% sand, 2% fines   |                  |           |  |       |   |      |        |                    |             |    |      | ×        |               |                  |  |                        |   |                                  |          |                      |
|                           | 0<br>-<br>- 31%                                  | 6 gravel, 65% sand, 4% fines   |                  | 3         |  |       |   |      |        | 10.0               |             |    |      |          | <b>(</b>      |                  |  |                        | 6- 6-<br>6- 6-<br>6- 6-<br>6- 6-<br>6- 6-<br>6- 6-<br>6- 6- |                                  |          | Ţ                    |
| 6.°.                      |  | SS 2<br>, sand with silt<br>e gravel   | 166.0            | 4         | 12.00  |       |   |      |        |                    |             |    |      |          | 1 - 2 - 1     |                  |  |                        |   |                                  |          |                      |
|                           | - occ  | e visible ice, Vx (<10%)<br>gravel, 93% sand, 6% fines   |                  | 5         |  |       |   |      |        |                    |             |    |      |          | ×             |                  |  |                        |   |                                  | <b>8</b> |                      |
|                           |  |  |                  |           |  |       |   |      |        |                    |             |    |      |          | ×             |                  |  |                        |   |                                  | m        |                      |
|                           |  | of Davidsola at C.C. as Davids   | 164.0            | 6         | -1 -1 -1<br>  -1 -1 -1<br>  -1 -1 -1<br>  -1 -1 -1 |       | · 1 · 3 · 6 · 6 · 6 · 6 · 6 · 6 · 6 · 6 · 6 |      |        | 1000               |             |    |      |          |               |                  |  |                        |   |                                  |          | <u> </u>             |
|                           | Ena  | of Borehole at 6.0 m Depth   |                  |           |  |       |   |      |        |                    |             |    |      |          |               |                  |  |                        |   |                                  |          |                      |
|                           |  |  |                  |           |  |       |   |      |        |                    |             |    |      |          |               |                  |  |                        |   |                                  |          |                      |
|                           |  |  |                  |           |  |       |   |      |        |                    |             |    |      |          |               |                  |  |                        |   |                                  |          |                      |
| NOTES<br>1. Bore<br>use b |  | quires interpretation by exp. before   | WATE             | LI<br>R L | _EVEL  |       | COR   |      | ole Op | en .               | ]           | Ru | ın T |          | CO            |                  | RIL  |                        | REC   | ORD                              |          | QD %                 |
|                           | -  | vised by an exp representative.  | Time<br>mpletion | L         | Level (<br>Froze                                   | m)    | +   |      | To (m  |                    | +           | No |      |          | (m            |                  | -  | /0 F                   | <b>.</b>  | +                                | IX.      | <i>7</i> سيد         |
| 4. See                    | Notes on Sa                                      | ed with drill cuttings upon completion.  Imple Descriptions  read with exp. Services Inc. report |                  |           | . 320  |       |   |      |        |                    |             |    |      |          |               |                  |  |                        |   |                                  |          |                      |



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# Method of Test for Sieve Analysis of Aggregate ASTM C-136



| Exp Project No.:     | OTT-00219428-A0 | Project Name :     | Geotechnical In   | vestigation - Northwest Deposit |            |              |
|----------------------|-----------------|--------------------|-------------------|---------------------------------|------------|--------------|
| Client :             | City of Iqaluit | Project Location : | lqaluit, NU       |                                 |            |              |
| Date Sampled :       | May 12, 2015    | Borehole:          | 8                 | Sample: S1, S3, S4 & S5         | Depth (m): | as indicated |
| Sample Description : |                 | GRAVEL with sand   | to SAND with silt |                                 | Figure :   | 18           |

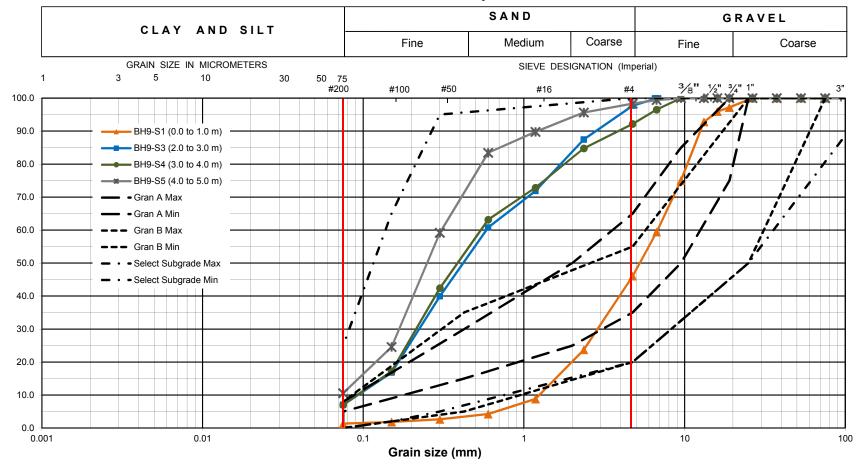
| use b<br>Field | y others<br>work super | vised by an exp representative.  ed with drill cuttings upon completion.                | Elapsed Time Completion |             | Wate<br>evel (<br>Froze | er<br>(m)         |                         | Hole O<br>To (r |        |          | Run<br>No.  | De <sub>l</sub>                | oth                                       |                       | % R                    |                 | Ť   | RQ          |
|----------------|------------------------|---|-------------------------|-------------|-------------------------|-------------------|-------------------------|-----------------|--------|----------|---|--------------------------------|---|-----------------------|------------------------|-----------------|-----|-------------|
| OTES<br>Borel  | 6:<br>nole data re     | quires interpretation by exp. before  | WATE                    | R L         | EVEL                    | RE                | CORD                    | <br>S           |        | <br>] [  |   | CC                             | RE D                                      | RILI                  | LING F                 | RECC            | RD  |             |
|                |                        |   |                         |             |                         |                   |                         |                 |        |          |   |                                |   |                       |                        |                 |     |             |
|                | End                    | of Borehole at 6.0 m Depth  |                         |             |                         |                   |                         |                 |        |          |   |                                |   |                       |                        |                 |     |             |
|                |                        |   |                         | 6           |                         |                   |                         |                 |        |          |   |                                | ×   |                       |                        |                 |     | m           |
|                | - occ                  | asional cobbles and boulders<br>e visible ice, Vx (<10%)<br>gravel, 87% sand, 11% fines | _                       | 5           |                         |                   |                         |                 |        |          |   |                                | ×   |                       |                        |                 |     |             |
| **             | - trac                 | , silty sand<br>e gravel  | 164.0                   | 4           |                         |                   | 2 . N                   |                 |        |          |   |                                |   |                       |                        |                 |     | -           |
|                | - 7%                   | gravel, 86% sand, 7% fines  | _                       |             |                         |                   |                         |                 |        |          | + 3 + 3 + 6<br>+ 3 + 3 + 6 | <b>+</b> ×                     | 1 - 3 - 5 - 5 - 5 - 5 - 5 - 5 - 5 - 5 - 5 |                       |                        | 100             |     | m,          |
|                | - 3%                   | gravel, 90% sand, 7% fines  |                         | 3           | 10.00                   |                   |                         |                 |        |          | - 2 - 2 - 2<br>- 2 - 2 - 2<br>- 3 - 2 - 2 | <b>×</b>                       |   |                       |                        |                 |     |             |
|                | - trac                 | e gravel<br>uent cobbles and boulders<br>visible ice content                            |                         | 2           |                         |                   |                         |                 |        |          |   |                                |   |                       |                        |                 |     | .00c        |
|                | CLAS                   | SS 2<br>brown, sand with silt   | 166.5                   |             |                         |                   |                         |                 |        |          |   | <b>X</b>                       |   |                       |                        |                 |     | <b>M</b>    |
|                | - freq                 | uent cobbles and boulders<br>visible ice content<br>gravel, 43% sand, 2% fines          |                         | 1           |                         |                   |                         |                 |        |          | - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1   | *                              | - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2   |                       |                        |                 |     | <b>8</b>    |
| MBOL           |                        | brown, gravel with sand   | 168                     | p<br>t<br>h | She                     | 20<br>ar St<br>50 | rength                  | 00              | 150    | 200      | kPa   | 1                              | tural M<br>berg Li                        | loistu<br>imits<br>40 | re Cont<br>(% Dry<br>) | ent %<br>Weight | 1)  | NU          |
| S              | <del>-</del>           |   | GEODETIC                | De          | Vane                    | Test              | dard Pe                 | netratior       | Test N | Value    |   |                                | istible \                                 | Vapo<br>50            | ur Read                | 750             | om) | S<br>A<br>M |
| atur<br>ogge   |                        | GEODETIC SB Checked by: J   | AS                      | _           | Shelb                   | y Tul             | one Te<br>oe<br>ngth by |                 |        | +<br>s   |   | Undrain<br>% Strain<br>Shear S | n at Fa<br>Strengt                        | ilure<br>h by         |                        |                 |     | (           |
|                | _                      | AIR TRACK   |                         | -           | Auger                   | San               | nple                    | -               |        |          |   | Natural<br>Atterber            | Moistu                                    | ıre C                 |                        | 9               | ⊢   |             |
|                | Drilled:               | IQALUIT, NU<br>5/12/15  |                         |             | Split S                 | Spool             | n Samp                  | le              |        | <u> </u> |   | Combu                          | stible \                                  | /anoi                 | ır Reac                | lina            |     | ſ           |
|                | tion:                  | IOALLIIT NILL   |                         |             |                         |                   |                         |                 |        |          |   | Pa                             | ge.                                       | _1                    | _ of                   | _1              | _   |             |





100-2650 Queensview Drive Ottawa, ON K2B 8H6

# Method of Test for Sieve Analysis of Aggregate ASTM C-136



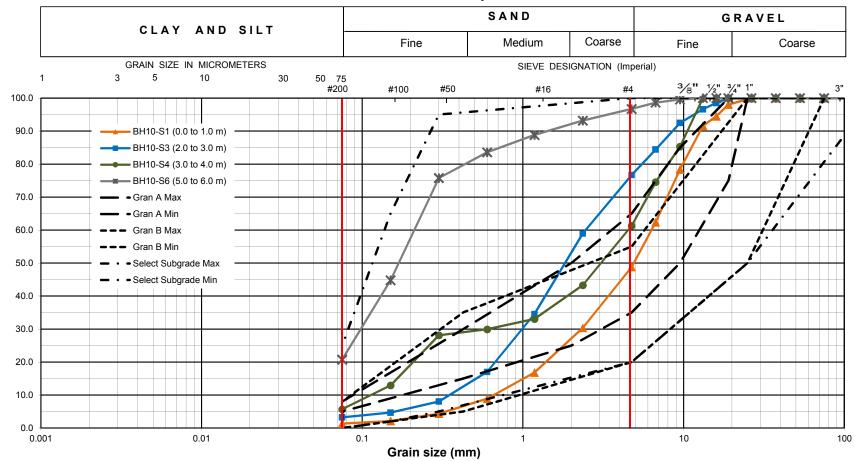
| Exp Project No.:     | OTT-00219428-A0 | Project Name :          | Geotechnical In   | vestigation - Northwest Deposit |            |              |
|----------------------|-----------------|-------------------------|-------------------|---------------------------------|------------|--------------|
| Client :             | City of Iqaluit | Project Location :      | Iqaluit, NU       |                                 |            |              |
| Date Sampled :       | May 12, 2015    | Borehole:               | 9                 | Sample: S1, S3, S4 & S5         | Depth (m): | as indicated |
| Sample Description : |                 | <b>GRAVEL</b> with sand | to SAND with silt |                                 | Figure :   | 20           |

| OTE<br>Bore   | S:<br>ehole data re<br>by others |  | WATE                 |                | EVE<br>Wat | ter            |               |                | lole C  | Oper                       | 1  | F               | lun |            | CO                       |                   | DRIL  | LINC          | G RE                  |   | RD  | R        | QD 9           |
|---------------|----------------------------------|--|----------------------|----------------|------------|----------------|---------------|----------------|---------|----------------------------|--|-----------------|-----|------------|--------------------------|-------------------|---|---------------|-----------------------|---|-----|----------|----------------|
|               |                                  |  |                      |                |            |                |               |                |         |                            |  |                 |     |            |                          |                   |   |               |                       |   |     |          |                |
|               | End                              | of Borehole at 6.0 m Depth   |                      |                |            |                |               |                |         |                            |  |                 |     |            |                          |                   |   |               |                       |   |     |          |                |
|               |                                  |  | 164.0                | 6              |            |                |               |                |         |                            |  |                 |     |            | ×                        |                   |   |               |                       |   |     | 3        |                |
|               | - occ                            | casional cobbles and boulders<br>ce visible ice, Vx (<10%)<br>gravel, 76% sand, 21% fines    |                      | 5              |            |                |               |                |         |                            |  |                 |     |            | <b>-&gt;</b>             | <b>(</b>          |   |               |                       |   |     | <b>8</b> |                |
| 8.*           |                                  | SS 3<br>/, silty sand<br>ce gravel   | 166.0                | 4              |            |                |               |                |         |                            |  |                 |     |            |                          |                   |   |               |                       |   |     |          |                |
|               | - 40%                            | % gravel, 54% sand, 6% fines   |                      | 3              | 000        |                |               |                |         | \$<br>\$<br>\$<br>\$<br>\$ | 3 - 6 - 6 -<br>3 - 6 - 6 -<br>3 - 6 - 6 -<br>3 - 6 - 6 -<br>2 - 6 - 6 -<br>3 - 6 - 6 - |                 |     |            | <b>×</b>                 |                   | 0 - 3 - 1<br>0 - 3 - 1<br>0 - 3 - 1<br>0 - 3 - 1<br>0 - 3 - 1 |               |                       | -0-0-0-<br>-0-0-0-<br>-0-0-0-<br>-0-0-0-<br>-0-0-0- |     | \$.      |                |
|               | - 249                            | % gravel, 73% sand, 3% fines   | _                    |                |            |                |               |                |         |                            |  |                 |     | ×          |                          |                   |   |               |                       |   |     | <b>8</b> |                |
|               |                                  |  |                      | ,              |            |                |               |                |         |                            |  |                 |     | *          |                          |                   |   |               |                       |   |     | 87.      |                |
|               | - trac<br>- frec                 | ce silt<br>quent cobbles and boulders<br>visible ice content<br>% gravel, 47% sand, 1% fines |                      | 1              | 12.0       |                |               |                |         |                            |  |                 |     | *          |                          |                   |   |               |                       |   |     |          |                |
| V   N         | M<br>CLA                         | t brown, gravel with sand to sand with   | GEODETII<br>m<br>170 | C P t h        | Sh         | ear S          | 20<br>Streng  | 40<br>th<br>10 |         | 150                        |  | 200             | kPa |            | Nati<br>Atterb           | 50<br>ural Nerg L | Joistu<br>imits   | re Co<br>(% D | 75<br>onten<br>ory Wo | nt %<br>eight                                       | )   |          | Na<br>Un<br>kľ |
|               | ged by:                          | SB Checked by: JAS   |                      | T <sub>D</sub> | Van        | ar St<br>e Tes | rength        |                | etratio | n Te                       |  | +<br>S<br>/alue |     | She<br>Per | ear St<br>netror<br>mbus | rengt<br>neter    | th by<br>Test   | t<br>our Re   |                       |   | om) | S        | <u> </u>       |
| orill<br>Oatu | Type:<br>ım:                     | AIR TRACK GEODETIC   |                      | _              | SPT        | (N) amic       | Value<br>Cone | Tes            | t       | _                          |  | )<br>)          |     | Atte       | rbero<br>draine          | g Lim<br>ed Tri   |   | at            |                       |   | H   |          | ⊕              |
|               | e Drilled:                       |  |                      | _              |            |                | on Sa         | mple           | ;       |                            |  | ——<br>⊠<br>∎0   |     |            |                          |                   |   | our Re        |                       | g   |     |          | ×              |
| _OCa          | ation:                           | IQALUIT, NU  |                      |                |            |                |               |                |         |                            |  |                 |     |            | ια                       | ge.               |   | — `           | · -                   |   | -   |          |                |



100-2650 Queensview Drive Ottawa, ON K2B 8H6

# Method of Test for Sieve Analysis of Aggregate ASTM C-136



| Exp Project No.:     | OTT-00219428-A0 | Project Name :          | Geotechnical In | vestigation - Northwest Deposit |            |              |  |  |  |  |
|----------------------|-----------------|-------------------------|-----------------|---------------------------------|------------|--------------|--|--|--|--|
| Client :             | City of Iqaluit | Project Location :      | lqaluit, NU     | Iqaluit, NU                     |            |              |  |  |  |  |
| Date Sampled :       | May 13, 2015    | Borehole:               | 10              | Sample: S1, S3, S4 & S6         | Depth (m): | as indicated |  |  |  |  |
| Sample Description : |                 | <b>GRAVEL</b> with sand | Figure :        | 22                              |            |              |  |  |  |  |

| ate Drilled: 5/14/15  rill Type: AIR TRACK  atum: GEODETIC  ogged by: SB Checked by: JAS  Spit Spoon Sample Auger Sample Natural Moisture Content  Alterberg Limits Undersided Triaxial at Shelby Tube Shear Strength by Penetrometer Test  Shear Strength by Shear Strength by Penetrometer Test  Soil Description  Soil Description  Soil Description  CLASS 1 to CLASS 2  Medium brown, sand with silt and gravel to sand with gravel - no visible ice content  - 36% gravel, 58% sand, 8% fines  CLASS 4 sand, 3% fines  Spit Spoon Sample Auger Sample Natural Moisture Content  Spit Ny Value O Atterberg Limits Undersided Triaxial at Shelby Tube Shear Strength by Penetrometer Test  Shear Strength by Shear Strength by Penetrometer Test  Shear Strength by Shear Strength by Penetrometer Test  Shear Strength by O Shear Strength by Penetrometer Test  Shear Strength by Shear Strength by Penetrometer Test  Shear Strength by O Shear Strength by Penetrometer Test  Shear Strength by O Shear Strength by Penetrometer Test  Shear Strength by O Shear Strength by Penetrometer Test  Shear Strength by O Shear Strength by Penetrometer Test  Shear Strength by O Shear Strength by Penetrometer Test  Shear Strength by O Shear Strength by Penetrometer Test  Shear Strength by O Shear Stren |   |                |            | sanu, 3% iines            |
|--|---|----------------|------------|---------------------------|
| Aller TRACK  Itum: GEODETIC  gged by: SB Checked by: JAS  Solit Description  SOIL Description  Solit Description  GEODETIC  The standard Penetration Test N Value  Solit Description  GEODETIC  The standard Penetration Test N Value  Solit Description  GEODETIC  The standard Penetration Test N Value  Solit Description  GEODETIC  The standard Penetration Test N Value  Solit Description  GEODETIC  The standard Penetration Test N Value  Solit Description  GEODETIC  The standard Penetration Test N Value  Solit Description  GEODETIC  The standard Penetration Test N Value  Solit Description  Solit Description  GEODETIC  The standard Penetration Test N Value  Solit Description  Solit Description  GEODETIC  The standard Penetration Test N Value  Solit Description  Standard Penetration Test N Value  Solit Description  Solit Description  Solit Description  Solit Description  To solit Description  Solit Description  The standard Penetration Test N Value  Solit Description  Solit Description  Solit Description  Solit Description  Solit Description  To solit Penetration Test N Value  Solit Description  Solit Descr | <b>*</b>  |                |            | sand 3% fines             |
| Auger Sample   |   |                | 3          | _                         |
| Auger Sample SPT (N) Value O Atterberg Limits Undrained Triaxial at Shelby Tube Shear Strength by Vane Test Shelby Tube Shear Strength Shear Strength Shelby Tube Shear Strength Shelby Tube Shear Strength Shelby Tube Shear Strength Shelby Tube Shear Strength Shear Strength Shelby Tube Shear Strength Shelby Tube Shear Strength Shelby Tube Shear Strength Shelby Tube Shear Strength Shear Strength Shelby Tube Shear Strength Shelby Tube Shear Strength Shear Stren |   |                |            | sanu, 3% iines            |
| Auger Sample SPT (N) Value  GEODETIC  GEODETIC  GEODETIC  GEODETIC  GEODETIC  Shear Strength by Vane Test  Shear Strength by Vane Test  Shear Strength by Vane Test  GEODETIC  GEODETIC  Shear Strength by Vane Test  Shear Strength by Vane Test  GEODETIC  The performance of the per | *   |                |            | eand 3% fines —           |
| Type: AIR TRACK  GEODETIC  ged by: SB Checked by: JAS  SOIL DESCRIPTION  GEODETIC  SOIL DESCRIPTION  GEODETIC  GEODETIC  GEODETIC  Shear Strength by Vane Test  Shear Strength by Vane Test  CLASS 1 to CLASS 2  Medium brown, sand with silt and gravel to sand with gravel  - frequent cobbles and boulders  - no visible ice content  Auger Sample  SPT (N) Value  O Atterberg Limits  Undrained Triaxial at % Strain at Failure  Shear Strength by Yane Test  Shear Strength by Penetrometer Test  Combustible Vapour Reading (ppm)  250 500 750  Natural Moisture Content  Shear Strength by Penetrometer Test  CLASS 1 to CLASS 2  Medium brown, sand with silt and gravel to sand with gravel  - frequent cobbles and boulders  - no visible ice content  |   |                | 2          | _                         |
| Auger Sample   |   |                |            |                           |
| Auger Sample SPT (N) Value Atterberg Limits  M: GEODETIC  ed by: SB Checked by: JAS  Shelby Tube Shear Strength by Vane Test  SOIL DESCRIPTION  GEODETIC  GEODETIC  SOIL DESCRIPTION  GEODETIC  GEODETIC  GEODETIC  GEODETIC  M 170  Auger Sample SPT (N) Value O Atterberg Limits W Strain at Failure Shear Strength by Penetrometer Test  Shelby Tube Shear Strength by Penetrometer Test  Combustible Vapour Reading (ppm) 250 500 750 Natural Moisture Content W Atterberg Limits W Strain at Failure  Shear Strength by Penetrometer Test  CLASS 1 to CLASS 2 Medium brown, sand with silt and gravel to sand with gravel - frequent cobbles and boulders - no visible ice content  | + + + + + + + + + + + + + + + + + + +                               |                |            | _                         |
| Auger Sample SPT (N) Value Atterberg Limits  Matural Moisture Content Atterberg Limits  Dynamic Cone Test Undrained Triaxial at Shelby Tube Shear Strength by Vane Test  Soll Description  Soll Description  GEODETIC  Soll Description  GEODETIC  GEODETIC  Shear Strength by Vane Test  Shelby Tube Shear Strength by Vane Test  Shelby Tube Shear Strength by Penetrometer Test  Shelby Tube Shear Strength by Penetrometer Test  Combustible Vapour Reading (ppm) 250 500 750 MALURAL Moisture Content % Atterberg Limits (% Dry Weight) Light Shear Strength by Penetrometer Test  CLASS 1 to CLASS 2 Medium brown, sand with silt and gravel to sand with gravel - frequent cobbles and boulders - no visible ice content  |   |                | 1          | _                         |
| Auger Sample SPT (N) Value Atterberg Limits  M: GEODETIC  Dynamic Cone Test Shelby Tube  Shear Strength by Yane Test  SOIL DESCRIPTION  GEODETIC  SOIL DESCRIPTION  GEODETIC  M  170  Auger Sample SPT (N) Value  Dynamic Cone Test Shelby Tube  Shear Strength by Yane Test N Value  250  20  Atterberg Limits  Undrained Triaxial at Shelby Tube  Shear Strength by Penetrometer Test  Shear Strength by Penetrometer Test  Solic Description  GEODETIC  M  170  Death Shear Strength Stear Strength Shear Strength |   |                | 1          | ent<br>sand, 8% fines     |
| Auger Sample SPT (N) Value Atterberg Limits  Matural Moisture Content Atterberg Limits  Dynamic Cone Test Shelby Tube Shear Strength by Vane Test  SOIL DESCRIPTION  GEODETIC  SOIL DESCRIPTION  GEODETIC  M  Solid DESCRIPTION  GEODETIC  M  Solid DESCRIPTION  GEODETIC  M  Standard Penetration Test N Value Standard | <u> </u>  |                |            | and boulders —            |
| Auger Sample   |   |                |            | d with silt and gravel to |
| Auger Sample SPT (N) Value  GEODETIC  Ed by:  SB  Checked by: JAS  Auger Sample SPT (N) Value O Atterberg Limits Undrained Triaxial at % Strain at Failure Shelby Tube Shear Strength by Vane Test  Shelby Tube Shear Strength by Penetrometer Test  |   | -              | h          | 2                         |
| Alr TRACK  Auger Sample SPT (N) Value  Dynamic Cone Test Shelby Tube  SB  Checked by: JAS  Auger Sample SPT (N) Value  Dynamic Cone Test Shelby Tube Shear Strength by Vane Test  Shear Strength by Penetrometer Test  Natural Moisture Content Atterberg Limits Undrained Triaxial at % Strain at Failure Shear Strength by Penetrometer Test   | 40 60 80 Natural Moisture Content % Atterberg Limits (% Dry Weight) | Shear Strength | t<br>h     | ESCRIPTION                |
| Auger Sample   | 250 500 750   | 20 40          | ETIC D e p | ESCRIPTION                |
| Type: AIR TRACK  Auger Sample  | 250 500 750   |                | D ETIC e   |                           |
| Type: AIR TRACK  Auger Sample SPT (N) Value  Dynamic Cone Test Shelby Tube  Auger Sample Atterberg Limits Undrained Triaxial at % Strain at Failure  | y + Shear Strength by S Penetrometer Test                           |                |            | Checked by: JAS           |
| Type: AIR TRACK  Auger Sample SPT (N) Value  Auger Sample Atterberg Limits  Atterberg Limits   | % Strain at Failure   |                |            |                           |
| Augus Sampla Natural Maistura Content  | O Atterberg Limits  | SPT (N) Value  |            |                           |
|  | _   |                |            |                           |
| ation: IQALUIT, NU   |   |                |            |                           |

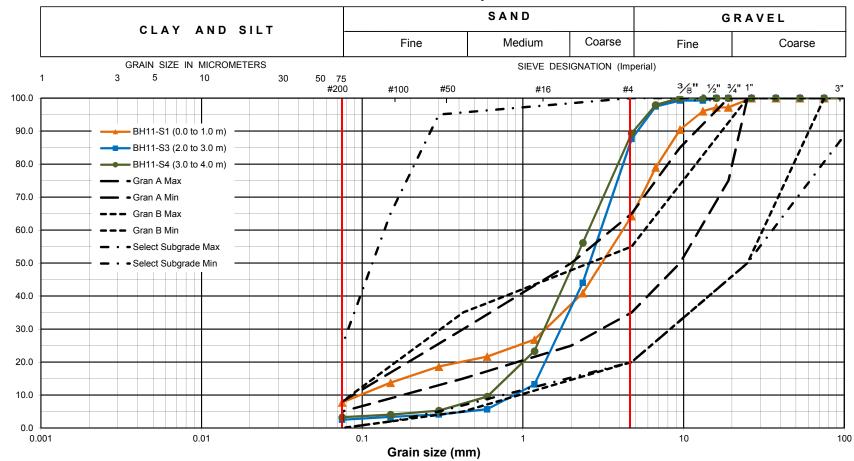
LOG OF BOREHOLE NORTHWESTDEPOSITBOREHOLELOGS.GPJ TROW OTTAWA.GDT 1/29/16

5. This Figure is to read with exp. Services Inc. report OTT-00219428-A0



100-2650 Queensview Drive Ottawa, ON K2B 8H6

# Method of Test for Sieve Analysis of Aggregate ASTM C-136



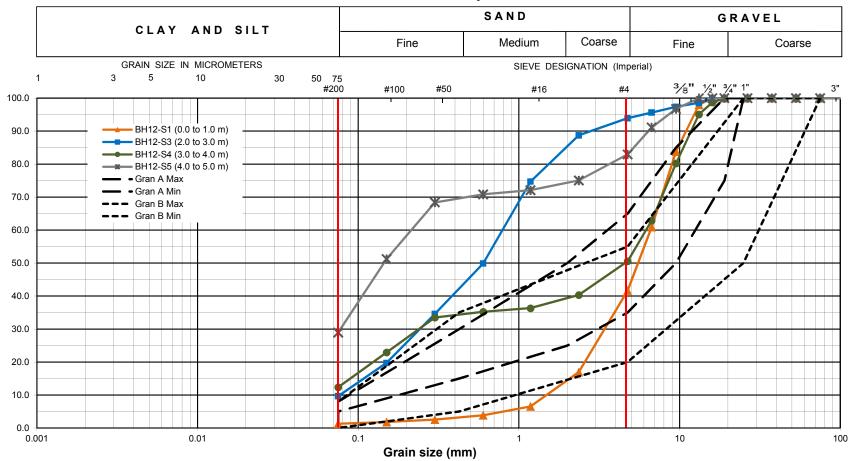
| Exp Project No.:     | OTT-00219428-A0 | Project Name :     | Geotechnical In | vestigation - Northwest Deposit |             |              |
|----------------------|-----------------|--------------------|-----------------|---------------------------------|-------------|--------------|
| Client :             | City of Iqaluit | Project Location : | Iqaluit, NU     |                                 |             |              |
| Date Sampled :       | May 14, 2015    | Borehole:          | 11              | Sample: S1, S3 & S4             | Depth (m) : | as indicated |
| Sample Description : |                 | SAND with          | gravel          | Figure :                        | 24          |              |

| Bo      | rehole<br>by o           | thers                   | equires interpretation by exp. before vised by an exp representative.   | WATElapsed Time Completion |       | Wa<br>Leve | eter<br>el (m<br>ozen     | ECOI                     |       | Hole Op<br>To (m |        |            | Run<br>No.       | D      | COF<br>epti<br>(m) |                                   | RILL  | .ING<br>% R |     | ORE  |            | QD                 |
|---------|--------------------------|-------------------------|---|----------------------------|-------|------------|---------------------------|--------------------------|-------|------------------|--------|------------|------------------|--------|--------------------|-----------------------------------|-------|-------------|-----|--|------------|--------------------|
| <u></u> | EŞ:                      |                         |   | 10/07                      | TED : | LEV"       |                           | ECC!                     |       |                  |        | <u>: :</u> |                  |        | 205                | DE DE                             | י יום | INC         | DEC | `OD5   | $\Box$     |                    |
|         |                          |                         |   |                            |       |            |                           |                          |       |                  |        |            |                  |        |                    |                                   |       |             |     |  |            |                    |
|         |                          | Ena                     | of Borehole at 6.0 m Depth  |                            |       |            |                           |                          |       |                  |        |            |                  |        |                    |                                   |       |             |     |  |            |                    |
|         |                          | -<br>- <u>-</u> .       |   | 166.0                      |       | 6          |                           |                          |       |                  |        |            |                  |        | *                  |                                   |       |             |     |  |            |                    |
|         | _                        | - 17%<br>-              | 6 gravel, 54% sand, 29% fines   | _                          |       | 5          |                           |                          |       |                  |        |            |                  |        |                    |                                   |       |             |     |  |            |                    |
|         |                          | - occ<br>som            | , silty sand with gravel<br>asional cobbles and boulders<br>ne visible ice, Vx (10% to 20%)                     | _                          |       |            |                           |                          |       |                  |        |            |                  |        | ×                  |                                   |       |             |     |  | - (P)      |                    |
| 3       |                          |                         | 6 gravel, 39% sand, 12% fines   | 168.0                      |       | 4          |                           |                          |       |                  |        |            |                  | ×      |                    |                                   |       |             |     |  | - <b>8</b> |                    |
| 100000  |                          | _                       |   |                            | :     | 3          |                           |                          |       |                  |        | - 1 - 3    |                  |        |                    |                                   |       |             | 4   |  |            |                    |
| 0.0000  |                          | _                       | gravel, 84% sand, 10% fines   |                            |       |            |                           |                          |       |                  |        |            |                  |        | *                  |                                   |       |             |     |  | -<br>-     |                    |
| 9       |                          | Dark<br>silty s<br>freq | brown, sand with silt and gravel sand with gravel puent cobbles and boulders the to some visible ice, Vx (5% to | 4                          | :     | 2          |                           |                          |       |                  |        |            |                  |        |                    |                                   |       |             |     |  |            |                    |
| 0,0000  |                          | CLAS                    | SS 2  | 170.5                      |       | 1          |                           |                          |       |                  |        |            |                  | ×      |                    |                                   |       |             |     |  |            |                    |
| 3.0.00  |                          | - freq<br>- no \        | uent cobbles and boulders<br>visible ice content<br>6 gravel, 41% sand, 1% fines                                |                            |       | 1 -        |                           |                          |       |                  |        |            |                  | ×      |                    |                                   |       |             |     |  | - 8        |                    |
| 0       | L                        | CLAS<br>Dark<br>- trac  | brown, gravel with sand   | 172                        |       | h -        |                           | 50                       | 10    | 00               | 150    | 2          | 00               |        | 20                 |                                   | 40    |             | 60  | 6 - 1 - 2<br>6 - 1 - 2<br>6 - 1 - 2<br>6 - 1 - 2 | S          | _                  |
| ,       | S<br>Y<br>M<br>B         |                         | SOIL DESCRIPTION  | GEODE<br>m                 | TIC   | D e p t S  | :                         | andard<br>20<br>Streng   | 4     | etration<br>0    | Test I |            | lue<br>30<br>kPa |        | 25                 | ible Va<br>0<br>ral Mo<br>erg Lin | 500   | )           | 750 |  |            | Na<br>Ur<br>k      |
| og      | ged                      | l by:                   | SB Checked by:  | JAS                        |       | She        | elby T<br>ear St<br>ne Te | rength                   | n by  |                  |        | +<br>s     |                  | Shea   | r Str              | at Fail<br>ength<br>eter T        | by    |             |     |  |            | 4                  |
|         | l Ty <sub>l</sub><br>um: |                         | AIR TRACK GEODETIC  |                            | _     | SP         | T (N)                     | ample<br>Value<br>: Cone |       | t                |        | <b>□</b>   |                  | Attert | berg               | oistur<br>Limits<br>d Triax       | ;     |             |     | ŀ  |            | <b>^</b><br>⊖<br>⊕ |
|         |                          |                         | 5/15/15   |                            |       |            |                           | on Sa                    | ımple | e                |        |            |                  |        |                    | ble Va                            |       |             | _   |  |            | _<br><b>&gt;</b>   |
| 00      | atio                     | n:                      | IQALUIT, NU   |                            |       |            |                           |                          |       |                  |        |            |                  | '      | ay                 | e                                 |       | _ 01        | _   | <u>'</u>   |            |                    |



100-2650 Queensview Drive Ottawa, ON K2B 8H6

# Method of Test for Sieve Analysis of Aggregate ASTM C-136



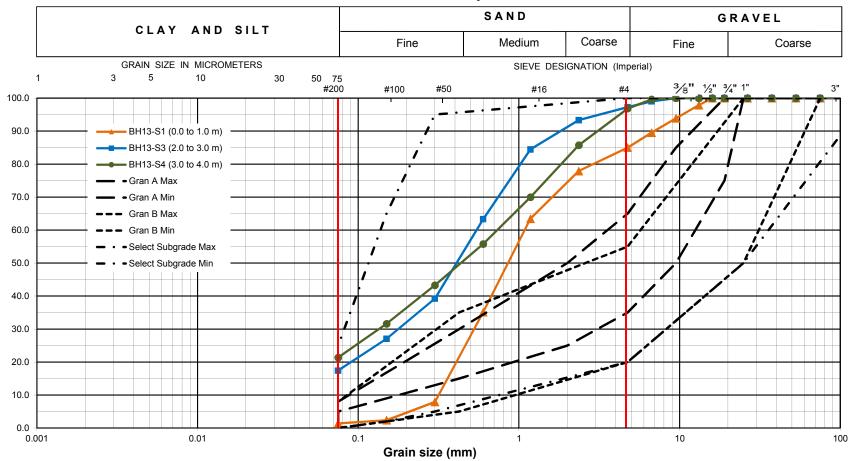
| Exp Project No.:     | OTT-00219428-A0 | Project Name :      | Geotechnical Investigation - Northwest Deposit |                         |            |              |  |  |  |  |  |  |
|----------------------|-----------------|---------------------|--|-------------------------|------------|--------------|--|--|--|--|--|--|
| Client :             | City of Iqaluit | Project Location :  | lqaluit, NU                                    |                         |            |              |  |  |  |  |  |  |
| Date Sampled :       | May 15, 2015    | Borehole:           | 12   | Sample: S1, S3, S4 & S5 | Depth (m): | as indicated |  |  |  |  |  |  |
| Sample Description : | GR              | AVEL with sand to s | ilty SAND with gr                              | avel                    | Figure :   | 26           |  |  |  |  |  |  |

| Project No:                   | OTT-00219428-A0   | g or bo         | <b>)</b>         | CIIO                                      |           | <u> </u>            | <u> </u>   |            | igure N                | Jo.                         | 27                        |                       | $\epsilon$         | X                            |
|-------------------------------|---|-----------------|------------------|---|-----------|---------------------|--|------------|------------------------|-----------------------------|---------------------------|-----------------------|--------------------|------------------------------|
| Project:                      | GEOTECHNICAL INVESTIGA  | TION - NORTHW   | /ES              | ST DEPOS                                  | IT        |                     |  | _ '        | Ū                      | _                           | 1 of                      | _                     |                    | '                            |
| Location:                     | IQALUIT, NU   |                 |                  |   |           |                     |  |            | ιαί                    | Je                          | 01                        |                       |                    |                              |
| Date Drilled:                 | 5/15/15   |                 | _                | Split Spoon Sa                            | ample     | :                   | $\boxtimes$  |            | Combus                 | tible Vap                   | our Readi                 | ng                    |                    |                              |
| Drill Type:                   | AIR TRACK   |                 | _                | Auger Sample<br>SPT (N) Value             |           |                     |  |            | Natural M<br>Atterberg |                             | Content                   |                       |                    | X                            |
| Datum:                        | GEODETIC  |                 | _                | Dynamic Cone                              |           | <del>-</del>        | _  |            | Undraine<br>% Strain   | ed Triaxia                  |                           |                       | •                  | Φ                            |
| Logged by:                    | SB Checked by:  | JAS             |                  | Shelby Tube<br>Shear Strengt<br>Vane Test | h by      |                     | +<br>s   |            | Shear St<br>Penetror   | trength b                   | у                         |                       |                    | •                            |
| SY MBO                        | SOIL DESCRIPTION  | GEODETIC<br>m   | D<br>e<br>p<br>t | 20<br>Shear Streng                        | 40<br>gth |                     | 8  | 30<br>kPa  | Nati<br>Atterb         | 50 sural Mois<br>perg Limit | ture Conte<br>ts (% Dry V | 50<br>nt %<br>Veight) | n) SA<br>MP<br>LES | Natural<br>Unit Wt.<br>kN/m³ |
| trac :                        | brown, sand with gravel<br>se silt  | 170             | 0                | 50  | 10        | 0 150               |  | 00         |                        | 20                          | 40 6                      | 50                    | 800                |                              |
|                               | visible ice content<br>6 gravel, 82% sand, 2% fines                           |                 | 1                |   |           |                     |  |            | <b>X</b>               |                             |                           |                       |                    | -                            |
| CLAS                          | SS 3  | 168.5           |                  |   |           |                     |  |            | ×                      |                             |                           |                       |                    | ?                            |
| Light<br>- trac<br>- occ      | brown to greyish brown, silty sa<br>te gravel<br>asional cobbles and boulders | and<br>—        | 2                |   |           |                     |  |            |                        |                             |                           |                       |                    | _                            |
|                               | visible ice content gravel, 80% sand, 17% fines                               | _               |                  |   |           |                     |  |            | ×                      |                             |                           |                       |                    | >                            |
|                               | ne visible ice, Vx (10% to 20%) to depth                                      | pelow           | 3                |   |           |                     | 1 - 3<br>1 - 3<br>1 - 3<br>1 - 3<br>1 - 3          |            |                        |                             |                           |                       |                    | -                            |
|                               | gravel, 76% sand, 21% fines   | -               |                  |   |           |                     | 6 + 2<br>6 + 2<br>6 + 2<br>6 + 2<br>6 + 2<br>6 + 2 |            | <b>******</b>          | <b>(</b>                    |                           |                       |                    | ,                            |
|                               |   | _               | 4                |   |           |                     | 1.0  |            |                        |                             |                           |                       |                    |                              |
|                               |   | -               |                  |   |           |                     |  |            | ×                      |                             |                           |                       | \m                 | ,                            |
|                               |   |                 | 5                |   |           |                     |  |            | ×                      |                             |                           |                       |                    | 2                            |
| End                           | of Borehole at 6.0 m depth  | 164.0           | 6                |   |           |                     | \$ - 5<br>\$ - 5<br>\$ - 5<br>\$ - 5               |            |                        |                             |                           |                       |                    |                              |
| Lind                          | or Boreliole at 0.0 ill depth   |                 |                  |   |           |                     |  |            |                        |                             |                           |                       |                    |                              |
|                               |   |                 |                  |   |           |                     |  |            |                        |                             |                           |                       |                    |                              |
|                               |   |                 |                  |   |           |                     |  |            |                        |                             |                           |                       |                    |                              |
| NOTES:<br>1. Borehole data re | equires interpretation by exp. before   | WATE            | ]<br>R L         | EVEL RECO                                 | RDS       |                     | ]  |            | CO                     | RE DRI                      | ILLING R                  | ECOF                  | D                  |                              |
| use by others                 | vised by an exp representative.   | Elapsed<br>Time | L                | Water<br>_evel (m)                        | F         | lole Open<br>To (m) | 1  | Run<br>No. | Dep                    |                             | % Re                      | C.                    | R                  | QD %                         |
| ·                             | led with drill cuttings upon completion.                                      | Completion      |                  | Frozen                                    |           | . ,                 |  |            | 1.77                   |                             |                           |                       |                    |                              |
| 4. See Notes on Sa            | ample Descriptions  |                 |                  |   |           |                     |  |            |                        |                             |                           |                       |                    |                              |
| OTT-00219428-                 | read with exp. Services Inc. report A0  |                 |                  |   |           |                     |  |            |                        |                             |                           |                       |                    |                              |



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# Method of Test for Sieve Analysis of Aggregate ASTM C-136



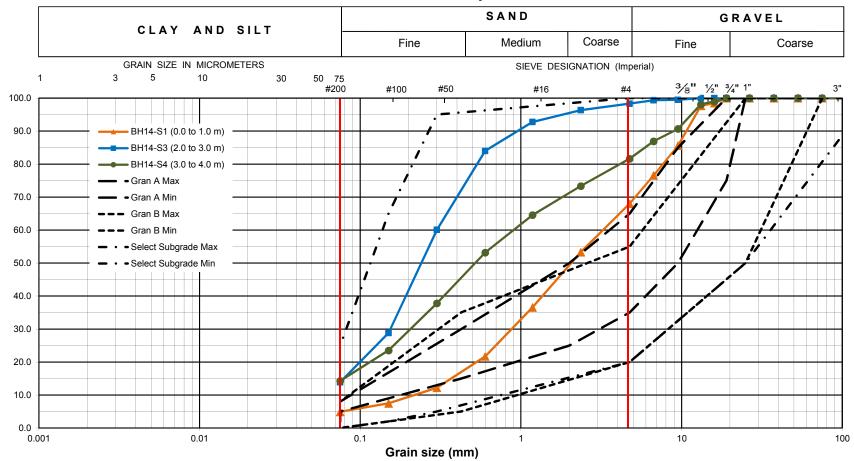
| Exp Project No.:     | OTT-00219428-A0 | Project Name :     | Geotechnical In | vestigation - Northwest Deposit |            |              |  |  |  |  |
|----------------------|-----------------|--------------------|-----------------|---------------------------------|------------|--------------|--|--|--|--|
| Client :             | City of Iqaluit | Project Location : | Iqaluit, NU     | Iqaluit, NU                     |            |              |  |  |  |  |
| Date Sampled :       | May 15, 2015    | Borehole:          | 13              | Sample: S1, S3 & S4             | Depth (m): | as indicated |  |  |  |  |
| Sample Description : |                 | SAND with grave    | I to silty SAND | Figure :                        | 28         |              |  |  |  |  |

| Project No:                        | OTT-00219428-A0  | g or be         |           |   |       | , <u>Di</u>                                 |                   |   | igure N              | lo   | 29                       | •••           | $\leftarrow$ | ;x                           |
|------------------------------------|--|-----------------|-----------|---|-------|---|-------------------|---|----------------------|--|--------------------------|---------------|--------------|------------------------------|
| Project:                           | GEOTECHNICAL INVESTIGA   | HON - NORTHW    | ES        | I DEPOS                                 | 11    |   |                   |   | Pag                  | ge   | 1_ of                    | 1_            |              |                              |
| Location:                          | IQALUIT, NU  |                 |           |   |       |   |                   | _   |                      |  |                          |               |              |                              |
| Date Drilled:                      | 5/19/15  |                 |           | Split Spoon S<br>Auger Sample           |       |   |                   |   | Combust<br>Natural N |  | our Readir               | ng            |              | ×                            |
| Drill Type:                        | AIR TRACK  |                 |           | SPT (N) Value                           | •     |   | 0                 |   | Atterberg            |  | Content                  | Ī             |              | <b>→</b>                     |
| Datum:                             | GEODETIC   |                 |           | Dynamic Con-<br>Shelby Tube             | e Tes | t —   | _                 |   | Undraine<br>% Strain |  |                          |               |              | $\oplus$                     |
| Logged by:                         | SB Checked by:   | JAS             |           | Shear Strengt<br>Vane Test              | h by  |   | +<br>s            |   | Shear St<br>Penetron |  |                          |               |              | <b>A</b>                     |
| S Y M B O L                        | SOIL DESCRIPTION   | GEODETIC<br>m   | D e p t h | Standard<br>20<br>Shear Streng<br>50    | 4     |   | Valu<br>8         | 0<br>kPa  | 25                   | 50 5<br>ural Mois<br>erg Limit   | ture Conte<br>s (% Dry W | 50            | SAMPLES      | Natural<br>Unit Wt.<br>kN/m³ |
|                                    | SS 1<br>ium brown, sand with gravel<br>e silt  | 205             | 0         | 50                                      | - I   | 00 150                                      | 20                |   | 2                    |  | 40 6                     |               | 3            |                              |
| ) occ                              | casional cobbles and boulders<br>visible ice content<br>% gravel, 62% sand, 5% fines | 204.0           |           |   |       |   |                   |   | ×                    | - 2 - 2 - 2 - 2  |                          |               | -100         | ·                            |
| CLA<br>Ligh<br>grav                | t brown, silty sand to silty sand w  | 204.0           | 1         |   |       |   |                   |   |                      |  |                          |               |              |                              |
| - free                             | quent cobbles and boulders visible ice content                                       |                 |           |   |       |   |                   |   | X                    |  |                          |               | -\ <b>®</b>  |                              |
|                                    |  | _               | 2         |   |       |   |                   |   |                      |  |                          |               |              |                              |
| - 3%                               | gravel, 83% sand, 14% fines  |                 |           |   |       |   |                   |   | X                    | - 3 - 3 - 3 - 3 - 3 - 3 - 3 - 3 - 3 - 3                                  |                          |               | -100         | ,                            |
|                                    |  |                 | 3         | - 0 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - |       |   |                   | - 6 - 6 - 6 - 6 -<br>- 6 - 6 - 6 - 6 -<br>- 6 - 6 |                      | - 3 - 0 - 0 - 3<br>- 3 - 0 - 0 - 3<br>- 3 - 0 - 0 - 3<br>- 3 - 0 - 0 - 3 |                          | -3-6-1-       | en.          |                              |
| - 189                              | % gravel, 68% sand, 14% fines  | 201.0           |           |   |       |   |                   |   | X                    |  |                          |               |              | •                            |
| End<br>- infe                      | of Borehole at 4.0 m Depth<br>erred bedrock  |                 | 4         |   |       |   |                   |   |                      |  |                          |               |              |                              |
|                                    | ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,   |                 |           |   |       |   |                   |   |                      |  |                          |               |              |                              |
|                                    |  |                 |           |   |       |   |                   |   |                      |  |                          |               |              |                              |
|                                    |  |                 |           |   |       |   |                   |   |                      |  |                          |               |              |                              |
|                                    |  |                 |           |   |       |   |                   |   |                      |  |                          |               |              |                              |
|                                    |  |                 |           |   |       |   |                   |   |                      |  |                          |               |              |                              |
|                                    |  |                 |           |   |       |   |                   |   |                      |  |                          |               |              |                              |
|                                    |  |                 |           |   |       |   |                   |   |                      |  |                          |               |              |                              |
| NOTES:                             | equires interpretation by exp. before  | WATER           | <br>      | EVEL RECO                               | RDS   | <u>                                    </u> | ] [               |   | COI                  | RE DRI   | LLING R                  | ECOR          | :<br>D       |                              |
| use by others                      |  | Elapsed<br>Time |           | Water<br>evel (m)                       |       | Hole Open<br>To (m)                         | $\dagger \dagger$ | Run<br>No.  | Dept<br>(m)          | th   | % Re                     |               |              | QD %                         |
|                                    | rvised by an exp representative.  led with drill cuttings upon completion.           | Completion      |           | Frozen                                  |       | 10 (111)                                    |                   | INU.  | (111)                |  |                          | $\overline{}$ |              |                              |
|                                    | ample Descriptions   |                 |           |   |       |   |                   |   |                      |  |                          |               |              |                              |
| 5. This Figure is to OTT-00219428- | read with exp. Services Inc. report A0   |                 |           |   |       |   |                   |   |                      |  |                          |               |              |                              |



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# Method of Test for Sieve Analysis of Aggregate ASTM C-136



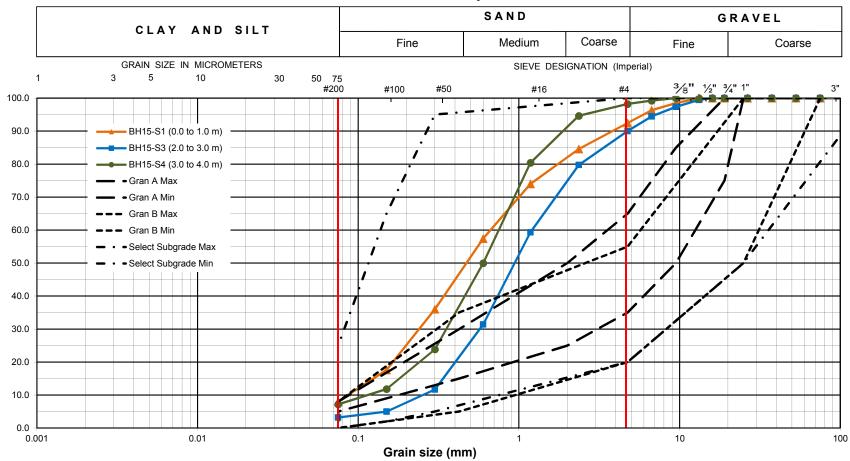
| Exp Project No.:     | OTT-00219428-A0 | Project Name :     | Geotechnical In | vestigation - Northwest Deposit |            |              |  |  |  |  |
|----------------------|-----------------|--------------------|-----------------|---------------------------------|------------|--------------|--|--|--|--|
| Client :             | City of Iqaluit | Project Location : | lqaluit, NU     | Iqaluit, NU                     |            |              |  |  |  |  |
| Date Sampled :       | May 19, 2015    | Borehole:          | 14              | Sample: S1, S3 & S4             | Depth (m): | as indicated |  |  |  |  |
| Sample Description : |                 | SAND with grave    | I to silty SAND | Figure :                        | 30         |              |  |  |  |  |

| Project No:                       | OTT-00219428-A0   |               |         | CIIO   | ıc               |                                     |  |            | Tigura N                          | la.                              | 31                       |  | $\mathbf{C}$       | X                             |
|-----------------------------------|---|---------------|---------|--|------------------|-------------------------------------|--|------------|-----------------------------------|----------------------------------|--------------------------|--|--------------------|-------------------------------|
| Project:                          | GEOTECHNICAL INVESTIGATION - N  | NORTHW        | /ES     | ST DEPOS   | IT               |                                     |  | _ '        | igure N                           |                                  |                          | . 1  |                    | '                             |
| Location:                         | IQALUIT, NU   |               |         |  |                  |                                     |  | _          | Pag                               | je                               | 1_ of _                  |  |                    |                               |
| Date Drilled:                     | 5/20/15   |               |         | Split Spoon Sa   | ample            |                                     |  |            | Combust                           | ible Vapo                        | our Readir               | ng   |                    | П                             |
| Drill Type:                       | AIR TRACK   |               |         | Auger Sample   |                  |                                     |  |            | Natural N                         |                                  | Content                  |  |                    | ×                             |
| Datum:                            | GEODETIC  |               | _       | SPT (N) Value<br>Dynamic Cone                                      |                  | -                                   |  |            | Atterberg<br>Undraine             | d Triaxia                        |                          | ļ  |                    | <del>-</del> О                |
| Logged by:                        | SB Checked by: JAS  |               | _       | Shelby Tube<br>Shear Strengt<br>Vane Test                          | h by             |                                     | +<br>s   |            | % Strain<br>Shear Str<br>Penetron | rength by                        | /                        |  |                    | <b>A</b>                      |
| s y                               |   |               | De      | Standard   | Penet            | ration Te                           | st N Val   | ue         | Combus<br>25                      |                                  | our Readir               | ng (ppm  | ) S<br>A<br>M<br>P | Natural                       |
| G M B O L                         | SOIL DESCRIPTION  | GEODETIC<br>m | e p t h | 20<br>Shear Streng<br>50   | 40<br>gth<br>100 | 60<br>150                           |  | kPa<br>00  |                                   | ıral Moist<br>erg Limits         | ure Conter<br>s (% Dry W | nt %<br>/eight)  | —<br>NE L L L      | Unit Wt.<br>kN/m <sup>3</sup> |
|                                   | SS 2<br>um brown to light brown, sand with silt<br>be gravel              |               |         | -5 6- 8-5 8-5<br>-5 6- 8-5 8-5<br>-5 6- 8-5 8-5<br>-5 6- 8-5 - 8-5 |                  |                                     | 2 -0 - 0 - 2 -<br>2 -0 - 0 - 2 -<br>2 -0 - 0 - 2 -<br>2 -0 - 0 - 2 - |            |                                   | -1-0-0-1                         |                          | - 2- 2- 3 -<br>- 2- 2- 3 -<br>- 2- 2- 3 -<br>- 2- 2- 3 - |                    |                               |
| frec                              | quent cobbles and boulders visible ice content gravel, 85% sand, 8% fines |               |         |  |                  |                                     |  |            | ×                                 |                                  |                          |  | -83                |                               |
|                                   | -   |               | 1       |  |                  |                                     |  |            |                                   |                                  |                          |  |                    |                               |
|                                   | -   |               |         |  |                  |                                     |  |            | ×                                 |                                  |                          |  | - P                |                               |
|                                   | -   |               | 2       |  |                  |                                     |  |            |                                   |                                  |                          |  |                    |                               |
| :                                 | % gravel, 87% sand, 3% fines  |               |         |  |                  |                                     |  |            | *                                 |                                  |                          |  | - FP               |                               |
|                                   | -   |               | 3       | -3 (-1 - 3 - 3 - 4 - 3 - 3 - 4 - 3 - 3 - 4 - 3 - 3                 |                  | - 1 - 2 1 - 1 - 1 - 1 - 1 - 1 - 1 - | 3 -0 - 0 - 3 - 3 - 3 - 3 - 3 - 3 - 3 - 3                             |            |                                   | -1-1-1-1<br>-1-1-1-1<br>-1-1-1-1 |                          |  |                    |                               |
|                                   |   |               |         |  |                  |                                     | 3 -0 - 0 - 3 - 3 - 3 - 3 - 3 - 3 - 3 - 3                             |            | ×                                 |                                  |                          |  | _m,                |                               |
| : 2%                              | gravel, 91% sand, 7% fines  |               |         |  |                  |                                     |  |            |                                   |                                  |                          |  | ,                  |                               |
|                                   |   |               | *       |  |                  |                                     |  |            |                                   |                                  |                          |  | ,                  |                               |
|                                   | -   |               |         |  |                  |                                     |  |            | <b>X</b>                          |                                  |                          |  |                    |                               |
| End<br>- infe                     | of Borehole at 5.0 m Depth  | 189.0         | - 5     |  |                  |                                     |  |            |                                   |                                  |                          |  |                    |                               |
|                                   |   |               |         |  |                  |                                     |  |            |                                   |                                  |                          |  |                    |                               |
|                                   |   |               |         |  |                  |                                     |  |            |                                   |                                  |                          |  |                    |                               |
|                                   |   |               |         |  |                  |                                     |  |            |                                   |                                  |                          |  |                    |                               |
|                                   |   |               |         |  |                  |                                     |  |            |                                   |                                  |                          |  |                    |                               |
|                                   |   |               |         |  |                  |                                     |  |            |                                   |                                  |                          |  |                    |                               |
|                                   |   |               |         |  |                  |                                     |  |            |                                   |                                  |                          |  |                    |                               |
| NOTES:<br>1.Borehole data re      | equires interpretation by exp. before                                     | WATE          | RL      | EVEL RECO  | RDS              |                                     | $\neg \bar{ }$   |            | COF                               | RE DRII                          | LING RI                  | ECOR   | D                  |                               |
| use by others 2. Field work super | vised by an exp representative.   | ne            | L       | Water<br>₋evel (m)   |                  | ole Oper<br>To (m)                  | ı  | Run<br>No. | Dept<br>(m)                       |                                  | % Red                    | D.   | R                  | QD %                          |
|                                   | led with drill cuttings upon completion.                                  | letion        |         | Frozen   |                  |                                     |  |            |                                   |                                  |                          |  |                    |                               |
|                                   | ample Descriptions read with exp. Services Inc. report                    |               |         |  |                  |                                     |  |            |                                   |                                  |                          |  |                    |                               |



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# Method of Test for Sieve Analysis of Aggregate ASTM C-136



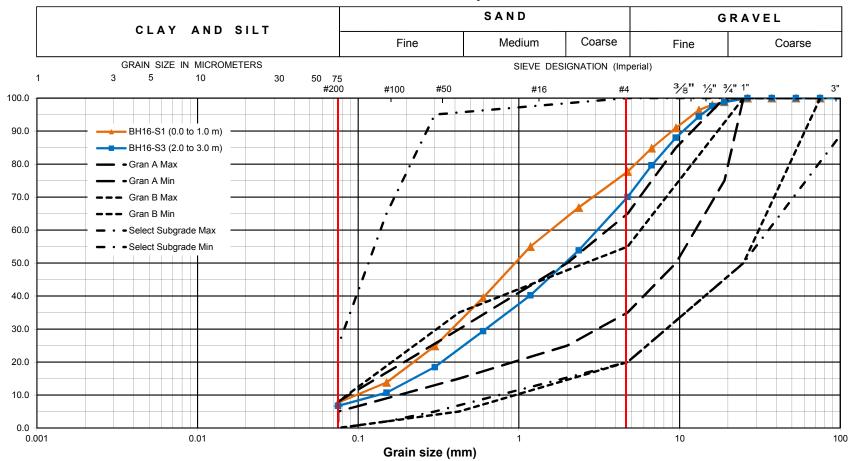
| Exp Project No.:     | OTT-00219428-A0 | Project Name :     | Geotechnical In                   | vestigation - Northwest Deposit |            |              |  |  |  |  |
|----------------------|-----------------|--------------------|-----------------------------------|---------------------------------|------------|--------------|--|--|--|--|
| Client :             | City of Iqaluit | Project Location : | lqaluit, NU                       | Iqaluit, NU                     |            |              |  |  |  |  |
| Date Sampled :       | May 21, 2015    | Borehole:          | 15                                | Sample: S1, S3 & S4             | Depth (m): | as indicated |  |  |  |  |
| Sample Description : |                 | SAND to SAND with  | SAND to SAND with silt and gravel |                                 |            |              |  |  |  |  |

| Project No:<br>Project:                   | OTT-00219428-A0  GEOTECHNICAL INVESTIGA                         | TION - NORTHW      |           |                               |          | <u> </u>   | _      |           | igure N               | lo                     | 33                       |                       | $\leftarrow$            | X                            |
|---|---|--------------------|-----------|-------------------------------|----------|------------|--------|-----------|-----------------------|------------------------|--------------------------|-----------------------|-------------------------|------------------------------|
| Location:                                 | IQALUIT, NU   | TION - NORTHW      | L         | JI DLI OO                     |          |            |        |           | Pag                   | je                     | 1_ of                    | 1_                    |                         |                              |
| Date Drilled:                             |   |                    |           |                               |          |            |        | _         |                       |                        |                          |                       |                         |                              |
| Drill Type:                               |   |                    | -         | Split Spoon S<br>Auger Sample |          | )          |        |           | Natural N             |                        | our Readi<br>Content     | ng                    |                         | ×                            |
| Datum:                                    | AIR TRACK GEODETIC  |                    | -         | SPT (N) Value<br>Dynamic Cone |          | t <u> </u> | 0      |           | Atterberg<br>Undraine |                        | al at                    |                       | <u> </u>                | <b>→</b>                     |
| Logged by:                                | SB Checked by:  | IAC                | -         | Shelby Tube                   |          |            | -      |           | % Strain<br>Shear Str | at Failur              | е                        |                       |                         | <b>⊕</b>                     |
| Logged by.                                | SB Checked by.  | JAS                |           | Shear Strengt<br>Vane Test    | h by     |            | +<br>s |           | Penetron              |                        |                          |                       |                         | •                            |
| G Y M B O L                               | SOIL DESCRIPTION  | GEODETIC<br>m      | D e p t h | 20<br>Shear Streng            | 4<br>gth |            | 8      | 80<br>kPa | 25<br>Natu<br>Atterb  | iral Mois<br>erg Limit | ture Conte<br>s (% Dry V | 50<br>nt %<br>/eight) | SA<br>M<br>P<br>L<br>ES | Natural<br>Unit Wt.<br>kN/m³ |
| Med                                       | ium brown, sand with silt and gra<br>quent cobbles and boulders | 185<br>avel        | 0         | 50                            | 10       | 0 150      |        | 00        | 2                     | - 1 - 1 - 1 - 1        | 40 6                     | 0                     | 8                       |                              |
| - no                                      | visible ice content<br>% gravel, 69% sand, 8% fines             |                    | 1         |                               |          |            |        |           |                       |                        |                          |                       |                         | -                            |
|   |   |                    |           |                               |          |            |        |           | ×                     |                        |                          |                       | (m)                     | >                            |
|   |   | _                  | 2         |                               |          |            |        |           |                       |                        |                          |                       |                         | -                            |
| :   | % gravel, 63% sand, 7% fines                                    | _                  |           |                               |          |            |        |           | ×                     |                        |                          |                       | <sub>60</sub> 0         | ,                            |
|   |   | 182.0              |           |                               |          |            |        |           | 0.000                 |                        |                          |                       |                         |                              |
|   | erred bedrock   |                    |           |                               |          |            |        |           |                       |                        |                          |                       |                         |                              |
| NOTES:<br>1. Borehole data ruse by others | equires interpretation by exp. before                           | Elapsed            |           | EVEL RECO<br>Water            |          | lole Open  |        | Run       | Dept                  | th                     | LLING R                  |                       |                         | QD %                         |
|   | rvised by an exp representative.                                | Time<br>Completion |           | evel (m)<br>Frozen            |          | To (m)     | +      | No.       | (m)                   | +                      |                          |                       |                         |                              |
|   | led with drill cuttings upon completion. ample Descriptions     |                    |           |                               |          |            |        |           |                       |                        |                          |                       |                         |                              |
| 5. This Figure is to<br>OTT-00219428-     | read with exp. Services Inc. report A0                          |                    |           |                               |          |            |        |           |                       |                        |                          |                       |                         |                              |



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# Method of Test for Sieve Analysis of Aggregate ASTM C-136



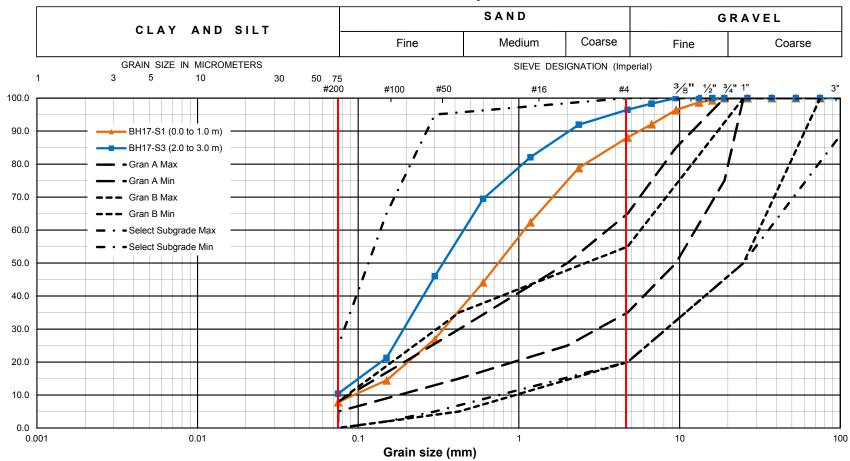
| Exp Project No.:     | OTT-00219428-A0 | Project Name :     | Geotechnical I | nvestigation - | Northwest Deposi | t           |              |
|----------------------|-----------------|--------------------|----------------|----------------|------------------|-------------|--------------|
| Client :             | City of Iqaluit | Project Location : | lqaluit, NU    |                |                  |             |              |
| Date Sampled :       | May 21, 2015    | Borehole:          | 16             | Sample:        | S1 & S3          | Depth (m) : | as indicated |
| Sample Description : |                 | SAND with silt     | and gravel     |                |                  | Figure :    | 34           |

| roject No:                               | Log o OTT-00219428-A0 GEOTECHNICAL INVESTIGATION - N  |               |           |                       |                |      | E                          | <u>П</u>  |            | Figure N            | No                        | 3                            | 5                      |  | е       | Χŗ                           |
|--|---|---------------|-----------|-----------------------|----------------|------|----------------------------|---|------------|---------------------|---------------------------|------------------------------|------------------------|--|---------|------------------------------|
| ocation:                                 | IQALUIT, NU   | NOKTHW        | E         | אם ועבר               | OSH            |      |                            |   |            | Pa                  | ge                        | <u>1</u> c                   | of _                   | 1_                                     |         |                              |
| ate Drilled:                             |   |               |           | Calit Can             | an Can         |      |                            |   |            | Cambus              | tible \/a                 |                              | - di                   | _                                      |         |                              |
|  | AIR TRACK   |               |           | Split Spo<br>Auger Sa | mple           | ipie |                            |   |            | Combus<br>Natural   | Moisture                  | e Conter                     | -                      | 3                                      |         | X                            |
| atum:                                    | GEODETIC  |               |           | SPT (N)  Dynamic      |                | est  |                            |   | ·<br>-     | Atterber            | -                         |                              |                        | H                                      |         | <b>⊕</b>                     |
|  | SB Checked by: JAS  |               |           | Shelby T<br>Shear St  |                | 21/  |                            | +   | •          | % Strain<br>Shear S |                           |                              |                        |  |         | <b>D</b>                     |
| ggod 27.                                 | Oncorda by one  |               |           | Vane Te               |                | Ју   |                            | S   |            | Penetro             | neter Te                  | est                          |                        |  |         |                              |
| S<br>Y<br>M<br>B<br>O<br>L               | SOIL DESCRIPTION  | GEODETIC<br>m | D e p t h | Shear                 | 20<br>Strength | 40   | 6                          |   | 80<br>kPa  | Nat<br>Attert       | 50<br>ural Moi<br>erg Lim | 500<br>isture Co<br>its (% D | 750<br>Intent<br>ry We | %<br>eight)                            | SAMPLES | Natural<br>Unit Wt.<br>kN/m³ |
| CLAS<br>Medi<br>sand<br>- freq<br>- no v | um brown, sand with silt and gravel to with silt uent cobbles and boulders risble ice content       | _180          | 0         |                       | 50             | 100  | 15                         |   | 200        | ×                   | 20                        | 40                           | 60                     |  | S       |                              |
|  | 6 gravel, 80% sand, 8% fines<br>-   |               | 1         |                       |                |      |                            |   |            |                     |                           |                              |                        |  |         |                              |
|  | -   |               | 2         |                       |                |      |                            |   |            | <b>X</b>            |                           |                              |                        |  |         |                              |
| - 3%                                     | gravel, 86% sand, 11% fines   |               | 4         |                       |                |      |                            |   |            | *                   |                           |                              |                        |  |         |                              |
|  |   | 177.0         |           | 3 6 1 6               |                |      | 13 6 1<br>13 6 1<br>13 6 1 | +3 -0 - 0 + 3<br>+3 -0 - 0 + 3<br>+3 -0 - 0 + 3 | 1.1.3.0.1  |                     | -3-0-0-                   |                              |                        | 3 (+ 1 + 5<br>3 (+ 1 + 5<br>3 (+ 1 + 5 |         |                              |
|  | of Borehole at 3.0 m Depth rred bedrock   |               |           |                       |                |      |                            |   |            |                     |                           |                              |                        |  |         |                              |
| TES:                                     |   | MATER         | . <br>    | EVEL RI               | =COP           | ns   |                            |   |            | 1::::               | RE DE                     | RILLING                      | PE                     | COPE                                   |         |                              |
| se by others                             | quires interpretation by exp. before  Elap vised by an exp representative.                          | sed<br>ne     | L         | Water<br>evel (m)     |                | Hole | Ope<br>(m)                 | en  | Run<br>No. | Dep<br>(m           | th                        |                              | Rec.                   |  |         | QD %                         |
| Borehole backfill<br>See Notes on Sa     | comp ed with drill cuttings upon completion. Imple Descriptions read with exp. Services Inc. report | letion        |           | Frozen                |                |      |                            |   |            |                     |                           |                              |                        |  |         |                              |



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# Method of Test for Sieve Analysis of Aggregate ASTM C-136



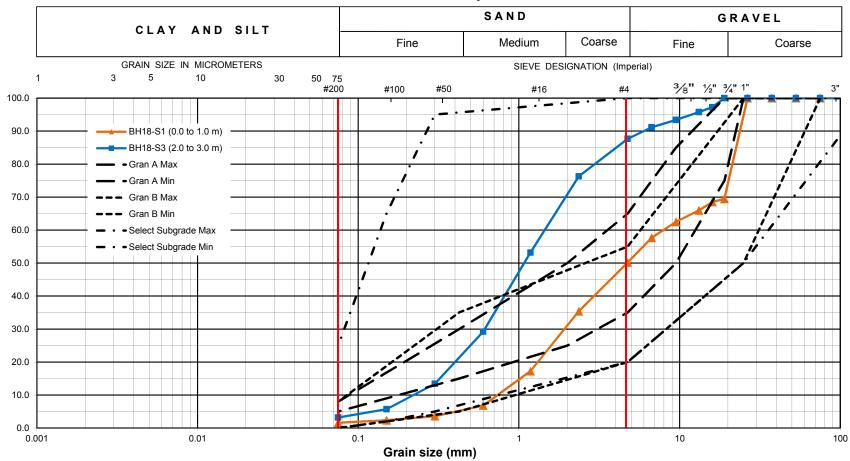
| Exp Project No.:     | OTT-00219428-A0 | Project Name :       | Geotechnical II  | nvestigation - | Northwest Deposit |            |              |
|----------------------|-----------------|----------------------|------------------|----------------|-------------------|------------|--------------|
| Client :             | City of Iqaluit | Project Location :   | Iqaluit, NU      |                |                   |            |              |
| Date Sampled :       | May 21, 2015    | Borehole:            | 17               | Sample:        | S1 & S3           | Depth (m): | as indicated |
| Sample Description : | SA              | ND with silt to SAND | with silt and gr | avel           |                   | Figure :   | 36           |

| Project No:                          | OTT-00219428-A0  |                            |           |                             |               | e <u>F</u>        | <u>3H</u> |            | =igure N             | No                          | 37   | ·     | $\epsilon$  | XĽ                                       |
|--------------------------------------|--|----------------------------|-----------|-----------------------------|---------------|-------------------|-----------|------------|----------------------|-----------------------------|--|-------|-------------|--|
| Project:                             | GEOTECHNICAL INVESTIGATION   | - NORTHW                   | ES        | ST DEP                      | OSIT          |                   |           |            | Pag                  | ge                          | 1_ of                                      | _1_   |             | -  |
| ocation:                             | IQALUIT, NU  |                            |           |                             |               |                   |           |            |                      |                             |  |       |             |  |
| ate Drilled:                         |  |                            |           | Split Spoo                  |               | le                |           |            |                      |                             | our Read                                   | ding  |             | ×  |
| ٠.                                   | AIR TRACK  |                            |           | SPT (N) \                   | /alue         | -4                | C         |            | Atterberg            | g Limits                    |  |       | <del></del> |  |
| atum:                                | GEODETIC   |                            |           | Dynamic<br>Shelby Tu        |               | Sī                |           | -<br>I     | Undraine<br>% Strain | at Failu                    | re   |       |             | $\oplus$                                 |
| ogged by:                            | SB Checked by: JAS   |                            |           | Shear Str<br>Vane Tes       |               | '                 | - <br> -  | -          | Shear St<br>Penetror |                             |  |       |             | •  |
| S<br>Y<br>M<br>B<br>O                | SOIL DESCRIPTION   | GEODETIC<br>m              | D e p t h |                             | 0<br>Strength |                   | 60        | 80<br>kPa  | Nat<br>Atterb        | 50<br>ural Mois<br>erg Limi | pour Read<br>500<br>sture Con<br>ts (% Dry | 750   | SAMPLES     | Natural<br>Unit Wt.<br>kN/m <sup>3</sup> |
| with q                               | um brown, gravel with sand to sand gravel<br>e silt<br>uent cobbles and boulders | 186                        | 0         | 5                           | 0             | 00 1              | 50        | 200        | 2                    | 0                           | 40   | 60    | s<br>m      | >  |
|                                      | visible ice content<br>6 gravel, 48% sand, 2% fines                              | -                          | 1         |                             |               |                   |           |            |                      |                             |  |       |             | -  |
|                                      |  |                            | 2         |                             |               |                   |           |            | X                    |                             |  |       |             | -  |
|                                      | 6 gravel, 84% sand, 3% fines of Borehole at 3.0 m Depth                          | 183.0                      | 3         |                             |               |                   |           |            | *                    |                             |  |       |             | ,  |
|                                      |  |                            |           |                             |               |                   |           |            |                      |                             |  |       |             |  |
|                                      | quires interpretation by exp. before   |                            | ٦L        | EVEL RE                     | ECORD         | S                 |           |            | СО                   | RE DR                       | ILLING                                     | RECOR | D           |  |
| Borehole backfill<br>See Notes on Sa | vised by an exp representative.  | lapsed<br>Time<br>mpletion |           | Water<br>evel (m)<br>Frozen |               | Hole Op<br>To (m) |           | Run<br>No. | Dep<br>(m            |                             | % R  | ec.   | R           | QD %                                     |



100-2650 Queensview Drive Ottawa, ON K2B 8H6

# Method of Test for Sieve Analysis of Aggregate ASTM C-136



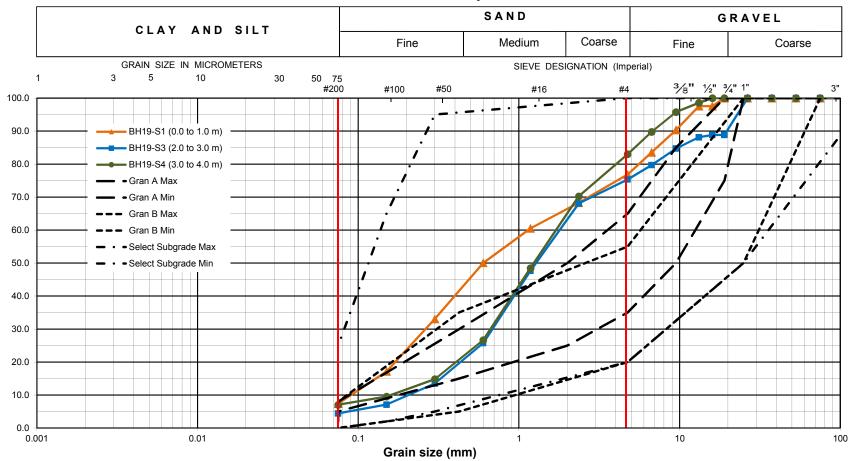
| Exp Project No.:     | OTT-00219428-A0 | Project Name :       | Geotechnical II  | nvestigation - | Northwest Deposi | t           |              |
|----------------------|-----------------|----------------------|------------------|----------------|------------------|-------------|--------------|
| Client :             | City of Iqaluit | Project Location :   | Iqaluit, NU      |                |                  |             |              |
| Date Sampled :       | May 21, 2015    | Borehole:            | 18               | Sample:        | S1 & S3          | Depth (m) : | as indicated |
| Sample Description : | SA              | ND with silt to SAND | with silt and gr | avel           |                  | Figure :    | 38           |

| Project No:                           | OTT-00219428-A0  | g of be            |       |  |  | <u> </u>        | <u> </u>      |                 | igure N               | lo  | 39   |  | $\leftarrow$                         | X                            |
|---------------------------------------|--|--------------------|-------|--|--|-----------------|---------------|-----------------|-----------------------|---|--|--|--------------------------------------|------------------------------|
| Project:<br>Location:                 | GEOTECHNICAL INVESTIGA   | TION - NORTHW      | E3    | ST DEPUS                               | 11                                       |                 |               | _               | Pag                   | ge  | 1_ of  | _1_                                      |                                      |                              |
|                                       | IQALUIT, NU  |                    |       |  |  |                 |               |                 |                       |   |  |  |                                      |                              |
| Date Drilled:                         |  |                    | -     | Split Spoon S<br>Auger Sample          |  | 9               |               |                 | Combust<br>Natural M  |   | our Readii<br>Content                            | ng                                       |                                      | ×                            |
| Drill Type:                           | AIR TRACK  |                    | -     | SPT (N) Value<br>Dynamic Cone          |  |                 | 0             |                 | Atterberg<br>Undraine |   | al at  |  | <u> </u>                             | →                            |
| Datum:                                | GEODETIC Charles de han  | 14.0               | -     | Shelby Tube                            |  |                 | _             |                 | % Strain Shear Str    | at Failur                                     | е  |  |                                      | $\oplus$                     |
| Logged by:                            | SB Checked by:   | JAS                |       | Shear Strengt<br>Vane Test             | h by                                     |                 | +<br>s        |                 | Penetron              |   |  |  |                                      | •                            |
| S Y Y M B C O                         | SOIL DESCRIPTION   | GEODETIC<br>m      | Depth | '                                      | 4  | etration Test N |               | ue<br>30<br>kPa | 25                    | 50 5  | oour Readii<br>500 7<br>ture Conte<br>s (% Dry V | 50                                       | SAMPLES                              | Natural<br>Unit Wt.<br>kN/m³ |
| ្តុំ <sup>ខ្លុ</sup> ំ្ - fred        | ium brown, sand with silt and gra<br>quent cobbles and boulders            | 183<br>avel        | 0     | 50                                     | 10                                       | 00 150          | 2             | 00              | 2                     | 0   | 40 6   | 80                                       | S                                    |                              |
| - no<br>- 24                          | visible ice content<br>% gravel, 69% sand,7% fines                         |                    | 1     |  |  |                 | 2 . 5         |                 | ×                     |   |  |  |                                      |                              |
|                                       |  |                    |       |  |  |                 |               |                 | <b>X</b>              |   |  |  | m                                    |                              |
|                                       |  | _                  | 2     |  |  |                 |               |                 |                       |   |  |  |                                      |                              |
| • • • • • • • • • • • • • • • • • • • | % gravel, 71% sand, 4% fines   | _                  |       |  |  |                 |               |                 | ×                     |   |  |  | m                                    |                              |
|                                       |  | _                  | 3     |  | 4. 1. 1<br>4. 1. 1<br>4. 1. 1<br>4. 1. 1 |                 |               |                 |                       | - 3 - 3 - 3 - 3<br>- 3 - 3 - 3 - 3<br>- 3 - 3 |  | -0.0-1-<br>-0.0-1-<br>-0.0-1-<br>-0.0-1- | \$ -<br>\$ -<br>\$ -<br>\$ -<br>\$ - |                              |
| ) 17º                                 | % gravel, 76% sand, 7% fines   | 470.0              |       | +0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | \$1.51<br>\$1.51<br>\$1.51<br>\$1.51     |                 |               |                 | ×                     | - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2       |  |  | - m                                  |                              |
| End                                   | of Borehole at 4.0 m Depth   | 179.0              | 4     |  |  |                 |               |                 |                       |   |  |  |                                      |                              |
|                                       |  |                    |       |  |  |                 |               |                 |                       |   |  |  |                                      |                              |
|                                       |  |                    |       |  |  |                 |               |                 |                       |   |  |  |                                      |                              |
|                                       |  |                    |       |  |  |                 |               |                 |                       |   |  |  |                                      |                              |
|                                       |  |                    |       |  |  |                 |               |                 |                       |   |  |  |                                      |                              |
|                                       |  |                    |       |  |  |                 |               |                 |                       |   |  |  |                                      |                              |
|                                       |  |                    |       |  |  |                 |               |                 |                       |   |  |  |                                      |                              |
| NOTES:                                |  |                    |       |  |  |                 | 7             |                 |                       |   |  |  |                                      |                              |
| Borehole data re<br>use by others     | equires interpretation by exp. before                                      | Elapsed            |       | EVEL RECO                              |  | Hole Open       | $\frac{1}{2}$ | Run             | Dept                  | th  | LLING R<br>% Re                                  |  |                                      | QD %                         |
|                                       | rvised by an exp representative.  led with drill cuttings upon completion. | Time<br>Completion |       | <u>evel (m)</u><br>Frozen              |  | To (m)          |               | No.             | (m)                   | +   |  | $\dashv$                                 |                                      |                              |
|                                       | ample Descriptions   |                    |       |  |  |                 |               |                 |                       |   |  |  |                                      |                              |
| 5. This Figure is to<br>OTT-00219428- | read with exp. Services Inc. report A0                                     |                    |       |  |  |                 |               |                 |                       |   |  |  |                                      |                              |



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# Method of Test for Sieve Analysis of Aggregate ASTM C-136



| Exp Project No.:     | OTT-00219428-A0 | Project Name :     | Geotechnical | Investigation - | Northwest Deposit |            |              |
|----------------------|-----------------|--------------------|--------------|-----------------|-------------------|------------|--------------|
| Client :             | City of Iqaluit | Project Location : | Iqaluit, NU  |                 |                   |            |              |
| Date Sampled :       | May 21, 2015    | Borehole:          | 19           | Sample:         | S1, S3 & S4       | Depth (m): | as indicated |
| Sample Description : |                 | SAND with silt     | and gravel   |                 |                   | Figure :   | 40           |

|        |        | End              | of Borehole at 6.0 m Depth                               | 177.0 | -   | 6                   |         |                           |      | 1.3.5   |          |             | -2-0-1   |              |               | - 2 - 2 - 3      |                  |                                |        |                         |              |          |
|--------|--------|------------------|--|-------|-----|---------------------|---------|---------------------------|------|---|----------|-------------|--|--------------|---------------|------------------|------------------|--------------------------------|--------|-------------------------|--------------|----------|
|        |        | -                |  | +     |     |                     |         |                           |      | 1.2.2   |          |             |  | <b> </b>     | <b>(</b>      |                  |                  |                                |        |                         | · 60         |          |
|        |        | _                |  |       |     | 5                   |         |                           |      |   |          |             |  |              |               |                  |                  |                                |        |                         |              |          |
|        |        |                  | asional cobbles and boulders<br>e visible ice, Vx (<10%) |       |     |                     |         |                           |      |   |          |             |  |              |               |                  |                  |                                |        |                         |              |          |
|        |        | Medi<br>- som    | um brown, sand with gravel<br>ne silt                    |       |     |                     |         |                           |      |   |          |             |  | <br> -×      |               |                  |                  |                                |        |                         | W.           |          |
| 6<br>6 |        | CLAS             | 39.2   | 179.0 |     | 4                   |         |                           |      | 1.3.0   |          |             | 13 (1) (1)   |              |               |                  |                  | 1.1.1.1<br>1.1.1.1<br>1.1.1.1  |        |                         |              | -        |
|        |        | _<br>- 14%       | % gravel, 82% sand, 4% fines                             | -     |     | 10.0                | -1-2    |                           |      | 1-3-0   | 1-2-0-1  |             | +3 +0+ 6<br>+3 +0+ 6<br>+3 +0+ 6<br>+3 +0+ 6             | ×            |               | - 3 - 2 - 4      |                  |                                |        | 4-1-0<br>4-1-0<br>4-1-0 | · (%)        | ,        |
| 9      |        | _                |  | -     | ;   | 3                   | - 1 - 2 |                           |      | 1 · 3 · 5 · 6 · 6 · 6 · 6 · 6 · 6 · 6 · 6 · 6 | 1-2-0-1  |             | -3-0-1   |              |               | - 1 - 1 - 1      |                  |                                |        |                         |              |          |
|        |        | - 14%            | % gravel, 83% sand, 3% fines                             | -     |     | 10.0                | - 1 - 2 |                           |      | 1 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 -       | -3 -3 -1 |             | - 2 - 2 - 2<br>- 2 - 2 - 2<br>- 3 - 2 - 2<br>- 3 - 2 - 2 | *            |               |                  |                  |                                |        |                         | -183         |          |
| 9      |        |                  |  |       |     | -                   |         |                           |      |   |          |             |  |              |               |                  |                  |                                |        |                         |              |          |
| 000    |        | _                |  |       |     | 2                   |         |                           |      |   |          |             |  |              |               |                  |                  |                                |        |                         |              |          |
|        |        | _                |  |       |     |                     |         |                           |      |   |          |             |  | <b> </b>     |               |                  |                  |                                |        |                         | m            | ,        |
| 9000   |        |                  | % gravel, 77% sand, 3% fines                             |       |     | 1                   |         |                           |      |   |          |             |  |              |               |                  |                  |                                |        |                         |              | -        |
| Ď      |        | trac -<br>freq - |  | -     |     | 10.0                | - 1 - 2 |                           |      | 1.3.0   |          |             | 13 (0) (   | <b>×</b>     |               |                  |                  |                                |        |                         | 100          |          |
| Ĉ.     | L      | CLAS<br>Medi     | SS 1<br>um brown, sand with gravel                       | 183   |     | h 01                |         | 50<br>                    | 100  | 1   | 50       | 200         | -3-0-1   |              | 2             |                  | 40               |                                | 60     |                         | S            | kN       |
| 7 NE   | SYMBO. |                  | SOIL DESCRIPTION   | GEODE | TIC | D<br>e<br>p<br>t Sh | 2       | ndard F<br>20<br>Strength | 40   |   | Test N \ | /alue<br>80 | kPa  |              | 25            | 0                | 50               | ur Rea<br>0<br>re Con<br>% Dry | 750    |                         | │<br>∽⊞୮Ѣ≧≽∽ | Na<br>Un |
| .00    |        | l by:            | SB Checked by:   | JAS   |     |                     | e Tes   |                           |      | otion '                                       |          | +<br>S      |  | Pene         | etron         | rength<br>neter  | Test             | ır Doo                         | dina   | (nnm)                   | Tel          | •        |
|        | um:    |                  | GEODETIC   |       | _   | Dyn                 |         | Cone 7                    | Test |   |          | _           |  | Undr<br>% St | raine<br>rain | d Tria<br>at Fai | ixial a<br>ilure | at                             |        | -                       |              | 0        |
|        | ΙТу    |                  | AIR TRACK  |       |     | Aug                 | er Sa   | on San<br>Imple<br>Value  | ibie |   | [        | X<br>II     |  | Natu         | ıral N        |                  | re Co            | ontent                         | -      | ŀ                       |              | ∟<br>×   |
|        | catio  |                  | 1QALUIT, NU<br>5/21/15                                   |       |     | Codia               |         | an Can                    |      |   |          |             |  | Com          |               | ible \/          |                  | ır Rea                         | س منام |                         |              | _        |
| J      | catic  | n:               | IQALUIT, NU  |       |     |                     |         |                           |      |   |          |             |  | ١            | Pag           | je.              |                  | _ or                           | _      | <u>'</u>                |              |          |

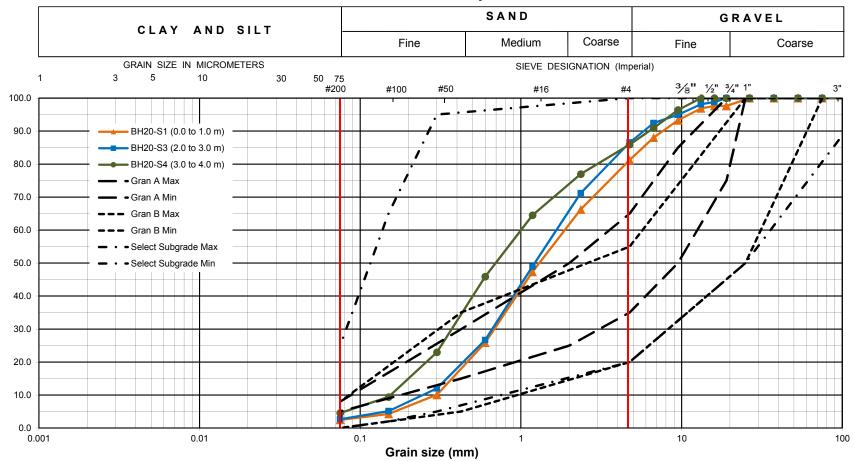
### **Grain-Size Distribution Curve**



Percent Passing

100-2650 Queensview Drive Ottawa, ON K2B 8H6

# Method of Test for Sieve Analysis of Aggregate ASTM C-136



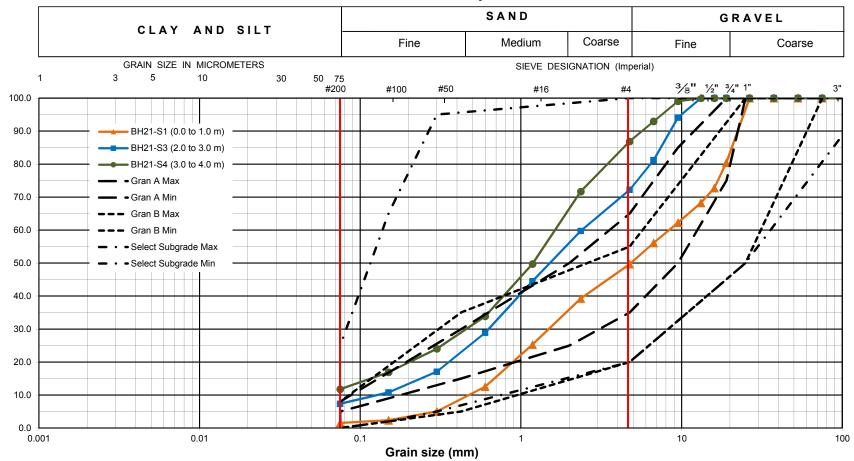
| Exp Project No.:     | OTT-00219428-A0 | Project Name :     | Geotechnical I | nvestigation - | Northwest Deposit |             |              |
|----------------------|-----------------|--------------------|----------------|----------------|-------------------|-------------|--------------|
| Client :             | City of Iqaluit | Project Location : | Iqaluit, NU    |                |                   |             |              |
| Date Sampled :       | May 21, 2015    | Borehole:          | 20             | Sample:        | S1, S3 & S4       | Depth (m) : | as indicated |
| Sample Description : |                 | SAND with          | gravel         |                |                   | Figure :    | 42           |

|             | oject<br>oject             |                         | OTT-00219428-A0 GEOTECHNICAL INVESTIGA   | TION - NORTHV   | VES      | ST [                                    | DEP                       | os         | IT    |            |       |   |          |          | F  | igu |               |       |                             |       | 43    |                 | _           |                 |
|-------------|----------------------------|-------------------------|--|-----------------|----------|---|---------------------------|------------|-------|------------|-------|---|----------|----------|--|-----|---------------|-------|-----------------------------|-------|-------|-----------------|-------------|-----------------|
|             | catio                      |                         | IQALUIT, NU  |                 |          |   |                           |            |       |            |       |   |          |          |  |     | Pa            | ge.   | _                           | 1_    | of _  | 1_              |             |                 |
| Da          | ite D                      | rilled:                 | 5/22/15  |                 |          | Split                                   | Spoo                      | on Sa      | ample | <u> </u>   |       |   |          | _        |  | Cor | nhus          | tible | · Vapo                      | our R | eadir | าต              |             | П               |
|             | ill Ty                     |                         | AIR TRACK  |                 | _        | Aug                                     | er Sa                     | mple       |       | •          |       |   |          |          |  | Nat | ural          | Mois  | ture (                      |       |       | '9              | -           | X               |
|             | ıtum:                      | -                       | GEODETIC   |                 | -        |   | (N) \<br>amic             |            |       | t          |       |   | <u> </u> |          |  | Unc | Irain         |       | riaxia                      |       |       |                 | 1           | —⊖<br>⊕         |
| Lo          | gged                       | d by:                   | SB Checked by:   | JAS             | _        | She                                     | lby Tu<br>ar Str<br>e Tes | engt       | h by  |            |       |   | +<br>s   |          |  | She | ar S          | tren  | Failure<br>gth by<br>er Tes | /     |       |                 |             | <b>▲</b>        |
| G<br>W<br>L | S<br>M<br>B<br>O<br>L      |                         | SOIL DESCRIPTION   | GEODETII<br>m   | t<br>h   | Sh                                      | Star<br>2<br>lear S       | 0<br>trenç | 4     |            | on Te | 0                                       | 8        | 0        | :Pa  |     | Nat<br>Atterl | 50    | Moist<br>Limits             | 00    | 75    | nt %<br>/eight) | n)   5      | Natur<br>Unit W |
|             |                            | CLAS<br>Light<br>- trac | brown, gravel with sand  | 174             | 0        | 1                                       |                           | - 1 - 5    | - I-  |            | 13    |   |          |          |  | -61 |               | 1     |                             | 10    |       |                 |             | 3               |
|             |                            | - freq<br>- no v        | uent cobbles and boulders<br>visible ice content<br>6 gravel, 47% sand, 2% fines               |                 |          |   |                           |            |       |            |       |   |          |          |  | ×   |               |       |                             |       |       |                 | - fu        | ny              |
|             |                            | - Cl 45                 | 20.0   | 172.5           | 1        |   |                           |            |       |            |       |   |          |          |  | ×   |               |       |                             |       |       |                 | - ku        | ny              |
|             |                            | - occ                   | brown, sand with silt and grave asional cobbles and boulders visible ice content               | el<br>_         | 2        | 2                                       |                           |            |       |            |       |   |          |          |  |     |               |       |                             |       |       |                 |             |                 |
|             |                            | _<br>27%                | gravel, 66% sand, 7% fines   | -               |          |   |                           |            |       |            |       | - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 |          |          |  | ×   |               |       |                             |       |       |                 | - fu        | nj              |
|             |                            | CLAS<br>Grey,           | SS 3<br>, silty sand<br>ne gravel  | 171.0           | 3        | 9 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 |                           |            |       | - 6- 6-    |       | -3 -0-                                  |          |          | -0. 0.<br>-0. 0.<br>-0. 0.<br>-0. 0.<br>-0. 0. |     |               |       |                             |       |       |                 |             |                 |
|             |                            | - occ:<br>- no v        | asional cobbles and boulders visible ice content 6 gravel, 75% sand, 12% fines                 |                 | 4        |   |                           |            |       |            |       | - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 - 2 |          |          |  | ×   |               |       |                             |       |       |                 | - fu        | <u>"</u>        |
|             |                            | F                       | of Developed 4.0 vs Develo   | 169.7           | <u> </u> |   |                           |            |       |            |       |   | <u> </u> |          |  | ×   |               |       |                             |       |       |                 | · · · · · · | <b>"</b> 2      |
| 1/23/10     |                            | Ena                     | of Borehole at 4.3 m Depth   |                 |          |   |                           |            |       |            |       |   |          |          |  |     |               |       |                             |       |       |                 |             |                 |
|             |                            |                         |  |                 |          |   |                           |            |       |            |       |   |          |          |  |     |               |       |                             |       |       |                 |             |                 |
|             |                            |                         |  |                 |          |   |                           |            |       |            |       |   |          |          |  |     |               |       |                             |       |       |                 |             |                 |
| )           |                            |                         |  |                 |          |   |                           |            |       |            |       |   |          |          |  |     |               |       |                             |       |       |                 |             |                 |
| NO NO.      |                            |                         |  |                 |          |   |                           |            |       |            |       |   |          |          |  |     |               |       |                             |       |       |                 |             |                 |
|             |                            |                         |  |                 |          |   |                           |            |       |            |       |   |          |          |  |     |               |       |                             |       |       |                 |             |                 |
| NO<br>1.B   | TES:<br>oreholo<br>se by c | e data re               | quires interpretation by exp. before   | WATE            | RL       |   |                           | СО         |       |            |       |   |          | _        |  |     |               |       | DRII                        |       |       | ECOF            |             |                 |
|             | -                          |                         | vised by an exp representative.  | Elapsed<br>Time | l        | Wa<br>Level                             | (m)                       |            | ŀ     | Hole<br>To |       | en                                      |          | Ru<br>No |  |     | Dep<br>(m     |       |                             | %     | Red   | Э.              |             | RQD %           |
| 4.S<br>5.T  | ee Not                     | es on Sa                | ed with drill cuttings upon completion. Imple Descriptions read with exp. Services Inc. report | Completion      |          | Froz                                    | œn                        |            |       |            |       |   |          |          |  |     |               |       |                             |       |       |                 |             |                 |



100-2650 Queensview Drive Ottawa, ON K2B 8H6

# Method of Test for Sieve Analysis of Aggregate ASTM C-136



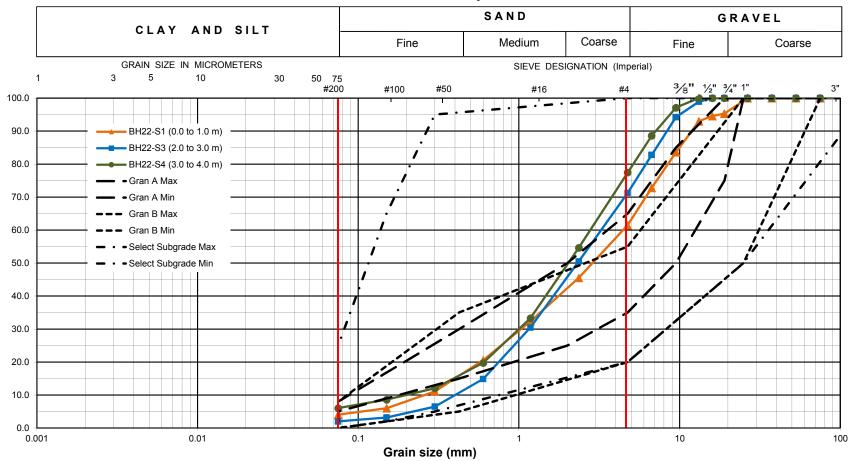
| Exp Project No.:     | OTT-00219428-A0 | Project Name :          | Geotechnical     | Investigation - | Northwest Deposit |            |              |
|----------------------|-----------------|-------------------------|------------------|-----------------|-------------------|------------|--------------|
| Client :             | City of Iqaluit | Project Location :      | Iqaluit, NU      |                 |                   |            |              |
| Date Sampled :       | May 21, 2015    | Borehole:               | 21               | Sample:         | S1, S3 & S4       | Depth (m): | as indicated |
| Sample Description : |                 | <b>GRAVEL</b> with SAND | with silt and gr | avel            |                   | Figure :   | 44           |

| Project No:                        | OTT-00219428-A0  |               |        |  |           |                    |             |                 | igure       | Nο                                    | 45   | ;    |          | へト                           |
|------------------------------------|--|---------------|--------|--|-----------|--------------------|-------------|-----------------|-------------|---------------------------------------|--|------|----------|------------------------------|
| Project:                           | GEOTECHNICAL INVESTIGATION - I   | NORTHW        | ES     | ST DEPOS                                 | SIT       |                    |             | _ '             | -           | _                                     | 1 of   | _    |          | '                            |
| ocation:                           | IQALUIT, NU  |               |        |  |           |                    |             | _               | га          | ye                                    | 01   |      |          |                              |
| Date Drilled:                      | 5/22/15  |               |        | Split Spoon S                            | Sampl     | е                  | $\boxtimes$ |                 | Combu       | stible Va <sub>l</sub>                | pour Read                                    | ding |          |                              |
| Orill Type:                        | AIR TRACK  |               |        | Auger Sampl<br>SPT (N) Valu              |           |                    |             |                 |             | Moisture                              | Content                                      | ı    |          | X<br>⊖                       |
| Datum:                             | GEODETIC   |               |        | Dynamic Con                              |           | st                 |             |                 | Undrain     | ed Triax                              |  |      |          | ⊕                            |
| ogged by:                          | SB Checked by: JAS   |               |        | Shelby Tube<br>Shear Streng<br>Vane Test | th by     |                    | +<br>s      |                 | Shear S     | n at Failu<br>Strength I<br>ometer Te | ру   |      |          | •                            |
| S Y M B O L                        | SOIL DESCRIPTION   | GEODETIC<br>m | t<br>h | Standar<br>20<br>Shear Stren<br>50       | 4<br>ngth | netration T<br>0 6 | 0 ε         | ue<br>80<br>kPa | Na<br>Atter | 250                                   | pour Read<br>500<br>sture Cont<br>its (% Dry | 750  |          | Natural<br>Jnit Wt.<br>kN/m³ |
| - trac<br>- occ<br>- no v<br>- 38% | um brown, sand with gravel se silt asional cobbles and boulders visible ice content & gravel, 58% sand, 4% fines | 164.0         | 2      |  |           |                    |             |                 | *<br>*      |                                       |  |      |          |                              |
| End (                              | of Borehole at 4.5 m Depth   | 162.5         | 4      |  |           |                    |             |                 | ×           |                                       |  |      | <b>8</b> |                              |
|                                    |  |               |        |  |           |                    |             |                 |             |                                       |  |      |          |                              |
| NOTES:                             |  |               |        |  |           |                    |             | 1 : : : :       |             | 1:::                                  |  | 1111 |          |                              |
| .Borehole data re<br>use by others | equires interpretation by exp. before  | WATER         | ٦L     | EVEL RECO                                |           | Hole Ope           | en          | Run             | CC          |                                       | ILLING I<br>% R                              |      |          | D %                          |
| .Field work super                  | vised by an exp representative.  | ne<br>oletion |        | evel (m)<br>Frozen                       | <u> </u>  | To (m)             |             | No.             | (m          |                                       | ,,,,   |      |          | /•                           |
|                                    | led with drill cuttings upon completion.   |               |        |  | 1         |                    | 1 1         |                 |             |                                       |  | 1    |          |                              |



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# Method of Test for Sieve Analysis of Aggregate ASTM C-136



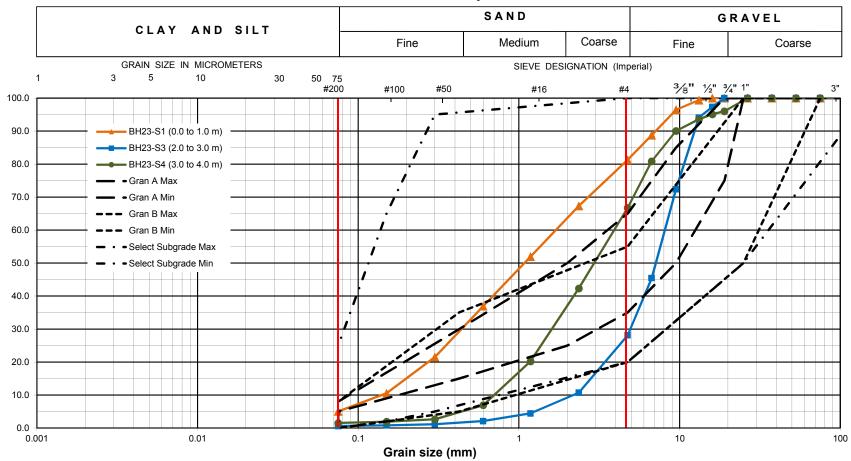
| Exp Project No.:     | OTT-00219428-A0  | Project Name :     | Geotechnical II | Geotechnical Investigation - Northwest Deposit |             |            |              |  |  |  |  |
|----------------------|--|--------------------|-----------------|--|-------------|------------|--------------|--|--|--|--|
| Client :             | City of Iqaluit  | Project Location : | Iqaluit, NU     |  |             |            |              |  |  |  |  |
| Date Sampled :       | May 21, 2015   | Borehole:          | 22              | Sample:  | S1, S3 & S4 | Depth (m): | as indicated |  |  |  |  |
| Sample Description : | SAND with gravel to SAND with silt and gravel Figure : |                    |                 |  |             |            |              |  |  |  |  |

| roject No:   | OTT-00219428-A0   |               |                                  |  |           |     |            |                          |   |          | Figure No. 47 |    |               |          |  |
|--|---|---------------|----------------------------------|--|-----------|-----|------------|--------------------------|---|----------|---------------|----|---------------|----------|--|
| roject:  | GEOTECHNICAL INVESTIGATION - N  | NORTHW        | ES                               | ST DEPOS                                 | SIT       |     |            | _                        | -   | <br>e. 1 |               | _  |               | Ċ        |  |
| ocation:   | IQALUIT, NU   |               |                                  |  |           |     |            |                          | <u> </u>  |          |               |    |               |          |  |
| ate Drilled:   | 5/22/15   |               | Split Spoon Sample  Auger Sample |  |           |     |            | Combustib<br>Natural Mo  |   |          | ing           |    | □<br><b>X</b> |          |  |
| ill Type:  | AIR TRACK   |               |                                  | SPT (N) Valu                             | е         |     | 0          |                          | Atterberg L   | imits    |               | I  |               | <b>→</b> |  |
| ıtum:  | GEODETIC  | -             | Dynamic Cor<br>Shelby Tube       | e Test                                   | _         |     | •          | Undrained<br>% Strain at |   | t        |               |    | $\oplus$      |          |  |
| gged by:   | SB Checked by: JAS  |               |                                  | Shear Streng<br>Vane Test                | th by     |     | +<br>s     |                          | Shear Stre<br>Penetrome   |          |               |    |               | <b>A</b> |  |
| S<br>Y<br>M<br>B<br>O<br>L   | SOIL DESCRIPTION  | GEODETIC<br>m | D<br>e<br>p<br>t                 | 9 40 00                                  |           |     |            | 80<br>kPa                | Combustible Vapour Reading (ppn<br>250 500 750<br>Natural Moisture Content %<br>Atterberg Limits (% Dry Weight) |          |               | 50 | M Natu        |          |  |
| CLAS<br>Light<br>sand  | brown, sand with gravel to gravel with  | 168           | 0                                | 50                                       | 100       | 150 | 2          | 200                      | 20  | 40       |               | 60 | s<br>-83      |          |  |
| - no v   | luent cobbles and boulders<br>visible ice content<br>6 gravel, 76% sand, 5% fines - |               | 1                                |  |           |     |            |                          |   |          |               |    |               |          |  |
|  | -   |               |                                  |  |           |     |            |                          | *   |          |               |    | -m            |          |  |
|  | 6 gravel, 27% sand, 1% fines  | -             | 2                                |  |           |     |            |                          | *   |          |               |    | -m2           |          |  |
|  | -<br>6 gravel, 66% sand, 1% fines   |               | 3                                |  |           |     |            |                          | <b>*</b>  |          |               |    | -63           |          |  |
| End  | of Borehole at 4.0 m Depth  | 164.0         | 4                                |  |           |     |            |                          |   |          |               |    |               |          |  |
| NOTES: Borehole data requires interpretation by exp. before use by others  Elapsed Time Completion  See Notes on Sample Descriptions |   | sed<br>ne     | L                                | EVEL RECO<br>Water<br>evel (m)<br>Frozen | Hole Open |     | Run<br>No. |                          | CORI<br>Depth<br>(m)  |          | RILLING RECO  |    | RD RQD %      |          |  |



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# Method of Test for Sieve Analysis of Aggregate ASTM C-136



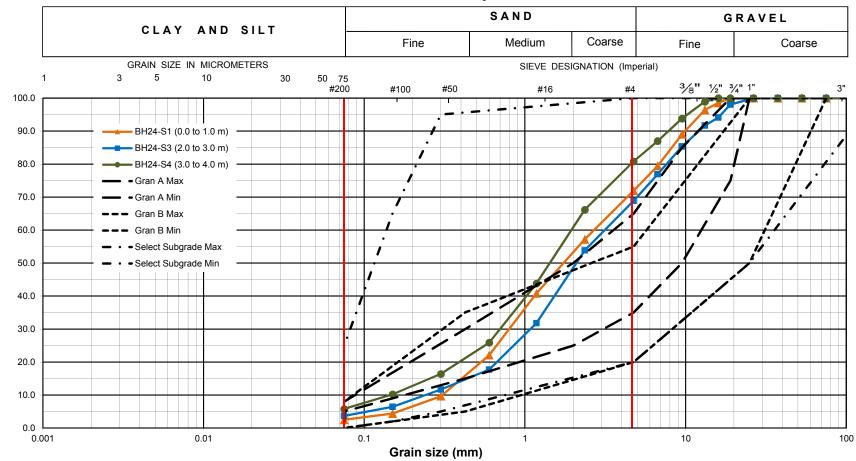
| Exp Project No.:     | OTT-00219428-A0 | Project Name :     | Geotechnical Investigation - Northwest Deposit |         |             |            |              |  |  |
|----------------------|-----------------|--------------------|--|---------|-------------|------------|--------------|--|--|
| Client :             | City of Iqaluit | Project Location : | Iqaluit, NU                                    |         |             |            |              |  |  |
| Date Sampled :       | May 21, 2015    | Borehole:          | 23   | Sample: | S1, S3 & S4 | Depth (m): | as indicated |  |  |
| Sample Description : | (               | Figure :           | 48   |         |             |            |              |  |  |

| Borel<br>use b   | hole data re<br>by others                                       | quires interpretation by exp. before vised by an exp representative.                      | Elapsed Time Completion | Le                 | Water<br>evel (m<br>Frozen   |                 |   | S<br>Hole O <sub>l</sub><br>To (m |        |           | Run<br>No.                 |                 | COF<br>Dept<br>(m) | h                         | RILI          | _ING<br>% F                                  |  | CORI   |                   | RQD      |
|------------------|---|---|-------------------------|--------------------|------------------------------|-----------------|---|-----------------------------------|--------|-----------|----------------------------|-----------------|--------------------|---------------------------|---------------|--|--|--|-------------------|----------|
| OTES             |   |   |                         | ]                  | -> /E-: =                    | : :             |   |                                   |        | <u>::</u> |                            |                 | 00                 | )                         | D":           | 1010   |  |  | _                 | <u></u>  |
|                  |   |   |                         |                    |                              |                 |   |                                   |        |           |                            |                 |                    |                           |               |  |  |  |                   |          |
|                  |   |   |                         |                    |                              |                 |   |                                   |        |           |                            |                 |                    |                           |               |  |  |  |                   |          |
|                  | Liid  | or Borenole at 3.0 m Beptin   |                         |                    |                              |                 |   |                                   |        |           |                            |                 |                    |                           |               |  |  |  |                   |          |
| Ø.;              |   | of Borehole at 5.0 m Depth  | 169.0                   | 5                  |                              |                 |   |                                   |        |           |                            |                 |                    |                           |               |  |  |  |                   |          |
|                  |   |   |                         |                    |                              |                 |   |                                   |        |           |                            | ×               |                    |                           |               |  |  |  |                   | 3        |
|                  | - 20%   | 6 gravel, 74% sand, 6% fines  | _                       | 4                  |                              |                 |   |                                   |        |           |                            |                 |                    |                           |               |  |  |  |                   |          |
|                  | - frequent cobbles and boulde<br>- trace visible ice, Vx (<10%) | um brown, sand with silt and gra<br>uent cobbles and boulders<br>e visible ice, Vx (<10%) | avel _                  |                    | +0                           |                 | 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 |                                   |        |           |                            | · · · ·         | <b>×</b>           | - 3 - 3 - 4               |               | 6 + 3 + 3 + 3 + 3 + 3 + 3 + 3 + 3 + 3 +      |  | - 6 - 1 -<br>- 6 - 1 - |                   | 3        |
|                  |   | 6 gravel, 63% sand, 4% fines  | 171.0                   | 3                  | -0.4-1-1                     | - 1 - 1 - 2     |   |                                   |        |           |                            | *               |                    | - 1 - 1 - 1               |               | (-) -(-)<br>(-) -(-)<br>(-) -(-)<br>(-) -(-) | \$-   -3<br>\$-   -3<br>\$-   -3<br>\$-   -3 |  |                   |          |
|                  |   |   |                         | 2                  |                              |                 |   |                                   |        |           |                            |                 |                    |                           |               |  |  |  | m                 | 2        |
|                  |   |   | -                       |                    |                              |                 |   |                                   |        |           |                            | ×               |                    |                           |               |  |  |  | -100              | 2        |
|                  | - 21 /  | o g. avo., 10 /0 oana, 0 /0 iiilos  | -                       | 1                  |                              |                 |   |                                   |        |           |                            |                 |                    |                           |               |  |  |  |                   |          |
| - trace          |   | _   |                         |                    |                              |                 |   |                                   |        |           | ×                          |                 |                    |                           |               |  |  |  | h                 |          |
| M<br>B<br>O<br>L | ÇLAS<br>Medi  | SS 1<br>um brown, sand with gravel  | 174                     | h<br>0             | Shear                        |                 |   |                                   |        |           | kPa                        | Natu<br>Atterbe |                    |                           | mits 40       |  | Wei  |  | LES               | k        |
| G Y M B C O      |   | SOIL DESCRIPTION  | GEODETIC                | Ь                  | St                           |                 | d Per                                   | etration                          | Test N | l Vali    | ле<br>0                    |                 | 25                 | 0                         | 50            | ur Rea                                       | 750  |  | ) SA<br>MP<br>LES | N<br>Ur  |
| atuı<br>ogg      | ed by:  | GEODETIC  SB Checked by:  | JAS                     |                    | Shelby Shear S<br>Vane Te    | Tube<br>Strengt |   |                                   |        | +<br>s    |                            | % St<br>Shea    | rain<br>ar Str     | at Fai<br>rength          | ilure<br>n by | al   |  |  |                   | 4        |
|                  | Гуре:   | AIR TRACK   |                         |                    | Auger S<br>SPT (N)<br>Dynami | Value           | 9                                       | ŧ                                 |        | 0         |                            | Atter           | berg               | Noistu<br>Limit<br>d Tria | s             | ontent                                       |  | I  | <del></del>       | <b>→</b> |
|                  | Drilled:  |   |                         | Split Spoon Sample |                              |                 |   |                                   |        | _         | Combustible Vapour Reading |                 |                    |                           |               |  |  |  |                   |          |
| oca              | ition:  | GEOTECHNICAL INVESTIGATION - NORTHWEST DEPOSIT  QALUIT, NU                                |                         |                    |                              |                 |   |                                   |        |           | Page1_ of _1_              |                 |                    |                           |               |  |  |  |                   |          |



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# Method of Test for Sieve Analysis of Aggregate ASTM C-136



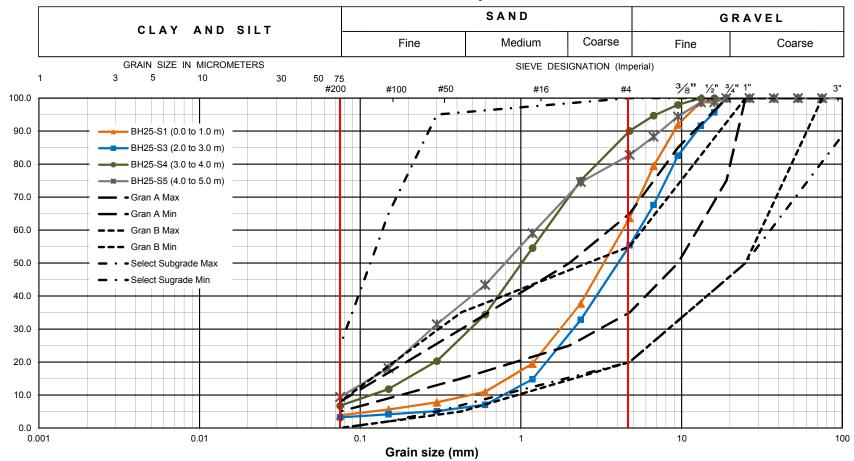
| Exp Project No.:     | OTT-00219428-A0   | Project Name :     | Geotechnical I | nvestigation - | Northwest Deposit | sit        |              |  |  |  |  |  |
|----------------------|---|--------------------|----------------|----------------|-------------------|------------|--------------|--|--|--|--|--|
| Client :             | City of Iqaluit   | Project Location : | Iqaluit, NU    |                |                   |            |              |  |  |  |  |  |
| Date Sampled :       | May 21, 2015  | Borehole:          | 24             | Sample:        | S1, S3 & S4       | Depth (m): | as indicated |  |  |  |  |  |
| Sample Description : | SAND with gravel to SAND with silt and gravel Figure : 50 |                    |                |                |                   |            |              |  |  |  |  |  |

| Project No:                                    | <b>Lo</b> OTT-00219428-A0   | g of B             | 0             | rel  | าด                  | ΙE             | <u>E</u> | <u>3H</u>                                | <u> 25</u>       |                    |   |                             |     | E                                      | XĽ                                       |
|--|---|--------------------|---------------|--|---------------------|----------------|----------|--|------------------|--------------------|---|-----------------------------|-----|--|--|
| Project:                                       | GEOTECHNICAL INVESTIGA  | TION - NORTH       | \ <b>\</b> /⊏ | ST DE  | :DOS                | :IT            |          |  |                  | Figure N           | No                                      | 51                          | _   |  |  |
| Location:                                      | IQALUIT, NU   | TION - NORTH       | V V L         | 31 DL  | .1 00               | 711            |          |  |                  | Pa                 | ge                                      | of                          | _1_ |  |  |
| Date Drilled:                                  |   |                    |               |  |                     |                |          |  | _                |                    |   |                             |     |  |  |
|  |   |                    | _             | Split S<br>Auger                               |                     |                | е        |  |                  |                    |   | pour Read<br>Content        | ing |  | ×  |
| Drill Type:                                    | AIR TRACK   |                    | _             | SPT (N   |                     |                | .+       | C  | )                | Atterber           | -                                       |                             |     | <u> </u>                               | —  |
| Datum:   | GEODETIC  |                    | _             | Shelby   |                     | 10 100         |          |  | Ī                | % Strain           | at Failu                                | ire                         |     |  | $\oplus$                                 |
| Logged by:                                     | SB Checked by:  | JAS                |               | Shear<br>Vane 1                                |                     | th by          |          | +<br>S                                   | -<br>;           | Shear S<br>Penetro |   |                             |     |  | <b>A</b>                                 |
| G W L B O L                                    | SOIL DESCRIPTION  | GEODET<br>m<br>174 | TIC D e p t h | Shea   | 20<br>r Strer<br>50 | 4<br>ngth      |          | 0  | 80<br>kPa<br>200 | Nat<br>Attert      | 50                                      | sture Conte<br>its (% Dry \ | 750 | IA                                     | Natural<br>Unit Wt.<br>kN/m <sup>3</sup> |
| ૄ૿૿ૺ∙∳ - trac                                  | um brown, sand with gravel<br>se silt                                       |                    |               | -0.6-1   |                     |                |          | -3 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3 - |                  |                    |   |                             |     | 900                                    |  |
| • no   | asional cobbles and boulders visible ice content gravel, 59% sand, 4% fines |                    | 1             | -2-2-1   |                     |                |          |  |                  | <b>X</b>           |   |                             |     |  | 2  |
|  |   | _                  |               |  |                     |                |          |  |                  | *                  |   |                             |     | ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~ | ,  |
| *****-<br>*******************************      | gravel, 52% sand, 3% fines  | _                  | 2             |  |                     |                |          |  |                  | ×                  |   |                             |     | (P)                                    | <u>-</u>                                 |
| CLA:   | SS 2<br>um brown to grey, sand with silt                                    | 171.0              | 3             | -3 (-1   |                     |                |          |  |                  |                    |   |                             |     |  | -  |
| grave<br>grave<br>e occ<br>e occ               |   | allu _             |               | -0-0-0<br>-0-0-0<br>-0-0-0<br>-0-0-0<br>-0-0-0 |                     |                |          |  |                  | <del> </del> ×     |   |                             |     | ····                                   | >  |
| - 179  | % gravel, 74% sand, 9% fines  |                    |               |  |                     |                |          |  |                  | ×                  |   |                             |     | W.                                     | >  |
|  | ers of massive ice below 5.0 m  | depth              | 5             |  |                     |                |          |  |                  |                    |   |                             |     | ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~ | ,  |
| End  | of Borehole at 6.0 m Depth  | 168.0              | 6             | -3-6-1   |                     |                |          | -3-1-1-1                                 |                  |                    | - 3 - 3 - 3 - 4 - 3 - 3 - 4 - 4 - 4 - 4 |                             |     |  |  |
|  |   |                    |               |  |                     |                |          |  |                  |                    |   |                             |     |  |  |
|  |   |                    |               |  |                     |                |          |  |                  |                    |   |                             |     |  |  |
|  |   |                    |               |  |                     |                |          |  |                  |                    |   |                             |     |  |  |
| NOTES:<br>1. Borehole data re<br>use by others | rehole data requires interpretation by exp. before                          |                    |               |  |                     | ORDS Hole Open |          |  | Run              | CO                 |   | RILLING F                   |     |  | QD %                                     |
| ·  | rvised by an exp representative.  | Time<br>Completion | L             | evel (r<br>Froze                               | n)                  | <del> </del>   | To (m)   |  | No.              | (m                 |   |                             | -   |  |  |
|  | led with drill cuttings upon completion.                                    |                    |               |  |                     |                |          |  |                  |                    |   |                             |     |  |  |
|  | read with exp. Services Inc. report   |                    |               |  |                     |                |          |  |                  |                    |   |                             |     |  |  |



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# Method of Test for Sieve Analysis of Aggregate ASTM C-136



| Exp Project No.:     | OTT-00219428-A0 | Project Name :     | Geotechnical In |                         |            |              |
|----------------------|-----------------|--------------------|-----------------|-------------------------|------------|--------------|
| Client :             | City of Iqaluit | Project Location : | Iqaluit, NU     |                         |            |              |
| Date Sampled :       | May 21, 2015    | Borehole:          | 25              | Sample: S1, S3, S4 & S5 | Depth (m): | as indicated |
| Sample Description : | SAN             | Figure :           | 52              |                         |            |              |

Client: City of Iqaluit Project Name: Geotechnical Investigation, Northwest Granular Deposit

Location: Iqaluit, Nunavut Project Number: OTT-00219428-A0

Date: January 29, 2016

### **List of Distribution**

**Report Distributed To:** 

Mr. Paul Clow - P.Clow@city.iqaluit.nu.ca

