THOR LAKE RARE EARTH METALS BASELINE PROJECT

Environmental Baseline Report: Volume 4 – Terrain, Soils and Permafrost

FINAL INTERIM REPORT

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EXECUTIVE SUMMARY

Avalon Rare Metals Inc (Avalon) is currently undertaking a Prefeasibility Study (PFS) for the development of the Nechalacho Deposit, located on mineral leases it holds at its' Thor Lake site in the Northwest Territories. The deposit is located approximately 100 km southeast of Yellowknife and 4 km north of the Hearne Channel of Great Slave Lake. The Thor Lake site is within the Taiga Shield ecozone, characterized by Precambrian bedrock outcrops with many lakes and wetlands in glacially carved depressions. The site is located within the Akaitcho Territory, an area currently under negotiation of a comprehensive land claim between the federal government and the Akaitcho First Nations, representing First Nations in LutselK'e, Fort Resolution, Ndilo and Dettah. Thor Lake lies within the Mackenzie Valley region of the NWT and is, therefore, subject to the provisions of the *Mackenzie Valley Resource Management Act* (MVRMA) in addition to other federal and territorial legislation of general application.

The Thor Lake site has been subject to mineral exploration by others since the 1970s. Previous exploration focused on beryllium resources in the T-zone and included drilling and bulk sampling. Since acquiring the property in 2006, Avalon has focused on delineating the rare earth resource within the Nechalacho Deposit, which is not part of the T-zone. Preliminary development concepts being considered for the Nechalacho Deposit during the PFS include development of an underground mine, mineral concentration, tailings disposal, waste rock disposal, fuel and concentrate storage, power generation and transportation infrastructure (airstrip, upgraded site roads, wharf on Great Slave Lake). Concentrate would be shipped off-site seasonally for refinement into a marketable rare earth product.

Stantec (formerly Jacques Whitford) initiated environmental baseline studies at the Thor Lake project site in fall 2008. Aquatic monitoring of drilling was undertaken during fall 2007 and winter 2008. This Technical Data Report (TDR) presents and analyzes data collected for the terrain, soils and permafrost disciplines as of fall 2009.

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1 PROJECT BACKGROUND

1.1 Focus of Baseline Investigation

The main objective of this investigation is to characterize the soils, terrain and permafrost distribution in the vicinity of the proposed Thor Lake project mine and related infrastructure. Detailed information on the surficial geology, landforms diversity, permafrost distribution and associated terrain constraints is paramount in the support of infrastructure planning, facility sitting and routing considerations.

The focus of baseline investigations include

- Identification and distribution of surficial material types
- Identification and distribution of permafrost conditions
- Soil types and their distribution
- Land capability classification of soils
- Soil suitability for reclamation
- Susceptibility to soil acidification from acid emissions
- Baseline metal content of soils
- Descriptions and location of erosion-prone sensitive soils
- The study area's susceptibility to soil compaction.

This report presents the data collected to date with respect to the above topics.

1.2 Study Area and Physiography

The Thor Lake Regional Study Area (RSA), mine lease 3178, is located within NTS 85I/SE, near the northeast shores of the Hearne Channel, Great Slave Lake, Northwest Territories, some. 100 km east/southeast of Yellowknife (Figure 1-1).

The study area falls within the Bear Slave Uplands of the physiographic Kazan Region (Bostock 1970). This region consists of vast areas of massive rocks that form flat, broad, sloping uplands, plateaus and lowlands.

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Date:	01/12/2009
Drawn By:	KS
Approved By:	NL

Avalon Rare Metals INC.

Site Location

Draft Technical Data Report

Thor Lake Project, Nechalacho Deposit

PREPARED BY

Figure: 1-1

1.2.1 Quaternary History

The study area was covered by the Laurentide Ice Sheet during the last glaciation, in the Late Wisconsinan. During glacial maximum, about 18 ka ago, the dominant ice flow direction was southwest, flowing from the Keewatin Ice Divide (Dyke and Dredge 1989; Lemmen, *et al.* 1994; Fulton 1995).

The Laurentide Ice Sheet retreated to the northeast of the Project area, leaving the area free of ice between 10,000 and 9,000 years before present (Dyke and Dredge 1989; Dyke, *et al.* 2003). Glacial meltwater impounded along this margin, forming Glacial Lake McConnell (Dyke, *et al.* 2003; Lemmen, *et al.* 1994; Smith 1995). Great Bear Lake (NWT), Great Slave Lake (NWT) and Lake Athabasca (AB/SASK) are remnants of this lake, though it wasn't until around 8,000 years before present that the lakes completely separated to their modern configurations. Glacial Lake McConnell covered approximately 240 000 km^2. Former lake shores of glacial Lake McConnell reached elevations between 245 and 295 metres above sea level (m asl) (Craig 1965). Observation in the Yellowknife area showed material reworked by wave action as far as 70 km inland from the actual location of Great Slave Lake (Kerr and Wilson 2000). This implies that glacial Lake McConnell reached elevations averaging 275 to 285 m asl.

1.2.2 Landforms and Surficial Geology

The bedrock of the region is covered by a thin and discontinuous veneer of glacial till material (Fulton 1995). Great Slave Lake was far more extensive in the past, as part of Glacial Lake McConnell, but very little sediment seems to have been deposited in this lake (Dyke and Dredge 1989; Kerr and Wilson 2000).

The regional landscape and surficial geology in the vicinity of Yellowknife was described by Kerr and Wilson (2000) as a vast terrain of low relief with topographic variations usually ranging between 10 and 30 m. The earth's surface consists mostly of bare rocky outcrops intersected by generally thin accumulation of glacial and glaciolacustrine sediments. The most common surficial deposit consists of till and commonly shows signs of reworking by glacial meltwater and glaciolacustrine processes, resulting in a variety of material facies and textures.

1.2.3 Climate and Permafrost Conditions

The weather station with the oldest historical data is located 100 km to the northwest in the city of Yellowknife (62°27'N, 114°26'W, elevation 206 m), an area characterized by a sub-arctic, semi-arid climate. The annual mean air temperature for the period from 1971 to 2000 was -4.6°C (Environment Canada 2002). The region had approximately 1,835.5 thawing degree-days and approximately 3,475.4 freezing degree-days. Winter (continuous daily mean temperature below 0°C) begins in early-October and ends around late-April, for a mean total of 222 days/year. The annual precipitation is 280.7 mm/year, of which 41 percent (151.8 cm) falls as snow (Environment Canada 2002).

By definition, permafrost refers to a condition when the ground, either loose material or bedrock, remains at or below a temperature of 0°C for a minimum period of two years (NRC, Permafrost

Subcommittee 1988). The Thor Lake Project is located in the extensive discontinuous permafrost zone of Canada (Heginbottom *et al.* 1995; Frozen Ground Data Center, http://nsidc.org/data/ggd318.html) . This zone consists of an area where 50 to 90 percent of the land is characterized by permafrost conditions. Ground ice, which is a direct indicator of permafrost conditions, occurs under three main forms: (1) as coating on grains and as crystals within pores of unconsolidated deposits (pore ice); (2) as thin ice lenses and ice veins (segregated ice, intrusive ice and reticulate ice); and (3) as large bodies of more-or-less pure ice (i.e. ice wedges, massive ice and pingo ice).

In the Yellowknife area, permafrost can be absent or present depending on the geological and physiographic contexts. Where permafrost is present, reported thicknesses vary between 30 to 90 m. Close to Table Mountain (~ 63.6° N, 123.6° W) and Norman Wells (~ 65.3° N, 127° W) reported permafrost thicknesses vary respectively between 40 to 70 m and 15 to 61 m. The reported geothermal gradient for the Yellowknife area is 12°C/km and varies between 48 to 62 °C/km for Norman Wells.

1.2.4 General Soil Patterns

There have been few extensive soil surveys completed for the Thor Lake area. The Canadian Soil Information System (CanSIS) has limited information for the Thor Lake Study Area. The Project area lies north of Great Slave Lake and has extensive areas of bedrock outcrops. Soils in upland areas typically consist of Orthic Gray Luvisols, Orthic or Eluviated Dystric or Eutric Brunisols, and Regosols. Gleyed Regosolic, Cryosolic and Organic soils are found in low-lying, imperfectly to very poorly drained areas.

1.3 Methodology

The baseline program for this study used a combination of research techniques including a review of historical data, a field inventory program and detailed mapping using Stantec’s HD-MAPP system.

1.3.1 Literature Review

A literature review of terrain, permafrost and soils conditions around the Thor Lake area was conducted in order to collect valuable background information and in order to identify any data gaps.

Detailed information specific to the Project area is very scarce. There is very few or no large scale bedrock geology, surficial geology or soils maps available for the study area, as per a review of federal and territorial government publications. There is also very limited information related to permafrost and ground temperature within the general Thor Lake Project area.

1.3.2 High Definition Mapping and Applications (HD-MAPP)

Mapping of the surficial geology and soil resources of the Project area was completed by terrain and soil scientists using Stantec’s HD-MAPP system. HD-MAPP incorporates both PurVIEW^{TM} and ArcGIS applications, allowing scientists to view medium to small scale aerial photography (e.g., 1:40,000) in a digital environment at scales as large as 1:1,500. The ability to view imagery at such detailed scales provides a number of significant advantages, including better delineation and classification of key landscape features.

Relatively homogenous terrain units were initially delineated at a scale of 1:5,000 based on surficial sediment type (e.g., till, organic, etc.), surface expression (e.g., hummocky, veneer, fan, etc.), slope, drainage, and geomorphologic processes (e.g., groundwater seepage, mass wasting, permafrost, etc.). Mapping of permafrost related landforms and ground ice distribution was conducted using base data derived from surficial deposits, vegetation and drainage. Soils were generally based on terrain polygons, and further divided into soil units representing a combination of both soil order and parent material texture. Appendix C contains the physical and chemical characteristics of each soil unit identified in the Project area from the preliminary field work conducted in 2008.

Soil unit polygons were delineated at a scale of 1:5,000 based on soil texture and Great Group. These polygons can be used to determine soil spatial extents in the Project area (Figure 2-12)

In this interim report, the following maps will be provided:

- Overview of project area
- Surficial geology
- Location of potential ice rich deposits in the Project area
- Soil and terrain inspection sites, soil unit polygons and dominant soil types.

1.3.3 Field Program

The purpose of the field inventory program was to collect data to verify preliminary terrain and soils mapping and to obtain detailed data for classification. Fieldwork was undertaken over the entire Project area in early October, 2008.

As the Local Study Area (LSA) and the specific locations of the mine and related infrastructure (infrastructure footprint) were not determined at the time of the fieldwork, the area of investigation for terrain, permafrost and soils consists of the general project area surrounding Thor Lake and Long Lake, an area of approximately 1,097 ha.

Most field sites were accessed by foot, with minimum quads and helicopter support. At each site the following general site data were recorded on a standard data sheet:

- GPS coordinates
- Slope position, aspect, gradient, and length
- Sediment type
- Surface expression
- Land use
- Terrain and soil texture
- Percentage of clasts
- Clast roundness and size

- Drainage
- Geomorphic modifying processes.

Additional information relevant to the site was recorded in a notes section. Ground inspection sites were selected while completing mapping using the HD-MAPP system. GPS coordinates for each site were downloaded from the HD-MAPP system into a handheld GPS unit set to NAD83 to allow for efficient sampling. Sixty-three (63) field sites were visited during the 2008 program.

1.3.3.1 Permafrost

Field investigations relative to the permafrost characterization were specifically conducted in the fall, a period when the active layer is fairly deep. An overview helicopter flight was also conducted to observe the Project area and to better identify any permafrost related landforms. Four days of field investigation were dedicated to permafrost observations. The area of investigation was limited to five sites; these sites were previously identified as potential ice rich deposits during the air photo interpretation and subsequently confirmed during the aerial reconnaissance flight.

Specific field methods and operations were conducted in order to confirm terrain mapping and in order to collect site-specific information and samples concerning the local permafrost conditions. Measurements of the active layer thickness were done in various types of materials, including fine-grained soils, coarse grained till, and peat deposits. This was done manually using a graduated steel probe. A series of test pits were dug in order to observe the materials and to study the stratigraphic sequence throughout the Project Area. In order to characterize the thaw-susceptibility of the permafrost, five shallow boreholes were drilled in potentially ice-rich areas. A portable shallow core drill with a carbide and diamond crown (12 cm in diameter) was used. Maximum drilling depth averaged 3.5 m. Core recovery was almost 100 -percent and material was sampled along the entire sequence. Samples within the active layer were taken from the walls of the test pits. A detailed cryostratigraphic description of the test pits and core samples was conducted in the field. Core descriptions were done following the classification of Murton and French (1994) and included dip of the sedimentary strata, cryostructure, type of ice, organic matter decomposition, and type of sediments. The core samples were logged in the field and brought back frozen to the camp where they were kept in a freezer. The frozen samples were analyzed at the Cold regions geomorphology and geotechnical laboratory (University of Montreal). The analyses included gravimetric and volumetric water content, pH, conductivity and grain size distribution (by sieving and hydrometer methods, ASTM D422).

The temperature regime of the active layer and upper permafrost was measured in October 2008 using a thermistor cable installed in a borehole (0- 14.1 m) backfilled with sand. The borehole is located a few tens of meters to the south-west of Thor Lake.

1.3.3.2 Soils

At each soil inspection site, soil profiles were described using criteria established by the Soil Classification Working Group (1998) and according to national standards established by the *Expert*

Committee on Soil Survey (1983). The following information was collected for each horizon when field conditions permitted:

- Depth
- Texture
- Moisture
- Color
- Structure
- Consistence
- Coarse fragment content
- Presence of salts
- Field pH (Bm horizons)
- Calcareousness
- Extent of mottling
- Presence of frozen horizons
- Samples taken for analysis.

Soil profiles were assigned a unit based on their textural group and soil order using the Canadian System of Soil Classification (Soil Classification Working Group, 1998). Representative profiles from each soil series were sampled by horizon to characterize the physical and chemical characteristics of each. Samples were placed in clean plastic bags, labeled and delivered to Exova Canada Inc. in Edmonton. Analyses conducted include:

- Electrical conductivity (saturated paste)
- pH (saturated paste, 1:2 H2O, 0.01 M CaCl2)
- Soluble cations (calcium, magnesium, sodium, and potassium)
- Saturation percentage and sodium adsorption ratio
- Exchangeable calcium, magnesium, sodium, potassium
- Calcium carbonate equivalent or total inorganic carbon
- Total Kjeldahl nitrogen
- Total organic carbon
- Particle size analysis (hydrometer method)
- Bulk density
- Metals Analysis.

1.4 Quality Assurance/Quality Control

Quality control and quality assessments were completed by Stantec's Practice Lead for terrain sciences during the preliminary mapping, field inventory program, final mapping, and classification phases of the work.

1.4.1 Preliminary Mapping

Preliminary terrain linework was reviewed by a senior terrain scientist early in the mapping process to ensure that mapping adhered to standards established for the Project (e.g., 1cm^2 minimum polygon size, etc.). Approximately 40% of all linework was reviewed; any linework that was not acceptable was discussed with the mappers, modified and subsequently reviewed a second time.

1.4.2 Field Inventory Program

The QA assessment for the field program consisted of three activities: field correlation, a field assessment and a review of all field plot cards.

Field correlation was completed on a daily basis with discussions occurring between field team members at the end of each day. These correlation discussions focused on material types, landforms, quaternary history, and geomorphic modifying processes such as permafrost. Field plot cards were reviewed on a nightly basis to ensure the data was properly recorded and met internal data requirements.

1.4.3 Final Mapping and Classification

Final mapping and classification was reviewed to ensure compliance with the mapping standards for the Project. Formal classifications were reviewed and compared to assess their level of congruence. A minimum of 20% of all terrain and soils units (e.g., polygons) were reviewed throughout the final mapping process.

2 RESULTS

Results of the terrain and soils section are based on the 2008 field program.

2.1 Terrain

2.1.1 Surficial Geology and Geomorphology

The landforms and surficial geology within the Project area show strong evidence of glacial and post-glacial activity. The landscape consists of a gently undulating relief that gradually decreases in elevation towards Great Slave Lake. Elevation ranges from 235 m along the shore of Thor Lake, to about 265 m on top of the highest bedrock knobs. Elevations progressively drop to approximately 160 m along the north shore of Great Slave Lake.

Bedrock outcrops are dominant landscape elements throughout the Northwest Territories; within the Thor Lake Project area, bedrock accounts for 43.2 percent of the mapped area (Table 2-1). Several bedrock outcrops show glacial striations, grooves and scratches, all evidence of glacial erosion and ice flow directions. Those abrasion marks are formed by debris-carrying ice and represent some very good indicators of former ice-flow patterns. Several were recorded throughout the Project area and all were displaying a southwest orientation. A similar ice-flow pattern is reported in the literature for this general area (see Section 1.3.2, Quaternary History). A series of large-scale indicators such glacially smoothed bedrock outcrops, and roche moutonnées were also observed. At the study site, glacially profiled bedrock outcrops are aligned NE-SW which is consistent with the glacial striaes. These low elevation outcrops are separated by longitudinal glacial troughs and glacial overdeepening depressions now occupied by lakes (e.g., Thor Lake).

Slopes were measured throughout the Project area and usually ranged from 5 to 15% with slope lengths ranging from 100 to 500 m. Short slopes between 15 and 30% are present but less common. Steep slopes are rare although a series of bedrock outcrops show some escarpments up to 70% steep with a maximum height of 15 m. Maximum elevation difference between topographic highs and lows average 30 m. Bedrock outcrops show variable degree of weathering in relation with processes such as geological decompression, frost action and thermal expansion.

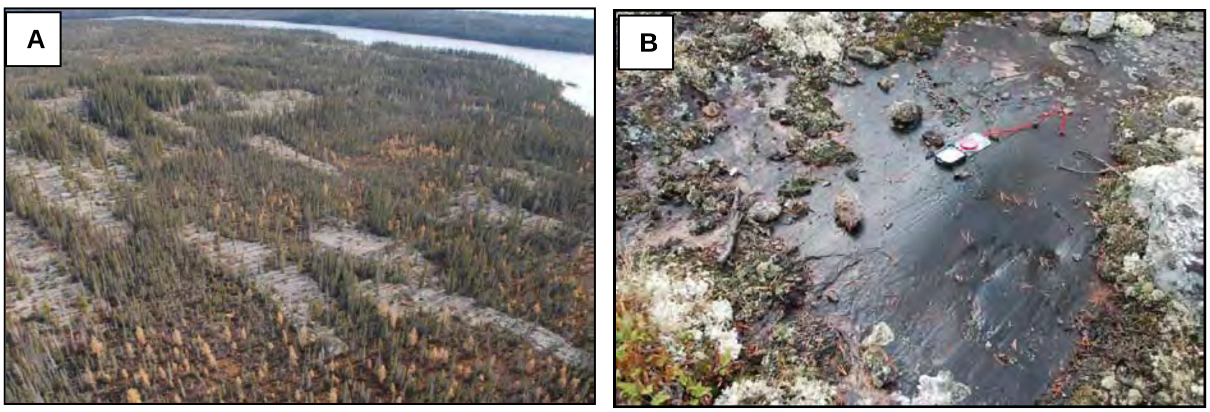
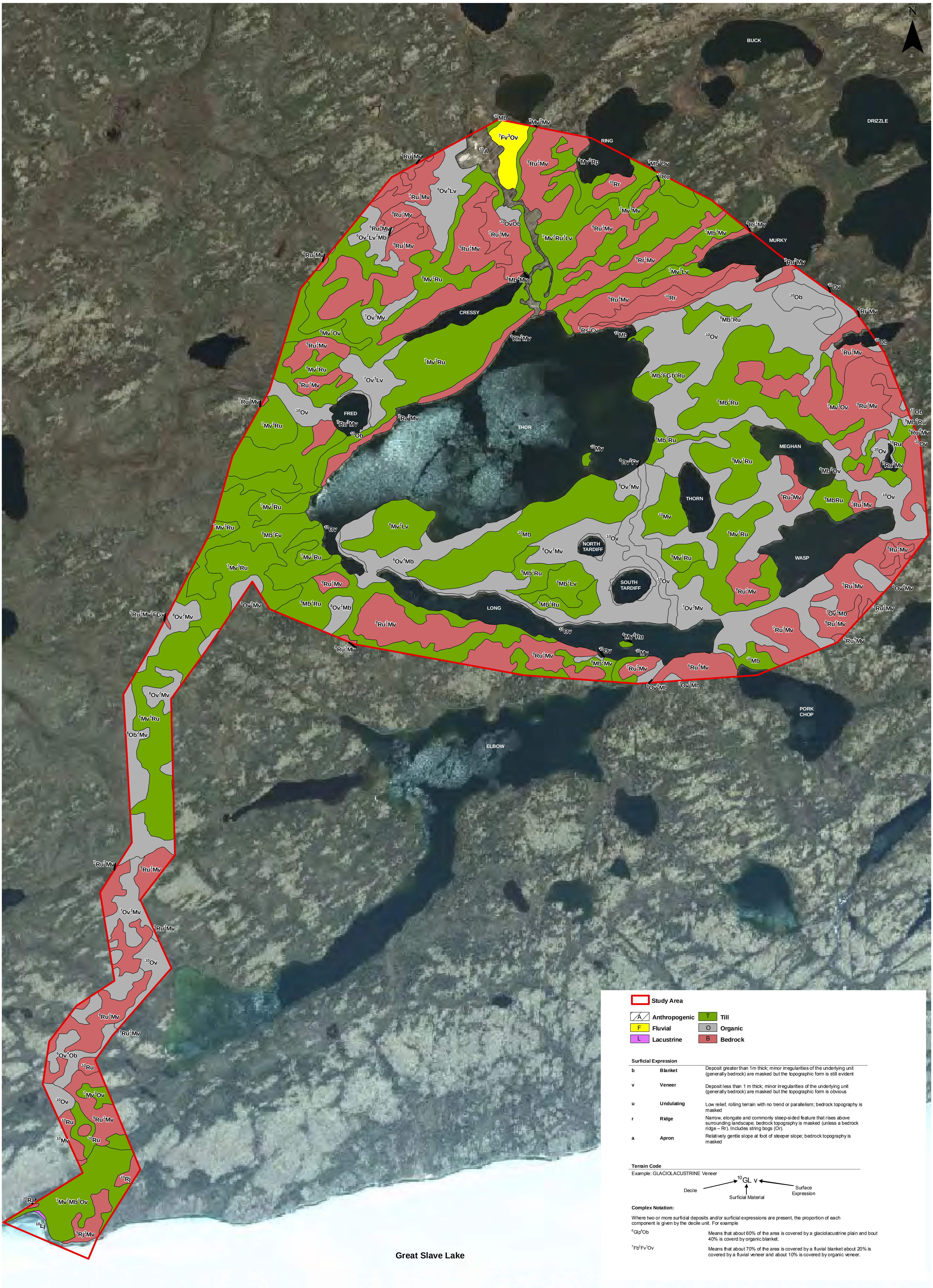


Figure 2-1: Bedrock Outcrops and Ice Flow Indicators

A) Extensive bedrock outcrops located within the Project area. Areas between the outcrops are mostly characterized by washed out tills and thin organic accumulations.

B) Glacially smoothed and striated bedrock surface showing a southwest ice flow (general orientation 230°, photo is from site ST12).



Study Area

A	Anthropogenic	T	Till
F	Fluvial	O	Organic
L	Lacustrine	B	Bedrock

Surficial Expression

b	Blanket	Deposit greater than 1m thick; minor irregularities of the underlying unit (generally bedrock) are masked but the topographic form is still evident
v	Veneer	Deposit less than 1 m thick; minor irregularities of the underlying unit (generally bedrock) are masked but the topographic form is obvious
u	Undulating	Low relief, rolling terrain with no trend or parallelism; bedrock topography is masked
r	Ridge	Narrow, elongate and commonly steep-sided feature that rises above surrounding landscape; bedrock topography is masked (unless a bedrock ridge – Rr). Includes string bogs (Or).
a	Apron	Relatively gentle slope at foot of steeper slope; bedrock topography is masked

Terrain Code

Example: GLACIOLACUSTRINE Veneer

^{10}GL v

Decile — Surficial Material — Surface Expression

Complex Notation:

Where two or more surficial deposits and/or surficial expressions are present, the proportion of each component is given by the decile unit. For example

^{6}Glp^{4}Ob	Means that about 60% of the area is covered by a glaciolacustrine plain and bout 40% is coverd by organic blanket.
^{7}Fb^{2}Fv^{1}Ov	Means that about 70% of the area is covered by a fluvial blanket about 20% is covered by a fluvial veneer and about 10% is covered by organic veneer.

Draft Technical Data Report
Thor Lake Project, Nechalacho Deposit

Surficial Geology of Thor Lake Study Area

AVALON RARE METALS INC.

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Kilometres

PREPARED BY Stantec

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Surficial Material Description

Table 2-1 provides a statistical summary of the surficial materials found throughout the Project area; these are described in detail below. Figure 2-2 shows the distribution of the parent materials throughout the Thor Lake Project area. In Figure 2-2, the colors displayed on the map correspond to the dominant parent material only (i.e., Decile 1).

Table 2-1: Surficial Materials within the Thor Lake Project Area

Surficial Material	Total Area (ha)	Percent of Project Area (%)
Bedrock	469.2	43.2
Surficial Deposits		
Glacial Deposits		
Glaciofluvial	3.4	0.3
Till	270.4	24.5
Post-glacial Deposits		
Colluvium	0	0
Fluvial	24.5	2.2
Lacustrine	16.4	1.5
Organic	240.4	21.7
Water Body	72.7	6.6
Anthropogenic	0.1	<1.0
Total	**1097.1**	**100.0**

2.1.1.1 Glacial Deposits

Till Deposits

Till is the dominant surficial deposit found within the Project area accounting for 24.5 percent. It consists of material deposited directly by ice by lodgment, melt out, or post-melt out gravity flow. Till deposits are generally found as discontinuous veneers (<1 m in thickness) and blankets (>1 m in thickness but not masking the underlying bedrock surface) directly overlying the bedrock. The surface topography is generally flat to very gently undulating.

Till facies varies considerably throughout the Project area but generally consist of a poorly compact, stony, matrix supported diamicton (Figure 2-3). Depending on the location and the degree of reworking of the material, the matrix ranges from silty clay to medium sand with minor amount of silt. Clasts range in size from pebbles to boulders and are sub-rounded to angular. Several erratics are found throughout the area, with diameters up to 1.5 m. Clast content is generally high, averaging 30 to 50%, but observation pits and coring have showed till material with clast content below 10%. The material lithology reflects the underlying bedrock type or the bedrock found in up-ice areas of the Project area. Drainage of till deposits range for moderate to poor.

Some till deposits contain lenses and beds of reworked material. In some cases, till facies shows evidence of reworking by glacial meltwaters and wave action (former glacial lake McConnell and present-day Great Slave Lake). Similar observations have been made in the Yellowknife area, where wave-washed bouldery till surface was found up to 100 m (275-280 m a.s.l.) above the present Great Slave Lake level (Kerr and Wilson 2000). These tills are generally coarser, in relation with the fine sediment being removed.

Figure 2-3: Till material (ST21)

Observation pit showing coarse till material with approximately 50% coarse fragments in a silty sand matrix.

2.1.1.2 Glaciofluvial Deposits

Glaciofluvial deposits consist of well-sorted sediment deposited by glacial meltwaters (subaerial or outwash deposits) and also includes material deposited in proglacial lakes in contact with glacier ice (ice-contact deposits) and material deposited at the margins of glaciers. They are very uncommon within the study area (0.3 percent of the study area) and are mostly found as a minor polygon component. No glaciofluvial landforms (e.g., esker, kame, outwash, etc.) were observed within the Project area.

Glaciofluvial materials within the Thor Lake Project area consist of medium- to coarse textured sand with variable amount of gravels and pebbles (Figure 2-4). The clasts are for the most sub-rounded to round, with minor sub-angular. Glaciofluvial sediments are generally massive or vaguely horizontally bedded. Most observed deposits were forming discontinuous veneers, and generally located in topographic lows. Drainage of this type of material was usually good to moderate.


Figure 2-4: Glaciofluvial material (ST25)

Site ST25 showed medium to coarse sand with approximately 30% of subrounded gravel.

Glaciolacustrine Deposits

This type of material is generally well-sorted and consists of heavy clay to silty clay, deposited by suspension into the former glacial lake basin. The sediments are compact, firm and generally massive; although in some areas they are finely laminated (rhythmic beddings). Dropstones released by melting icebergs may be present. Buried organic horizons are not associated with glaciolacustrine sediments due to the limited amount of vegetation that existed in glacial times.

Glaciolacustrine material occupies former topographic depressions. No glaciolacustrine deposits were found exposed at the surface. A shallow borehole drilling revealed the presence of such material at 2.5 meters below the surface. The material consisted of silt and clay (see permafrost section for detailed material description). The bottom of the units was not reached during the drilling.

2.1.1.3 Post-glacial Deposits

Lacustrine Deposits

Lacustrine deposits were mapped over only 1.5 percent of the Project area (most lacustrine deposits were found underlying organic accumulations. Lacustrine sediment consists of massive to poorly laminated silt and clay with minor amount of sand (Figure 2-5). They also include sandy to gravelly beach deposits formed by currents wave action along the Great Slave Lake. Most lacustrine deposits are found in topographic low and bedrock controlled depressions. The thicknesses of lacustrine deposits are highly variable and the material was commonly found underlying organic accumulations.

Figure 2-5: Lacustrine Material Found at Site ST25

Observation pit at site ST25. Material consists mostly of massive silt with minor clay and very fine sand.

Fluvial Deposits

Fluvial sediments are rare throughout the study area accounting for slightly more than one percent of all materials mapped. They consist mainly of moderately well to well sorted, fine sand and silt with a very low amount of sub-rounded to well rounded gravels and pebbles. Fluvial deposits are generally massive, but bedding and lamination with thin buried organic layers are not uncommon. Fluvial material observed in the field was usually less than one meter thick and their drainage ranged from moderate to poor.

Colluvial Deposits

Colluvial deposits are composed of angular to very angular material, deposited by gravity-induced mass movement. They consist mainly of blocky talus, characterized by the absence of fine grained matrix. The thickness of the colluvial deposits found within the Project area is generally thin (less than 2 m). All were characterized as well to rapidly drained. Colluvial deposits are mostly derived from the weathering (gelifraction) of local bedrock and are commonly found mantling the edges of bedrock ridges. The material is generally very coarse and angular, with an average clast size in the 20 to 50 cm range (Figure 2-6). These types of deposits are very rare within the study area, in relation with the relatively flat topography.

Figure 2-6: Blocky Colluvial Deposit

A very coarse colluvial deposit found along a bedrock ridge, east of Thor Lake. Material consists mostly of very angular blocks derived from the local bedrock.

Organic Deposits

Organic accumulations are common throughout the study area and account for 17.9% of the surficial materials. They generally occupy topographic lows, and either rest directly on bedrock or overlie poorly drained surficial deposits such as fine-grained lacustrine or glaciolacustrine material. In lesser occasions, organic material is found overlying fine-grained till deposits. Only organic accumulations greater than 40 cm thick have been mapped as 'organic'. Accumulations less than 40 cm thick have been mapped according to the underlying surficial material.

Organic accumulations form bogs and fens which host varying amounts of grasses, sedges and sphagnum mosses. The average depth of organics is about 80 cm, however some areas only have thin veneers (<50 cm) and others are characterized by deposits over 2 m thick. Drainage of the organic deposit units is considered very poor. More details with regard to the organic peat depths and landform types are found in Section 2.2 (Permafrost)

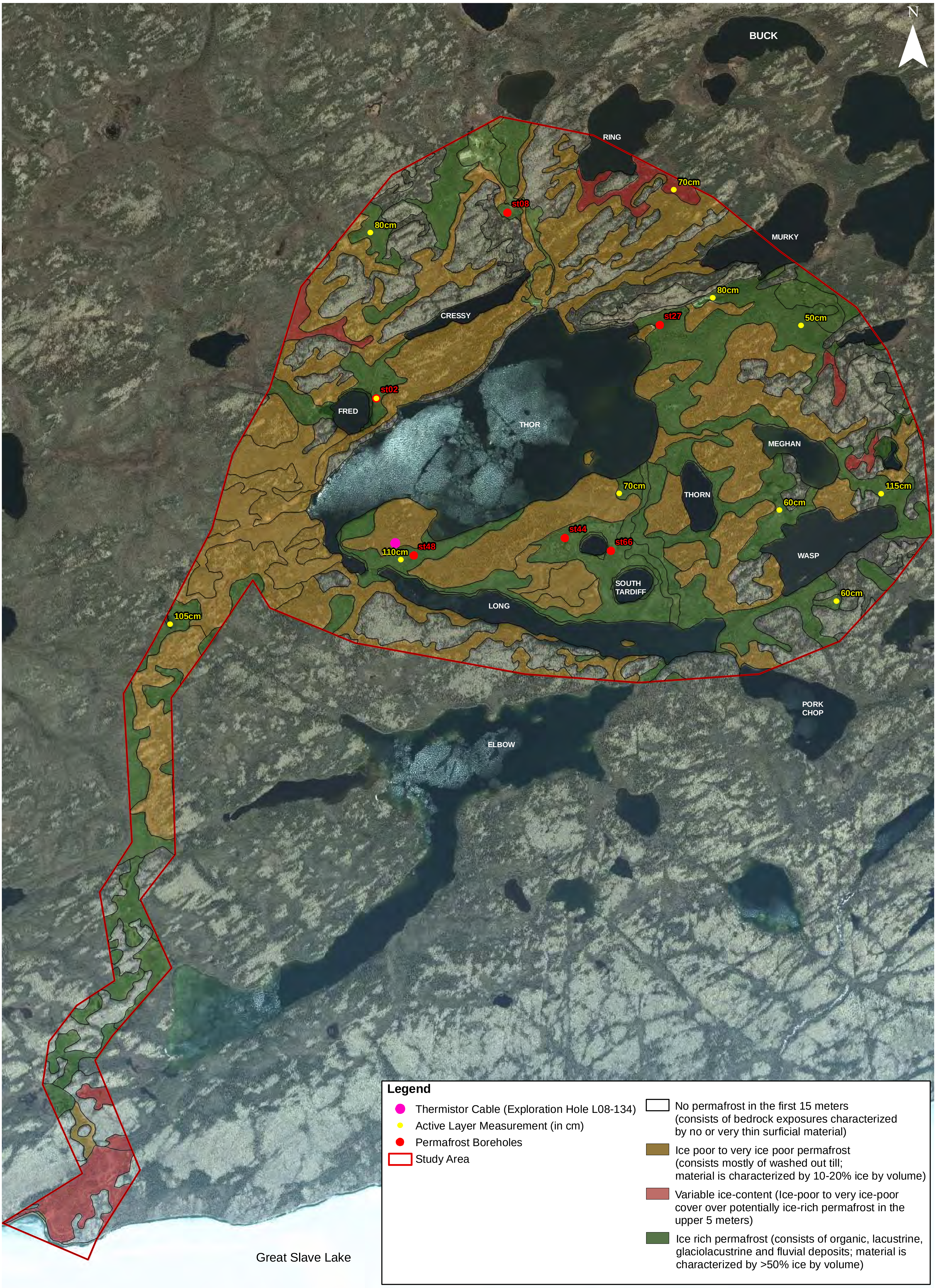
2.2 Permafrost

2.2.1 Permafrost Distribution and Landforms

The project site is located in the zone of extensive discontinuous permafrost. In this zone the spatial distribution of the permafrost is highly dependent on local factors. Factors promoting permafrost presence are thin snow cover, northern exposure, presence of a significant organic cover (>dm thick) and fine-grained sediments (silt, clay). Terrain with southern exposure, coarse-grained sediments (clean sand and gravel, pebbles, boulders), thick snow cover and large/deep lakes (e.g., Thor Lake) are unlikely to support permafrost conditions (Figure 2-7).

At the project site, glacial troughs filled with till (Figure 2-2) having a fine-grained matrix, glaciolacustrine and lacustrine deposits as well as peatlands are very likely affected by ice-bonded permafrost. These deposits represent approximately 50 percent of the Project area. North facing rock outcrops are also possibly affected by permafrost. However, these outcrops do not represent a geotechnical concern as they only contain a limited amount of ice (if any) in fractures and are therefore thaw-stable.

Permafrost landforms in the Project area are essentially represented by the presence of frost-shattered bedrock and frost-heaved sediments forming small uplifted peat plateaus. Permafrost degradation landforms are represented by thaw lakes, thermokarst pits and collapsed fens and bogs. Bathymetric data collected as part of the fisheries baseline assessment and field observations of permafrost degradation along lake shorelines suggest South Tardiff, North Tardiff and Fred lakes are pure thaw lakes. The north-west and south-east portion of Meghan Lake as well as the eastern portion of Thor Lake also likely resulted from the degradation of ice-rich permafrost.



Draft Technical Data Report
Thor Lake Project, Nechalacho Deposit

Permafrost Distribution

Area of Detail

AVALON RARE METALS INC.

0 0.25 0.5 1
Kilometres

PREPARED BY
Stantec

DRAFT DATE 14/01/2010			SCALE 1:20,000	
REVISION DATE			PROJECT 1036222	FIGURE NO. 2-7
DRAWN KS	CHECKED RH	APPROVED NL	VOL	

2.2.2 Permafrost thermal regime and thickness

Table 2-2 and Figure 2-8 show the temperature profile of the active layer and near surface permafrost as measured in a borehole located on the periphery of Thor Lake. In the permafrost, the depth at which there is no discernable change in temperature is termed the "depth of zero annual amplitude" (NRC, Permafrost Subcommittee 1988). Measurements made on October 9 and 21, 2009 indicate that the depth of zero annual amplitude is located a few decimeters below the deepest thermistor bead. The temperature at the depth of zero annual amplitude is used to calculate the permafrost thickness using the following equation:

$$PMF_t = (T_{zaa}/G) + D_{zaa}$$

Where:

PMF_t is the permafrost thickness
T_{zaa} is the temperature at the depth of zero annual amplitude
G is the local geothermal gradient
D_{zaa} is the depth of zero annual amplitude.

The geothermal gradient at Thor Lake is unknown, but Yellowknife measured *G* is 12°C/km (Smith and Burgess 2000). Assuming a similar geothermal gradient at Thor Lake, the permafrost thickness at the location of the thermistor cable can then be estimated to be around 60 m. This is similar to reported permafrost thicknesses for sites with similar elevation at Yellowknife, Table Mountain, Great Bear River and Norman Wells (Smith and Burgess 2000). It should be mentioned that the permafrost thickness at the study site can vary in the order of several meters to tens of meters depending on local factors (e.g., water bodies, soil type, snow cover, exposures).

Table 2-2: Active Layer and Near Surface Permafrost Temperatures as Measured by a Thermistor Cable Located Near Thor Lake (see Figure 2-8)

Depth (mbg)	Reading (°C)	Reading (°C)
	09-Oct-09	21-Oct-09
0.413	-5.93	-4.03
-0.087	0.59	0.03
-0.587	1.04	0.04
-1.087	0.64	0.05
-1.587	0.15	0.03
-2.087	0.05	0.02
-3.087	-0.33	-0.31
-4.087	-0.46	-0.43
-6.587	-0.59	-0.58
-8.087	-0.62	-0.61
-11.087	-0.66	-0.66
-14.087	-0.75	-0.67

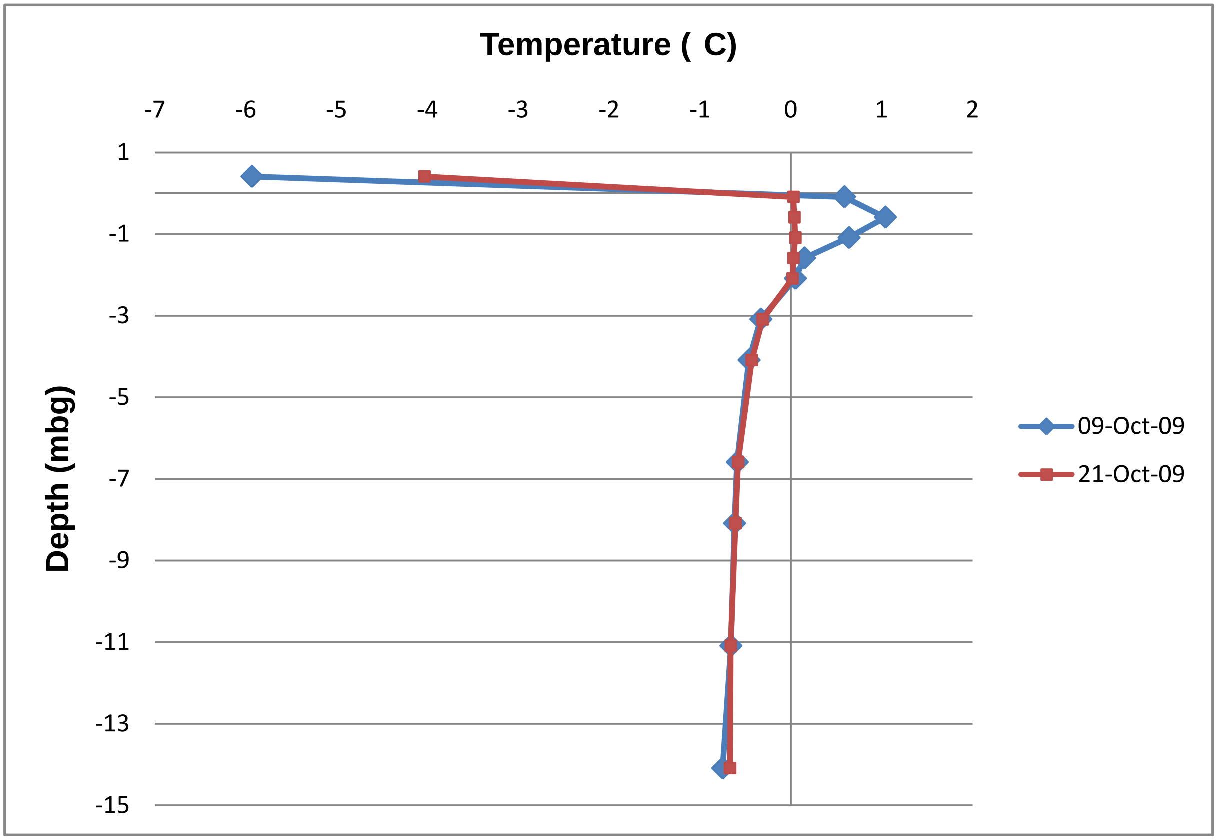


Figure 2-8: Temperature profile of the active layer and near surface permafrost

2.2.3 Active Layer Thickness

Sites with surficial deposits affected by permafrost have an active layer (the zone that freezes and thaws annually) that varies between about 40 and 200 cm. Variations in active layer thickness are related to local terrain factors, the most important being thickness of the organic cover and sediment texture. Sites with organic cover thicker than a few decimeters and underlain by fine-grained sediments (silt, clay, fine-grained till) usually have active layer in the order of 60 to 65 cm on average (n=12). In coarser sediments and in locations with thinner organic cover, the active layer will usually be thicker than 100 cm. In bedrock, the active layer can be a few meters thick.

2.2.4 Upper Permafrost Cryostructure, Ice Content and Thaw-Susceptibility

Five shallow boreholes indicate the near surface permafrost in the Project area is potentially very ice-rich and thus highly thaw-susceptible. From a geotechnical point of view, permafrost with volumetric ice content over 40% are considered very problematic upon thawing as they initiate major geomorphic and environmental changes such as thaw-settlement, soil consolidation, impeded drainage, excess pore water pressure and mass movement.

2.2.4.1 Peat Accumulation

Significant decimeter to meter thick peat cover was encountered in several locations in the Project Area. These organic accumulations usually support permafrost, the latter usually extending down in the sedimentary deposit or bedrock below. Frozen peat is generally very ice-rich with volumetric ice content over 40% (gravimetric ice content over 100% is very common). Frozen peat is highly thaw-susceptible. Degradation and erosion of frozen peat is also very problematic as peat provides an isolative cover protecting the intrasedimentary permafrost. Removal and destruction of peat cover initiates positive feedback effects which accelerate permafrost degradation.

2.2.4.2 Glaciolacustrine Deposit

Glaciolacustrine silt deposits becoming finer in texture with depth were encountered in boreholes ST44 and ST46 (west of North Tardiff Lake). These deposits are covered by a fine to medium sand blanket a few decimeters thick and peat up to 1.7 m thick. The active layer thickness was 50 cm in borehole ST44 and 80 cm in borehole ST46. Below the active layer the peat has a porous cryostructure and is very ice-rich (60 – 70% volumetric ice content). The sediments have lenticular to reticulate cryostructures and are very ice-rich (40 – 75% volumetric ice content). Glaciolacustrine sediments are considered highly thaw-susceptible. This type of deposit is covered by either peat or various types of sediments and has not been observed directly at the surface. The extent, depth and thickness of glaciolacustrine deposits are unknown but presumably important as the area was covered by glacial Lake McConnell.

2.2.4.3 Lacustrine Deposit

A lacustrine silty sand deposit was encountered in borehole ST48 (south-west of Thor Lake). This deposit is covered by about 70 cm of peat. The active layer is located at the interface between the peat and the mineral sediments. The silts have lenticular to suspended cryostructures and are generally ice-rich (25 – 62% volumetric ice content). Lacustrine deposits are considered highly thaw-susceptible. This type of deposit is covered by either peat or various types of sediments and has not been observed directly at the surface. The extent and thickness of this type of deposit are unknown but presumably smaller than glaciolacustrine deposits as they are related to isolation phases of former glacial Lake McConnell

2.2.4.4 Till with Fine-grained Matrix

A till deposit with a silty matrix was encountered in borehole ST02 (east of Fred Lake). This deposit is covered by peat a few decimeters thick. The active layer thickness was 40 cm and located at the mineral interface. The sediments have reticulate to suspended cryostructures and are very ice-rich (>65% volumetric ice content) in the first meter but the ice content decreased with depth. This type of deposit is presumably encountered at depth in several glacial troughs in the Project area. Locally this deposit has been washed out by waves of glacial Lake McConnell (see below).

2.2.4.5 Washed-out Till

A washed-out, coarse-grained till deposit was encountered in borehole ST08 (north of Thor Lake). This deposit was overlaid by about 75 cm of peat. The active layer was 55 cm thick. The peat has porous to micro-lenticular cryostructures and was very ice-rich (>480% gravimetric ice content, volumetric ice content not available). The sediment has a porous cryostructure and was ice-poor (<20% gravimetrictric ice content, volumetric ice content not available). Washed-out till deposits are considered thaw-stable.

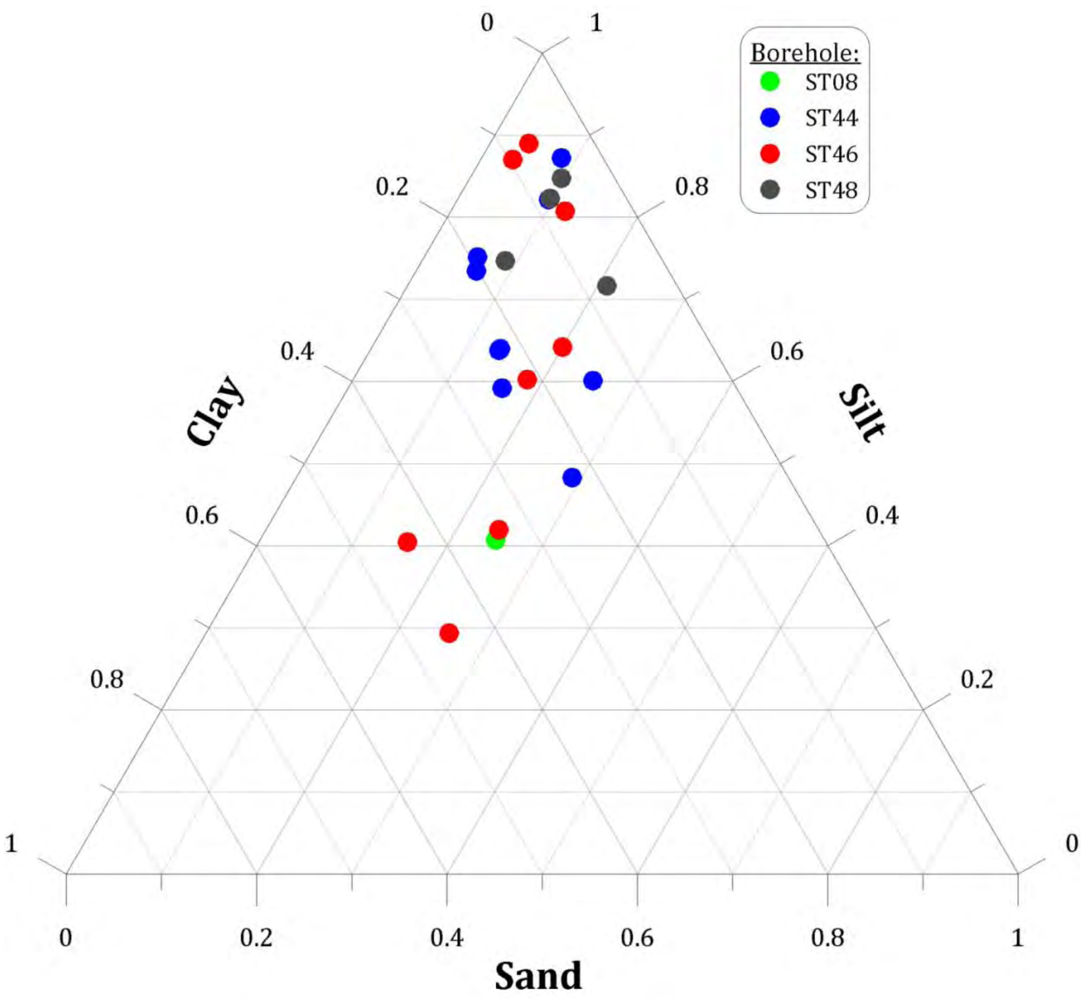


Figure 2-9: Selected sediment samples from the boreholes showing the fine-grained nature of glaciolacustrine (ST44, ST46), lacustrine (ST48) deposits and the coarse-grained nature of washed-out till (ST08) (see Appendix A for additional information)

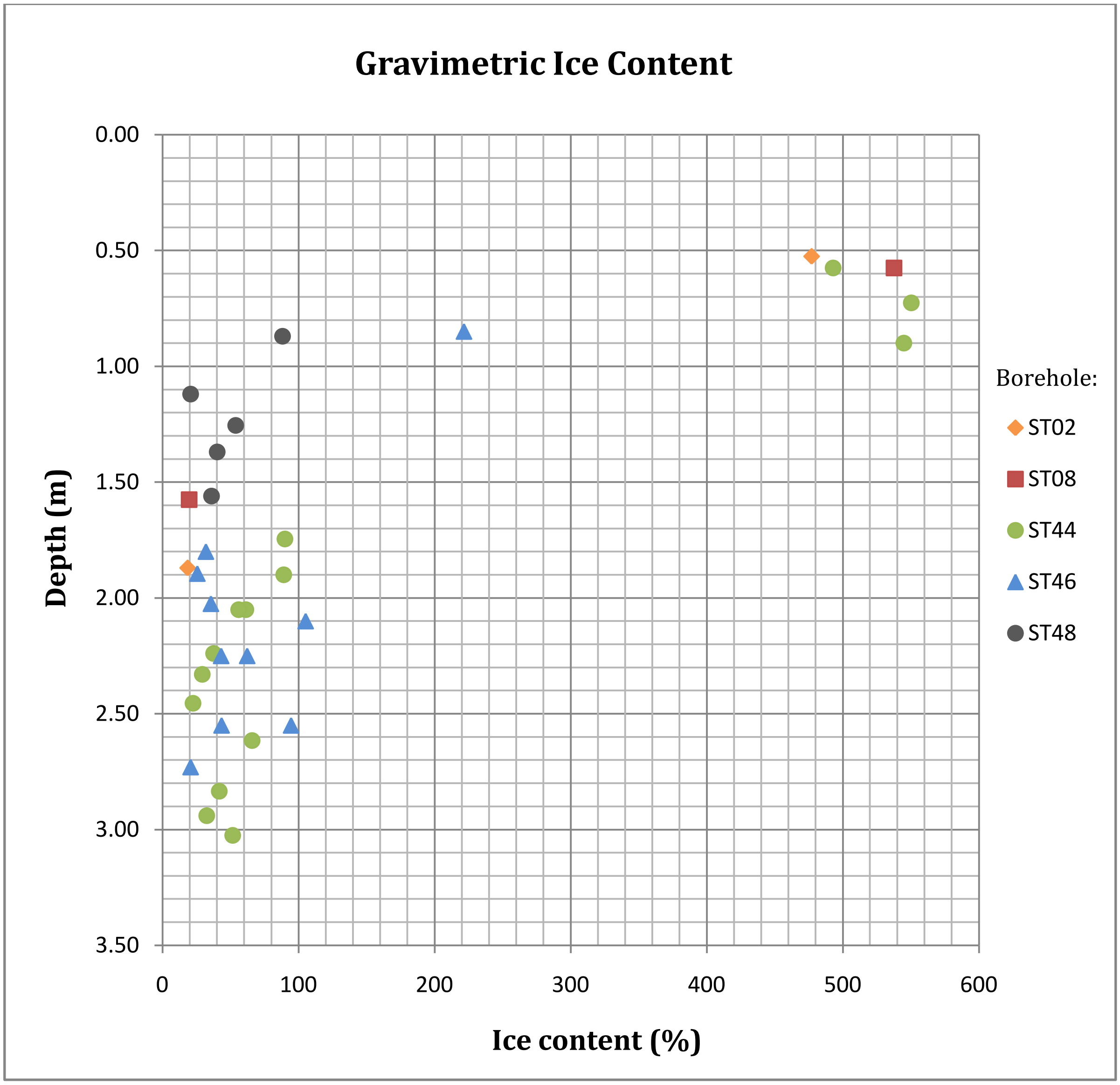


Figure 2-10: Selected gravimetric ice contents for various types of deposits encountered in the boreholes

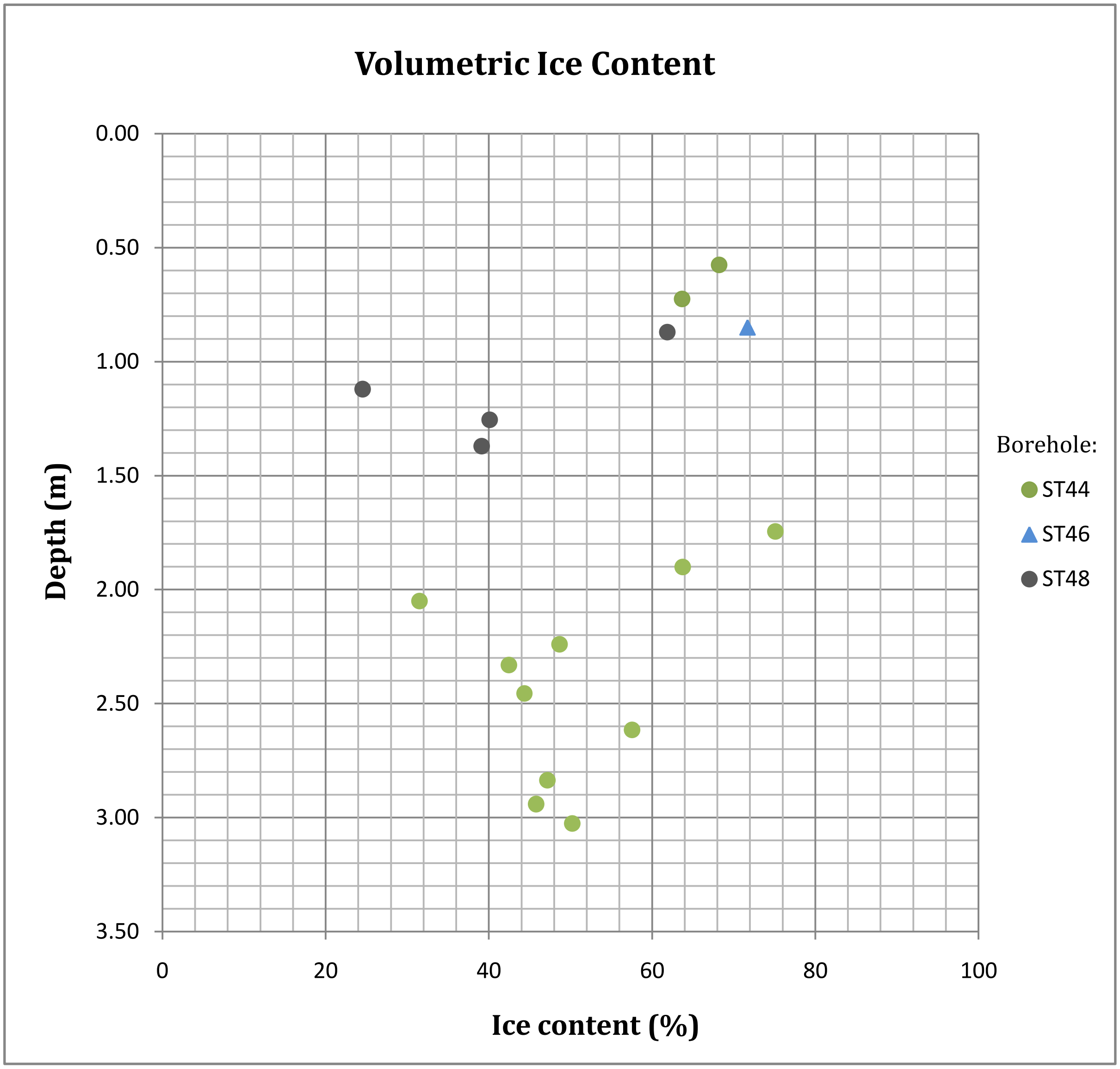


Figure 2-11: Selected volumetric ice contents for the permafrost boreholes (see appendix for additional information)

2.3 Soils

2.3.1 Overview

The Thor Lake Project area is comprised mainly of moderately well, poorly and very poorly drained soil complexes. These soils occur in patterns of Organics, peaty Regosols, Gleyed Regosols, Brunisols, Cryosols and bedrock exposures throughout the area. The patterns of soil can be quite complex in part due to the lack of well-established drainage pathways.

The Project area is composed of 37% (402.6 ha) mineral soils, 13% (148.3 ha) organic soils and 27% (295.8 ha) bedrock. The remainder is either previously disturbed land (1%, 8.4 ha), or open water (22%, 242 ha). Within the mineral soils, fine-textured soils (23%, 248.3 ha) almost double the area covered with coarse textured soils (12%, 128.6 ha). The rest of the mineral soil is composed of Cryosolic soils that are frozen within one meter of the surface (2%, 25.6 ha). Organic soils occupy 13 percent of the Project area, and 8% of these organic soils were mapped as Organic Cryosols. Soils personnel have found considerable extents of thin organic layers that are not of sufficient thickness (e.g., <40cm) to be designated as peatlands; some of these shallow organic areas have been mapped as organics by the Terrain program.

2.3.2 Soil Map Units

Eight (8) soil units based on texture and soil order were found and mapped in the area sampled in 2008 (Table 2-3). Four soil orders were identified in the field, including Brunisols, Cryosols, Organics and Regosols; Luvisols, which are known to occur regionally, were not found within the Project area. A total of 17 different soil subgroups were identified from the 63 soil investigations. The dominant soil order found in the Thor Lake Study Area was Regosolic.

Table 2-3 provides a summary of the eight soil units mapped within the Thor Lake Project area. These soil units were mapped at 1:5,000 (Figure 2-12). Mappable soil units are those occurring in extents large enough to be represented as polygons that are legible and meaningful.

Table 2-3: Description of Soil Units Mapped in the Thor Lake Project Area

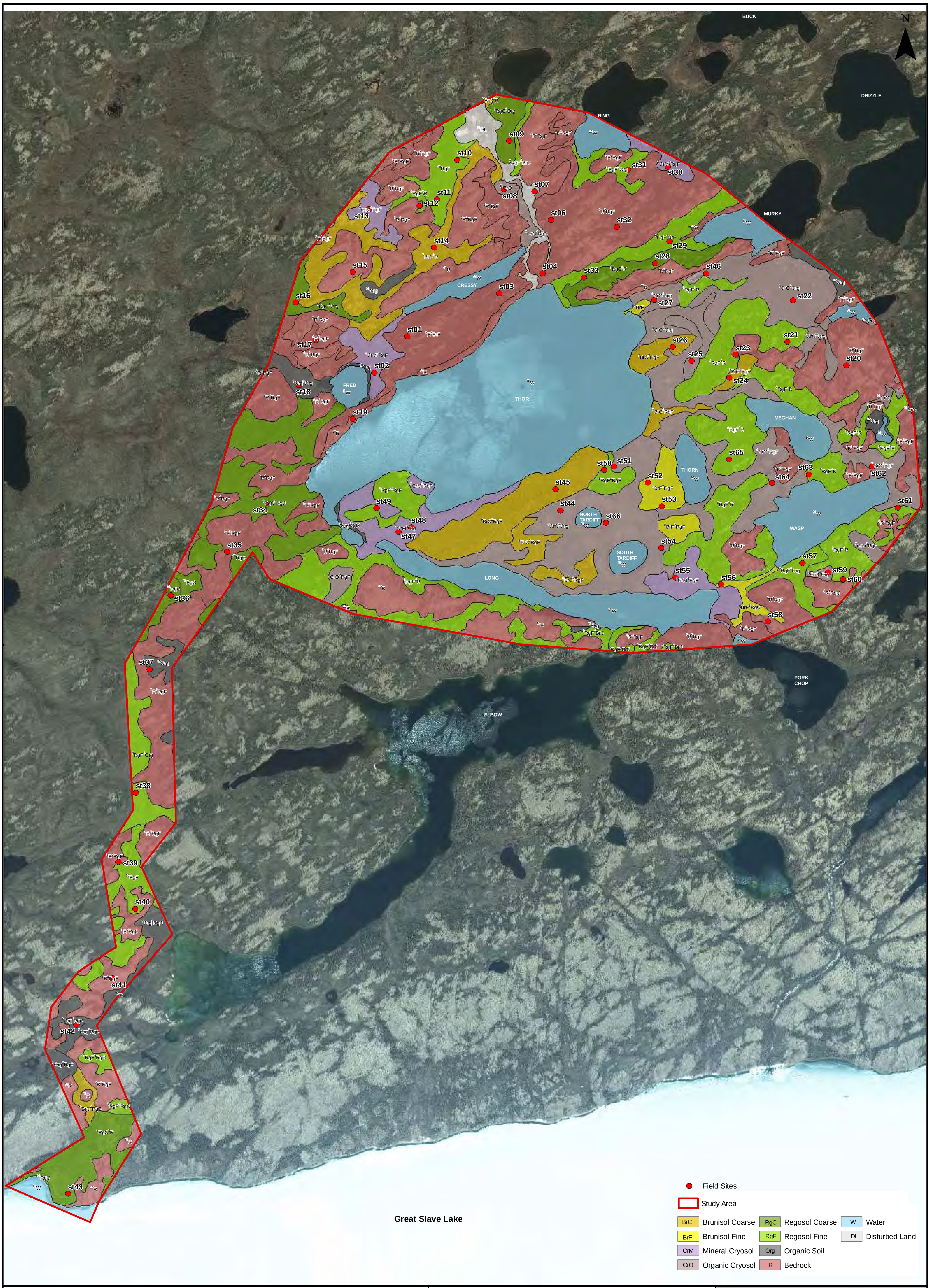
Soil Order	Mineral/ Organic	Texture	Soil Unit	Parent Materials (Sampled)	Soil Subgroups
Brunisolic	Mineral	Very Coarse to Medium	BrC	Till Glaciofluvial	Eluviated Dystric Brunisol
					Orthic Dystric Brunisol
					Orthic Eutric Brunisol
		Moderately Fine to Very Fine	BrF	Till, Glaciolacustrine	Orthic Eutric Brunisol
Regosols	Mineral	Very Coarse to Medium	RgC	Lacustrine, Glaciofluvial, Till, Fluvial	Orthic Regosol
					Gleyed Regosol
					Orthic Humic Regosol
					Gleyed Cumulic Regosol
		Moderately Fine to Very Fine	RgF	Lacustrine, Glaciolacustrine, Till, Fluvial	Gleyed Regosol
					Gleyed Cumulic Regosol
Cryosols	Organic	Mesic and Fibric	CrO	Organic	Fibric Organic Cryosol
					Mesic Organic Cryosol
					Terric Mesic Organic Cryosol
					Terric Fibric Organic Cryosol
	Mineral	Moderately Fine to Very Fine	CrM	Lacustrine, Glaciolacustrine	Gleyed Static Cryosol
					Rego Static Cryosol
					Histic Rego Static Cryosol
Organic	Organic	Mesic and Humic	Org	Organic	Terric Mesisol
					Terric Mesic Humisol
Bedrock		Bedrock	R	Rock	Non Soil

The characteristics of the soil units and mapping units are described in Table 2-3. The extent of each soil within the Thor Lake Project area is shown in Table 2-4; Figure 2-12 is a map showing the spatial distribution of the various mapped soil units. This map has been colour coded according to organic soils, mineral soils, disturbed land, water and bedrock. Detailed soil unit descriptions are provided in Appendix C. Each polygon has been assigned deciles to represent significant components or inclusions of other non-dominant soil types found in that polygon. All soils within a polygon may not mirror the typical profile description of the soil unit for that polygon. The natural variability inherent in soil results in an accepted range of characteristics classified within one unit. This map contains two miscellaneous map units that do not represent soil types. These units are disturbed land and open water; together, these units equate to approximately 23% of the total Project area. Water is by far the dominant miscellaneous unit at 22%. Disturbed land represents areas where the soil has been anthropogenically disturbed from its natural state.

Table 2-4: Extent of Soils Mapped within the Thor Lake Project Area

Soil Unit	Area (ha)	Proportion of PDA Study Area (%)
Mineral Soils		
BrC	56	5
BrF	29.9	3
RgC	72.8	7
RgF	218.7	20
CrM	25.6	2
Subtotal	**403**	**37**
Organic Soils		
CrO	101.4	9
Org	46.6	4
Subtotal	**148**	**13**
Bedrock		
R	295.8	27
Miscellaneous		
Disturbed land	8.4	1
Water	242	22
Subtotal	**250.4**	**23**
Total	**1,097.1**	**100**

NOTE:
Columns may not equal totals due to rounding



Draft Technical Data Report
Thor Lake Project, Nechalacho Deposit

Surficial Geology of Thor Lake Study Area

Area of Detail

AVALON RARE METALS INC.

0 0.25 0.5 1
Kilometres

PREPARED BY Stantec			
DRAFT DATE 21/12/2009		SCALE 1:20,000	
REVISION DATE		PROJECT 1036222	FIGURE NO. 2-12
DRAWN KS	CHECKED RH	APPROVED NL	VOL

3 CLOSURE

Stantec has prepared this report for the sole benefit of Avalon Rare Metals Inc. for the purpose of documenting baseline conditions at its Thor Lake site. The report may not be relied upon by any other person or entity, other than for its intended purposes, without the express written consent of Stantec and Avalon. Any use of this report by a third party, or any reliance on decisions made based upon it, are the responsibility of such third parties.

The information provided in this report was compiled from existing documents and data provided by Avalon and field data compiled by Stantec (formerly Jacques Whitford AXYS Ltd.).This report represents the best professional judgment of our personnel available at the time of its preparation. Stantec reserves the right to modify the contents of this report, in whole or in part, to reflect any new information that becomes available. If any conditions become apparent that differ significantly from our understanding of conditions as presented in this report, we request that we be notified immediately to reassess the conclusions provided herein.

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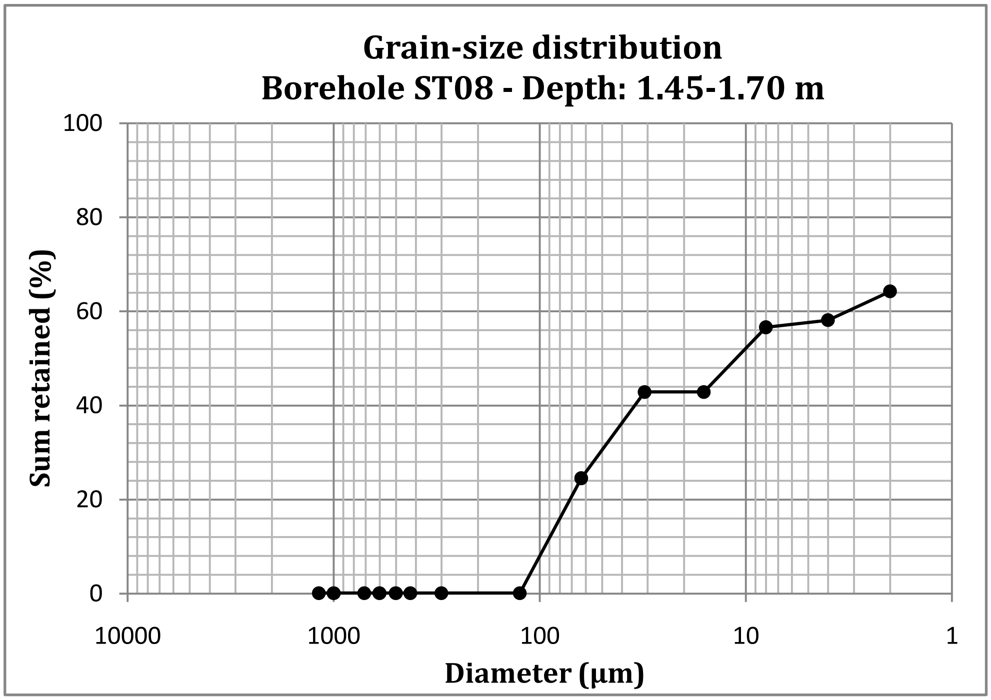
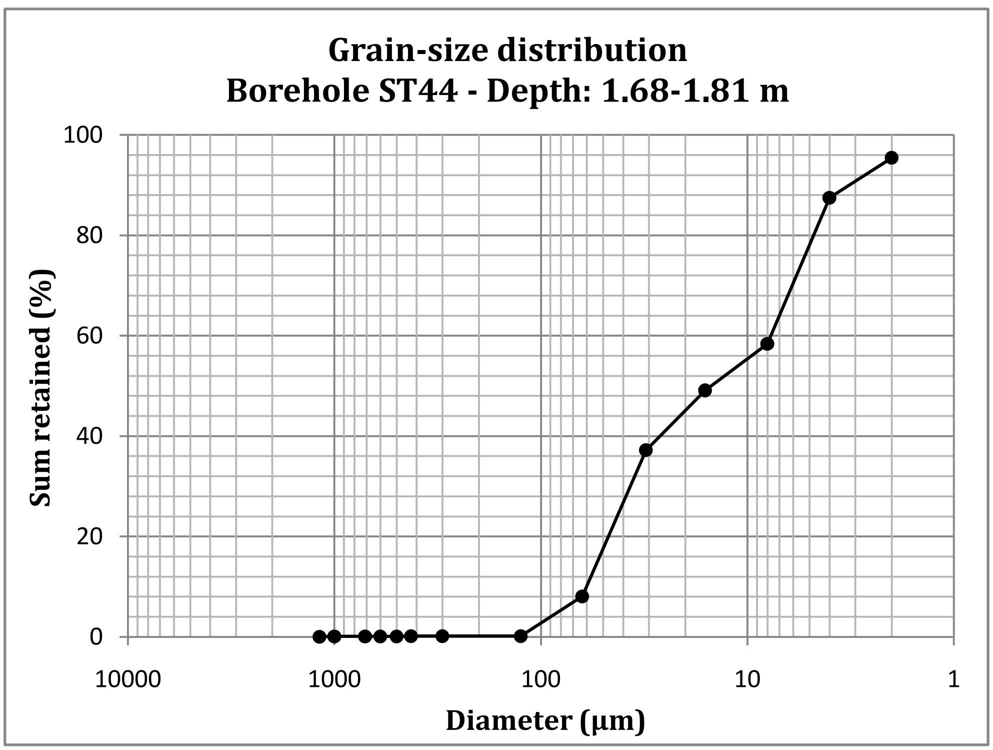
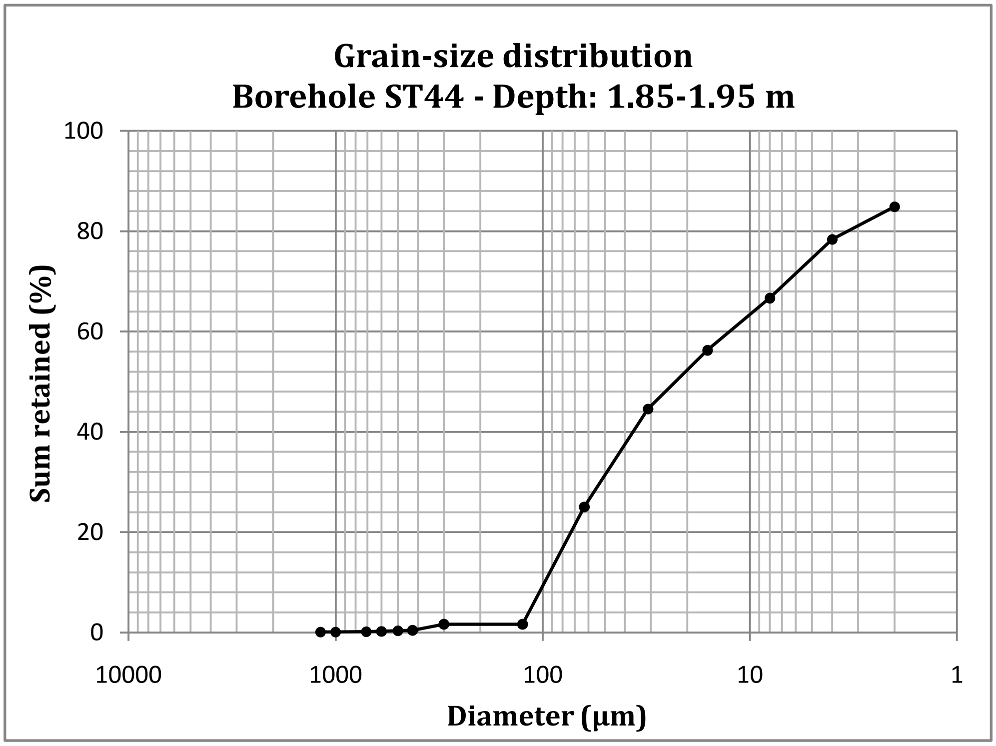
APPENDIX A

Permafrost Data

Grain-size Distribution Curves






Grain-size distribution
Borehole ST44 - Depth: 1.85-1.95 m
Sum retained (%)
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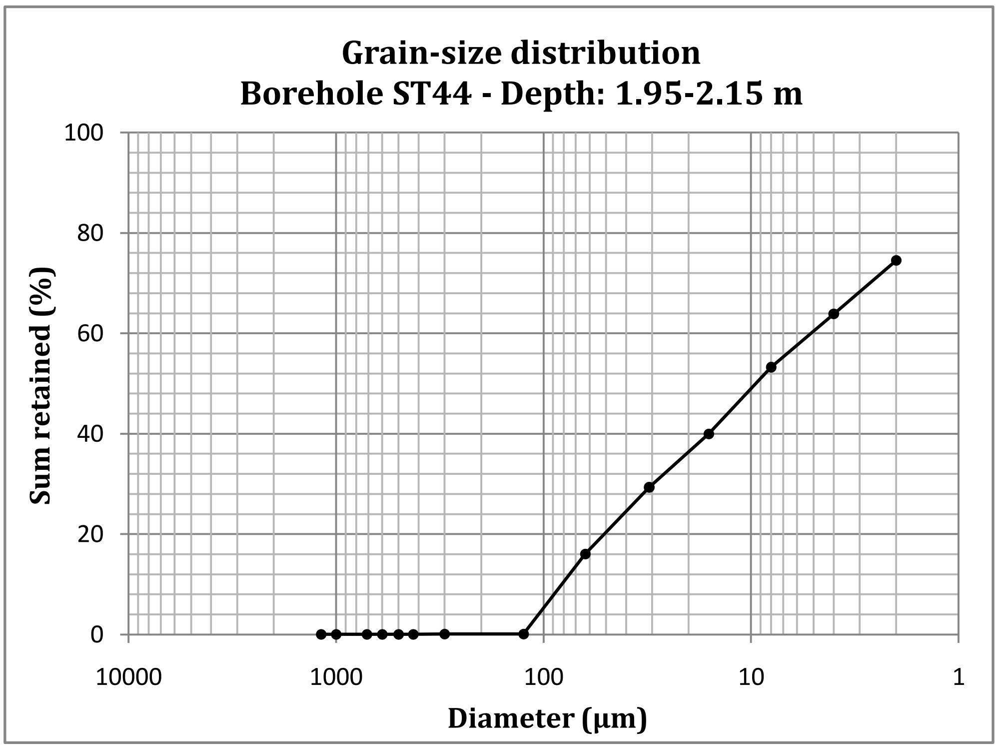
60
80
100
10000
1000
100
10
1
Diameter (µm)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Sum retained (%)
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10
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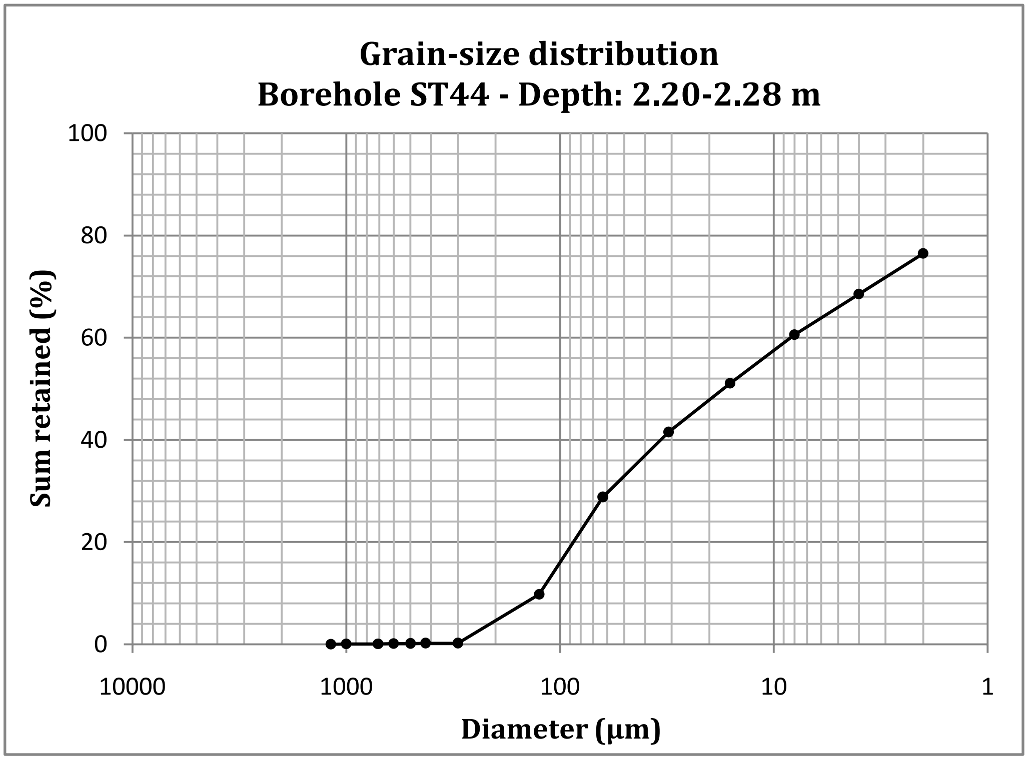
Diameter (µm)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Sum retained (%)
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10000
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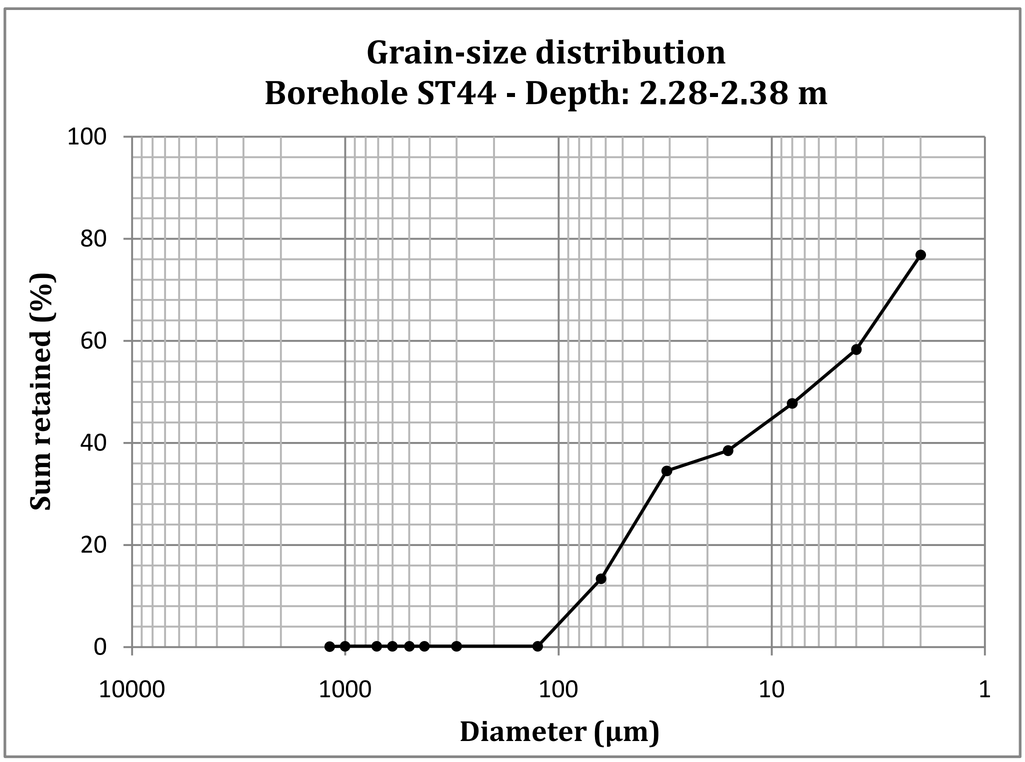
100
10
1
Diameter (µm)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10000
1000
100
10
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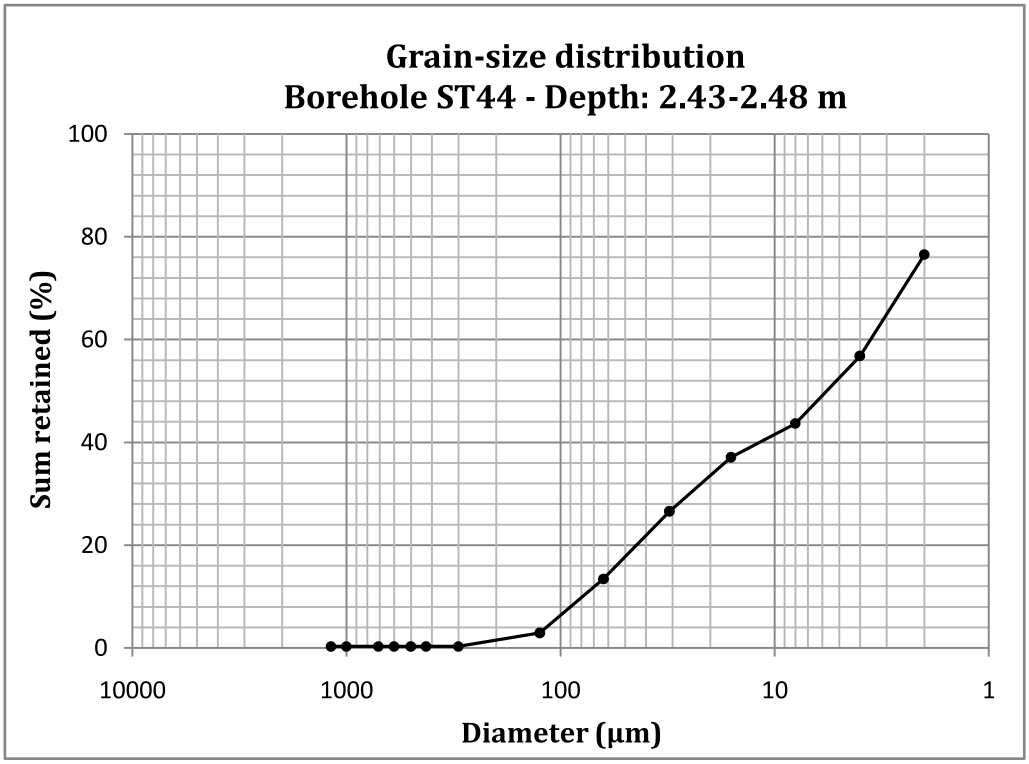
Diameter (µm)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Borehole ST44 - Depth: 2.43-2.48 m
Sum retained (%)
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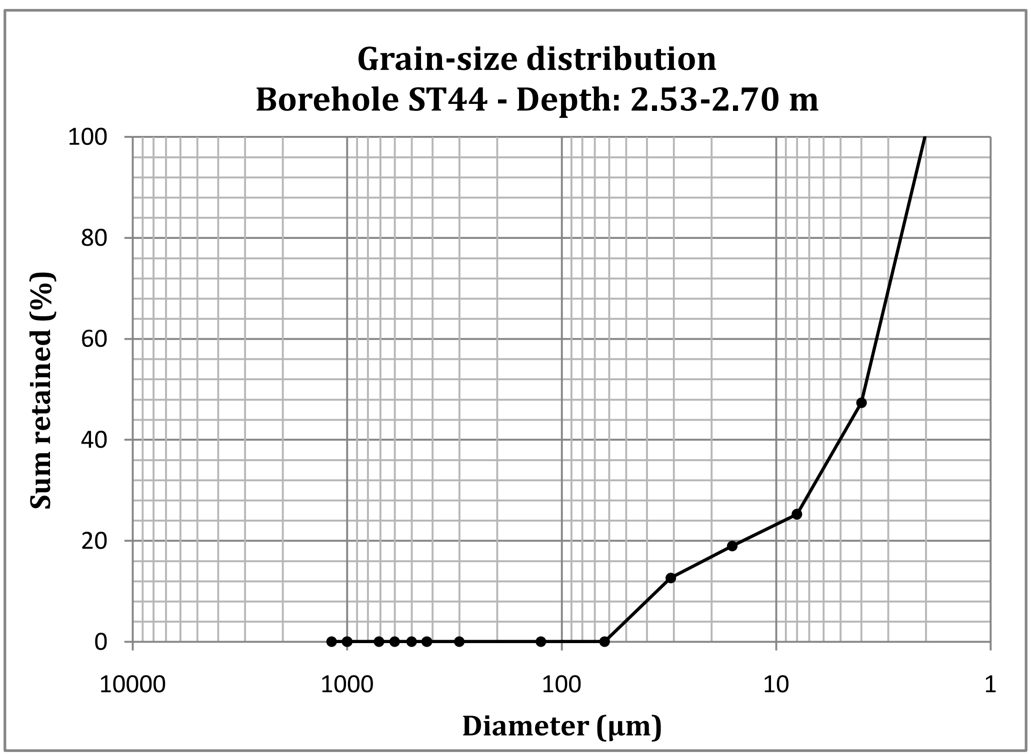
40
20
0
10000
1000
100
10
1
Diameter (µm)


Grain-size distribution
Borehole ST44 - Depth: 2.53-2.70 m
Sum retained (%)
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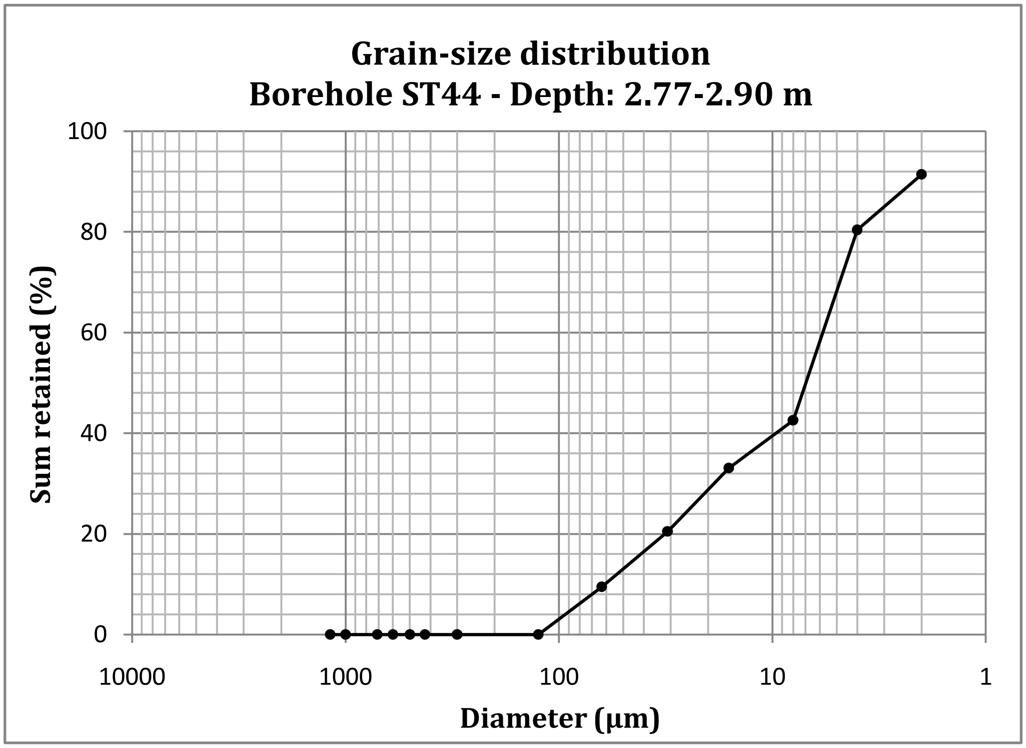
40
20
0
10000
1000
100
10
1
Diameter (µm)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Diameter (µm)
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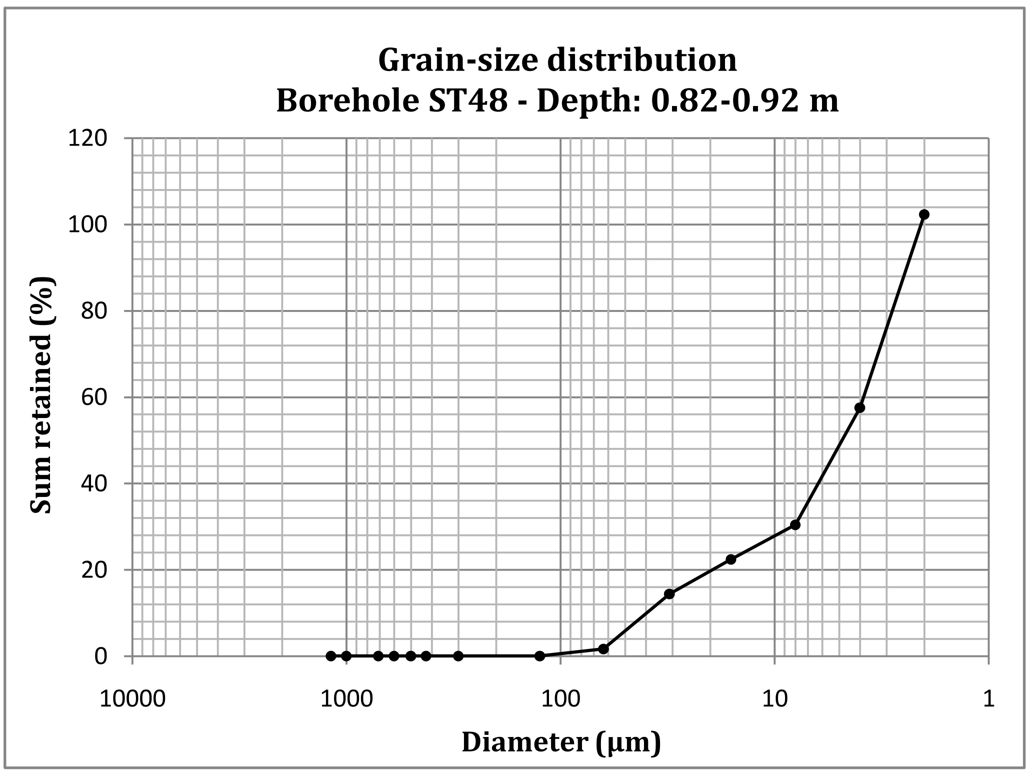
1000
100
10
1


Grain-size distribution
Borehole ST48 - Depth: 0.82-0.92 m
Sum retained (%)
Diameter (µm)
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10000
1000
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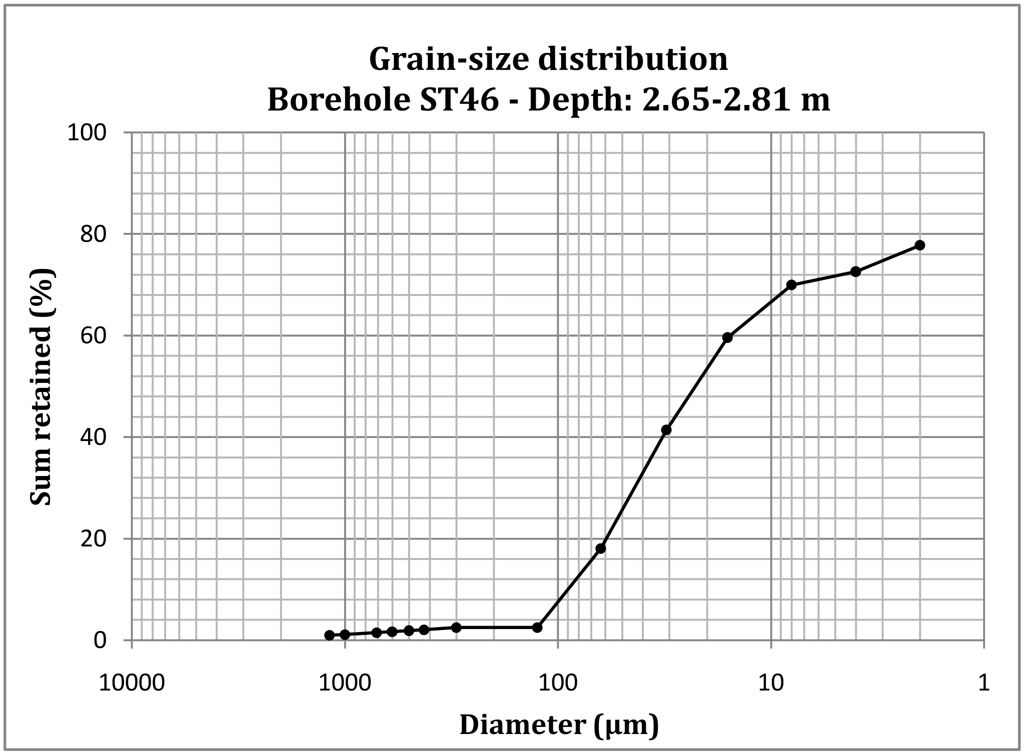
10
1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Sum retained (%)
Diameter (µm)
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40
60
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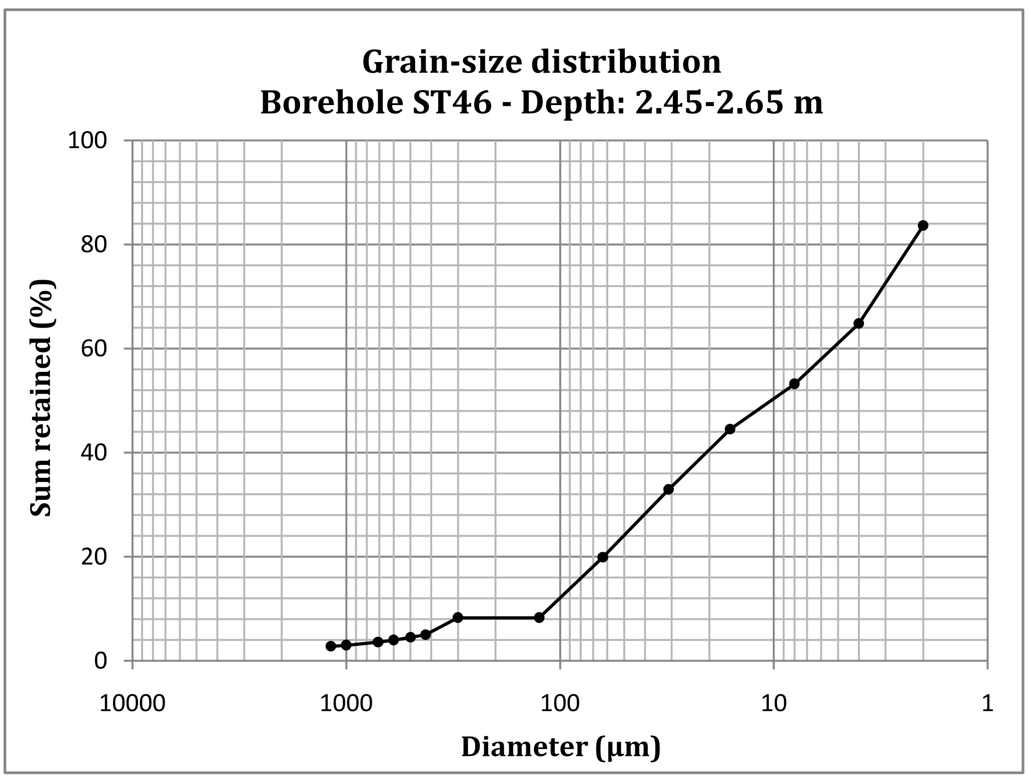
10000
1000
100
10
1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Sum retained (%)
Diameter (µm)
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1000
100
10
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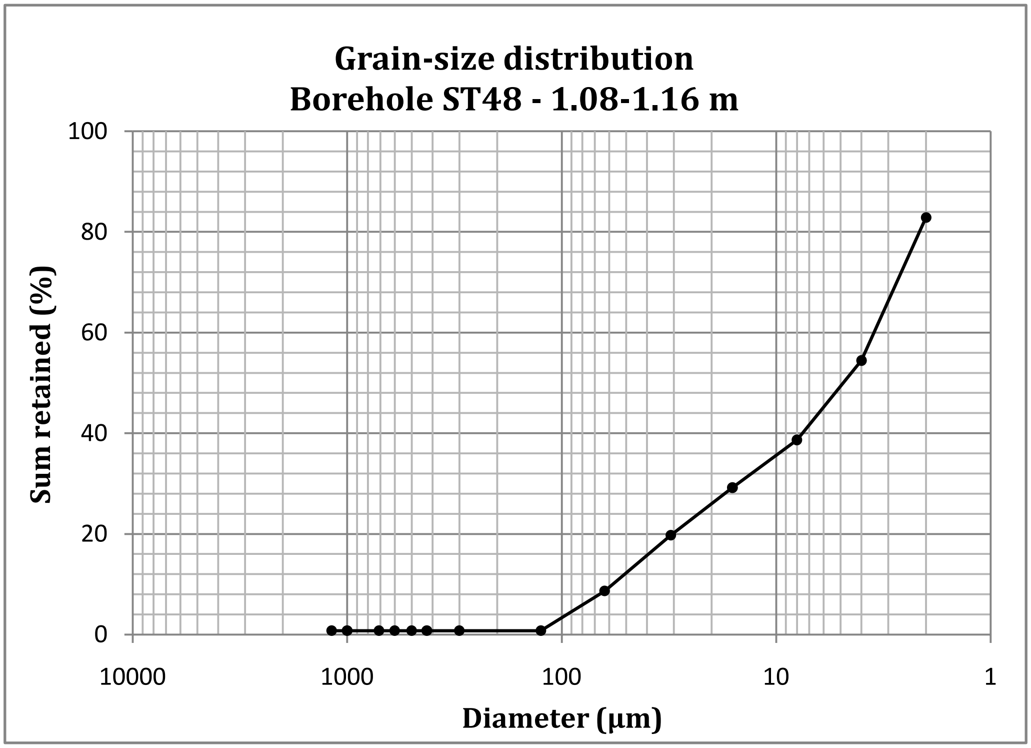
Grain-size distribution
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Sum retained (%)
Diameter (µm)
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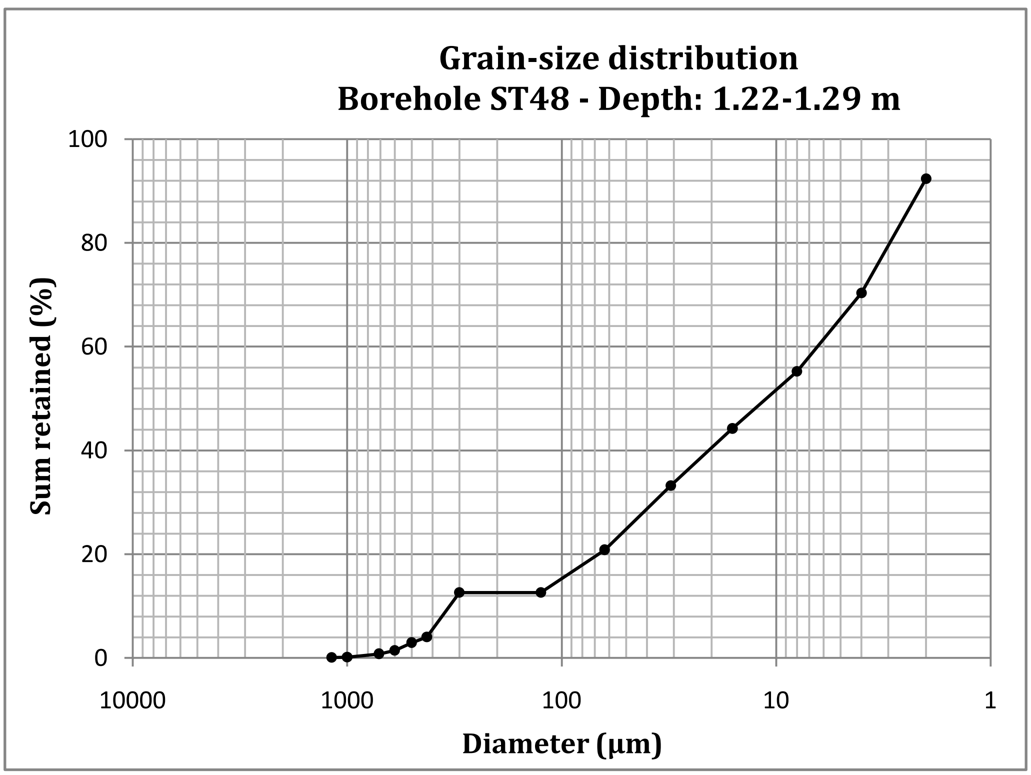
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Borehole ST48 - Depth: 1.22-1.29 m
Sum retained (%)
Diameter (µm)
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100
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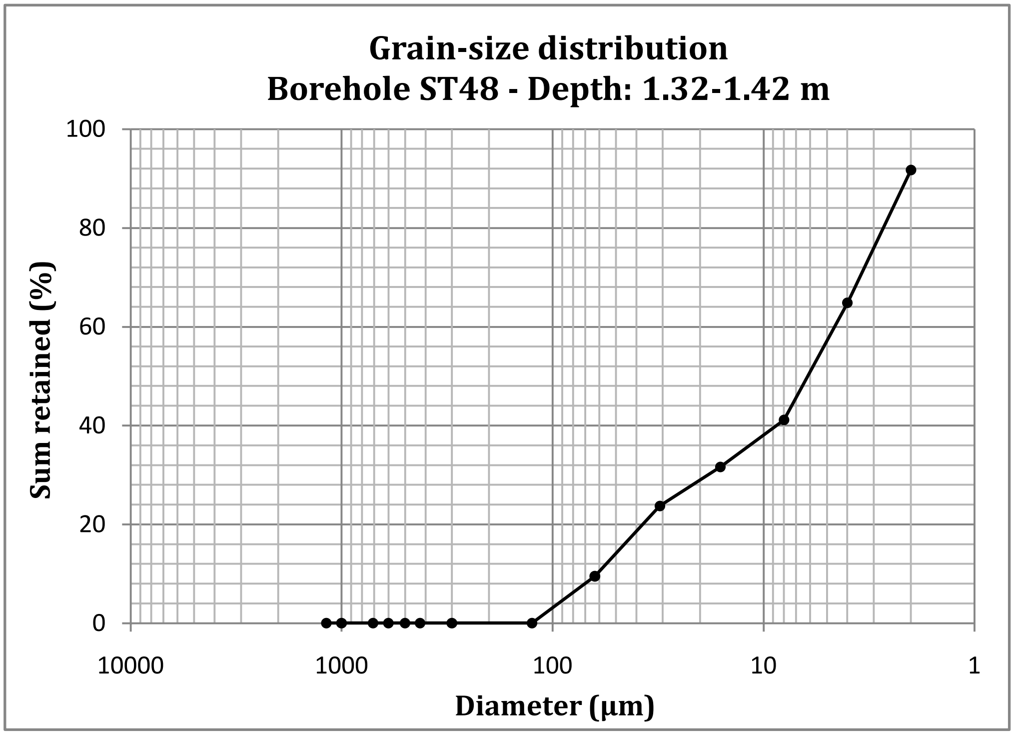
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Borehole ST48 - Depth: 1.32-1.42 m
Sum retained (%)
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100
10
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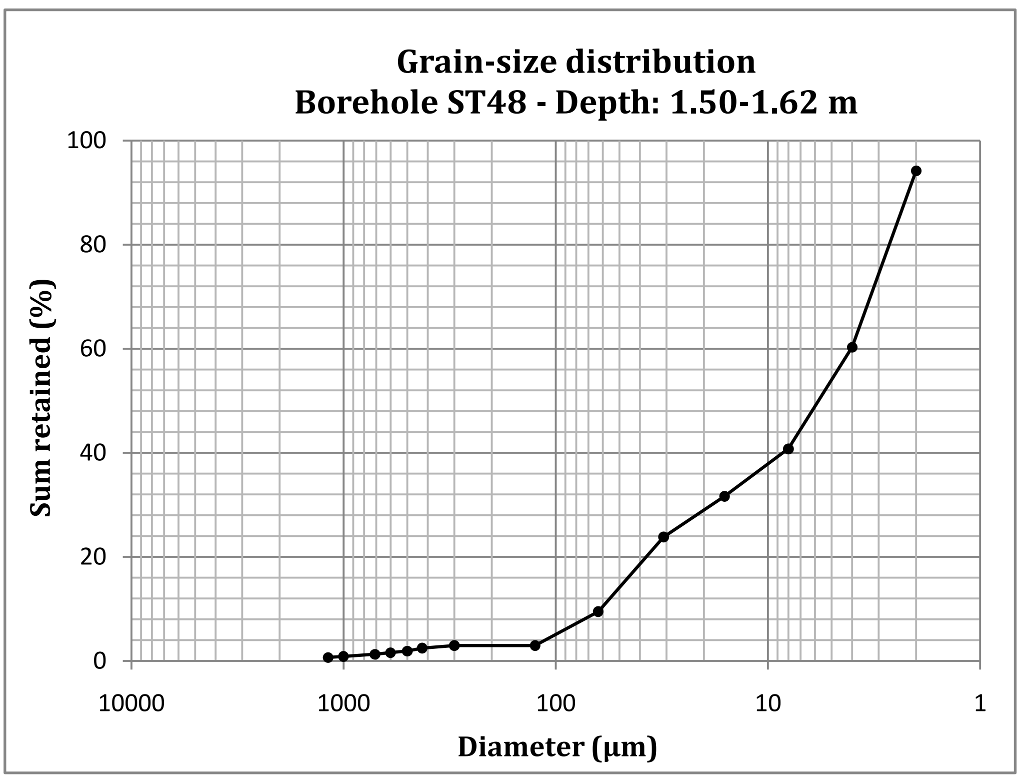
Diameter (µm)


Grain-size distribution
Borehole ST48 - Depth: 1.50-1.62 m
Sum retained (%)
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40
20
0
10000
1000
100
10
1
Diameter (µm)

Grain-size distribution statistics – Borehole ST 08

Borehole:	ST08
Depth (m):	1.45-1.70
Sample ID:	14
Sample type:	Trimodal, Very Poorly Sorted
Textural group:	Sandy Mud
Sediment name:	Very Fine Sandy Mud
Mean:	Medium Silt
Sorting:	Very Poorly Sorted
Skewness:	Symmetrical
Kurtosis:	Very Platykurtic
Mode 1 (µm):	1,500
Mode 2 (µm):	94,00
Mode 3 (µm):	12,00
D_{10} (µm):	1,214
D_{50} (µm):	11,16
D_{90} (µm):	94,70
% Gravel:	0,0%
% Sand:	24,7%
% Mud:	75,3%

Table 1: Grain-size Distribution Statistics – Borehole ST44

Borehole:	ST44	ST44	ST44	ST44	ST44	ST44	ST44	ST44	ST44	ST44
Depth (m):	1.68-181	1.85-1.95	1.95-2.15	2.20-2.28	2.28-2.38	2.40-2.48	2.53-2.70	2.77-2.90	2.90-2.98	2.98-3.07
Sample ID:	24	25	26	28	29	30	31	32	33	34
Sample Type:	Bimodal, Poorly Sorted	Trimodal, Very Poorly Sorted	Trimodal, Very Poorly Sorted	Bimodal, Very Poorly Sorted	Bimodal, Very Poorly Sorted	Bimodal, Very Poorly Sorted	Bimodal, Poorly Sorted	Bimodal, Poorly Sorted	Bimodal, Poorly Sorted	Trimodal, Poorly Sorted
Textural Group:	Mud	Sandy Mud	Sandy Mud	Sandy Mud	Sandy Mud	Sandy Mud	Mud	Mud	Mud	Mud
Sediment Name:	Very Coarse Silt	Very Fine Sandy Very Coarse Silt	Very Fine Sandy Medium Silt	Very Fine Sandy Very Coarse Silt	Very Fine Sandy Very Coarse Silt	Very Fine Sandy Very Fine Silt	Clay	Fine Silt	Very Fine Silt	Very Fine Silt
Mean:	Medium Silt	Coarse Silt	Medium Silt	Medium Silt	Medium Silt	Medium Silt	Fine Silt	Medium Silt	Fine Silt	Fine Silt
Sorting:	Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Poorly Sorted	Poorly Sorted	Poorly Sorted	Poorly Sorted
Skewness:	Symmetrical	Fine Skewed	Symmetrical	Fine Skewed	Coarse Skewed	Coarse Skewed	Very Coarse Skewed	Very Coarse Skewed	Very Coarse Skewed	Very Coarse Skewed
Kurtosis:	Platykurtic	Platykurtic	Very Platykurtic	Very Platykurtic	Very Platykurtic	Platykurtic	Leptokurtic	Mesokurtic	Platykurtic	Leptokurtic
Mode 1 (μm):	6,000	94,00	1,500	1,500	1,500	1,500	3,000	6,000	3,000	3,000
Mode 2 (μm):	47,00	1,500	94,00	94,00	47,00	47,00	47,00	23,50	47,00	23,50
Mode 3 (μm):		6,000	12,00							362,5
D_{10} (μm):	3,215	1,582	1,313	1,343	1,349	1,344	2,306	2,189	1,416	1,393
D_{50} (μm):	14,98	22,81	9,483	17,25	6,901	5,732	3,866	6,981	3,992	3,673
D_{90} (μm):	60,14	97,90	81,69	124,0	75,03	78,85	36,02	60,84	48,90	29,11
% Gravel:	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
% Sand:	8,4%	25,3%	16,2%	29,0%	13,6%	13,6%	0,2%	9,6%	5,6%	6,4%
% Mud:	91,6%	74,7%	83,8%	71,0%	86,4%	86,4%	99,8%	90,4%	94,4%	93,6%

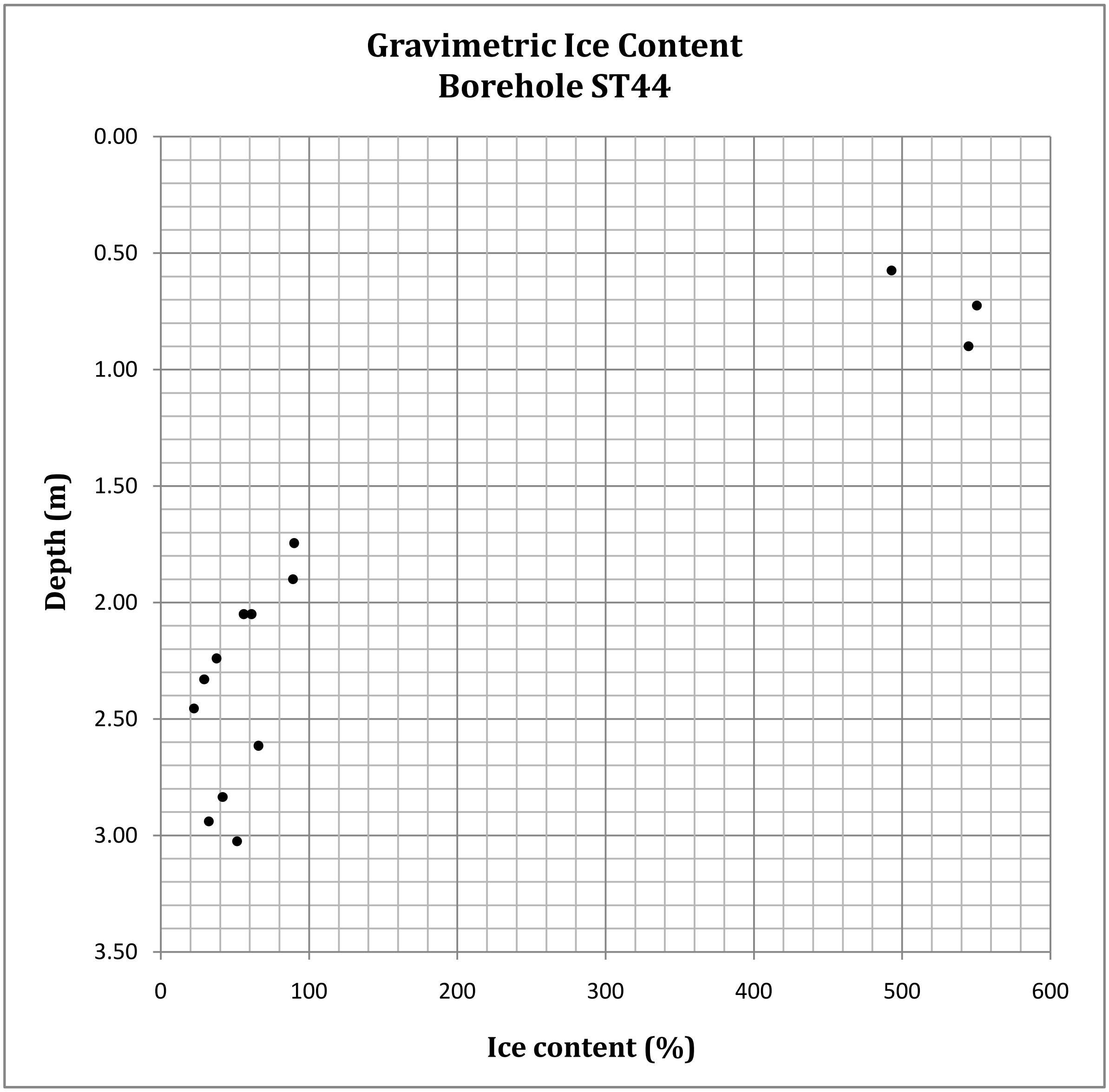
Table 2: Grain-size distribution statistics – Borehole ST46

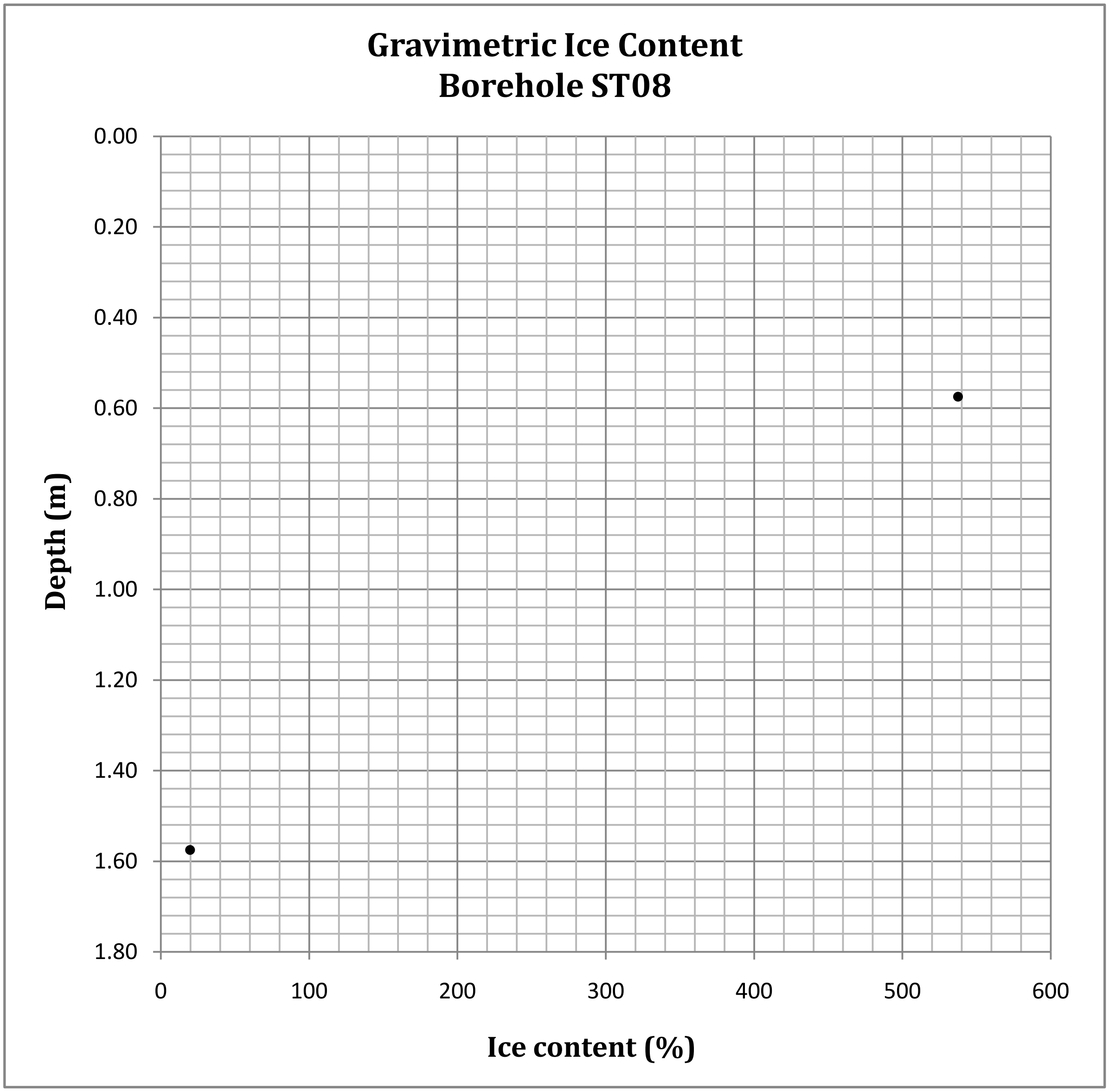
Borehole:	ST46	ST46	ST46	ST46	ST46	ST46	ST46	ST46
Depth (m):	0.80-0.90	1.75-1.85	1.87-192	2.00-2.05	2.05-2.15	2.15-2.35	2.45-2.65	2.65-2.81
Sample ID:	35	41	42	43	44	45	46	47
Sample type:	Bimodal, Very Poorly Sorted	Bimodal, Very Poorly Sorted	Bimodal, Very Poorly Sorted	Bimodal, Poorly Sorted	Trimodal, Very Poorly Sorted	Bimodal, Poorly Sorted	Trimodal, Very Poorly Sorted	Bimodal, Very Poorly Sorted
Textural group:	Sandy Mud	Sandy Mud	Sandy Mud	Mud	Sandy Mud	Mud	Sandy Mud	Sandy Mud
Sediment name:	Very Fine Sandy Mud	Very Fine Sandy Mud	Very Fine Sandy Mud	Very Fine Silt	Very Fine Sandy Very Fine Silt	Very Fine Silt	Very Fine Sandy Very Fine Silt	Very Fine Sandy Very Coarse Silt
Mean:	Fine Silt	Medium Silt	Fine Silt	Medium Silt	Medium Silt	Medium Silt	Medium Silt	Medium Silt
Sorting:	Very Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Poorly Sorted	Very Poorly Sorted	Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted
Skewness:	Very Coarse Skewed	Fine Skewed	Very Coarse Skewed	Coarse Skewed	Very Coarse Skewed	Very Coarse Skewed	Coarse Skewed	Very Fine Skewed
Kurtosis:	Very Platykurtic	Very Platykurtic	Very Platykurtic	Very Platykurtic	Mesokurtic	Platykurtic	Platykurtic	Very Platykurtic
Mode 1 (µm):	1,500	1,500	1,500	3,000	3,000	3,000	3,000	47,00
Mode 2 (µm):	94,00	94,00	47,00	47,00	23,50	47,00	47,00	1,500
Mode 3 (µm):					462,5		362,5	
D_{10} (µm):	1,160	1,221	1,165	2,002	2,120	2,124	1,529	1,366
D_{50} (µm):	2,686	18,36	2,981	6,263	6,095	5,485	10,35	22,70
D_{90} (µm):	102,5	98,24	83,99	50,00	79,64	48,58	113,1	89,87
% Gravel:	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
% Sand:	25,6%	24,5%	15,6%	3,4%	12,0%	4,1%	20,0%	18,3%
% Mud:	74,4%	75,5%	84,4%	96,6%	88,0%	95,9%	80,0%	81,7%

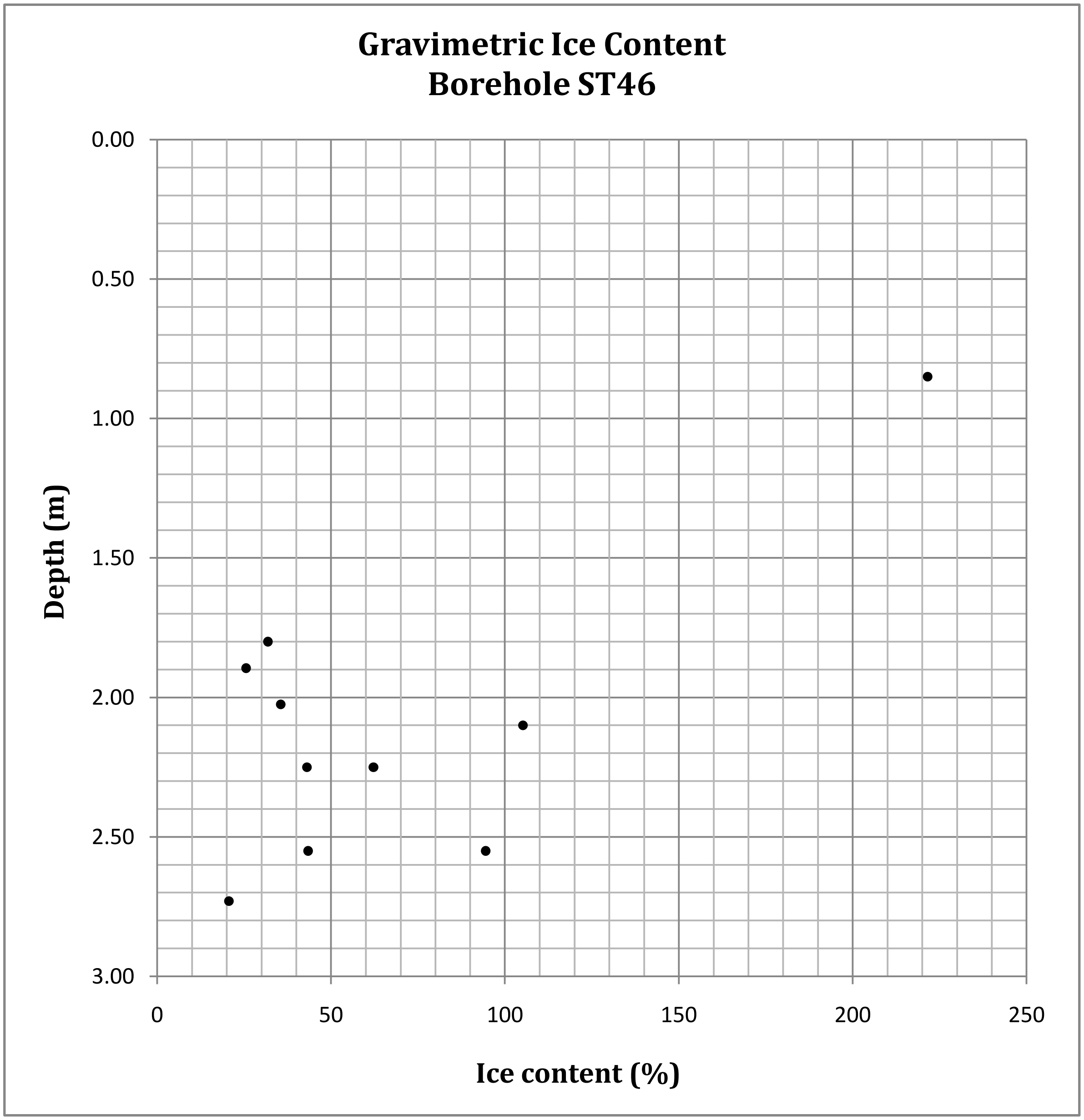
Table 3: Grain-size distribution statistics – Borehole ST48

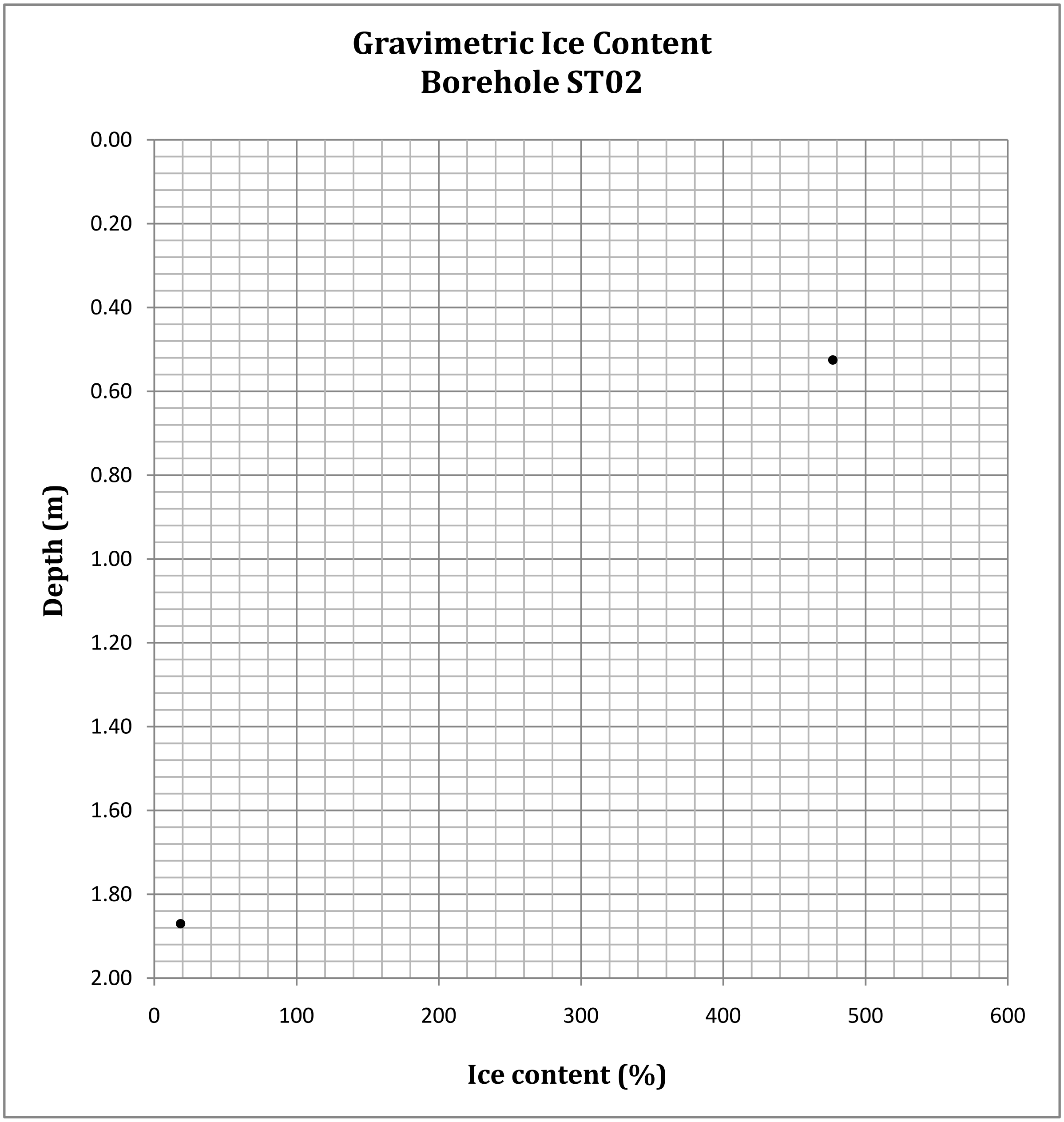
Borehole:	ST48	ST48	ST48	ST48	ST48
Depth (m):	0.82-0.92	1.08-1.16	1.22-1.29	1.32-1.42	1.50-1.62
Sample ID:	48	50	51	52	53
Sample type:	Bimodal, Poorly Sorted	Bimodal, Very Poorly Sorted	Polymodal, Very Poorly Sorted	Bimodal, Poorly Sorted	Bimodal, Poorly Sorted
Textural group:	Mud	Mud	Sandy Mud	Mud	Mud
Sediment name:	Clay	Very Fine Silt	Medium Sandy Very Fine Silt	Very Fine Silt	Very Fine Silt
Mean:	Fine Silt	Fine Silt	Medium Silt	Medium Silt	Medium Silt
Sorting:	Poorly Sorted	Very Poorly Sorted	Very Poorly Sorted	Poorly Sorted	Poorly Sorted
Skewness:	Very Coarse Skewed	Very Coarse Skewed	Coarse Skewed	Very Coarse Skewed	Very Coarse Skewed
Kurtosis:	Mesokurtic	Platykurtic	Platykurtic	Platykurtic	Platykurtic
Mode 1 (µm):	3,000	3,000	3,000	3,000	3,000
Mode 2 (µm):	47,00	47,00	362,5	47,00	47,00
Mode 3 (µm):			47,00		
D_{10} (µm):	2,420	1,499	2,156	2,089	2,180
D_{50} (µm):	4,853	4,863	11,13	6,173	5,770
D_{90} (µm):	39,64	57,77	333,5	61,53	61,51
% Gravel:	0,0%	0,0%	0,0%	0,0%	0,0%
% Sand:	1,8%	8,8%	21,0%	9,7%	9,7%
% Mud:	98,2%	91,2%	79,0%	90,3%	90,3%

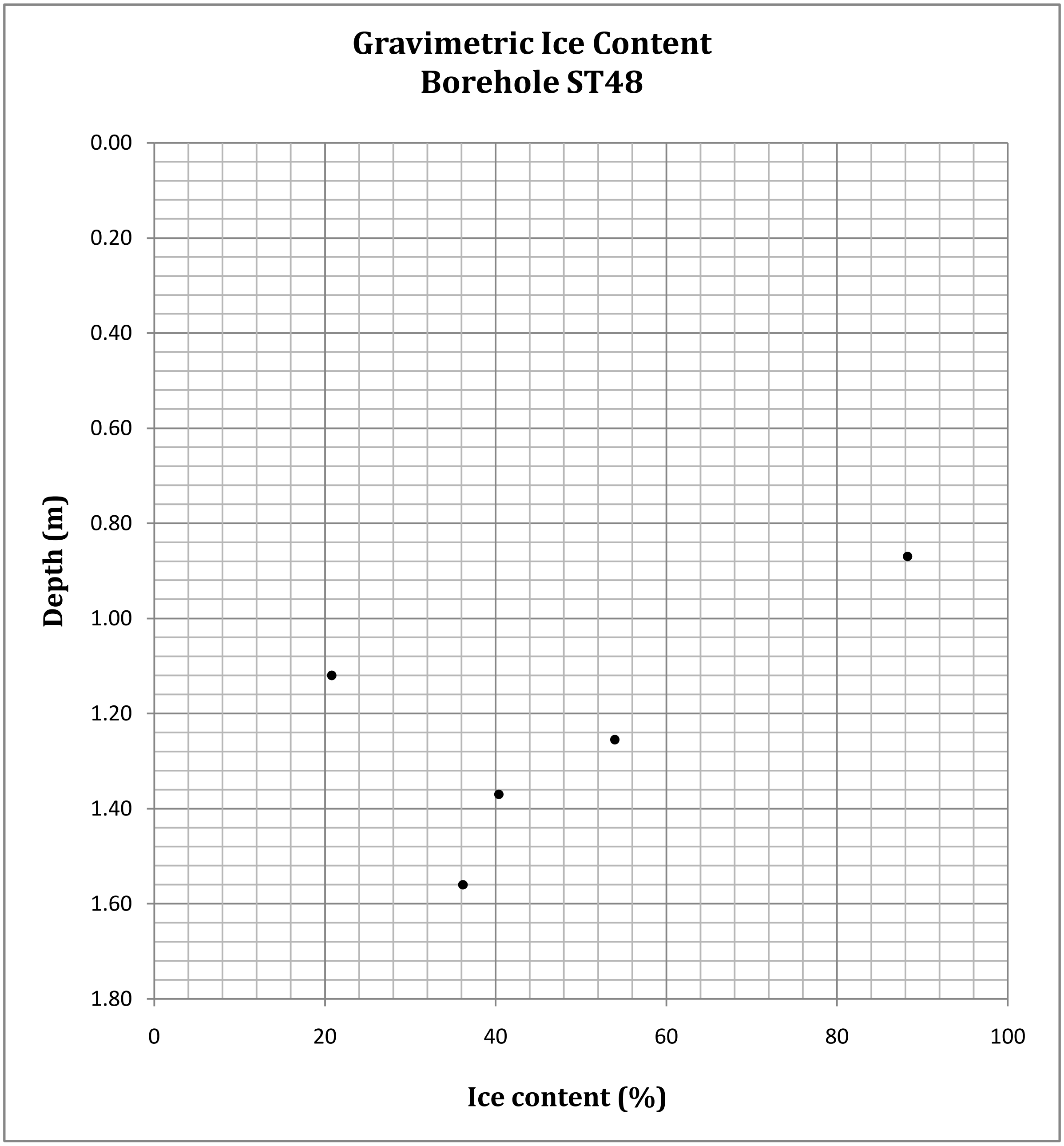
Ice Content


Gravimetric Ice Content
Borehole ST44
Depth (m)
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
0
100
200
300
400
500
600
Ice content (%)


Gravimetric Ice Content
Borehole ST08
Depth (m)
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
1.80
0
100
200
300
400
500
600
Ice content (%)


Gravimetric Ice Content
Borehole ST46
Depth (m)
0.00
0.50
1.00
1.50
2.00
2.50
3.00
0
50
100
150
200
250
Ice content (%)


Gravimetric Ice Content
Borehole ST02
Depth (m)
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
1.80
2.00
0
100
200
300
400
500
600
Ice content (%)


Gravimetric Ice Content
Borehole ST48
Depth (m)
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
1.60
1.80
0
20
40
60
80
100
Ice content (%)

APPENDIX B

Soil Data

Site ID	Subgroup	Modifier	Parent Material	Soil Code	Slope (%)	Aspect	Surface Expression	Slope Position	Site Drainage	LFH/O Thickness	Horizon	A Thickness (cm)	A Texture	Total Topsoil Thickness (ORG + A) (cm)	Horizon	Upper Subsoil (AB/B) Thickness (cm)	AB/B Texture	Horizon	Lower Subsoil (BC/C) Thickness (cm)	BC/C Texture	Overburden Thickness (cm)
ST01	Bedrock		RES	R	6	160	Undulating	Crest	R	5	-	-	-	5	-	-	-	Non Soil			5
ST02	TFI.OC		GLLC	CrM	<1	190	Undulating	Lower	P	45	-	-	-	45	-	-	-	C/Cz	25+	SiCL	>70
ST03	O.DYB		TILL	BrC	10	340	Undulating	Mid	R	12	-	-	-	12	Bm	18	LS	C1/C2/R	42	LS/SiCL	60
ST04	Bedrock		RES	RgC	5	15	Undulating	Upper	R	6	-	-	-	6	-	-	-	Non Soil	-	-	6
ST05	O.R		TILL/RES	RgC	10	280	Undulating	Mid	R	15	-	-	-	15	-	-	-	C/R	45+	SL-SCL	45
ST06	GL.HR	pt	LACU	RgF	0	N/A	Level	Level	I	17	Ah	10	SiCL	27	-	-	-	Cgj	144	fSL	>181
ST07	Disturbed		TILL	RgC	12	140	Undulating	Mid	R		-	-	-		-	-	-	C	50	LS	>50
ST08	TME.OC		ORG/TILL	CrO	0	N/A	Level	Level	VP	115	-	-	-	115	-	-	-	Cgz	15+	LS	>130
ST09	GLCU.R	pt	FLUV/LACU	RgC	0	N/A	Level	Level	P	16	C/IIAhb	30	cS/L	46	-	-	-	IIC	90	SiCL	>120
ST10	GL.R	pt	LACU	RgF	0	N/A	Level	Level	P	32	-	-	-	32	-	-	-	Cgj	90	SiCL	>120
ST11	GL.R	pt	GLLC	RgF	0	N/A	Level	Level	P	40	-	-	-	40	-	-	-	C1/C2/C3	90	SiCL/LfS/SiCL	>120
ST12	Bedrock		RES	R	17	360	Undulating	Upper	R	2	-	-	-	2	-	-	-	Non Soil	-	-	2
ST13	HR.SC		LACU	CrM	0	N/A	Level	Lower	P	27	-	-	-	27	-	-	-	C/Cz	70+	SiCL	>97
ST14	O.EB	pt	TILL/RES	BrC	1	200	Level	Lower	W	17	-	-	-	17	Bm	15	LS	C/R	10+	SL-SCL	42
ST15	Bedrock		RES	R	4	40	Ridged	Crest	R	7	-	-	-	7	-	-	-	Non Soil	-	-	7
ST16	GL.R		TILL/RES	RgC	0	N/A	Level	Level	I	11	-	-	-	11	-	-	-	Cgj/R	54+	SiL	65
ST17	GL.R	pt	TILL	RgC	2	30	Undulating	Lower	MW	19	-	-	-	19	-	-	-	C/R	70+	SL	89
ST18	R.HG	pt	ORG/LACU	RgF	0	N/A	Level	Depression	VP	80	Ah	30	SiL	110	-	-	-	Cg	20	C	>130

ST19	Bedrock		RES	R	11	180	Undulating	Mid	R	4	-	-	-	4	-	-	-	Non Soil	-	-	4
ST20	Bedrock		RES	R	5	64	Undulating	Upper	R		-	-	-	-	-	-	-	Non Soil	-	-	0
ST21	GL.R	pt	TILL	RgC	2	340	Undulating	Lower	I	45	-	-	-	45	-	-	-	C	65	LS	>110
ST22	TME.OC		ORG	CrO	0	N/A	Level	Level	VP	51+	-	-	-	51	-	-	-	-	-	-	>51
ST23	Bedrock		RES	R	6	110	Undulating		R		-	-	-	-	-	-	-	Non Soil	-	-	0
ST24	E.DYB	pt	TILL	BrC	2	350	Level	Lower	MW	36	Ae	6	S	42	Bmgj	23	fS	C	36	LS	>91
ST25	GL.R	pt	LACU/RES	RgF	0	N/A	Level	Level	I	15	-	-	-	15				C/R	77+	SiCL	>92
ST26	E.DYB		GLFL	BrC	0	N/A	Level	Level	R	7	Ae	5	fS	12	Bm	12	fS	BCgj/C	63	fS/LS	>87
ST27	TME.OC		ORG	CrO	2	300	Level	Lower	VP	50+	-	-	-	50	-	-	-	-	-	-	>50
ST28	Bedrock		RES	R	11	20	Ridged	Upper	R		-	-	-	-	-	-	-	Non Soil	-	-	0
ST29	O.EB		GLLC	BrF	2	120		Level	W	10	-	-	-	10	Bm	16	fSL	C/R	59+	SiCL	>85
ST30	HR.SC		GLLC	CrM	0	N/A	Level	Level		40	Ah	21	SiL-SiCL	61	-	-	-	C/Cz	14	SiCL	>75
ST31	GL.R	pt	TILL	RgF	0	N/A	Level	Level	MW	25	Ah	9	SiCL	34	-	-	-	C1/C2/C3	95	SiCL/LcS/C	>139
ST32	O.R		TILL	RgC	0	N/A	Level	Level	W	4	Aej	4	SiL	8	-	-	-	C	42	SL	>50
ST33	O.R		TILL	RgC	3	250	Undulating	Mid		7	-	-	-	7	-	-	-	C	55	SL	>62
ST34	GLCU.R	pt	FLUV/LACU	RgC	0	N/A	Level	Level	I	22	-	-	-	22	-	-	-	C1/C2	100	mS/SiC-SiCL	>120
ST36	GL.R	pt	GLFL/TILL	RgC	0	N/A	Undulating	Depression	I	16	-	-	-	16	-	-	-	C/IIC	105	c-mS/SL	>120
ST37	TME.H		ORG/TILL	Org	0	N/A		Level	VP	80	-	-	-	80	-	-	-	C/R	10+	SL	90
ST38	GL.R	pt	TILL	RgF	1-2	250	Level	Level	P	25	-	-	-	25	-	-	-	C	100	SCL	>125
ST41	Bedrock		RES	R			Undulating	Upper	R		-	-	-	-	-	-	-	Non Soil	-	-	0
ST42	GL.R	pt	GLFL	RgC	1	10	Level	Level	P	25	-	-	-	25	-	-	-	C	60	cS	85
ST43	O.R	pt	TILL	RgC	N/A	0	Level	Level	I	50	-	-	-	50	-	-	-	C	20+	SL	>120

ST44	FI.OC		ORG	CrO	N/A	0	Level	L	VP	168	-	-	-	168	-	-	-	Cz	50+	SiL	>168
ST45	O.DYB		TILL	BrC	6	35	Undulating	Mid	W	5	-	-	-	5	Bm	12	SL	C	53	SL-SCL	>70
ST46	ME.OC		ORG/FLUV/GLLC	CrO	0	N/A	Level	Depression		162	-	-	-	162	-	-	-	Cgz1/Cgz2	178	LS/C	>340
ST48	GL.SC	pt	LACU	CrM	N/A	0	Level	Level	P	22	-	-	-	22	-	-	-	Cgj/C/Cg/Cgz	250+	lFs/SiCL/SiL	>250
ST49	R.SC		LACU	CrM	N/A	0	Level	Level	I	13	-	-	-	13	-	-	-	C1/C2/Cgj/Cgz	110+	LS/C/SiC	>123
ST50	O.R		TILL	RgF	7	350	Undulating	Mid	W	7	-	-	-	7	-	-	-	C1/C2/R	50+	SiL/C	50
ST51	TME.OC		LACU	CrO	<2	N/E	Undulating	Level	VP	65	-	-	-	65	-	-	-	C/Cgz	10+	SL	>140
ST53	O.EB		TILL	BrF	4	140	Undulating	Mid	W	7	-	-	-	7	Bm	20	CL	C/R	50+	CL	70
ST54	T.M		ORG/LACU	Org	N/A		Level	Level	I	50	-	-	-	50	-	-	-	C	70	SiC	>120
ST55	GL.SC	pt	LACU	CrM	1	200	Level	Mid	I	28	-	-	-	28	-	-	-	C/Cgj/Cgz	62+		>90
ST56	O.DYB		GLFL	BrC	14	130	Undulating	Mid	W	14	-	-	-	14	Bm	15	LfS	C/R	80+	SiL	95
ST57	GL.R	pt	TILL	RgF	1-2	330	Undulating	Level	I	16	-	-	-	16	-	-	-	C	110	CL	>126
ST58	Bedrock		RES	R					R		-	-	-		-	-	-	Non Soil	-	-	0
ST59	TFI.OC		ORG	CrO	0	N/A	Level	Level	VP	65+	-	-	-	65	-	-	-	-	-	-	>65
ST60	GL.R		TILL	RgC	<2	N	Level	Level	I	25	-	-	-	25	-	-	-	C1/C2	55	S/SL-SCL	>80
ST61	GL.R		TILL	RgC	0	N/A	Level	Level	I	30	-	-	-	30	-	-	-	C1/C2	110	LS/SiCL	>130
ST62	ME.OC		ORG	CrO	0	N/A		Depression	VP	120	-	-	-	120	-	-	-	-	-	-	>120
ST63	GL.R		TILL/RES	RgF	0	N/A	Level	Level	I	10	-	-	-	10	-	-	-	C/R	68+	CL	68
ST64	ORG		ORG	Org	0	N/A	Level	L	VP	110+	-	-	-	110	-	-	-	-	-	-	>110
ST65	GL.R	pt	TILL	RgF	0	N/A	Level	Level	W	17	-	-	-	17	-	-	-	C	60	CL	>76
ST66	TME.OC		ORG/LACU/GLLC	CrO	0	N/A	Level	Level	VP	90	-	-	-	90	-	-	-	Cgz	90+		>90
ST67	O.R		TILL	RgF	2	120	Level	Level	I	15	Ah	8	CL	15	-	-	-	C1/C2/C3	47	SiL/C/SL	>70
ST68	O.DYB		TILL	BrC	4	NE	Undulating	Upper	W	5	-	-	-	5	Bm	6	SL	BC/C/Ck	54	LcS/SL/SCL	>65

APPENDIX C

Soil Unit Descriptions and Chemical Characteristics of Soils in the LSA

This Appendix provides a brief description of the pertinent characteristics and important comments for the eight soil units located within the LSA. The tables within each series description present a typical site and profile description and are ordered according to soil classification with Brunisols described first, then Regosols, Cryosols, Organics, and Bedrock. The descriptions are based on field data collected during 2008. Additional tables portray the chemical characteristics of each soil series.

Brunisolic Soil Units

Brunisolic soils are moderately developed soils that have a Bm horizon at least 5 cm thick (CSSC). The soils in the study area included the Eutric and Dystric great groups. These soil great groups are similar except Dystric Brunisols have a pH less than 5.5 and Eutric Brunisols have a pH equal to or greater than 5.5. Dystric Brunisols surveyed in the study area included orthic and eluviated subgroups. Eutric Brunisols surveyed in the study area included only orthic subgroups. The Orthic Eutric and Orthic Dystric Brunisols surveyed did not include an A horizon and had Bm horizons that ranged from 6 to 20 cm thick. Eluviated Dystric Brunisols surveyed displayed diagnostic Ae horizons that ranged from 5 to 6 cm thick.

Parent material textures of Brunisols surveyed in the study area were divided into coarse and fine categories. Coarse textured Brunisolic soils included very coarse to medium textured materials and fine textured Brunisolic soils included moderately fine to very fine material. Brunisols were found on several parent materials including till, lacustrine, glaciolacustrine and glaciofluvial. Drainage observed in Brunisols during the soil survey ranged from moderately well to rapid. These soils were found to exist on a variety of slopes and level to undulating topography.

BrC Soil Unit

The BrC soil unit occurs on very coarse to medium textured materials. The parent materials often associated with this soil unit are glaciofluvial and till. The BrC soil unit is generally associated with Eluviated Dystric Brunisols, Orthic Dystric Brunisols, and Orthic Eutric Brunisols. The BrC soils are similar to the BrF soils with the main difference being the coarser textures found with BrC soils.

Table C-1: BrC Summary Table

Dominant Soil Classification		Eluviated Dystric Brunisol, Orthic Dystric Brunisol, Orthic Eutric Brunisol	
Site and Profile Data		**Calculations**	
Texture	Very Coarse to Medium	Land Capability Class	5MR
Parent Material	Glaciofluvial or Till	Reclamation Suitability (Topsoil/Subsoil)	N/A / Poor
Surface Expression	Level to Undulating	Wind Erosion Risk Rating	High
Range of Slopes (%)	0 – 14	Water Erosion Risk Rating (<5% / 5-9% / 9-15% slopes)	Low/Low/Moderate
Drainage Class	Rapid to Well	Compaction Risk Rating (Topsoil/Upper Subsoil/Lower Subsoil)	Low/Low/Low
Topsoil/Subsoil texture	Organic/Loamy Sand, Sandy Loam	Average Topsoil thickness (cm)	15.3
		Area/Proportion of the Study Area (ha)/(%)	56/5

NOTE:
N/A = Not applicable.

Table C-2: Description of BrC Soil Unit

Soil Classification	Orthic Dystric Brunisol
Parent Material	Medium Textured Till
Soil Drainage Class	Well
Topsoil Thickness (cm)	5
Forest Land Capability Calculation	5MR
UTM Coordinates (northing/easting)	12U 6886529/416938

Example Profile – Site ST45							
Horizon	**Depth (cm)**	**Moisture**	**Colour**	**Texture**	**Coarse Fragment Content (%)**	**Structure**	**Consistence**
Of	5 – 0	–	–	–	–	–	–
Bm	0 – 12	Moist	10YR 4/6	Sandy Loam	40	Subangular Blocky	Friable
C	12 – 65	Moist	7.5YR 4/4	Loam	40	Massive	Friable

Table C-3: Physical and Chemical Characteristics of the BrC Soil Unit – Site ST45

Horizon	Depth (cm)	pH (Saturated paste)	EC (dS/m)	Saturation (%)	SAR	TOC (%)	TKN (%)	Texture
Of	5-0	–	–	–	–	35.6	0.36	–
Bm	0-12	5.1	0.06	49	0.4	–	–	Sandy Loam
C	12-65	7.7	0.32	34	0.1	–	–	Loam

NOTES:
[1] TOC = Total Organic carbon, EC = Electrical conductivity, SAR = Sodium adsorption ratio, and TKN = Total Kjeldhal Nitrogen

BrF Soil Unit

The BrF soil unit occurs on moderately fine to very fine textured materials. The parent materials often associated with this soil unit are glaciofluvial and till. The BrF soil unit is generally associated with Orthic Eutric Brunisols.

Table C-4 BrF Summary Table

Dominant Soil Classification		Orthic Eutric Brunisol	
Site and Profile Data		**Calculations**	
Texture	Moderately Fine to Very Fine	Land Capability Class	4DR
Parent Material	Glaciofluvial or Till	Reclamation Suitability (Topsoil/Subsoil)	N/A/Fair
Surface Expression	Undulating	Wind Erosion Risk Rating	Low
Range of Slopes (%)	2-4	Water Erosion Risk Rating (<5% / 5-9% / 9-15% slopes)	Low/Low/Moderate
Drainage Class	Well	Compaction Risk Rating (Topsoil/Upper Subsoil/Lower Subsoil)	N/A/Low/Moderate
Topsoil/Subsoil texture	Sandy Loam, Loam/ Loam, Silty Clay Loam	Average Topsoil thickness (cm)	8.5
		Area/Proportion of the Study Area (ha)/(%)	29.9/3

NOTE:
N/A = Not applicable

Table C-5: Description of BrF Soil Unit

Soil Classification	Orthic Eutric Brunisol
Parent Material	Medium Textured Till
Soil Drainage Class	Well
Topsoil Thickness (cm)	7
Forest Land Capability Calculation	4DR
UTM Coordinates (northing/easting)	12U 6886433/417558

Example Profile – Site ST53							
Horizon	**Depth (cm)**	**Moisture**	**Colour**	**Texture**	**Coarse Fragment Content (%)**	**Structure**	**Consistence**
LFH	7-0	–	–	–	–	–	–
Bm	0-20	Moist	7.5YR 4/4	Loam	15	Granular	Friable
C	20-70	Moist	7.5YR 4/3	Loam	20	Massive	Friable
R	70+	–	–	–	–	–	–

Table C-6: Physical and Chemical Characteristics of the BrF Soil Unit – Site ST53

Horizon	Depth(cm)	pH (Saturated paste)	EC (dS/m)	Saturation (%)	SAR	TOC (%)	TKN (%)	Texture
LFH	7-0	–	–	–	–	29.8	0.55	–
Bm	0-20	6.3	0.27	46	0.2	–	–	Loam
C	20-70	7.9	0.35	41	0.1	–	–	Loam
R	70+	–	–	–	–	–	–	–

NOTES:
[1] TOC = Total Organic carbon, EC = Electrical conductivity, SAR = Sodium adsorption ratio, and TKN = Total Kjeldhal Nitrogen

Regosolic Order

Regosols were found on all major parent material types, except organic. The most commonly observed parent material type was till. Drainages observed at the Regosol survey sites ranged from rapid to poor. This large range exists because of the variety of textures found in the study area. There were a large number of poorly and imperfectly drained soils found because of restricting layers (frozen layers and bedrock) causing perched water tables.

Regosolic soils are weakly developed soils. These soils do not contain a recognizable B horizon which distinguishes these soils from Brunisols (see Brunisolic Order above). One Gleyed Humic Regosol was identified during the soil survey. This soil is characterized by an Ah horizon at least

10 cm thick and gley characteristics within 50 cm of the mineral surface. Other Regosolic soil subgroups identified in the study area were Orthic Regosols, Gleyed Regosols, and Gleyed Cumulic Regosols. Orthic Regosols are characterized by a C horizon overlain by an organic layer less than 15 cm. Gleyed Regosols found in the study area differed by having gley characteristics (mottling or seepage) in the C horizon. Gleyed Regosols surveyed were often peaty varieties (had greater than 15 cm of organic overlying the mineral surface). The Gleyed Cumulic Regosols found in the study area were characterized by thin layers below the surface that vary in organic matter content or colour from each other.

RgC Soil Unit

The RgC soil unit occurs on very coarse to medium textured materials. The parent materials often associated with this soil unit are Lacustrine, fluvial, glaciofluvial and till. The RgC soil unit is generally associated with Orthic Regosols, Gleyed Regosol, Orthic Humic Regosols, and Gleyed Cumulic Regosols. The RgC soils are similar to the RgF soils with the main difference being the coarser textures found with RgC soils.

Table C-7: RgC Summary Table

Dominant Soil Classification		Orthic Regosol, Gleyed Regosol, Orthic Humic Regosol, and Gleyed Cumulic Regosol	
Site and Profile Data		**Calculations**	
Texture	Very Coarse to Medium	Land Capability Class	5MR
Parent Material	Lacustrine, Glaciofluvial, Till, Fluvial	Reclamation Suitability (Topsoil/Subsoil)	N/A
Surface Expression	Level to Undulating	Wind Erosion Risk Rating	High
Range of Slopes (%)	0-12	Water Erosion Risk Rating (<5% / 5-9% / 9-15% slopes)	Low/Low/Moderate
Drainage Class	Imperfect, Poor, Rapid	Compaction Risk Rating (Topsoil/Upper Subsoil/Lower Subsoil)	N/A/N/A/Low
Topsoil/Subsoil texture	Organic/Loamy Sand, Sandy Loam	Average Topsoil thickness (cm)	21.7
		Area/Proportion of the Study Area (ha)/(%)	72.8/7

NOTE:
N/A = Not applicable

Table C-8: Description of RgC Soil Unit

Soil Classification	Gleyed Regosol
Parent Material	Very Coarse Glaciofluvial
Soil Drainage Class	Poor
Topsoil Thickness (cm)	25
Forest Land Capability Calculation	5MR
UTM Coordinates (northing/easting)	12U 6883417/414152

Example Profile – Site ST42							
Horizon	**Depth (cm)**	**Moisture**	**Colour**	**Texture**	**Coarse Fragment Content (%)**	**Structure**	**Consistence**
Om	25-0	–	–	–	–	–	–
C	0-60	Wet	7.5YR 3/4	Loamy Sand	80	Single Grain	Non-sticky

Table C-9: Physical and Chemical Characteristics of the RgC Soil Unit – Site ST42

Horizon	Depth (cm)	pH (Saturated paste)	EC (dS/m)	Saturation (%)	SAR	TOC (%)	TKN (%)	Texture
Om	25-0	–	–	–	–	30.0	0.38	–
C	0-60	7.8	0.36	27	0.3	–	–	Loamy Sand

NOTES:
[1] TOC = Total Organic carbon, EC = Electrical conductivity, SAR = Sodium adsorption ratio, and TKN = Total Kjeldhal Nitrogen

RgF Soil Unit

The RgF soil unit occurs on moderately fine to very fine materials. The parent materials often associated with this soil unit are lacustrine, fluvial, glaciofluvial, and till. The RgF soil unit is generally associated with Gleyed Regosol and Gleyed Cumulic Regosols.

Table C-10: RgF Summary Table

Dominant Soil Classification		Gleyed Regosol and Gleyed Cumulic Regosol	
Site and Profile Data		**Calculations**	
Texture	Moderately Fine to Very Fine	Land Capability Class	4R
Parent Material	Lacustrine, Glaciofluvial, Till, Fluvial	Reclamation Suitability (Topsoil/Subsoil)	N/A
Surface Expression	Level to Undulating	Wind Erosion Risk Rating	Low
Range of Slopes (%)	0-7	Water Erosion Risk Rating (<5% / 5-9% / 9-15% slopes)	Low/Low/Moderate
Drainage Class	Imperfect, Poor, Well	Compaction Risk Rating (Topsoil/Upper Subsoil/Lower Subsoil)	N/A/N/A/High
Topsoil/Subsoil texture	Organic/Clay Loam, Loam, Clay	Average Topsoil thickness (cm)	25.7
		Area/Proportion of the Study Area (ha)/(%)	218.7/20

NOTE:
N/A = Not applicable

Table C-11: Description of RgF Soil Unit

Soil Classification	Gleyed Regosol
Parent Material	Moderately Fine Lacustrine
Soil Drainage Class	Poor
Topsoil Thickness (cm)	32
Forest Land Capability Calculation	4R
UTM Coordinates (northing/easting)	12U 6888441/416366

Example Profile – Site ST10							
Horizon	**Depth (cm)**	**Moisture**	**Colour**	**Texture**	**Coarse Fragment Content (%)**	**Structure**	**Consistence**
Of	32 – 19	–	–	–	–	–	–
Om	19 – 0	–	–	–	–	–	–
Ckgj	0 – 90	Wet	10YR 5/3	Clay Loam	3	Massive	Sticky

Table C-12: Physical and Chemical Characteristics of the RgF Soil Unit – Site ST10

Horizon	Depth (cm)	pH (Saturated paste)	EC (dS/m)	Saturation (%)	SAR	TOC (%)	TKN (%)	Texture
Of	32 – 19	–	–	–	–	42.4	0.47	–
Om	19 – 0	–	–	–	–	31.1	0.39	–
Ckgj	0 – 90	7.5	0.83	48	0.2	–	–	Clay Loam

NOTES:
[1] TOC = Total Organic carbon, EC = Electrical conductivity, SAR = Sodium adsorption ratio, and TKN = Total Kjeldhal Nitrogen

Cryosolic Order

Cryosols in the study area were found to be either mineral or organic. Mineral Cryosols were only classified as static (had no marked evidence of cryoturbation) in the study area and were found on moderately fine to very fine textured parent material (lacustrine or glaciolacustrine). Static Cryosols had peaty material no thicker than 40 cm. Organic Cryosols in the study area are defined by having peaty material greater than 40 cm.

Drainage observed for Cryosols in the study area ranged from imperfect to poorly drained in the mineral profiles and was very poorly drained in the organic profiles. The Cryosolic soils found in the study area had permafrost within 1 m of the organic or mineral surface (CSSC, 1998).

Regosolic Static Cryosols and Histic Regosolic Static Cryosols were the only mineral Cryosols found during the soil survey. They differ by Histic Regosolic Static Cryosols having 15 to 40 cm of peat and Regosolic Static Cryosols having less than 15 cm of peat. A range of peat depths were observed in the study area on Static Cryosols. Both these soils have minimal horizon development.

The types of peat material found on the study area in all types of Organic Cryosols were fibric and mesic in organic texture. Fibric material is the least decomposed organic material. Mesic material is organic matter that is moderately decomposed. These soils can be further divided by where mineral contact was found. Terric Fibric and Terric Mesic Organic Cryosols have mineral contact within 1 m of the surface. Fibric and Mesic Organic Cryosols had mineral contact below 1 m of the soil surface and ranged from 120 to 168 cm in the study area.

CrO Soil Unit

The CrO soil unit occurs on organic materials. The parent materials often associated with this soil unit are organic. The CrO soil unit is generally associated with Fibric Organic Cryosols, Mesic Organic Cryosols, Terric Mesic Organic Cryosols and Terric Fibric Organic Cryosols.

Table C-13: CrO Summary Table

Dominant Soil Classification		Fibric Organic Cryosol, Mesic Organic Cryosol, Terric Mesic Organic Cryosol and Terric Fibric Organic Cryosol	
Site and Profile Data		**Calculations**	
Texture	Mesic and Fibric	Land Capability Class	5OR
Parent Material	Organic	Reclamation Suitability (Topsoil/Subsoil)	N/R
Surface Expression	Level	Wind Erosion Risk Rating	N/A
Range of Slopes (%)	0-2	Water Erosion Risk Rating (<5% / 5-9% / 9-15% slopes)	N/A
Drainage Class	Very Poor	Compaction Risk Rating (Topsoil/Upper Subsoil/Lower Subsoil)	High/N/A/ Moderate
Topsoil/Subsoil texture	Organic/Organic, Sandy Loam, Loamy Sand	Average Topsoil thickness (cm)	98.4
		Area/Proportion of the Study Area (ha)/(%)	101.4/9

NOTE:
N/A = Not applicable

Table C-14: Description of CrO Soil Unit

Soil Classification	Terric Mesic Organic Cryosol
Parent Material	Peat over Medium textured Till
Soil Drainage Class	Very Poor
Topsoil Thickness (cm)	115
Forest Land Capability Calculation	5OR
UTM Coordinates (northing/easting)	12U 6888272/416636

Example Profile – Site ST08							
Horizon	**Depth (cm)**	**Moisture**	**Colour**	**Texture**	**Coarse Fragment Content (%)**	**Structure**	**Consistence**
Om	0 – 55	–	–	–	–	–	–
Omz	55 – 115	–	–	–	–	–	–
Cgz	115 – 130	–	2.5Y 4/4	Loamy Sand	5	Massive	Very Firm

Table C-15: Physical and Chemical Characteristics of the CrO Soil Unit – Site ST08

Horizon	Depth (cm)	pH (Saturated paste)	EC (dS/m)	Saturation (%)	SAR	TOC (%)	TKN (%)	Texture
Om	0 – 55	–	–	–	–	44.1	1.59	–
Omz	55 – 115	–	–	–	–	44.4	0.46	–
Cgz	115 – 130	5.8	0.48	225	<0.1	–	–	Loamy Sand

NOTES:
[1] TOC = Total Organic carbon, EC = Electrical conductivity, SAR = Sodium adsorption ratio, and TKN = Total Kjeldhal Nitrogen

CrM Soil Unit

The CrM soil unit occurs on moderately fine to very fine materials. The parent materials often associated with this soil unit are lacustrine and glaciolacustrine. The CrM soil unit is generally associated with Gleyed Static Cryosols, Regosolic Static Cryosols and Histic Regosolic Static Cryosols.

Table C-16: CrM Summary Table

Dominant Soil Classification		Gleyed Static Cryosols, Regosolic Static Cryosols and Histic Regosolic Static Cryosols	
Site and Profile Data		**Calculations**	
Texture	Moderately Fine to Very Fine	Land Capability Class	3D
Parent Material	Lacustrine and glaciolacustrine	Reclamation Suitability (Topsoil/Subsoil)	N/A
Surface Expression	Level	Wind Erosion Risk Rating	Moderate
Range of Slopes (%)	0-1	Water Erosion Risk Rating (<5% / 5-9% / 9-15% slopes)	Low/Low/Moderate
Drainage Class	Imperfect to Poor	Compaction Risk Rating (Topsoil/Upper Subsoil/Lower Subsoil)	N/A/N/A/Low
Topsoil/Subsoil texture	Organic, Silt Loam/Silty Clay Loam, Clay Loam	Average Topsoil thickness (cm)	32.7
		Area/Proportion of the Study Area (ha)/(%)	25.6/2

NOTE:
N/A = Not applicable

Table C-17: Description of CrM Soil Unit

Soil Classification	Regosolic Static Cryosol
Parent Material	Fine Textured Lacustrine
Soil Drainage Class	Imperfect
Topsoil Thickness (cm)	13
Forest Land Capability Calculation	3D
UTM Coordinates (northing/easting)	12U 6886418/415896

Example Profile – Site ST49							
Horizon	**Depth (cm)**	**Moisture**	**Colour**	**Texture**	**Coarse Fragment Content (%)**	**Structure**	**Consistence**
LFH	13 – 0	–	–	–	–	–	–
Ck1	0 – 20	Wet	7.5YR 4/4	Loamy Sand	–	Single Grain	Non-sticky
Ck2	20 – 58	Wet	7.5YR 4/3	Clay Loam	–	Massive	Slightly Sticky
Ckgj	58 – 99	Wet	10YR 4/4	Clay Loam	–	Massive	Sticky
Cgz	99 – 110	–	–	–	–	–	–

Table C-18: Physical and Chemical Characteristics of the CrM Soil Unit – Site ST49

Horizon	Depth (cm)	pH (Saturated paste)	EC (dS/m)	Saturation (%)	SAR	TOC (%)	TKN (%)	Texture
LFH	13 – 0	–	–	–	–	41.4	0.73	–
Ck1	0 – 2 0	5.5	0.34	32	0.2	–	–	Loamy Sand
Ck2	20 – 8	7.2	0.74	54	0.2	–	–	Clay Loam
Ckgj	58 – 99	7.2	0.74	54	0.2	–	–	Clay Loam
Cgz	99 – 110	–	–	–		–	–	–

NOTES:
[1] TOC = Total Organic carbon, EC = Electrical conductivity, SAR = Sodium adsorption ratio, and TKN = Total Kjeldhal Nitrogen

Organic Soil Unit

The Organic (Org) soil unit occurs on mesic, and humic materials. The parent materials often associated with this soil unit is organic. The Org soil unit is generally associated with Terric Mesisols and Terric Mesic Humisols. Compaction Risk for these soils is high for organic topsoils and moderate for lower subsoils in terric profiles. Average topsoil depth for these soils in the study area is 80 cm.

They are found in only 4 percent of the Thor Lake Study Area. Organic topsoil texture is organic over various mineral textured subsoil (in Typic soils the subsoil texture is not applicable). The Org soils occur on level surface expressions and have an average slope of 0%.

Bedrock

The bedrock (R) soil unit occurs on bedrock. The R soil unit is generally associated with thin Orthic Regosols and nonsoils. Areas defined as bedrock or non-soils have less than 10 cm of unconsolidated mineral or organic material overlying them (CSSC, 1998). The bedrock observed in the study area had 0 to 7 cm organic material overlying them. Zero centimeters of organic material overlying the bedrock was the most common observance in the study area.