AVALON RARE METALS INC.

DEVELOPER'S ASSESSMENT REPORT THOR LAKE PROJECT, NWT

APPENDICES - VOLUME 2

SUBMITTED TO:
MACKENZIE VALLEY ENVIRONMENTAL IMPACT REVIEW BOARD

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A TETRA TECH COMPANY

Avalon Rare Metals Inc.

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THOR LAKE PROJECT
NORTHWEST TERRITORIES

APPENDICES
VOLUME 2

Submitted To:
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May 2011

LIST OF APPENDICES

APPENDIX A

STANTEC ENVIRONMENTAL BASELINE REPORTS

Appendix A.1 Thor Lake Rare Earth Metals Baseline Project Environmental Baseline Report: Volume 3 – Aquatics and Fisheries 2010

Appendix A.2 Thor Lake Rare Earth Metals Baseline Project Environmental Baseline Report: Volume 1 – Climate and Hydrology 2010

Appendix A.3 Thor Lake Rare Earth Metals Baseline Project Environmental Baseline Report: Volume 2 – Hydrogeology 2010

Appendix A.4 Thor Lake Rare Earth Metals Baseline Project Environmental Baseline Report: Volume 4 – Terrain, Soils, and Permafrost 2010

Appendix A.5 Thor Lake Rare Earth Metals Baseline Project Environmental Baseline Report: Volume 5 – Vegetation 2010

Appendix A.6 Thor Lake Rare Earth Metals Baseline Project Environmental Baseline Report: Volume 6 – Wildlife Resources 2010

Appendix A.2

Thor Lake Rare Earth Metals Baseline Project Environmental Baseline Report: Volume 1 – Climate and Hydrology 2010

THOR LAKE RARE EARTH METALS BASELINE PROJECT

Environmental Baseline Report: Volume 1 – Climate and Hydrology

FINAL INTERIM REPORT

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EXECUTIVE SUMMARY

This report presents methods and results for the baseline climate and hydrology studies conducted from 2008 to 2009 for Avalon Rare Metals Inc (Avalon), related to the development of the Nechalacho Deposit, located on mineral leases it holds at its' Thor Lake site in the Northwest Territories. The objectives were to:

- Describe the local area climatic and hydrological conditions during the year and their spatial variability
- Measure lake water levels and stream flow in the major water bodies at the Thor Lake site
- Conduct a snow survey in late winter to quantify snow water equivalent at the Thor Lake site.

The 2008/2009 field programs included climate monitoring and hydrologic monitoring in several water bodies at the project site. During the 2008/ 2009 field programs, climatic conditions were monitored with an AXYS Watchman 500 climate station. The station was installed on June 26 2008. Hydrologic monitoring included installation and measurements at lake water level gauges and stream gauges in a total of nine water bodies. A snow survey was completed in late March 2009 which coincided with regional snow surveys in the area completed by Environment Canada personnel.

Through the period of record, the measured temperature range at the site was approximately 70°C. The maximum monthly rainfall was approximately 50 mm in September 2008. Wind speeds tended to increase during the summer months and were lowest during the winter. Estimates of evaporation and evapotranspiration at the site are also included. Snow survey data at the project site from 2009 exceeded the regional long-term mean snow trends. Regional snowfall data indicate the winter of 2008 – 2009 also experienced greater snowfall accumulations than the historical average. The 2008 – 2009 data indicated evaporation is highest in July when solar radiation and mean daily temperatures were at their maximum levels.

Water levels and stream flows at the project site experience seasonal fluctuations associated with the freshet and rainfall during the summer and fall months. Drainage from the project site to Great Slave Lake (GSL) is by a series of small, intermittent streams and marshes to the southwest of Thor Lake.

ABBREVIATIONS AND ACRONYMS

BC	British Columbia
ENE	East North-East
ENSO	El Nino Southern Oscillation
GSL	Great Slave Lake
JWA	Jacques Whitford Axys
km	kilometres
INAC	Indian and Northern Affairs Canada
m^3/s	cubic meters per second
m asl	metres above sea level
MoE	Ministry of Environment
NWT	Northwest Territories
PFS	Pre Feasibility Study
SC	Snow Course
SRC	Saskatchewan Research Council
SWE	Snow Water Equivalent
TDR	Technical Data Report

TABLE OF CONTENTS

List of Figures

List of Appendices

List of Table in Appendix A

1 INTRODUCTION

1.1 Project 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 100km southeast of Yellowknife and 4km north of the Hearne Channel of Great Slave Lake (GSL). 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 GSL). 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. This Technical Data Report (TDR) presents and analyzes data collected for the Climate and Hydrology discipline as of fall 2009.

1.2 Discipline Summary

A climate and hydrology monitoring program was initiated in August 2008 at the Thor Lake site. The objective of the monitoring program was to provide baseline data on the climatic and hydrologic conditions at the Thor Lake site. This report summarizes data and information collected from June 2008 to October 2009.

2 BACKGROUND

2.1 Study Area Description

The study area is located approximately 100 km southeast of Yellowknife, approximately 4 km north of the Hearne Channel in GSL (Figure 2-1). The regional area lies within the Tazin Lake Upland Ecoregion of the Taiga Shield Ecozone as defined in the National Ecological Framework for Canada (1996). The region is characterized by rolling Precambrian bedrock outcrops with many lakes and wetlands in glacially-carved depressions. The site is relatively flat with maximum elevation change of approximately 50 m. Lowlands tend to have poor drainage and are commonly wet for prolonged periods. Permafrost is discontinuous but widespread.

The property is located approximately 230 m asl, approximately 80 m in elevation above GSL. Drainage from the study area moves through a series of lakes that are connected by marsh areas or small bedrock controlled streams. Lakes and streams are frozen from late October to late May or June. The summers are of short duration and can be hot. Rainfall events are occasional in the summer, but increase in frequency in the fall. Winters are long and cold and relatively dry.

2.2 Existing Information

The data gaps analysis performed by Jacques Whitford (JWA 2008) indicated prior hydrologic research at the site was limited to one report (SRC, 1989). The SRC report briefly discussed the general hydrologic characteristics of the site. The major hydrological findings of the report that are pertinent to this report include:

- Water from Elbow Lake seeps into GSL over a distance of 1.1 km
- Water from Cressy Lake seeps through peatlands into Fred Lake
- From Fred Lake the water moves through a series of small streams and peatlands eventually into GSL
- Stream flow from Fred Lake (the only gauging site reported on) was measured at 0.091 m^3/s (no information was provided on the duration of the stream flow gauging)
- Continuous peatland made up shorelines where one could otherwise expect outflow from lakes, including Cressy Lake, Fred Lake, and Elbow Lake. Any overland flow was too small to gauge.

3 METHODS

3.1 Climate

An AXYS Technologies Watchman 500 climate station was installed near the old mine site by AXYS Technologies personnel on June 26 2008 (Figure 3.1). The station has monitored the following parameters: temperature, rainfall (with tipping bucket), wind speed and direction, relative humidity, barometric pressure, and snow depth. The program was designed to power the station at one hour intervals for approximately 10 minutes to acquire climate data. Thus the recorded data are instantaneous data points (rather than averaged values of the previous 10 minutes).
The station uses AXYS Technologies' DMS operating software. Data for this report were collected to October 24 2009.

The recording devices for rain, temperature, humidity, and snow depth were installed at a height of approximately 3.3 m when the station was installed in June 2008. However, data analysis from the winter of 2008 – 2009 showed that the snow sensor was not recording valid snow depths and not reportable. After review of the sensor manual and in consultation with AXYS Technologies personnel, the station was adjusted in October 2009. The mounting arms of the weather station were also lowered to approximately 2.1 m above ground and a snowboard was installed below the sensor. The station program was updated to include a signal quality function in the snow sensor code. Testing of the snow sensor confirmed that signal quality of the sensor was good and the sensor should record accurate values in the future.

3.2 Snow Survey

Snow surveys derive areal estimates of snow distribution by sampling along snow courses. Snow courses cross areas of homogeneous land cover within a region of interest. Thus, one or more snow courses will cross each of the primary land cover types in an area. Snowpack surveys were conducted in late March 2009 and coincided with regional snowpack surveys completed by Environment Canada personnel. Field methods followed BC Ministry of Environment guidelines (BC MoE, 1981).

The rationale for the timing of the snow survey was based on the regional climate trends at Yellowknife. The long-term climate trends at Yellowknife indicate:

- Annual maximum snow depth occurs in March
- Approximately 10% of the annual snow accumulation occurs after March during the hydrologic year (November to October)
- Snow ablation begins to exceed snow accumulation in April
- Maximum air temperatures are below 0°C for 92% of March, freezing conditions are ideal for sample collection
- Rainfall typically begins in April (22% of monthly precipitation)
- 2008 – 2009 snow accumulations were ~ 1.3 times greater than the normal accumulation.

The snow survey was completed along six snow courses located in different types of land cover (Figure 3.2). Measurements along each snow course included snow depths and snow cores taken at a 10:1 ratio at approximately 50 – 100 m intervals. The 10:1 sampling ratio is standard practice since density tends to vary less than snow depth (Goodison, *et al*. 1981). This “double-sampling” technique yields less variable SWE areal estimates (Berezovskaya, *et al*. 2008).Snow depth, snow density and snow water equivalent (SWE) were measured during the survey.

3.2.1 Snow Course Descriptions

The snow course descriptions are as follows (Figure 3.2):

SC1 – Thor Lake – transect across Thor Lake, northwest to southeast. The transect crossed the mid-portions of the lake and was exposed to wind. Snowpack was well compacted and had several crust layers.

SC2 – South of Thor Lake (Forest) – transect runs west-east along the forested area south of Thor Lake, north of Long Lake. The transect ground cover consisted of relatively dense forest. The forest cover protected the ground from the wind packing.

SC3 – Ridge – consisted of a transect east-west between Thor Lake and Murky Lake along an open bedrock exposed ridge. The ridge sloped to the south and was sparsely vegetated, with few large trees.

SC4 – East Thor – transect was located southeast of Thor Lake, northwest of Thorn and Meghan Lakes, running southwest to northeast. The transect ground cover consisted of moderate forest cover, which protected the ground snow from winds.

SC5 – Weather Station – consisted of random samples in an open meadow near the weather station. The meadow was approximately 400 m^2. The ground cover in the meadow consisted of long grasses and shrubs and was surrounded by trees approximately 3 – 5 m in height.

SC6 – Long Lake Ridge – is an east-west transect south of Long Lake, north of Elbow Lake. The snow course was completed on an exposed, elevated ridge with moderate vegetation, including bushes to large trees.

Snow pits were excavated at the Thor Lake snow course, South of Thor Lake snow course, Weather Station snow course and near GSL to assess vertical snow density changes in the snow pack. Samples from each snow layer were weighed to determine density. Average density and variation in density were then determined once the entire snow cover layer had been sampled (Appendix B).

Regional snow survey data were collected at Tibbitt Lake, NWT (62° 30’ 47” N, 113° 23’ 43” W), by Environment Canada personnel on March 31 2009. These data, along with the long-term mean snow survey data at Tibbitt Lake (data record is 1981 – 2009 (28 years), were compared to the 2009 survey data at Thor Lake.

3.3 Hydrology

3.3.1 Field Monitoring

The field monitoring program took place during open-water conditions from August 2008 to October 2009 to characterize the seasonal variations in surface water hydrology. Stream flow and lake water level measurement sites were located at nine water bodies in the study area (Figure 3.1, Table 3-1, Appendix A). Water level monitoring stations were established in the following lakes at the study area:

- Thor Lake
- Long Lake
- Elbow Lake
- Cressy Lake.

Stream flow monitoring stations were established in the following streams at the study area:

- Thor Lake outlet
- Fred Lake outlet
- Murky Lake outlet
- Long Lake outlet
- Beaver Dam channel at Thor Lake (south-west end).

Each of the sites was instrumented with a staff gauge and a HOBO pressure transducer. The pressure transducer measured instantaneous water levels at 15 minute intervals. Stream measurements included continuous water-level gauging, and manual stream flow and channel geometry measurements. Table 3-1 shows the sampling periods for each station. Each site was measured several times over the field program. During each site visit, stream flow was measured and related to water level to develop a stage-discharge relationship. All stations were surveyed into stationary benchmarks at each site visit.

Discharge measurements were derived using one of the following techniques:

- The velocity-area method
- Salt dilution
- Bucket and stopwatch
- Float-area technique.

Stage-discharge plots were log-linear and a regression equation was derived for each stream. This relationship was used to establish hydrographs for each of the stations.

3.3.2 Site Descriptions

Thor Lake – lake level station was located in a bay northeast of the existing camp. A staff gauge was installed in August 2008 and re-established in June 2009 after late season lake ice had cleared from the site. Elevation control for the gauge was surveyed to the existing iron pin benchmark at camp.

Long Lake – lake level station was located near a rocky point at the western end of the lake. A staff gauge was installed in August 2008 and re-established in May 2009. Elevation control for the gauge was surveyed to temporary benchmarks on trees on the south shore of the lake.

Elbow Lake – lake level station was located near the portage trail to Long Lake along the northeast shore. A staff gauge was installed in June 2009 after late season lake ice had cleared from the shore. Elevation control for the gauge was surveyed to temporary benchmarks on trees along the portage trail to Long Lake. In October 2009, elevation control for the gauge was extended to the Long Lake control.

Cressy Lake – lake level station was located near an old submerged dock at the north end of the lake. A staff gauge was installed in May 2009. Elevation control for the gauge was surveyed into temporary benchmarks on trees along the southern shore near a road adjacent to the lake.

Thor Lake outlet – stream channel station was located in a bedrock channel at the outlet below a small bridge. This is the only outlet of Thor Lake. A staff gauge was attached to an iron angle secured to bedrock in the outlet channel in August 2008. Elevation control for the gauge was surveyed to temporary benchmarks in trees located near the outlet channel.

Fred Lake outlet – stream channel station was located downstream of the culvert along the GSL road. A staff gauge was installed in August 2008. Elevation control for the gauge was surveyed to temporary benchmarks on trees on the west side of road.

Murky Lake outlet – stream channel station was located approximately 2 km upstream of Thor Lake adjacent to a northeast trending ridge. A staff gauge was secured to a birch tree located beside the stream channel in September 2008. Elevation control for the gauge was surveyed to temporary benchmarks located on trees near the stream.

Long Lake outlet – stream channel station was located several meters downstream of the Long Lake outlet. A staff gauge was installed in August 2008 and re-established in May 2009. Elevation control for the gauge was surveyed to the same benchmarks as used for the Long Lake gauge.

Beaver Dam channel at Thor Lake – stream channel station was located near a beaver dam at the southwestern end of Thor Lake in a channel connected to Long Lake. A staff gauge was installed in August 2008 and re-established in May 2009. Elevation control for the gauge was surveyed to temporary benchmarks located on trees near a trail. In October 2009, elevation control for the gauge used the same benchmarks as the Long Lake gauges.

3.3.3 Drainage Mapping

Drainage basins for Thor Lake and Elbow Lake were delineated from a 1:250,000 NTS topographic map. Higher resolution data were not available for this report. Drainage from the site to GSL was determined for the Elbow Lake and Thor Lake drainages. Water drainages were determined from analysis of topographic maps, air photos, and site reconnaissance on foot and by air. Results of the drainage mapping exercises are discussed in Section 4.2

4 RESULTS

4.1 Climate

4.1.1 Temperature

The temperature probe installed on the Watchman station records a minimum temperature of -40°C. However, the care taker at camp noted temperatures of approximately -50°C during the winter of 2008 – 2009. Therefore, the temperature data likely does not account for the entire temperature range at the site.

Monthly temperature data from the study area from June 2008 to October 2009 are provided in Table 4-1 (Appendix A) and Figure 4-1. The mean July (2008 and 2009) temperature at the site was 15.1°C and the mean 2009 January temperature at the site was -25.3°C

The maximum recorded temperature at the site from June 2008 to October 2009 was 30.4°C on August 9, 2008 and the minimum temperature recorded was -40.1°C (on several occasions) (Table 4-1). The temperature range of the available data is 70.5°C.

Annually, daily temperature fluctuations are superimposed on the seasonal fluctuations as shown in Figure 4-2. Maximum temperatures over the period of record were in July 2008 and minimum temperatures were recorded in December 2008 and February 2009. A short December 2008 warm period caused water to begin discharging from the Thor Lake outlet (R. O'Keefe, pers. comm.). This stream flow was apparently maintained for the remainder of the winter according to camp staff.

4.1.2 Precipitation

Rainfall data from the site are provided in Table 4-2 (Appendix A) and Figure 4-3. Maximum monthly rainfall occurred in September 2008 (49.6 mm). Rainfall trends tend to increase during the summer and peak in the September. Temporally, the period from July to September 2009 was wetter than the same period in 2008 (Figure 4-3). The maximum recorded rainfall accumulation over a 1-hour interval was 4.8 mm in August 2009.

4.1.3 Wind

Monthly wind summaries were derived from the site (Table 4-3, Appendix A). Wind vector plots (Figures 4-4 to 4-7) represent the seasonal conditions at the site. The representative periods of the wind vector plots were adjusted to reflect the long summer and winter seasons and because data logging began in late June 2008.

Wind vector plots demonstrate that the dominant wind direction at the site was from the east-northeast (ENE) during November through June (Figures 4-4 – 4-7). From July through October, the wind directions are more dispersed, although still primarily from the ENE (Figure 4-4) This is likely associated with changes in the jet stream which allow more southerly systems to migrate north in the summer months. Wind directions during the winter period from November to April are primarily from the ENE (Figure 4-5). During the period from April to July 2009, ENE was the dominant wind direction. These winds tend to cool surface temperatures at the site. During the period July to late October 2009, the wind direction was still predominantly from the ENE, however winds were slightly dispersed as was observed during the similar period in 2008

Mean monthly wind speeds were highest during March, May, and June 2009 and gust speeds were greatest during July 2009 for the 2008 – 2009 period (June 2008 was not included in the comparison because only five days of data were collected). The lowest wind speeds were measured in December 2008 (Table 4-3). The maximum recorded wind speed for the June 26 2008 – October 22 2009 period was 5.5 m/s (19.8 km/h).

4.1.4 Estimated Evaporation and Evapotranspiration

Daily evaporation for the site was estimated using the Hamon evaporation model (1961). The model requires daily mean temperature, and estimates of solar radiation to derive daily evaporation rates. The estimated monthly evaporation rates at the site are provided in Table 4-4 (Appendix A). Evaporation tends to be greatest during July when solar radiation and mean daily temperatures are greatest. Evaporation estimates ranged from 0.0 mm in winter 2008 to 73.6 mm in July 2008.

Monthly evapotranspiration (ET) data were estimated using a Thornthwaite-type water balance model. Input to the model included precipitation and temperature data, an estimate of solar radiation (adjusted monthly), and soil moisture is held constant. ET is derived following the methods of Alley (1984) where water input (the sum of snowmelt and rain) is compared to potential evapotranspiration, which is based on temperature-based methods of Hamon (1961). The estimated evapotranspiration rates are provided in Table 4-4. Estimated evapotranspiration rates ranged from 0.0 to 83 mm in June 2009.

4.1.5 Relative Humidity and Barometric Pressure

Mean monthly summaries for relative humidity are provided in Table 4-5 (Appendix A). In general, the winter months tended to have higher relative humidity compared to drier summer conditions. The maximum mean monthly relative humidity was 91% in December 2008, while the minimum was 60.3% in May 2009.

Barometric pressure trends are shown in Figure 4.8 showing an increasing range in barometric pressure during the winter and lower pressure ranges in the summer months.

4.1.6 Snow Survey Data

Snow survey data from the six courses are summarized in Table 4-6 (Appendix A). Mean snow depths varied from 31.3 cm along the Thor Lake course to a maximum mean depth of 66.6 cm along the East Thor course. The mean site snow depth was 57 cm. Snow densities and SWE were greatest along the Thor Lake course and lowest along the East Thor snow course. The mean site SWE was approximately 94 mm, with a range from 79 to 115 mm.

Snow course 1 (Thor Lake) had the highest density, lowest depths and SWE. This reflects the effects of wind on the snowpack (e.g., wind packing). Snow course 6 (Long Lake ridge) also had relatively low SWE compared to the other locations, again reflective of wind effects on the snowpack. The thickest snowpacks and greatest SWE were found in forested areas (SC2 and SC4), where wind exposure is less.

Regionally, snow data are available from Tibbitt Lake which is located approximately 62 km to the northwest of Thor Lake. 2009 snow course data from Tibbitt Lake indicate snow depths were 108% of the historical end of March (i.e., maximum snowpack), while mean depth and SWE were 120% of the historical SWE (INAC, 2009; Table 4-7, Appendix A). Historically, the end of March SWE at Tibbitt Lake has varied from 29 to 148 mm. The long-term trend has varied with maximum SWE in the early 1990s (Figure 4-9).

The 2009 Thor Lake mean snow depths were approximately 143% of the long-term Tibbitt Lake and the Thor Lake SWE was 142% of the historical SWE. Thus higher density values at Tibbitt Lake account for the higher SWE at Tibbitt Lake in 2009 compared to Thor Lake. This may reflect the spatial density of samples taken at Thor Lake, where the objective was to sample in as many representative land covers as possible. The Tibbitt Lake survey occurs along the same snow course annually (a moderately forested area near the lake) and therefore the higher density values at Tibbitt Lake may reflect the snow course proximity to an open, exposed area.

4.1.7 Snow Accumulation Monitoring

In October 2009, snow depth rulers were installed at three locations around the study area to improve the spatial snow accumulation data for the site and to compliment the automatic snow sensor data collected at the weather station. The climate station was adjusted at this time and the program updated, details of the snow sensor adjustments and the resulting data are provided in Appendix C.

Snow pack information is important for characterizing the overall site hydrology since the hydrologic cycle is driven by snowmelt in northern Canada. The snow rulers are one meter in length and calibrated to two millimeters. Each gauge is secured to a tree. The snow rulers were secured to a tree at the following locations:

1. **Camp** – on north-facing slope behind the incinerator. Approximately 5 m down-slope, the gauge is visible from the top of the slope.
2. **Driller's Cache** – near the 'cache' on the south side of Thor Lake. Just before the road from Thor Lake enters the cache area, the gauge is located 5m from the right (west) side of the road. It is visible from the road.
3. **Climate Station** – the gauge is attached to one of the supports at the station.

A spreadsheet was sent to Avalon for the winter watchman to keep a record of accumulations at the site through the winter months. The spreadsheet included records for daily and month-end snow pack totals at each of the stations.

4.2 Hydrology

4.2.1 Basin Characteristics

The Thor Lake drainage basin is characterized by numerous lakes, marshes, and small streams. (Figure 3-1) The lakes vary in size and bathymetry (see Aquatics-Fisheries report for bathymetric information of lakes at the site). Hydrologic connectivity between the lakes is limited to small streams connecting marsh areas that bound the lake where outlets may be expected. This finding is similar to the findings in the SRC (1989) report summarized above.

Thor Lake is fed by the Murky Lake drainage and inflows from Long Lake. The stream flow in the channel between Long and Thor lakes is relatively stagnant and was observed to reverse during stream flow measurements. The Long Lake stream bed consists of alluvial material ranging from coarse gravel to silts and clays. The banks along the Long Lake outlet feature many failures and fallen trees in the water. The decreased capacity of the stream and low stream power may reflect changes in lake levels in Thor and Long lakes, which may be related to beaver activity or changes in the drainage at Thor Lake.

Field reconnaissance in May and June of 2009 evaluated the surface water connectivity between Elbow Lake and GSL as well as the connectivity of drainage from Thor Lake to GSL. The drainage from Elbow Lake to GSL passes though several marshes adjacent to the western shores of Elbow Lake. The water moves passively through a series of interconnected marsh areas to the west of Elbow Lake. Overland flow was observed during the summer as marshes overflow. The marshes drain to a large pond/marsh on the west side of the GSL access road. From there, the pond drains to GSL, initially through several smaller ponds and then via an incised channel as the topography steepens towards GSL (Figure 4-10).

Drainage from Thor Lake to GSL initially passes through Fred Lake and then drains towards the southwest through a series of streams and grassy and wooded marsh areas that lie between numerous lakes. Eventually, as the topography steepens, the drainage system becomes incised near GSL.

4.2.2 Lake Level Data

Relative lake water levels for each of the lake gauging sites in 2008 are provided in Figure 4-11. Monthly mean, maximum, and minimum lake levels are listed in Table 4.8 (Appendix A). In general, lake levels tended to decrease during August and early September 2008 until rain events caused an approximate 0.04 m increase in late September 2008. Water level data are provided for Long Lake outlet and Beaver Dam channel at Thor Lake as there was no obvious stage-discharge relationship Instead, these stations demonstrate the variations in lake levels in 2008 given their locations at the end of Long Lake and entry to Thor Lake.

Through the 2008 period, lake levels measured at the gauges were generally synchronous (Figure 4-12). Finer resolution variations superimposed on the seasonal water trends are evident at each of the stations. The Long Lake gauges appear to have more daily variations compared to the Thor Lake gauges. The fluctuations on the Thor Lake gauge are likely related to wave action. The Beaver Dam at Thor Lake was relatively quiescent compared to Thor Lake.

The lake level trends for 2009 are shown in Figure 4.12 and monthly summary data are listed in Table 4-8. In 2009 data loggers were installed at Cressy and Elbow Lakes. Late lake ice prohibited station installation in Elbow and Thor Lakes until late June.

All station water levels follow similar seasonal trends. Water levels in the gauged lakes decreased through June; these trends are likely due to cooler temperatures causing refreezing of any remaining snowpack and water stored in the shallow subsurface in early June. Water levels increased in July which is likely attributable to a combination of groundwater discharge and rainfall events. Water levels gradually decreased during the summer at similar rates with the exception of Cressy Lake which decreased more slowly. Late summer and fall rain events caused water levels to increase from late August to October.

Finer resolution variations superimposed on the seasonal trends are also similar among the lake stations with the exception of Beaver Dam at Thor Lake. This station had greater daily variations in water level compared to the other stations, which may reflect wave activity.

4.2.3 Preliminary Stream Flow Data

Monthly summaries of the preliminary stream flow data are provided in Table 4-9 (Appendix A). Individual stream flow measurements are provided in Table 4-10 (Appendix A) for each of the stream channels. Stage-discharge plots are provided in Appendix D. The quality of the regression equations is expressed by the coefficient of correlation (r^2) which ranged from 0.0 at Long Lake outlet to 0.97 at Fred Lake outlet. Stage-discharge curves were not developed for Long Lake outlet or Beaver Dam channel because a curve could not be fitted to the available stream flow dataset.

During site visits in 2008 and 2009, reverse flows were observed in both Long Lake outlet and Beaver Dam channel at Thor Lake indicating stream flow was traveling into Long Lake from Thor Lake. The reversals were observed through the entire water column. The period of the flow reversals averaged approximately 40 seconds and ranged from approximately 30 seconds to approximately 1 minute intervals.

The open water season is characterized by large variations in stream flow associated with spring freshet, and periods of wet and dry weather. In 2008, stream flow rates tended to vary with rainfall input. Thus higher rainfall led to increased stream flow in late September and October of 2008 (Figure 4-13 – the dates that stream flows were measured and rainfall are included in the hydrographs). Note, because of the dry conditions and because the outlet of Thor Lake was partially blocked by woody debris there was very low flow in Thor Lake outlet in 2008 (plotted on the secondary y-axis in Figure 4-13).

Stream flow data for 2009 are summarized in Table 4-10 and Figure 4-14 (including point stream flow measurements and rainfall). Immediately apparent is the higher stream flow rates at the Thor Lake outlet compared to 2008. This reflects the high water levels in Thor Lake as a result of a relatively wet fall and high antecedent moisture conditions in the ground at the start of spring 2009.

There is also a notable increase in stream flow at the Thor Lake outlet and Fred Lake outlet in early June 2009. The debris blockage at the Thor lake outlet was removed on June 2 causing an immediate increase in stream flow at that station. The increased stream flow to Fred Lake was noted downstream at Fred Lake outlet several hours later. After this point, stream flows diminished during June but increased again as a result of late June rainfall and the remaining surface runoff from snowmelt. Stream flow then decreased steadily over the summer and increased in fall as rainfall increased. Based on the low responses to rainfall events in the fall it appears the system had a high storage capacity during the late summer.

The large differences between 2008 and 2009 Thor Lake outlet flows (Table 4-9, Appendix A) likely reflect several factors. First, the outlet was partially blocked by woody debris throughout 2008; the debris was not removed until early June 2009. The blockage resulted in greater water storage (both surface and groundwater) in the basin, and once removed, the Thor Lake outlet drained water that had accumulated in both the Thor and Long Lake basins. Second, based on evaluations of regional meteorological data, the onsite data and field observations, there was more water available in 2009 than in 2008. Third, in 2008 stream flow gauging began in mid-August well after the effects of freshet, so that the flow measurements that began in August 2008 reflect only the seasonally warm and drier conditions. The drier conditions likely contributed to the order of magnitude rapid drop in the Thor Lake outlet flow that was measured over just one week during mid-August 2008.

5 DATA ANALYSIS

Long-term regional data were used to provide reliable long-term climate trends based on the available data records at six regional stations. The stations used were selected based on their proximity to the study area, physiographic conditions, data length, and available data parameters. The stations are distributed around GSL (Figure 5-1 and Table 5-1, Appendix A).

This section describes the regional climate conditions to compare to the local climate data from Thor Lake. Annual summaries of climatic conditions at the regional stations are provided in Table 5-2 (Appendix A). Data are provided for annual temperature, precipitation, rain, and snowfall. Maximum and minimum totals represent the highest and lowest accumulations on record, respectively. Comparisons of the Thor Lake data are made to the Yellowknife and Lutselk'e temperature and precipitation data records because of the proximity of those stations to the Thor Lake station, their similar physiographic conditions, and data lengths.

5.1 Temperature

Regional temperature data were summarized from the six stations listed in Table 5-1. Annual and monthly means and station maximum and minimum recorded temperatures were derived from the regional data (Table 5-2).

The Yellowknife and Lutselk'e stations are used for comparison to the onsite meteorological data because of their proximity to the site, data length, and local physiographic conditions. For the period of record at Yellowknife, daily temperatures have ranged from 32.5°C to -51.1°C for a total range of 83.6°C. At Lutselk'e, the daily temperatures ranged from 31.5°C to -47.0°C for a total range of 78.0°C. Figure 5-2 shows the mean monthly temperature records at Yellowknife and Lutselk'e and the seven-year running average at Yellowknife. The period of the running average was selected based on average El Nino Southern Oscillation (ENSO) event periodicity. However it is not apparent from the data series that ENSO events have had a substantial impact on temperatures in the region. Over the period of record, there has been a warming trend on the order of 1 or 2°C over (Figure 5-2). Most of the annual variability in temperature is associated with the annual minimum temperatures and a more recent trend of warmer minimum temperatures. The annual maximums show less variability over the long-term record. This indicates, that the long-term warming trend reflects warmer average winter temperatures rather than warmer summer temperatures.

The mean January temperature for the regional stations is -25.0°C and the mean July temperature for the regional stations is 15.3°C indicative of the cold winters and moderate summers in the region. Mean monthly temperature summaries for the regional stations are provided in Table 5.3. Spring thaws begin in late March or April when daily maximum temperatures exceed 0°C, although daily mean temperatures may not rise above freezing until May. Although the summers are warm, daily minimums may drop below freezing at night during August (Table 5-3). Annual temperatures reach maximum mean values in July and reach minimum mean values in January (Figure 5-3).

Historically, Yellowknife tends to have slightly higher summer temperatures and lower winter temperatures compared to Lutselk'e (Figure 5-3). For the period 2008 – 2009, Yellowknife had higher mean monthly temperatures during the summer compared to the Lutselk'e and Thor Lake stations (Figure 5-4). During the winter of 2008 – 2009, temperatures recorded at the Thor Lake station were similar to temperatures at the regional stations, with the exception of December 2008 when the Thor Lake station recorded slightly colder temperatures. The coefficients of correlation between the mean monthly temperature data from Thor Lake and the regional stations, for the period where the records overlapped, are high (0.99). These high correlations indicate the regional temperature datasets are well suited to provide long-term estimates of the temperature trends at Thor Lake.

5.2 Precipitation

Regionally, monthly precipitation totals are compiled for each station in Table 5-4 (Appendix A) and Figure 5-5. The maximum annual precipitation accumulation was 489 mm recorded at Pine Point. Annually, precipitation totals are generally highest in July, August, and September, particularly on the north shore of GSL, while the south side of the lake tends to have greater precipitation from September to November (Figure 5-5).

Monthly rainfall totals are given in Table 5-5, Appendix A. The maximum monthly rainfall on record is 141 mm recorded at Yellowknife. Annually, rainfall begins in late April or May, while the most amount of rainfall occurs in August and tends to diminishes in October as temperatures drop below freezing (Figure 5-6).

Monthly snowfall totals (as SWE) are given in Table 5-6, Appendix A. The maximum monthly snowfall on record is 132 mm (SWE) recorded at Fort Resolution. Snowfall may begin as early as September but the greatest accumulations tend to be in November (Figure 5-7).

Analysis of the available rainfall data from 2008 to 2009 at the study area indicates that monthly rainfall was lower than rainfall recorded in Yellowknife in 2008 and similar during 2009 (Figure 5-8, the Lutselk'e precipitation gauge was not operational in 2008 – 2009). Apparent differences in the timing of rainfall receipt in 2008 are a result of monitoring beginning in July 2008 at Thor Lake. In 2009, rainfall was recorded at the Thor Lake gauge in March compared to April at Yellowknife. The coefficient of correlation between the monthly rain data from Thor Lake and Yellowknife, where the data records overlapped, is good (0.79). This correlation indicates the regional rainfall dataset from Yellowknife is suited to provide long-term estimates of the rainfall trends at Thor Lake.

6 DISCUSSION

6.1 Project Considerations

A project update in September 2009 indicated the project design had expanded beyond the spatial area where field measurements had been complete. As such, field reconnaissance of the new project footprint was completed in October 2009 to provide an initial assessment of the surface water hydrology in the upper areas of the Thor Lake drainage basin.

The upper areas of the Thor Lake drainage basin include Ring, Buck, Drizzle and Murky Lakes. Ring Lake is the highest lake in the basin and is connected to Buck Lake via a marsh which may have seasonal drainage channels into Buck Lake. Water levels in the marsh connecting these lakes were approximately 0.10 – 0.30 m deep with no observable flow direction. Buck Lake appears to be a perched lake bounded at its lower end (southeast shore) by bedrock outcrops. There are no channelized alluvial features at the outlet of Buck Lake. A thin soil veneer overlays the bedrock at this location and the elevation difference between Buck Lake and Drizzle Lake is approximately 5 m, which is relatively steep for this area. However, shallow overland flow (0.02 – 0.05 m) between Buck

Lake and Drizzle Lake occurred in October 2009. This may have been caused by seasonally high water levels at the time which led to Buck Lake overflowing towards Drizzle Lake. To date, no hydrologic data have been collected in the upper part of the Thor Lake drainage basin.

Drizzle Lake flows into Murky Lake through a small marshy area. Murky Lake flows into Thor Lake via Murky Lake outlet. This channel is lined with a thin veneer of alluvium or confined by bedrock. Based on the Murky Lake outlet stream flow data, the channel experiences very low stream flow during dry periods in the summer.

7 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.

8 REFERENCES

Alley, WM. 1984. On the treatment of evapotranspiration, soil moisture accounting, and aquifer recharge in monthly water balance models.

Berezovskaya, SL, Derry, JE, Kane, DL, Gieck, RE, Lilly, MR, and White, DM, 2008. Snow survey data for the Kuparuk Foothills Hydrology Study: Spring 2008. University of Alaska Fairbanks, Water and Environmental Research Center, Report INE/WERC 08.14, Fairbanks, Alaska, 40 pp.

Goodison, BE, Ferguson, HL, and McKay, GA. 1981. ‘Measurement and data analysis’, in Gray, DM, and Male, DH (eds), Handbook of Snow: Principles, Processes, Management and Use. Pergamon Press, NY, pp. 191-274.

Hamon, WR. 1961. Estimating potential evapotranspiration. J. Hydraulic Division, Proc. ASCE. 87, 107-120.

INAC, 2009. Snow Surveys. http://nwt-tno.inac-ainc.gc.ca/wrd/table_e.asp?region=6

Ministry of Environment, BC. 1981. Snow survey sampling guide. Water Management Branch, Surface water section. Victoria BC. 31 pp.

9 FIGURES

Please see the following pages.

AVALON RARE METALS INC	Scale: 1:2,000,000 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 Stantec	Figure: 2-1

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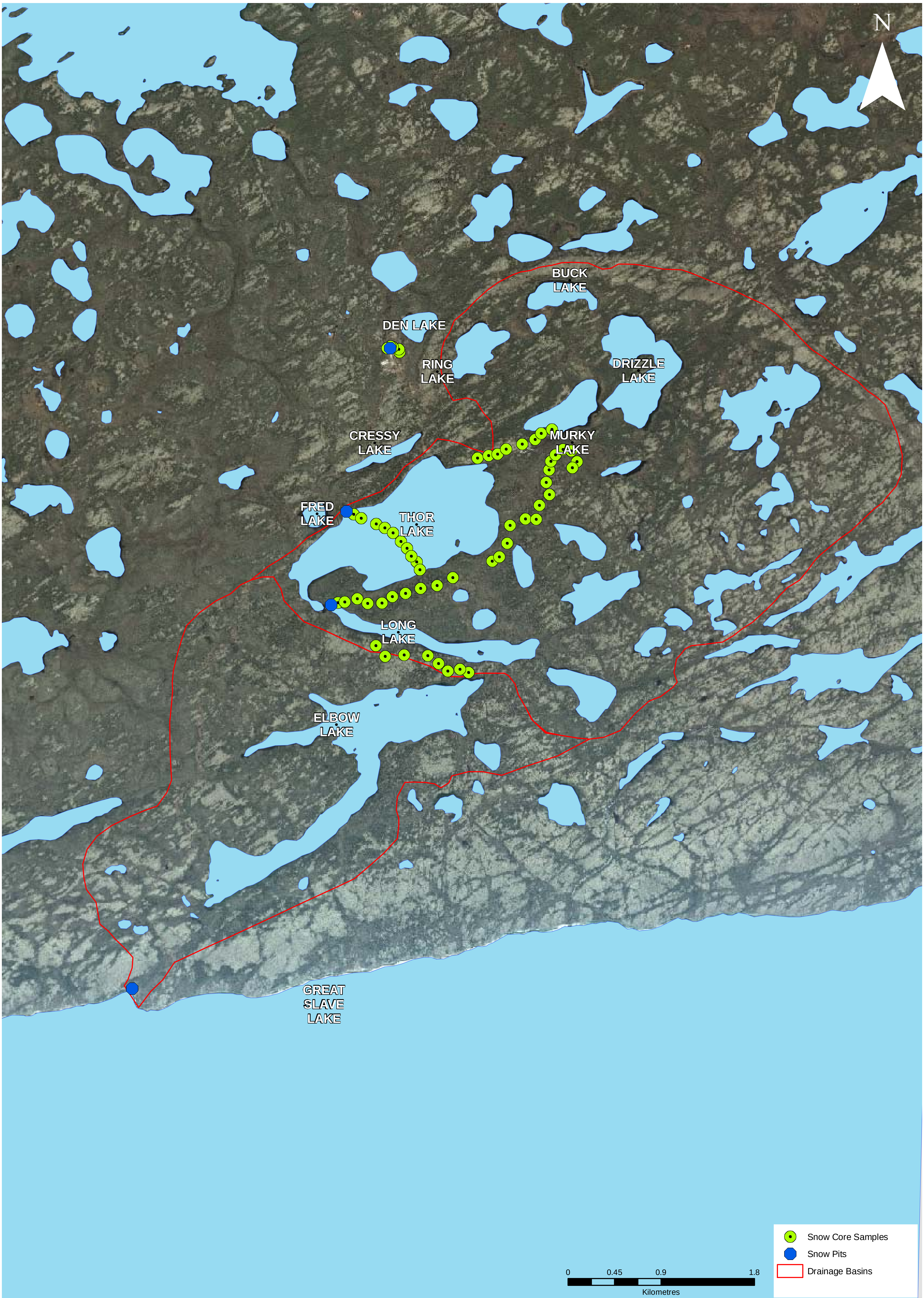
HYDROLOGY SAMPLE LOCATIONS

Area of Detail

AVALON RARE METALS INC

PREPARED BY Stantec				
DRAFT DATE 21/12/2009			SCALE 1:34,000	
REVISION DATE			PROJECT 1036222	FIGURE NO. 3-1
DRAWN RH	CHECKED TG	APPROVED NL	VOL	



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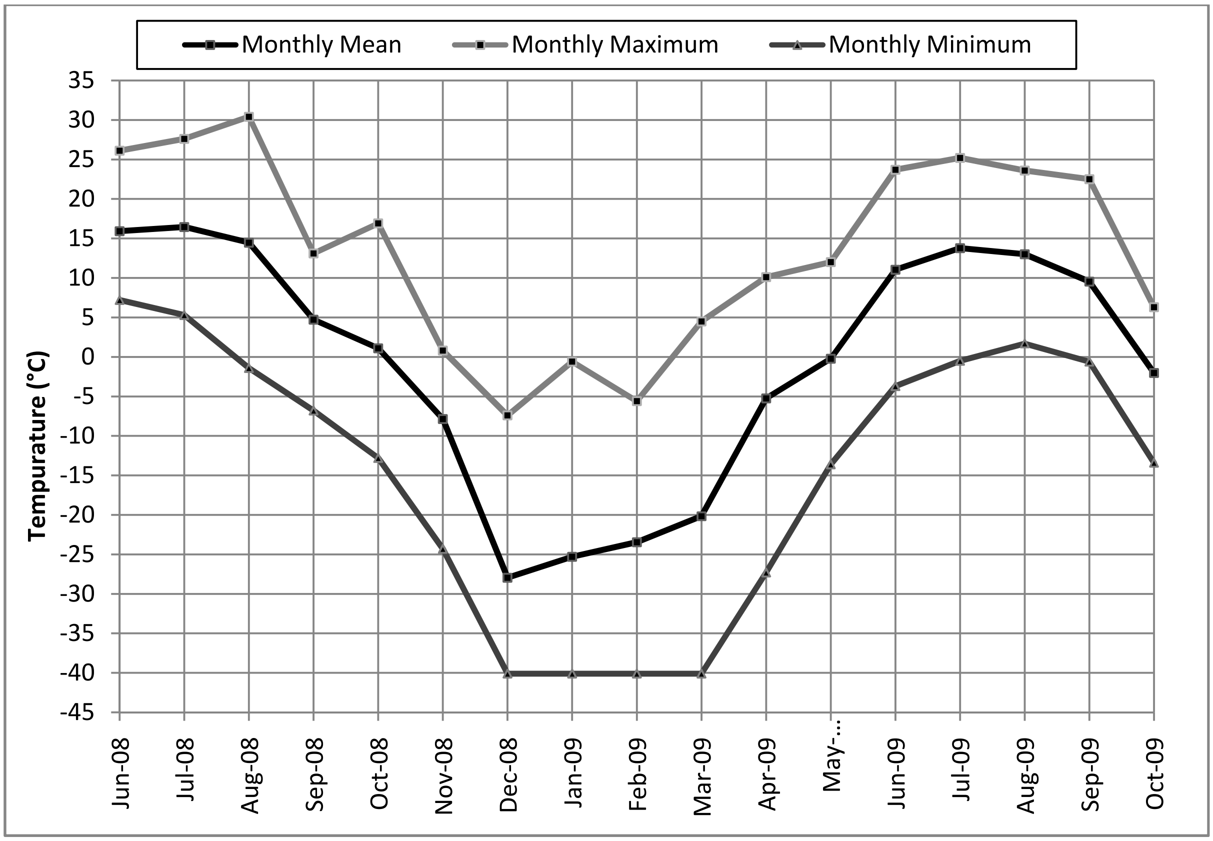
Snow Survey Locations

AVALON RARE METALS INC

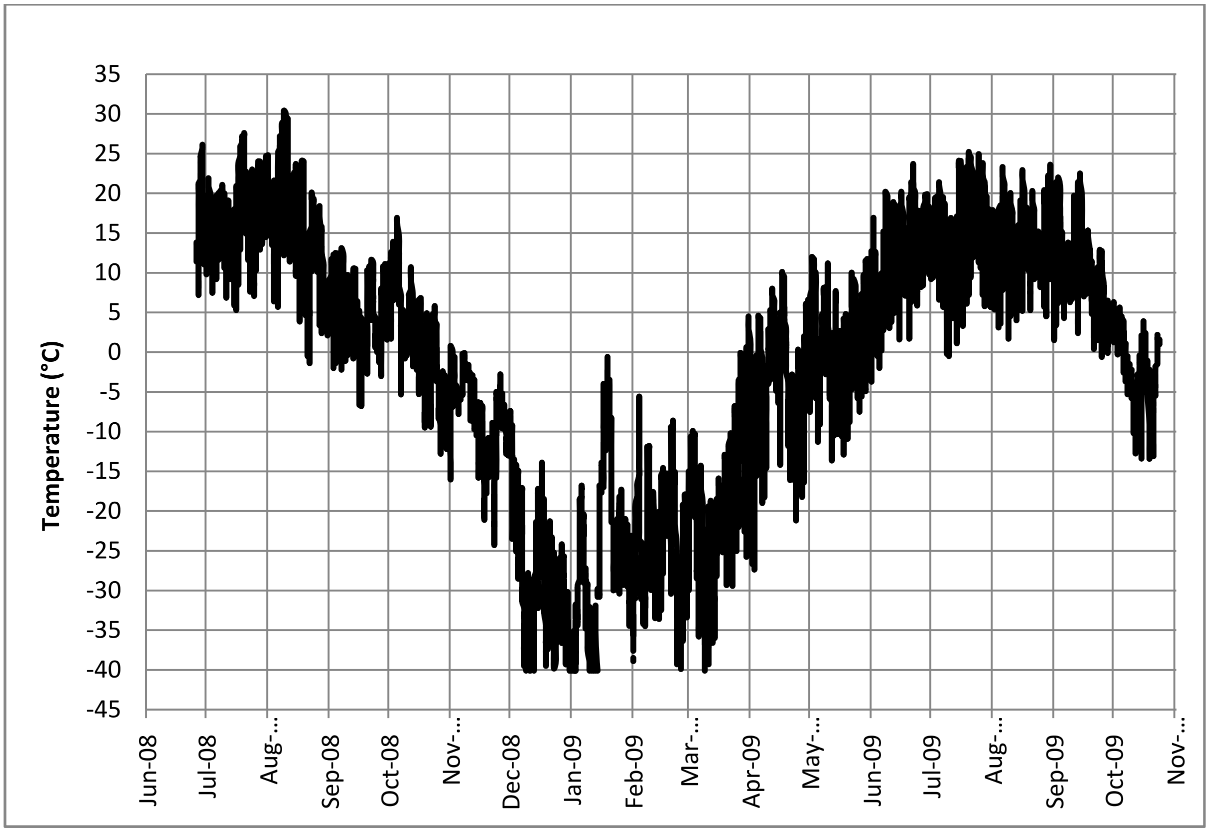
PREPARED BY Stantec				
DRAFT DATE 21/12/2009			SCALE 1:34,000	
REVISION DATE			PROJECT 1036222	FIGURE NO. 3-2
DRAWN RH	CHECKED TG	APPROVED NL	VOL	

Figure 4-1: 2008 – 2009 Thor Lake Mean Monthly Temperatures



Minimum and mean temperatures for December to March were affected by temperature probe operation, the probedid not record below -40 °C.

Figure 4-2: 2008 – 2009 Thor Lake Daily Temperature



Daily temperatures in December to March were affected by temperature probe, the probe did not record below -40 °C.

Figure 4-3: 2008 – 2009 Thor Lake Daily Rainfall

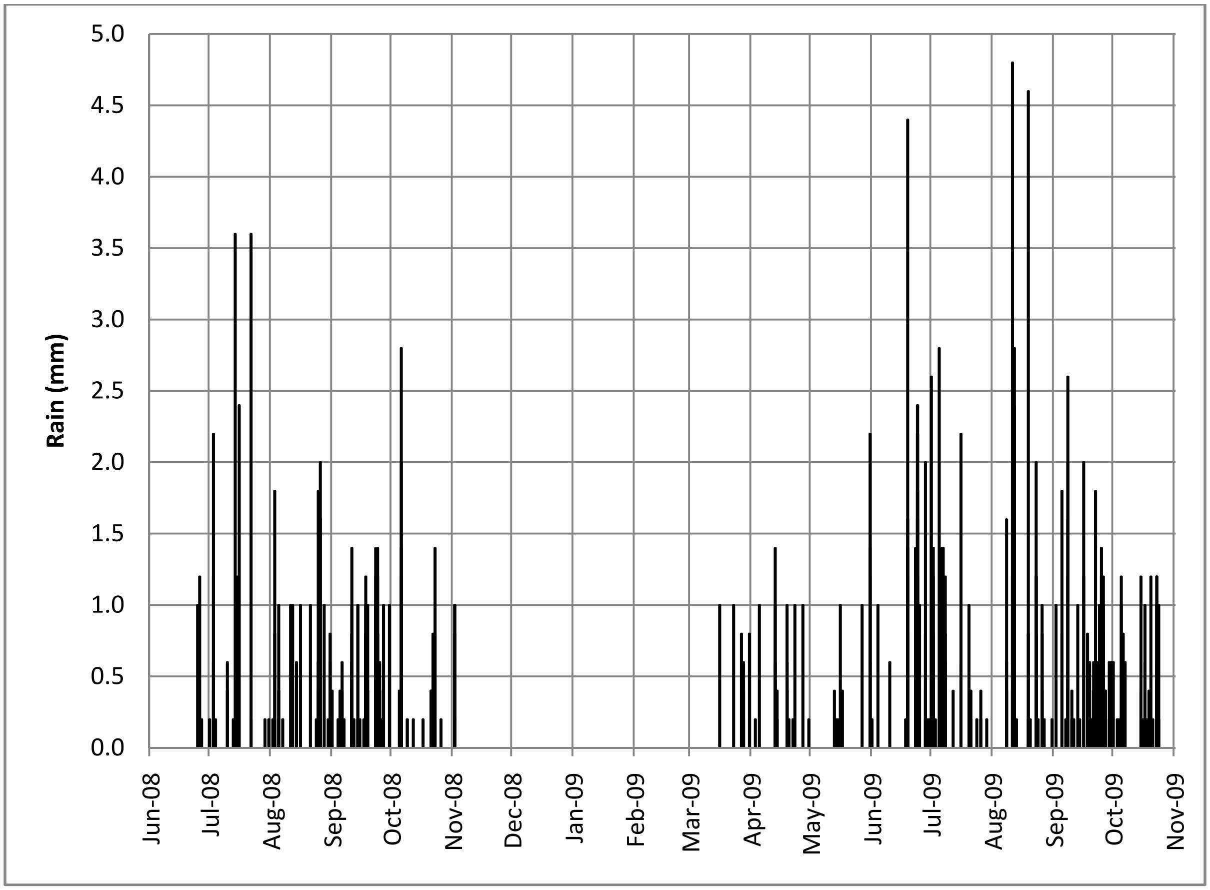
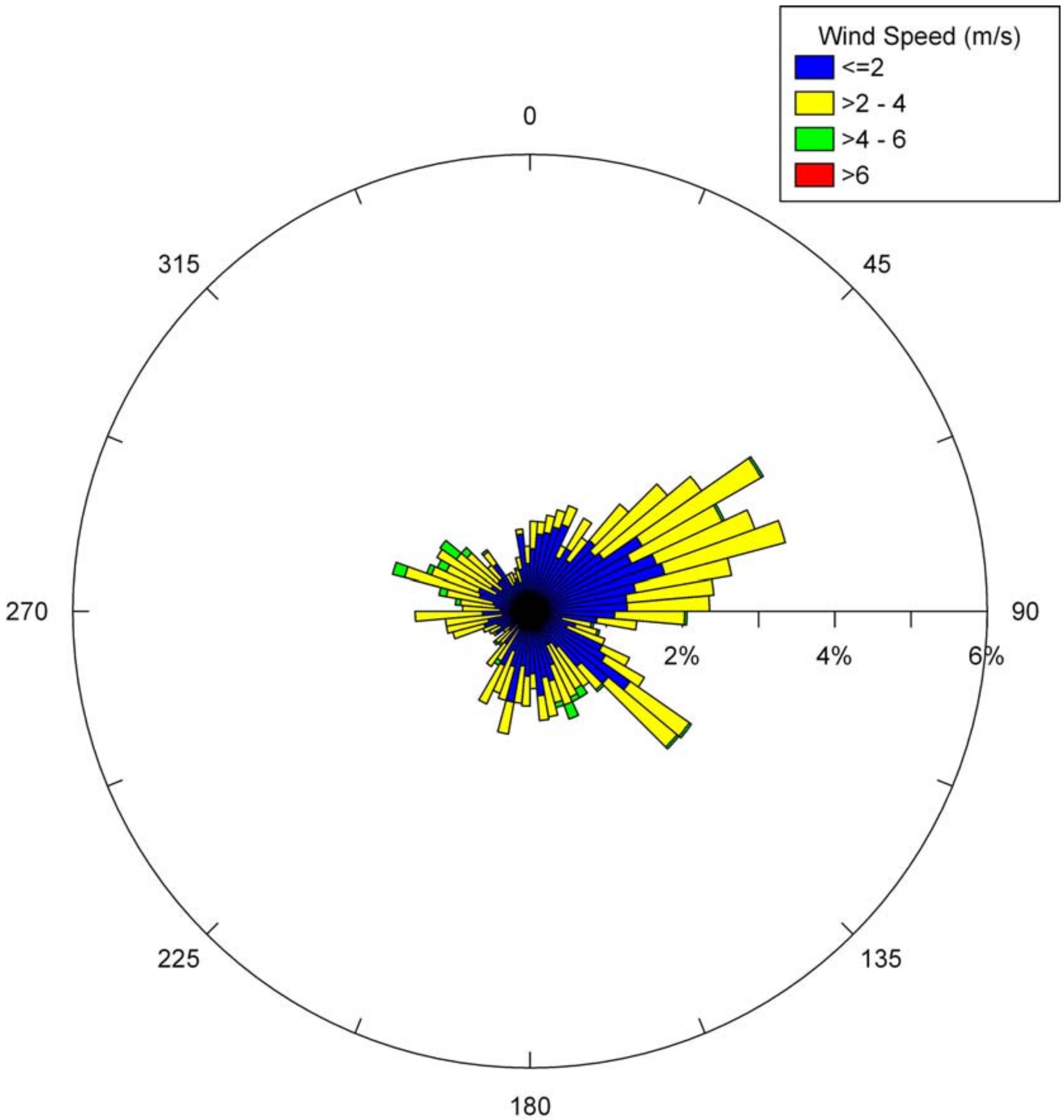
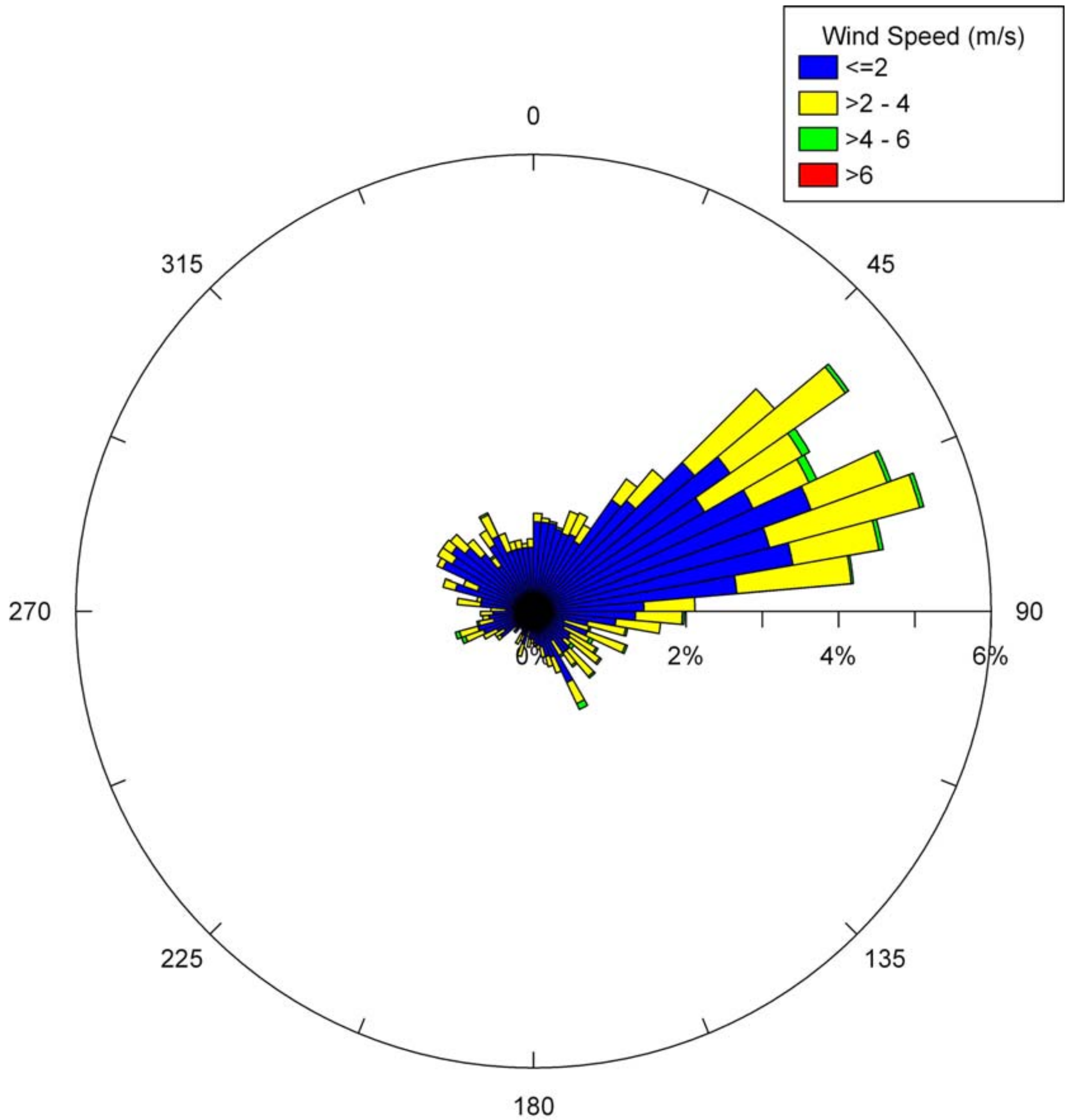


Figure 4-4: Wind Rose for June 26 2008 – October 31 2008



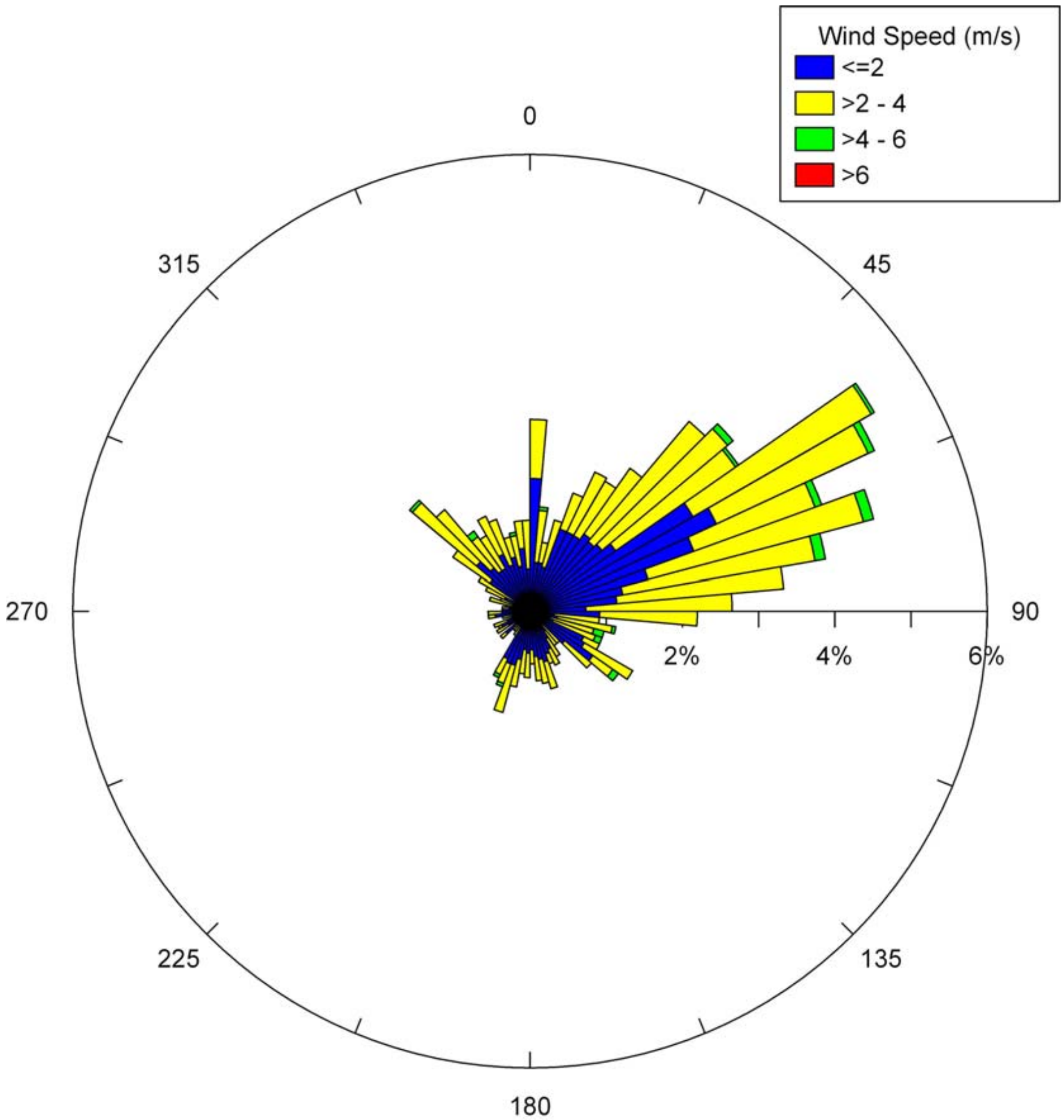
Bar direction represents direction from which wind came from. Data indicate percent of wind direction occurrence and bar color indicates wind speed (m/s).Dominant wind direction is from East-NorthEast. Period of graph is meant to represent summer and fall seasonal conditions at the site.

Figure 4-5: Wind Rose for November 1 2008 – March 31 2009



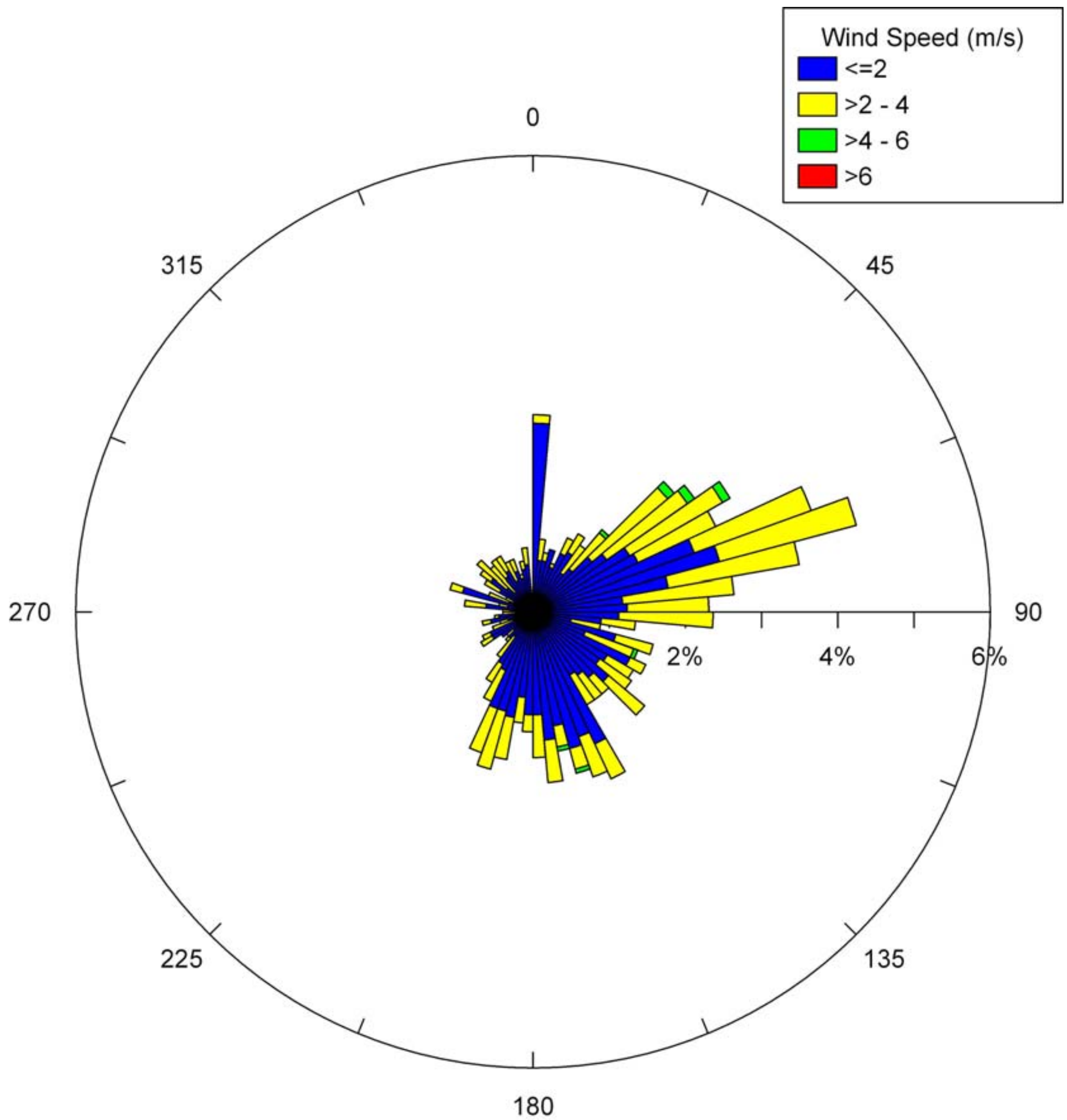
Bar direction represents direction from which wind came from. Data indicate percent of wind direction occurrence and bar color indicates wind speed (m/s).Dominant wind direction is from East-NorthEast. Period of graph is meant to capture winter season conditions at the site.

Figure 4-6: Wind Rose for April 1 2009 –June 31 2009



Bar direction represents direction from which wind came from. Data indicate percent of wind direction occurrence and bar color indicates wind speed (m/s).Dominant wind direction is from East-NorthEast. Period of graph is meant to capture spring and summer seasonal conditions at the site and to coincide with the 2008 data.

Figure 4-7: Wind Rose for July 1 2009 –October 22 2009



Bar direction represents direction from which wind came from. Data indicate percent of wind direction occurrence and bar color indicates wind speed (m/s).Dominant wind direction is from East-NorthEast. Period of graph was meant to coincide with 2008 data and to capture summer and fall conditions at the site.

Figure 4-8: –2008 – 2009 Barometric Pressure at Study Area

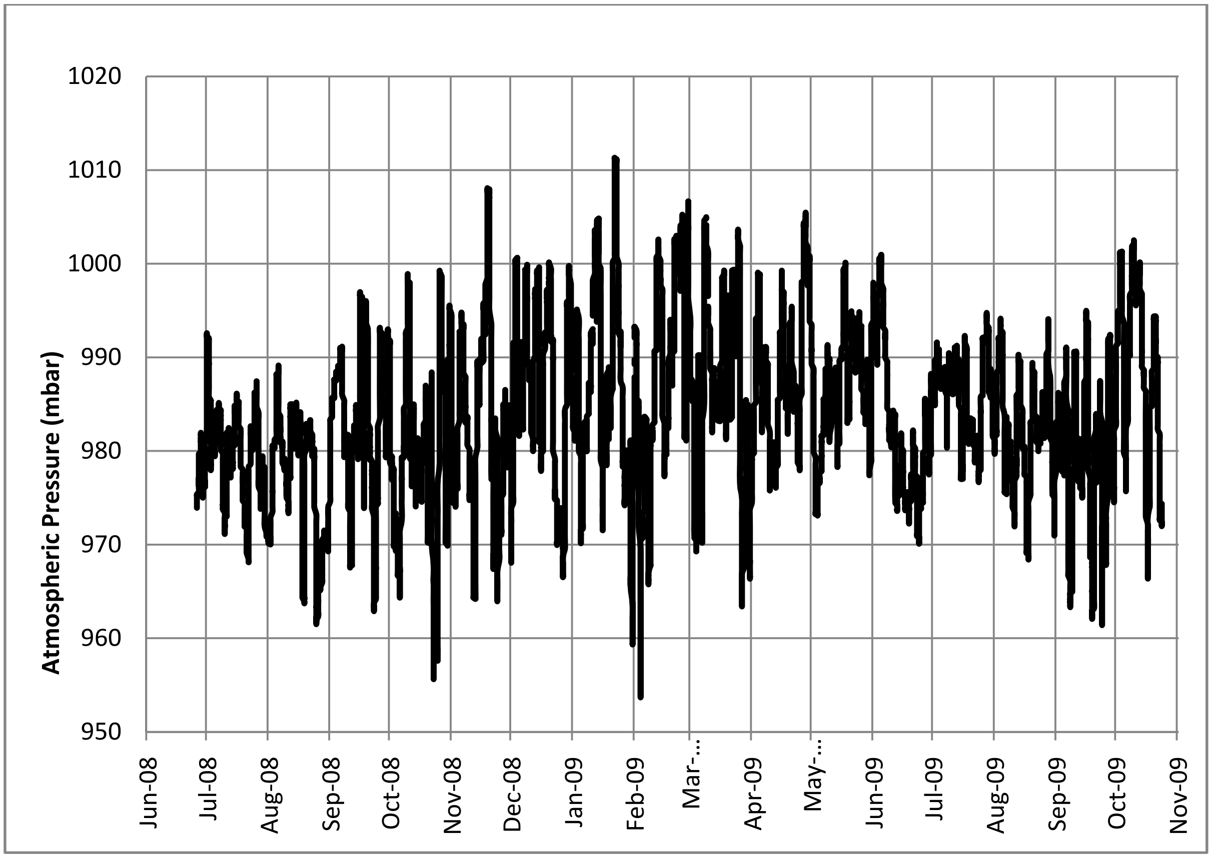
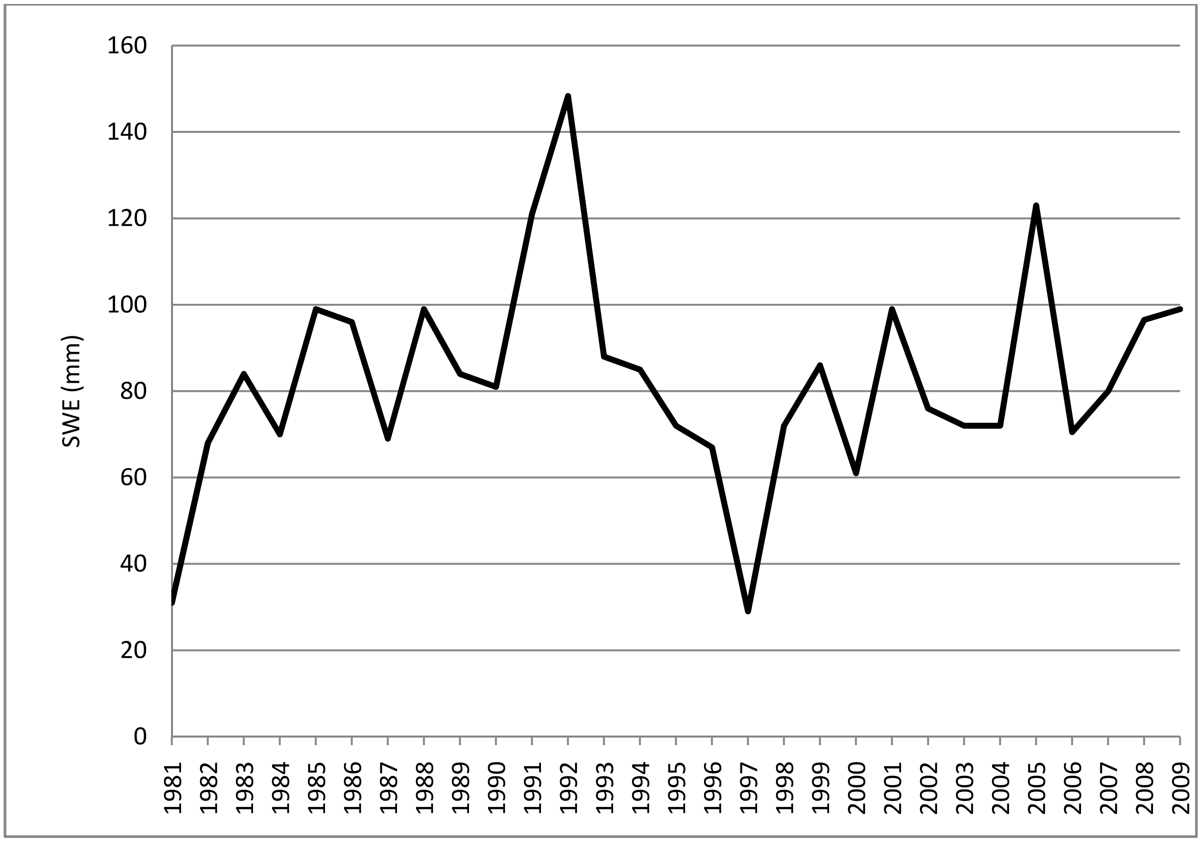


Figure 4-9: 1981 – 2009 Snow Water Equivalents at Tibbitt Lake



Data source: Environment Canada

Scale:	1:50,000
Date:	21/12/2009
Drawn By:	KS
Approved By:	

Avalon Rare Metals INC.

Thor Lake Drainage

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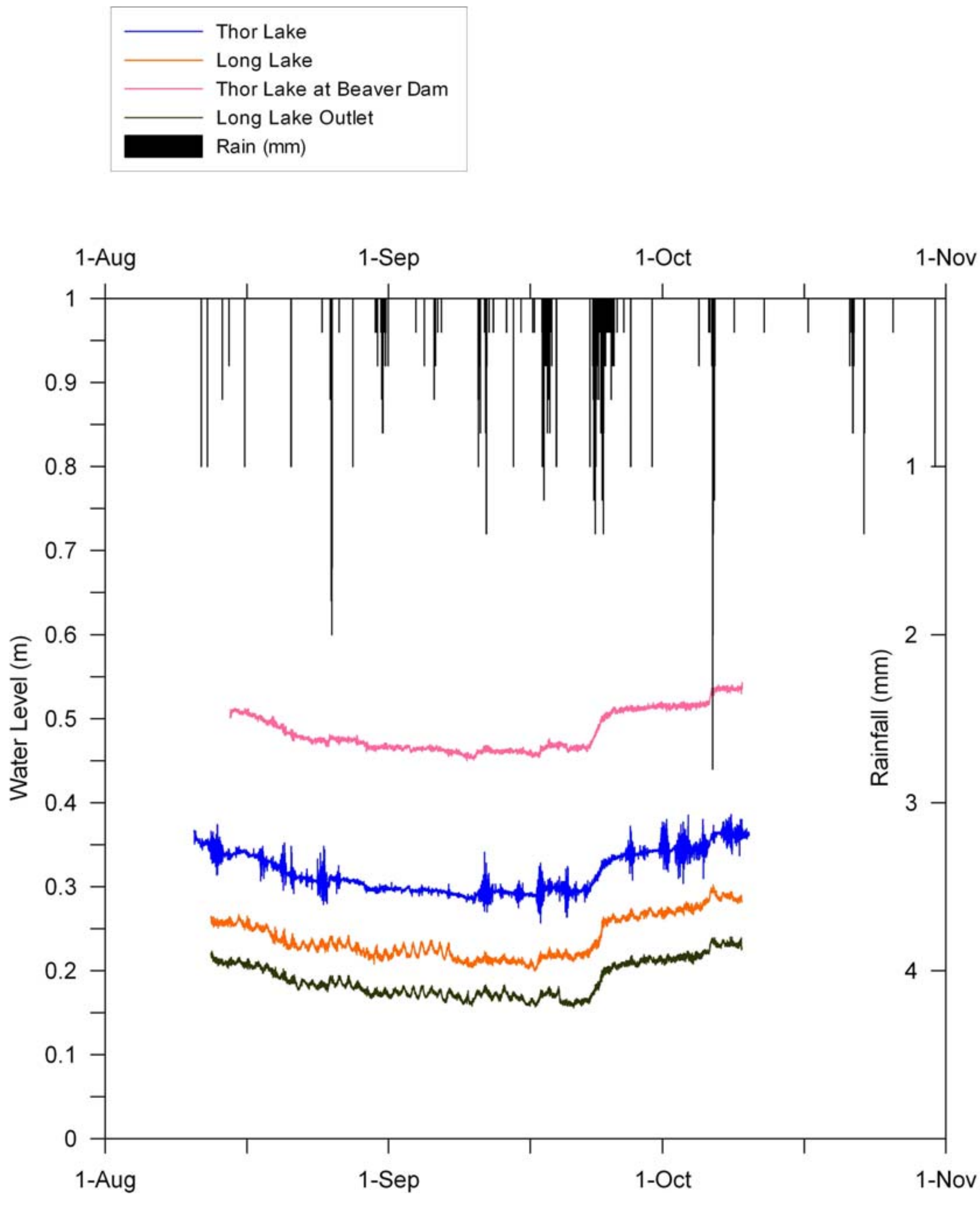
Thor Lake Project, Nechalacho Deposit

PREPARED BY Stantec

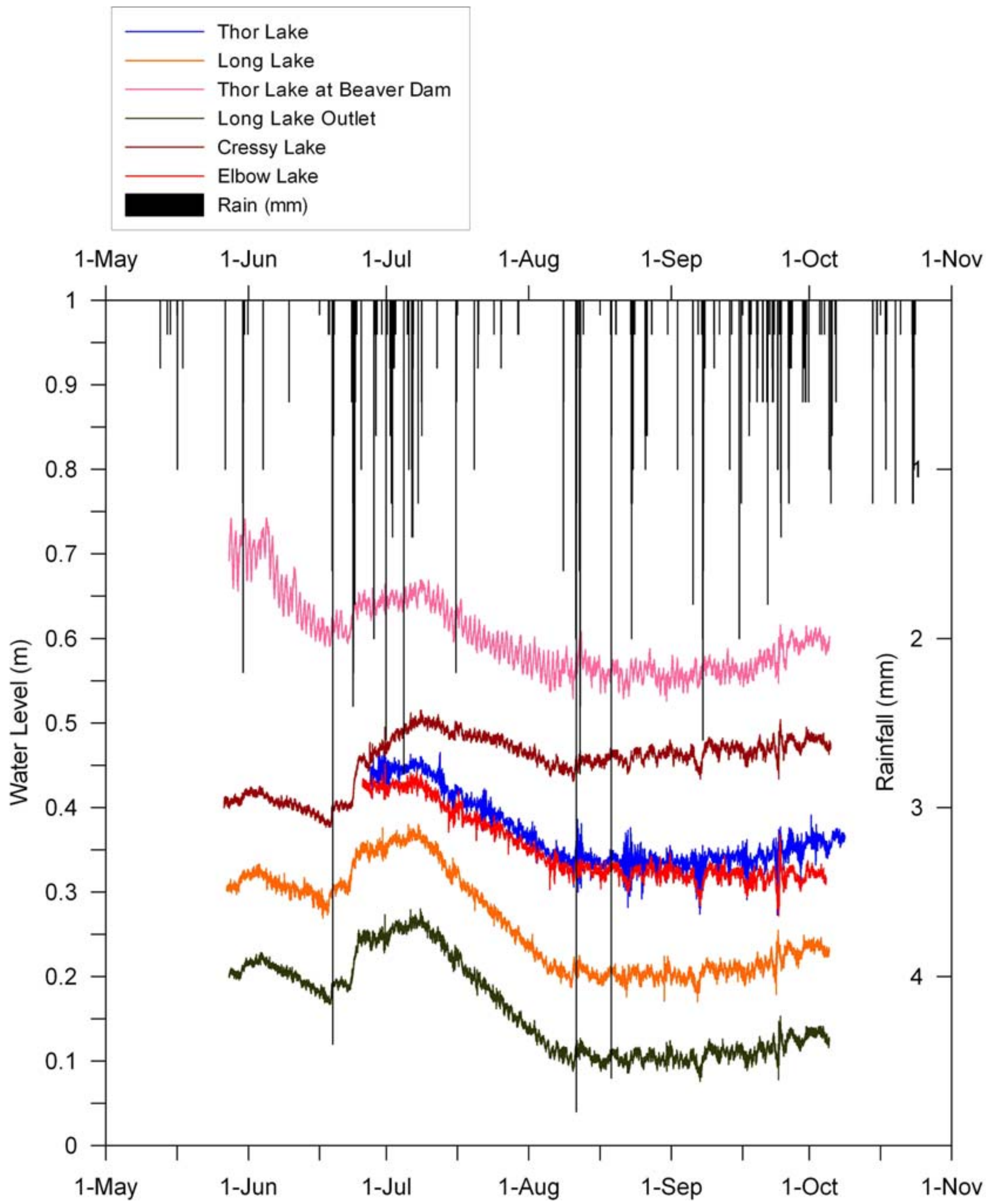
Figure: 5-1

Figure 4-11: 2008 Lake Water Levels and Rainfall



Lake level elevations are on a relative datum and do not reflect absolute water level differences between the lakes.

Figure 4-12: 2009 Lake Water Levels and Rainfall



Lake level elevations are on a relative datum and do not reflect absolute water level differences between the lakes.

Figure 4-13: 2008 Stream Flow and Rainfall

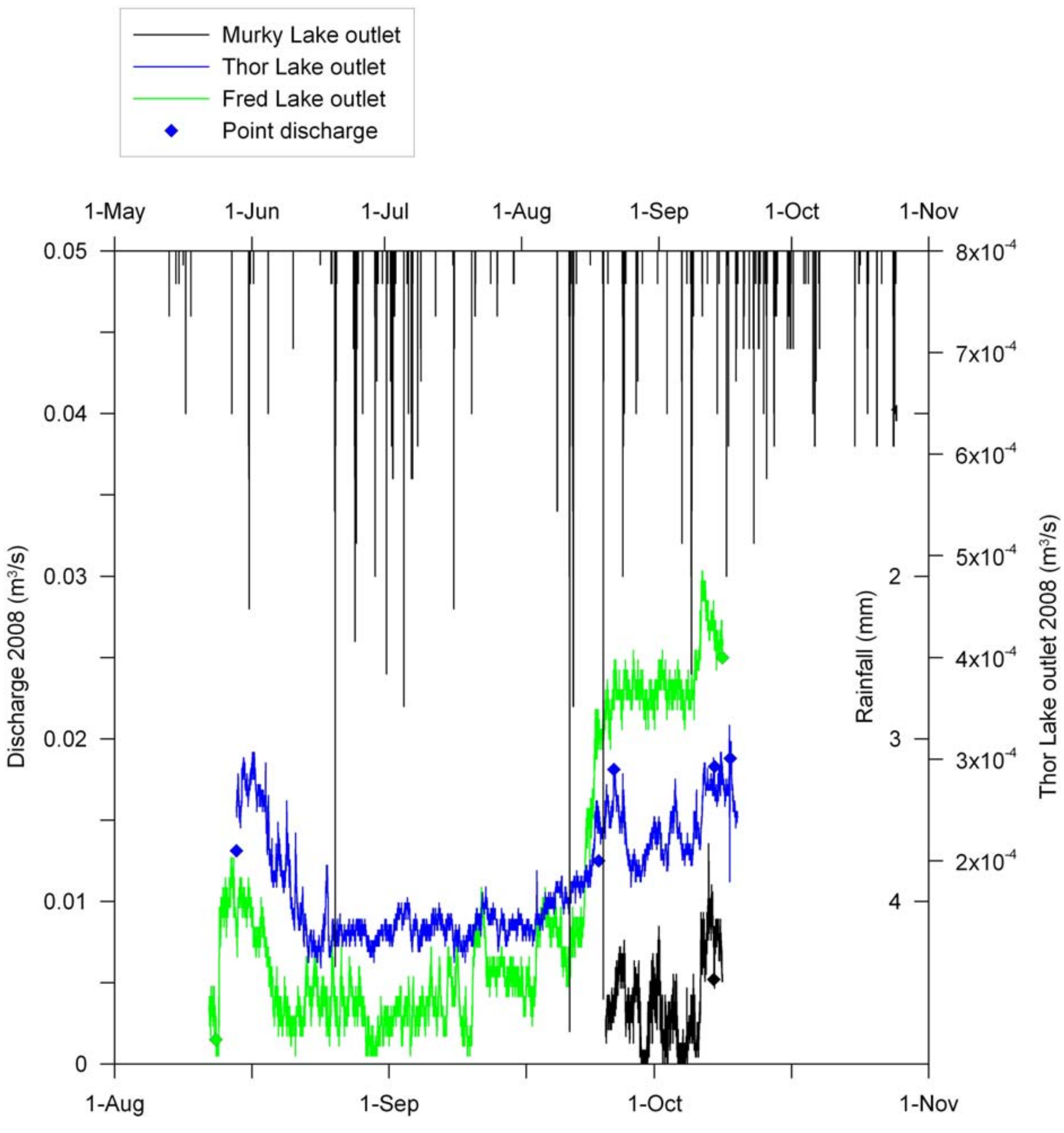
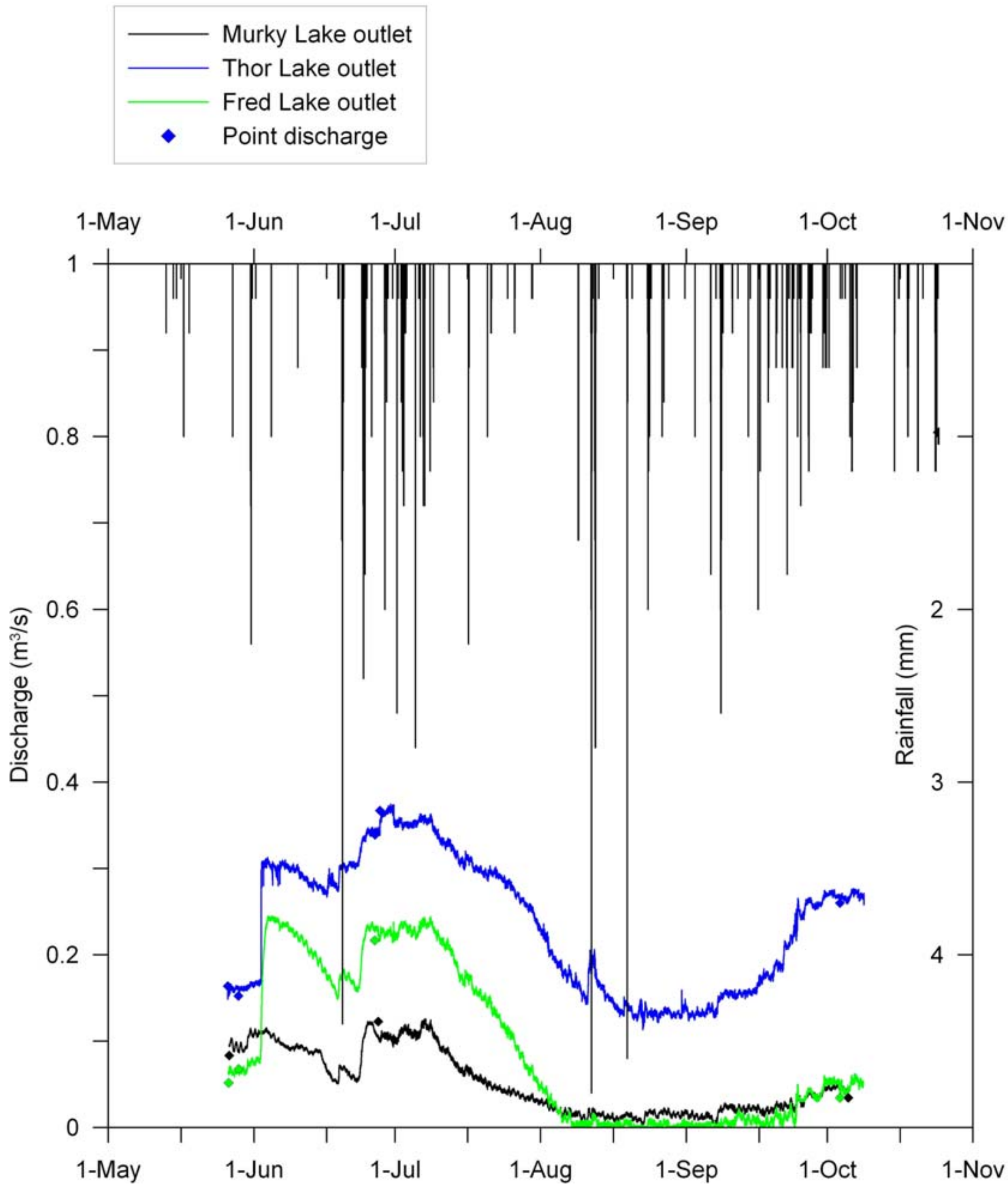


Figure 4-14: 2009 Stream Flow and Rainfall



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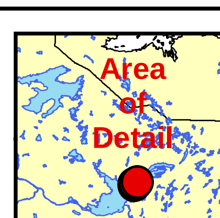
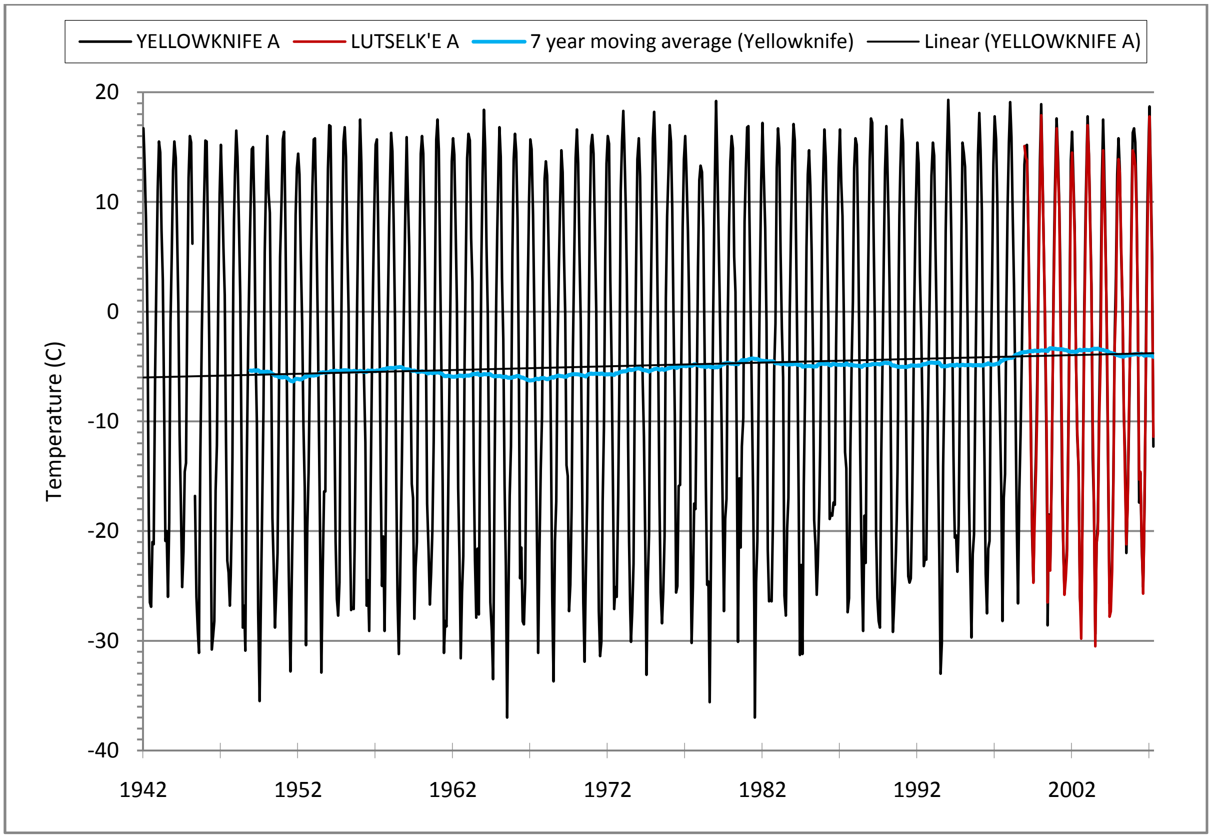
Regional Climate Stations



AVALON RARE METALS INC.

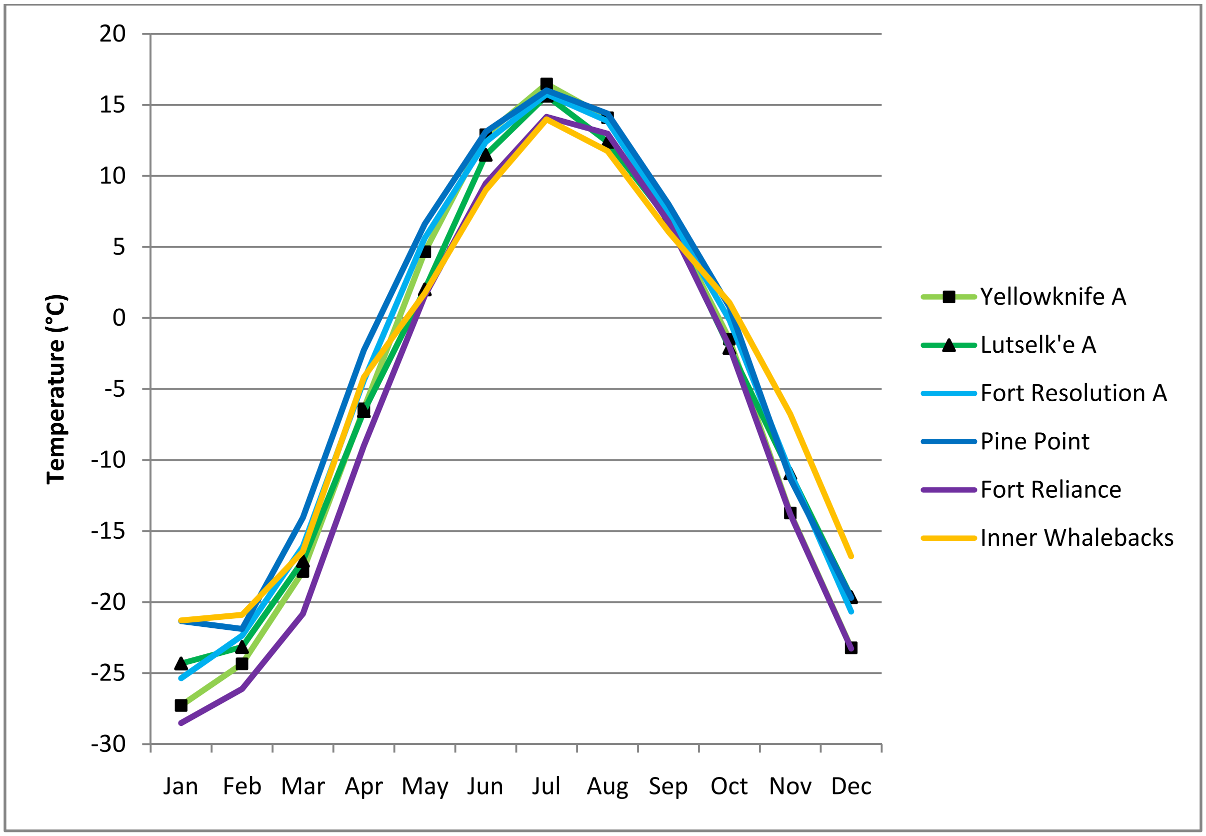
PREPARED BY: Stantec			
DRAFT DATE 18/12/2009		SCALE 1:2,000,000	
REVISION DATE		PROJECT 1036222	FIGURE NO. 5-1
DRAWN RH	CHECKED JT	APPROVED NL	VOL

Figure 5-2: Temperature Trends at Regional Climate Stations



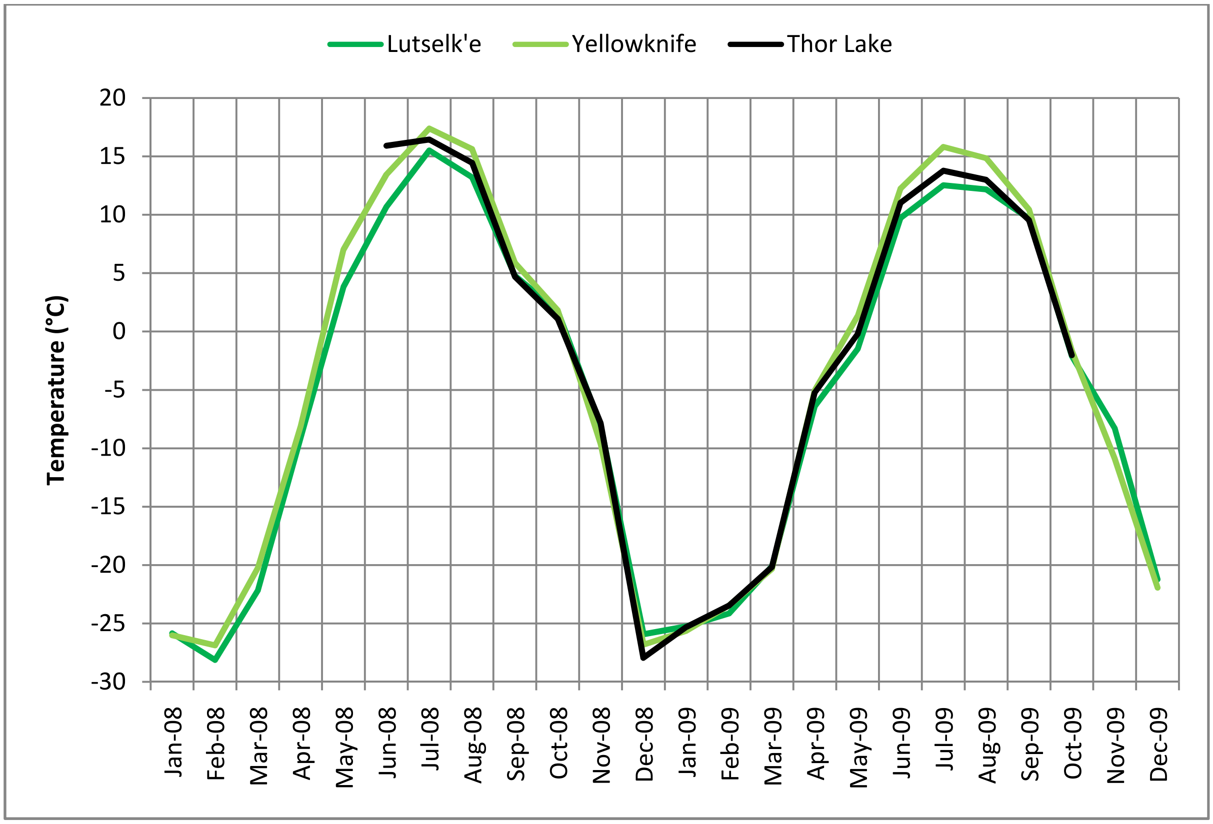
NOTES:
Data acquired from Environment Canada

Figure 5-3: Regional Mean Monthly Temperatures



NOTES:
Data acquired from Environment Canada

Figure 5-4: 2007 – 2009 Mean Monthly Temperature Data



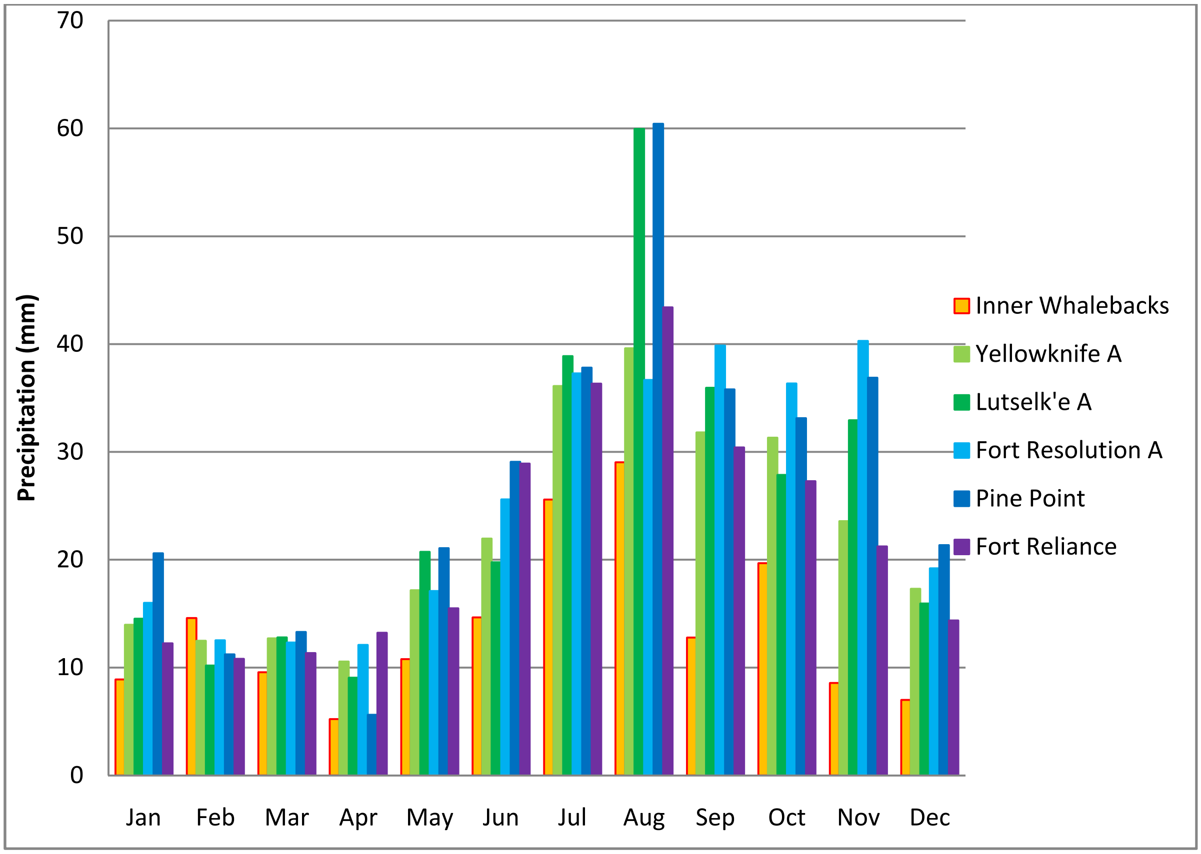
NOTES:

Regional data acquired from Environment Canada

Yellowknife to Thor Lake temperature coefficient of correlation = .99; y = 0.9762x-0.509

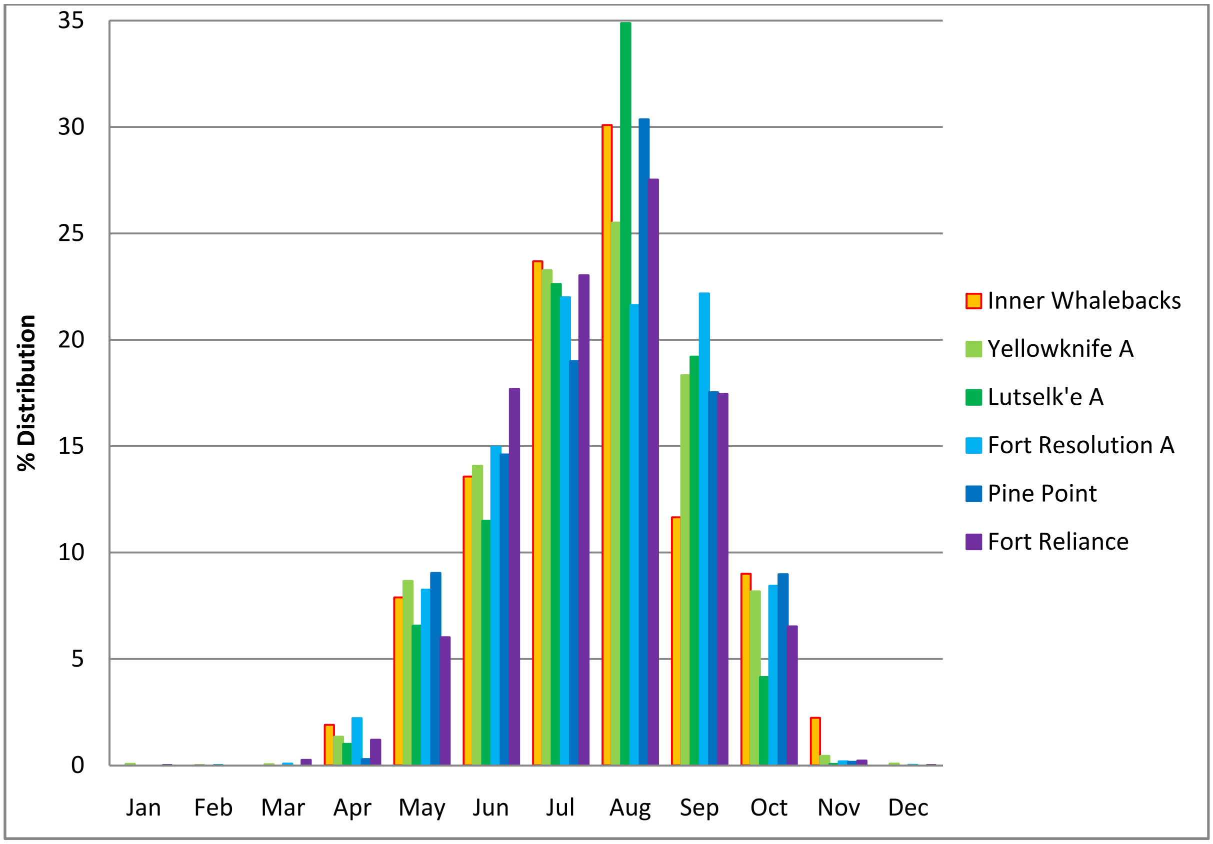
Lutselk'e to Thor Lake temperature coefficient of correlation = .99; y = 1.0482x+0.7266

Figure 5-5: Regional Mean Monthly Precipitation



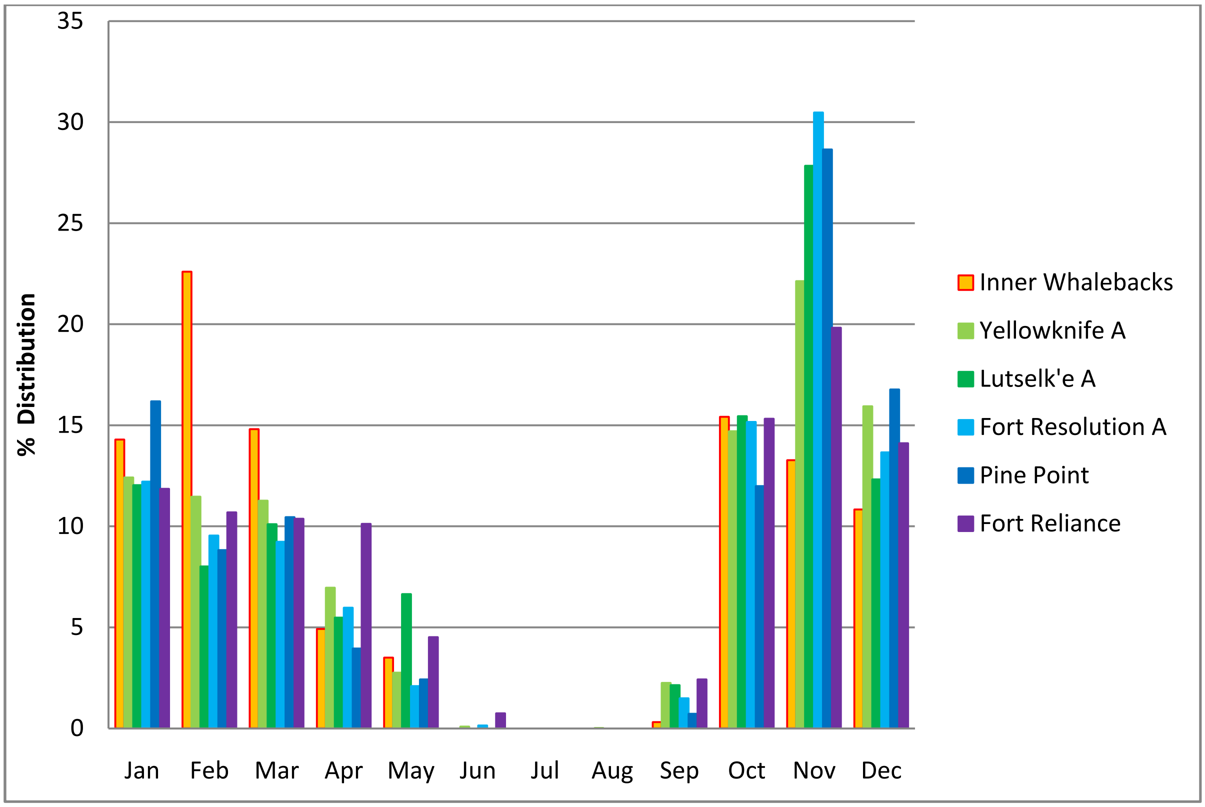
NOTES:
Regional data acquired from Environment Canada

Figure 5-6: Regional Monthly Rainfall Distribution



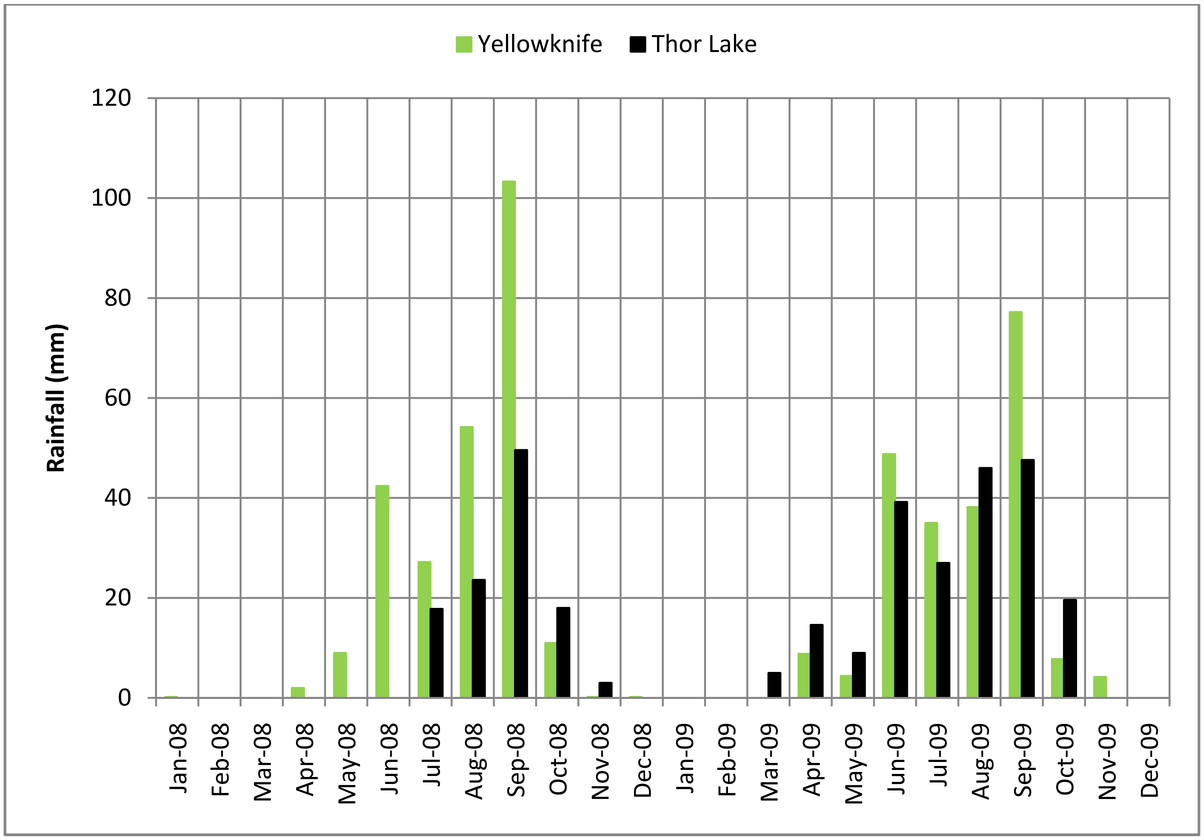
NOTES:
Regional data acquired from Environment Canada

Figure 5-7: Regional Monthly Snowfall Distribution



NOTES:
Regional data acquired from Environment Canada

Figure 5-8: 2007 – 2009 Rainfall Data



NOTES:

Regional data acquired from Environment Canada

Yellowknife to Thor Lake rainfall coefficient of correlation = .79; y = 0.4973x+7.061

APPENDIX A

Tables

Table 3-1: Study Area Stream Gauge Sites

Drainage Basin	Basin Area (km^2)	Sample Site	Sampling Periods
Thor Lake	16.55	Thor Lake Level	8/10/08 – 10/10/08 6/27/09 – 10/8/09
		Beaver Dam at Thor Lake	8/14/08 – 10/9/08 5/27/09 – 10/5/09
		Murky Lake outlet	9/25/08 – 10/8/08 5/24/09 – 10/5/09
Long Lake	nm	Long Lake Level	8/12/08 – 10/9/08 5/27/09 – 10/5/09
		Long Lake outlet	8/12/08 – 10/9/08 5/27/09 – 10/5/09
Fred Lake	nm	Thor Lake outlet	8/14/08 – 10/10/08 5/26/09 – 10/8/09
		Fred Lake outlet	8/11/08 – 10/8/08 5/26/09 – 10/8/09
Elbow Lake	8.63	Elbow Lake Level	6/25/09 – 10/4/09
Cressy Lake	nm	Cressy Lake Level	5/26/09 – 10/5/09

NOTE:
nm = no measurement

Table 4-1: 2008 – 2009 Study Area Mean Monthly Temperature

	Month												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2008													
Mean (°C)	–	–	–	–	–	15.9*	16.4	14.5	4.7	1.1	-7.9	-27.9^	0.5^
Maximum (°C)	–	–	–	–	–	26.1*	27.6	30.4	13.1	16.9	0.8	-7.4	30.4
Minimum (°C)	–	–	–	–	–	7.2*	5.3	-1.4	-6.8	-12.8	-24.3	-40.1^	-40.1^
2009													
Mean (°C)	-25.3^	-23.5^	-20.2^	-5.2	-0.2	11.0	13.8	13.0	9.5	- 2.0*	–	–	-2.7^
Maximum (°C)	-0.6	-5.6	4.5	10.1	12.0	23.7	25.2	23.6	22.5	6.3*	–	–	25.2
Minimum (°C)	-40.1^	-40.1^	-40.1^	-27.3	-13.6	-3.7	-0.5	1.7	-0.6	- 13.4*	–	–	-40.1^

NOTES:
Data collection from June 26 2008 to October 22 2009
– = no available data
All values in degrees celcius
* partial month
^ temperatures likely were lower but not recorded because probe minimum recordable temperature is -40C

Table 4-2: 2008 – 2009 Study Area Monthly Rainfall

	Month												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2008	–	–	–	–	–	2.4*	17.8	23.6	49.6	18.0	3.0	0.0	112.0
2009	0.0	0.0	5.0	14.6	9.0	39.2	27.0	46.0	47.6	19.6*	–	–	188.4

NOTES:
Data collection from June 26 2008 to October 22 2009
– = no available data
All values are in millimeters
* partial month

Table 4-3: 2008-2009 Study Area Mean Monthly Wind Speed and Gust Speed

	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008												
Wind Speed (m/s)	–	–	–	–	–	2.3*	1.9	1.9	1.6	1.9	1.7	0.5
Gust Speed (m/s)	–	–	–	–	–	4.6*	4.0	3.9	3.4	3.9	3.5	1.1
2009												
Wind Speed (m/s)	1.1	1.4	2.0	1.8	2.0	2.0	1.5	1.6	1.7	1.6*	–	–
Gust Speed (m/s)	2.4	2.7	3.9	3.7	4.1	4.2	3.2	3.5	3.5	3.4*	–	–

NOTES:
Data collection from June 26 2008 to October 22 2009
= no available data
* partial month

Table 4-4: 2008 – 2009 Study Area Evaporation Estimates

	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008												
Evaporation [a]	–	–	–	–	–	11.4*	73.6	67.2	33.1	21.4	0.0	0.0
Evapotranspiration[b]	–	–	–	–	–	25.0*	20.0	24.0	36.0	8.0	0.0	0.0
2009												
Evaporation [a]	0.0	0.0	0.0	7.7	17.1	51.6	62.6	59.4	46.9	6.8*	–	–
Evapotranspiration[b]	0.0	0.0	0.0	0.0	0.0	83.0	30.0	47.0	48.0	0.0*	–	–

NOTES:
[a] - Hamon Model
b - Thornthwaite Model
– no available data
* partial month
Data collection from June 26 2008 to October 22 2009

Table 4-5: 2008 – 2009 Study Area Mean Monthly Relative Humidity

	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2008												
Relative Humidity	–	–	–	–	–	65.6*	61.0	71.9	81.8	83.2	90.9	77.4
2009												
Relative Humidity	77.1	75.7	67.5	68.2	60.3	63.0	67.7	73.4	82.4	82.8*	–	–

NOTES:
Data collection from June 26 2008 to October 22 2009
* partial month

Table 4-6: 2009 Study Area Snow Course Summary

Snow Course	SC1	SC2	SC3	SC4	SC5	SC6	Site Mean
Depth (cm)	31.3	64.8	58.5	66.6	61.4	59.5	57.0
Density (kg/m³)	245.1	168.6	177.5	173.0	155.3	189.3	184.8
SWE (mm)	78.7	109.1	103.0	115.1	85.2	72.5	93.9

NOTES:
cm – centimeter
kg/m³ – kilogram per cubic meter
SWE – snow water equivalent
mm – millimeter
SC1 – Thor Lake transect
SC2 – South of Thor Lake
SC3 – Ridge
SC4 – East Thor
SC5 – Weather Station
SC6 – Long Lake Ridge

Table 4-7: Tibbitt Lake Historic Snow Survey Summary

	Depth (cm)	Density (kg/m³)	SWE (mm)
1981	20	155.0	31
1982	40	170.0	68
1983	51	164.7	84
1984	35	200.0	70
1985	52	190.4	99
1986	59	162.7	96
1987	41	168.3	69
1988	50	198.0	99
1989	43	195.3	84
1990	50	162.0	81
1991	62	195.2	121
1992	65	229.0	148
1993	38	231.6	88
1994	50	170.0	85
1995	52	138.5	72
1996	30	223.3	67
1997	31	93.5	29
1998	38	189.5	72
1999	38	226.3	86
2000	28	217.9	61
2001	63	157.1	99
2002	47	161.7	76
2003	44	163.6	72
2004	37	194.6	72
2005	62	199.0	123
2006	48	145.5	71
2007	55	144.9	80
2008	57	169.3	97
2009	50	196.4	99
Mean	46.1	179.8	82.7

NOTES:
Data values represent mean annual snowpack trends measured at the end of March
Tibbitt Lake snow data from Department of Indian and Northern Affairs, Water Resources Division, 2009
cm - centimeter
kg/m³ - kilogram per cubic meter
SWE - snow water equivalent
mm - millimeter