Note that the 1:2 year values for Rankin Inlet A (e.g., 183.0 mm for rainfall) represent statistical median values, and are not the same as the arithmetic means (e.g., 183.3 mm for rainfall) that were reported in Table 4-4.

It is also noted that the sum of rainfall and snowfall depths for a particular return period does not equal the precipitation amount as these values are independent (e.g., the 10 year wet rainfall and the 10 year dry snowfall event could occur in the same year, resulting in something close to the mean annual precipitation).

Because of the short data series, there is a low degree of confidence in derived values with return periods of 100 years and greater. Based on the hydrological year, annual rainfall depths at Rankin Inlet A for the hydrological period of 1982 to 2009 ranged from a low of 95.8 mm in 1997 to a high of 260.2 mm in 1990. Annual snowfall depth ranged from a low of 76.2 cm in 1997 to a high of 304.4 cm in 2005, and annual precipitation depth ranged from a low of 167.5 mm in 1997 to a high of 461.8 mm in 2005.

Short Duration Rainfall Events

Derivation of rainfall intensity-duration-frequency (IDF) curves for short durations ranging from 5 minutes to 24 hours requires a rainfall record in 5-minute intervals. The climate station at Churchill, Manitoba (MSC Station Number 5060600) is the closest long-term station that records this type of data and for which Environment Canada has derived IDF statistics. Churchill is located in northern Manitoba, on Hudson Bay, approximately 480 km south of the Project area. While the climate station is located on Hudson Bay, Environment Canada reports annual precipitation normals of 432 mm for years 1971 to 2000 (Environment Canada 2004). Mean annual precipitation in the Project area was estimated to be 305.5 mm (Section 4.1.3.1), suggesting that the reported short duration rainfall events may overestimate the conditions of the Project area. Thus, these values are likely conservative if used for stormwater management design purposes.

No adjustments were made for undercatch, because undercatch is generally not significant for extreme rainfall events on a daily time scale. IDF statistics are presented in Table 4-7.

Table 4-7: Short Duration Rainfall Intensities in Millimetres per Hour at Churchill, Manitoba

Duration	Return Period (years)					
	2	5	10	25	50	100
5 min	38.4	57.6	70.8	86.4	98.4	110.4
10 min	26.4	39.6	48.6	60.0	68.4	76.8
15 min	21.6	32.4	39.6	49.2	56.0	62.8
30 min	14.4	21.2	25.8	31.6	36.0	40.2
1 h	9.8	14.5	17.6	21.6	24.5	27.4
2 h	6.6	9.0	10.7	12.7	14.3	15.8
6 h	3.4	4.6	5.3	6.3	7.1	7.8
12 h	2.1	2.8	3.2	3.8	4.2	4.7
24 h	1.2	1.6	1.9	2.2	2.4	2.6

Note: h= hours
min= minutes

4.1.4 Evaporation

4.1.4.1 Local Data

Evaporation of water from lakes, ponds, and other open water surfaces is one of the primary mechanisms for moisture loss from a watershed. Evaporation is influenced by air and water temperatures, solar radiation, relative humidity, and wind combined.

Evaporation from waterbodies is difficult to measure directly. It is typically estimated by using local evaporation pan measurements and applying a coefficient (the “pan” coefficient), or by using energy budget relationships and computations based on the net energy input to the evaporation process.

Evaporation pan data were collected at the Project site using a Class A evaporation pan, during the open water season of 1997, 1998, 1999, and 2000 (AEE 1998a, 1998b, 1999; AMEC 2000). The Class A evaporation pan is recommended by the World Meteorological Organization and is used at many Environment Canada climate stations. Monthly gross evaporation values for 1997, 1998, 1999, and 2000 are presented in Table 4-8. Daily measurements are presented in Appendix A1.

Table 4-8: Previously Reported Meliadine West Camp Lake Evaporation Data (mm)

Year	Month*					Pan Coefficient
	Jun	Jul	Aug	Sep	Annual	
1997	46.9	142.1	97.3	41.3	328	0.70
1998	76.9	113.3	96.5	34.9	322	0.82
1999	81.3	109.8	89.8	44.6	326	0.82
2000	36.2	132.2	98.8	49.9	317	0.83
Mean	**60.4**	**124.4**	**95.6**	**42.7**	**323**	**0.79**

Note: *= gross lake evaporation calculated using AES method (Kohler et al. 1955)
mm= millimetres

It was estimated that evaporation only occurs in the months of June through September. The evaporation pan was usually in service from mid-June to the end of September. Typical adjustments were made to account for missing measurements as follows:

- the total for June was increased, at a linear rate from zero at the start of the month to the first recorded measurement;
- the total for September was decreased, declining at a linear rate to zero at the end of the month; and
- missing measurements due to data collection problems were estimated based on values for preceding and following days.

For the period of record 1997 to 2000, the observed mean annual lake evaporation value was 323 mm, with a peak of 124 mm for the month of July.

This lake evaporation value is larger than the regional values presented by Prowse and Ommanney (1990), who suggest a value slightly greater than 200 mm would be appropriate. However, monthly values for the months of

July, August, and September are similar to the 1971 to 2000 climate normals published for Churchill A, Manitoba (Environment Canada 2004) with a comparison highlighted in the following section. The Project is situated north of Churchill and lake evaporation typically decreases as latitude increases. For this reason, it is likely that the long-term mean value of lake evaporation for the Project area is less than the mean of the derived values for the period of 1997 to 2000 at the Project area.

4.1.4.2 Regional Data

Regional pan and lake evaporation data are scarce for northern Canada. Lake evaporation normals were available regionally at the MSC Churchill A climate station and are presented in Table 4-9, with Project values for the period 1997 to 2000 provided for comparison. Normals refer to averages based on observed values for a given location over a specific period of time (Environment Canada 2004). The Churchill A mean annual lake evaporation value is 268 mm, with a peak of 121 mm in July, based on the most recent normal period of 1971 to 2000.

Table 4-9: Regional Lake Evaporation Data at Churchill A

Station	Lake Evaporation (mm/d)			Evaporation: Derived Quantities (mm)			
	July	August	September	July	August	September	Annual
Churchill A (MSC)*	3.9	3.0	1.8	121	93	54	268
Meliadine West 1997-2000	4.0	3.1	1.4	124	96	43	263

Note: *= climate normals for 1971-2000 reported by Environment Canada (2004)
mm/d= millimetres per day, mm= millimetres

Note that no value of daily evaporation is reported for the month of June, and the estimated mean lake evaporation for the period 1997 to 2000 at the Project was 2.0 mm/d. Adopting this value for the Churchill A station would result in a mean annual lake evaporation value of 328 mm, comparable to that measured at the Project area.

4.1.5 Evapotranspiration

Evapotranspiration is defined as the moisture loss from land surfaces. It is the combination of evaporation of moisture from the soil surface plus transpiration of moisture from vegetation.

Values of evapotranspiration estimated by previous studies were 33.8 mm (AEE 1998a), 37.8 mm (AEE 1998b), and 38.0 mm (AEE 1999). The 1997 value was calculated by using the GD relationship (Granger and Gray 1989) and applying a coefficient to account for factors limiting available moisture. These factors included land areas with sparse or non-existent vegetation, vegetation that does not transpire or does so at lower rates than the reference vegetation for the GD relationship, and dry soil conditions after snowmelt. Estimates in 2008 and 2009 are not available due to the timing of initiation of the monitoring programs resulting in incomplete hydrographs.

4.1.6 Sublimation and Snow Redistribution

The quantity of spring snow melt water depends on the quantity of snow accumulated, redistributed, and sublimated over the preceding winter. Sublimation is the direct conversion of ice or snow to water vapour. Sublimation can occur directly from static snowpack or during blowing snow events, and rates of sublimation depend on humidity and wind speed (Essery et al. 1999; Déry and Yau 2002). Snow can also be redistributed by wind and gravity.

Snow sublimation and redistribution can have a large effect on the amount of snow available for melt in the spring. In dry areas located above the treeline, wind redistribution and sublimation during blowing snow events can have a large effect on snow depths (Marsh et al. 1994; Pomeroy et al. 1997). The assessment of these 2 processes in the Project area is based on the snowfall amounts discussed in Section 4.1.3.3 and on snow survey observations, discussed below.

Estimating snow sublimation and redistribution losses directly is difficult and requires extensive local data. Spring snow course survey results can be used to estimate sublimation for 2009 by comparing the pre-melt snow water equivalent with the estimated accumulated precipitation corrected for undercatch. It is assumed that all precipitation from October through May is accumulated on or in the snowpack, because snow as well as rain would be captured by the snowpack already on the ground. The calculation by this method is summarized in Table 4-10.

Table 4-10: Sublimation Losses, 2009

Parameters	Gross Value	Undercatch Correction Factor	Corrected Value
Snowfall (1 Oct 2008 – 31 May 2009)	101.9[a] cm	1.50	152.9 cm
Rainfall (1 Oct 2008 – 31 May 2009)	6.0[b] mm	1.13	6.8 mm
Total Precipitation (1 Oct 2008 – 31 May 2009)	107.9 mm	1.48[c]	159.6 mm
Weighted SWE (2009 Snow Survey)			76.6 mm
Sublimation Losses (Total Precipitation – Weighted SWE)			83.0 mm

Note: [a]= from Table 4-4
[b]= from Table 4-5
[c]= weighted value for the winter period of 2008 to 2009
cm= centimetres, mm= millimetres

Sublimation losses in 2009 are estimated to be 83 mm, or 52% of the undercatch-adjusted accumulated precipitation for the period October 2008 to May 2009.

Using a similar approach, the sublimation for the 1998 hydrological year was 113.0 mm, or 46% of the accumulated amount (AEE 1999). This loss was greater in 1999 and 2008 than 1998, possibly due to higher wind peak speeds. Sublimation losses reported by AEE for 1997 were based on a literature review citing that "losses of 20 percent to 30 percent of the total snow water equivalent of the winter snowfall have been estimated for Arctic tundra areas" (Pomeroy et al. 1997) and appear to be lower than losses estimated for other years. Sublimation values estimated for the 2009 field program as well as previous programs are reported in Table 4-11. Excluding 1997, mean annual loss of snowpack to sublimation and snow redistribution is estimated to vary between 46 and 52% of total precipitation for the winter period.

Table 4-11: Estimated Sublimation and Snow Redistribution Losses at the Project Area

Losses	1997[a]	1998[a]	1999[a]	2008[b]	2009
Derived	27 mm	113 mm	> 113 mm	91 mm	83 mm
% of Total Precipitation[c]	20 %	46 %	> 46 %	46 %	52 %

Note: a= AEE (1998a, 1998b, 1999)
b= Golder (2008)
c= Perriod of October to May
%= percent, mm= millimetres

The Project site is located in a primarily open area, surrounded by a large waterbody (i.e., Meliadine Lake). According to Essery et al. (1999), losses to sublimation for open tundra can reach up to 47% of the snow pack, and losses to snow redistribution can account for an additional 18 to 22% for lakes and open tundra. The range of average loss to snow redistribution and sublimation estimated at the Project site is within this reported range.

Sublimation losses from the spring snowpack prior to and during the melt process are estimated to be small relative to those occurring over the winter. Arctic water balance studies (Marsh and Woo 1979; Marsh et al. 1994) generally do not correct for this. Losses due to snow redistribution and sublimation depend on local geography and meteorological conditions, and therefore the range of loss estimated for the Project site should apply only to local watersheds within the immediate Project area.

4.1.7 Wind Speed and Direction

At the Rankin Inlet A climate station, MSC provides hourly mean data for wind speed and wind direction (Environment Canada 2009), and daily maximum wind gust data if the maximum gust speed exceeds 29 km/h. Wind data were analyzed for mean hourly wind speed and direction values, and a brief assessment is presented below for the period of 1981 to 2008. Data from 2009 were not available for the whole year at the time of reporting and were not included in the analysis.

At the Rankin Inlet A climate station, the recorded prevailing winds are from north-northwest and north. The wind frequency rose presented in Figure 4-5 shows that the wind blows from the two prevailing directions more than 30% of the time. The calm frequency, defined as less than 1.0 m/s, is 2.79% of the time. The least frequent wind direction is west-southwest with a frequency of 2.09%. The mean values for wind speed show that the north-northwest together with north and northwest winds have the highest speeds and tend to be the strongest. The values for wind speed frequency are presented in Table 4-12.

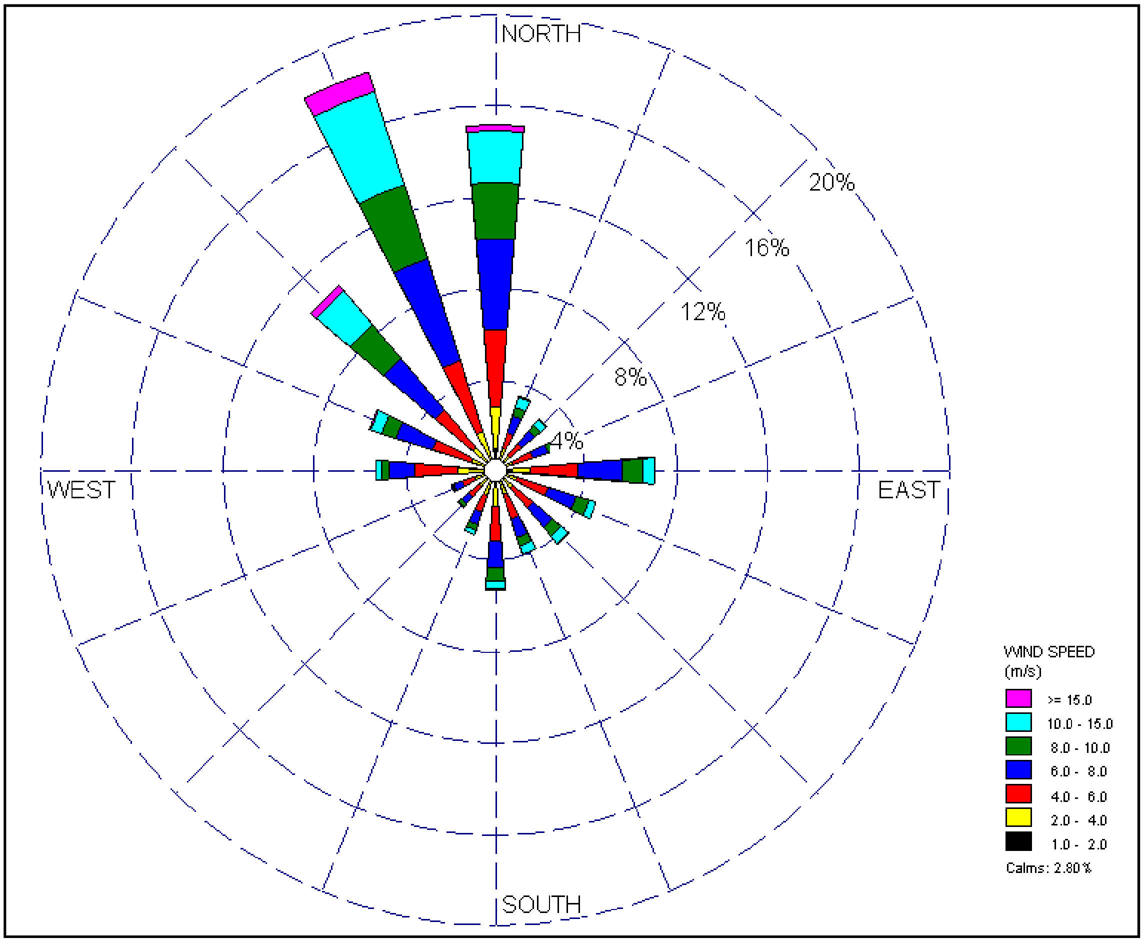


Figure 4-5: Rankin Inlet A Mean Wind Speed and Direction - Frequency Rose

Table 4-12: Rankin Inlet A Wind Rose Speed and Direction Frequencies, 1981 to 2008

Direction		Wind Classes (m/s)							
Cardinal or Intermediate	**Sector Midpoint (°)**	**1.0 - 2.0**	**2.0 - 4.0**	**4.0 - 6.0**	**6.0 - 8.0**	**8.0 - 10.0**	**10.0 - 15.0**	**>= 15.0**	**Total (%)**
N	0.0	0.99	1.81	3.40	3.96	2.45	2.25	0.28	15.12
NNE	22.5	0.48	0.56	0.72	0.75	0.43	0.44	0.07	3.45
NE	45.0	0.35	0.49	0.72	0.71	0.34	0.33	0.06	3.00
ENE	67.5	0.33	0.54	0.86	0.75	0.34	0.29	0.06	3.16
E	90.0	0.49	1.05	2.11	1.95	0.85	0.52	0.04	7.01
ESE	112.5	0.29	0.73	1.44	1.31	0.56	0.33	0.02	4.69
SE	135.0	0.32	0.69	1.21	1.12	0.47	0.43	0.02	4.26
SSE	157.5	0.35	0.77	1.17	0.82	0.40	0.35	0.02	3.88
S	180.0	0.58	1.04	1.47	1.18	0.57	0.38	0.02	5.25
SSW	202.5	0.43	0.73	0.78	0.59	0.28	0.18	0.01	3.00

Table 4-12: Rankin Inlet A Wind Rose Speed and Direction Frequencies, 1981 to 2008 (continued)

Direction		Wind Classes (m/s)							
Cardinal or Intermediate	Sector Midpoint (°)	1.0 - 2.0	2.0 - 4.0	4.0 - 6.0	6.0 - 8.0	8.0 - 10.0	10.0 - 15.0	>= 15.0	Total (%)
SW	225.0	0.39	0.59	0.59	0.38	0.16	0.09	0.01	2.21
WSW	247.5	0.36	0.61	0.61	0.33	0.10	0.06	0.00	2.09
W	270.0	0.54	1.18	1.87	1.09	0.33	0.24	0.02	5.27
WNW	292.5	0.33	0.78	1.79	1.69	0.67	0.51	0.09	5.86
NW	315.0	0.36	0.94	2.19	2.96	1.92	1.94	0.31	10.62
NNW	337.5	0.53	1.29	3.25	4.68	3.34	4.32	0.89	18.31
Sub-Total		7.13	13.81	24.20	24.27	13.22	12.65	1.92	96.86
Calms									2.79
Missing/Incomplete									0.35
Total									100.00

Note: °= degrees
m/s= metres per second

The wind class frequency distribution shows that the most frequent winds are the ones with velocities of 4.0 to 8.0 m/s, and they occur almost 50% of the time (Figure 4-6).

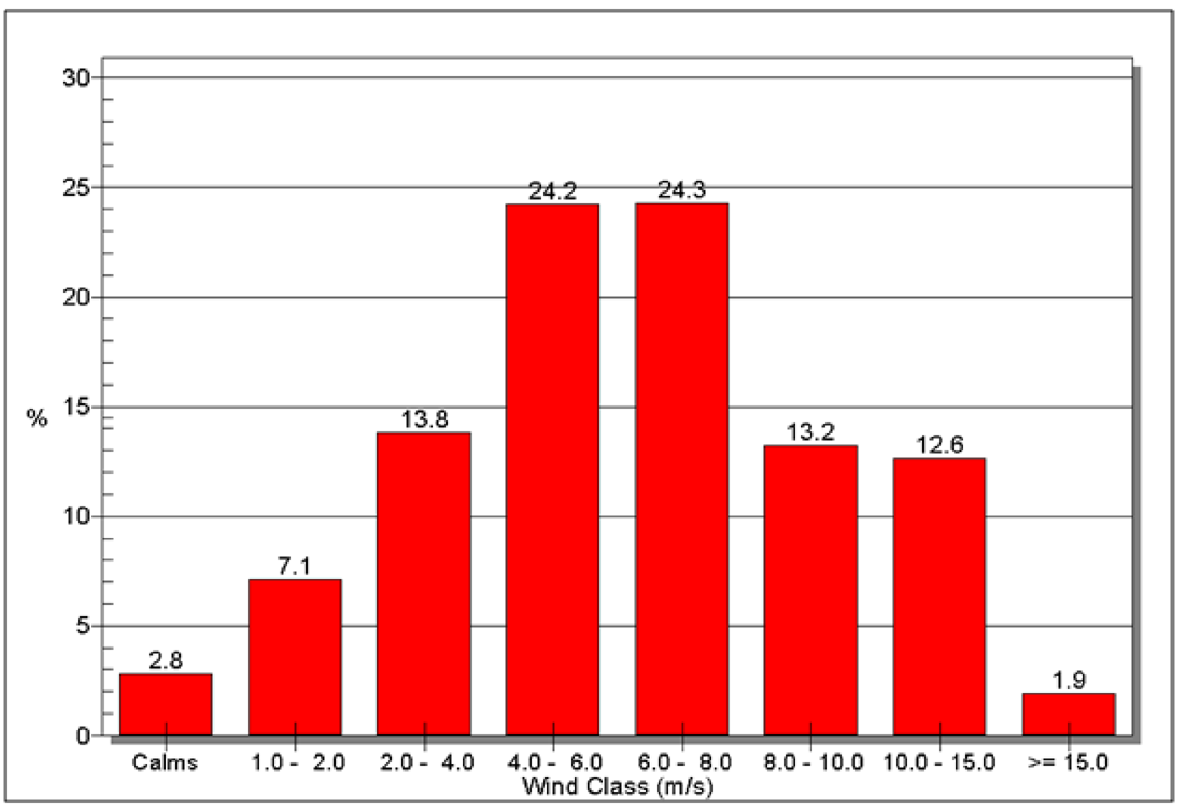


Figure 4-6: Rankin Inlet A Mean Wind Class Frequency Distribution

4.1.8 Relative Humidity and Solar Radiation

Table 4-13 provides a summary of the mean relative humidity values recorded at Rankin Inlet A climate station for the period of 1981 to 2008. Data for 2009 were not available for the whole year at the time of reporting and was not included in the analysis. Details of recorded data, summarized by month and year, are provided in Appendix A1.

Rankin Inlet A climate station is humid all year round, with peaks typically occurring during the months of May and October and lows during the winter in January and February.

Table 4-13: Mean Relative Humidity Recorded at Rankin Inlet A and Meliadine Camp

Month	Mean Monthly Relative Humidity [%]				
	Meliadine Camp				Rankin Inlet A
	1997	1998	1999	2000	1981 to 2008
January	Not recorded	70.8	78.3	Not recorded	66.6
February	Not recorded	78.4	83.9	Not recorded	67.0
March	Not recorded	77.9	84.3	Not recorded	70.2
April	88.5	88.5	91.2	Not recorded	78.9
May	85.7	91.4	93.1	Not recorded	86.1
June	80.1	85.6	84.8	86.8	80.8
July	74.2	81.3	81.2	78.2	77.2
August	81.0	89.5	85.7	85.5	81.2
September	Not recorded	94.2	89.3	89.6	84.0
October	93.5	94.5	Not recorded	Not recorded	86.7
November	89.6	95.4	Not recorded	Not recorded	77.9
December	84.4	83.6	Not recorded	Not recorded	70.2
Annual*	**84.6**	**85.9**	**85.8**	**85.0**	**77.3**

Note: *= based on recorded data
%= percent

The value of solar radiation is very much related with the length of the day in the north. The net solar radiation (the difference between the incoming solar radiation and the reflected radiation) data were collected at the climate station installed at Meliadine Camp and is reported for the years of 1997, 1999 and 2000, in Table 4-14.

Table 4-14: Mean Net Solar Radiation at Meliadine Camp, 1997, 1999, and 2000

Month	Monthly Mean Net Radiation ($MJ/m^2/d$)		
	1997	1999	2000
June	13.5	14.3	10.4
July	12.1	11.0	13.5
August	8.6	7.4	7.2
September	Not recorded	3.9	3.8

Note: $MJ/m^2/d$ = megajoules per square metre per day

4.2 Long-Term Local and Regional Hydrology

4.2.1 Field Monitoring Data

4.2.1.1 Introduction

Hydrometric data are available for main basins including the Meliadine and Diana basins and for Peninsula stations, including outlets of Lakes A1, A6, B2, B4, B5, B7, D5, and G2, and well as for Control Lake, Lake A54 and Lake A8. Additional hydrometric data are also available for Chickenhead Lake, Peter Lake, and the Char River. Rain gauge data are also available. These data were obtained from field programs in 1997, 1998, 1999, 2000, 2008, and 2009 (AEE 1998a, 1998b, 1999; AMEC 2000; Golder 2008). Data from 2009 are presented in Appendix A4. Basic information including available parameters, location, period of record, and alternate names of these stations is presented in Table 4-15 and Figure 4-7. The station locations are presented in UTM format in Zone 15V and refer to the most recent locations. Alternate names refer to previous naming conventions used in previous reports (AEE 1998a, 1998b, 1999; AMEC 2000).

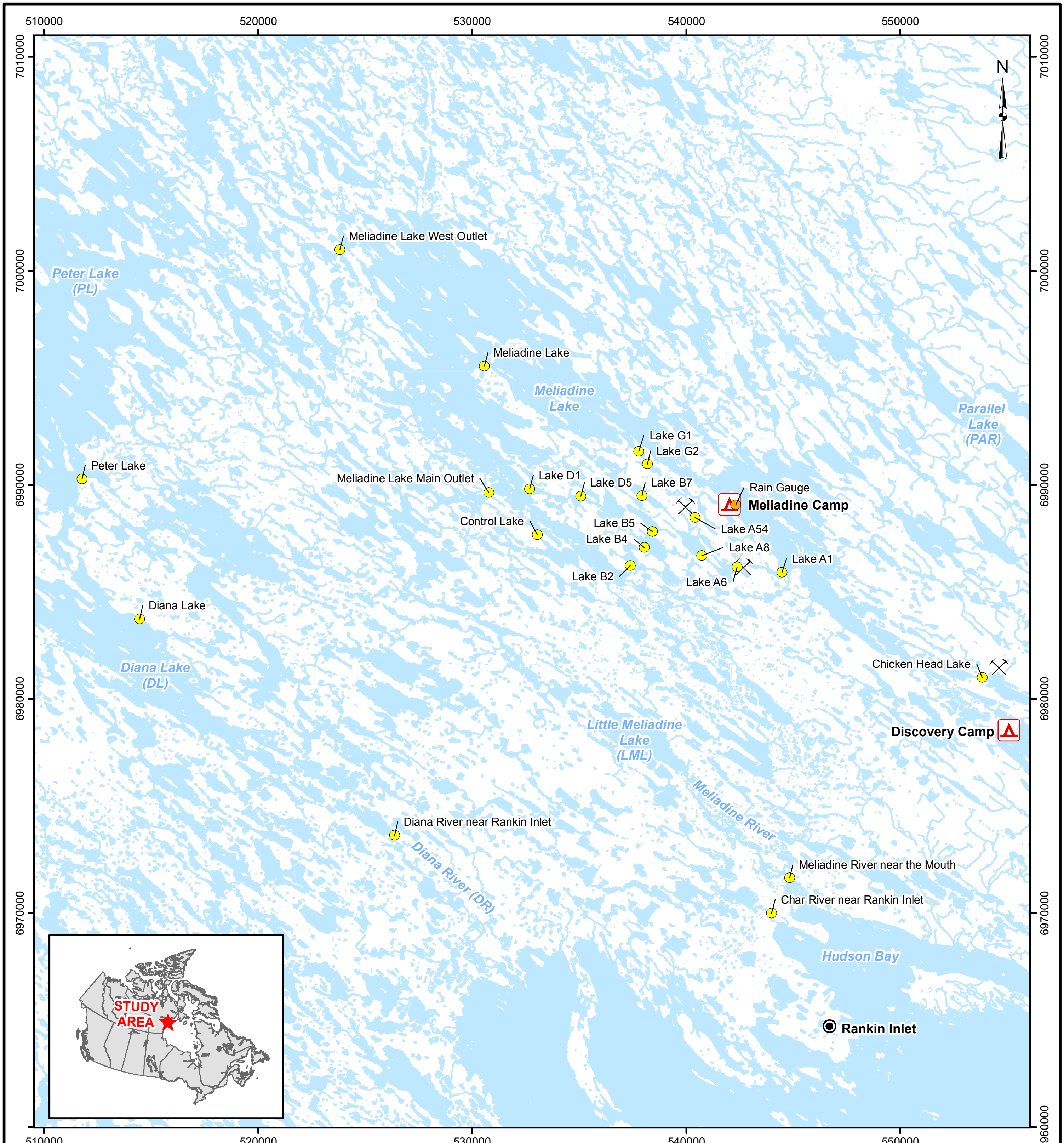
Table 4-15: Hydrometric and Rain Gauge Stations, 1997 to 2009

Hydrometric Station	UTM Zone 15 NAD 83		Period of Record	Parameters	Automated (Y/N)	Alternate Names
	Easting (m)	Northing (m)				
Meliadine Lake Main Outlet	530780	6989640	1997 to 2000 2008 to 2009	Q, WL	Y (1997 to 2000)	Meliadine River at Meliadine Lake Outlet
Meliadine Lake West Outlet	523818	7000994	1997 to 2000 2008 to 2009	Q, WL	Y (1997 to 2000)	West Outlet of Meliadine Lake
Meliadine River near the Mouth	544835	6971643	1997 to 2000 2008 to 2009	Q, WL	Y (1997 to 2000)	-
Meliadine Lake	530573	6995555	1997 to 2000 2008 to 2009	WL	Y	-
Diana River near Rankin Inlet	526374	6973649	1997 to 1999	Q, WL	Y	-
Diana Lake	514458	6983733	1997 to 1999	WL	N	-
Peter Lake	511770	6990277	1997 to 1999	WL	N	-
Char River near Rankin Inlet	544000	6970000	2000	Q, WL	N	-
Lake A1	544479	6985918	1997 to 2000 2008 to 2009	Q, WL	Y	Peg Creek
Lake A6	542374	6986171	1997 to 1998	Q, WL	Y	Peg Lake
Lake B2	537375	6986232	1998 to 2000 2008 to 2009	Q, WL	Y	Woodstock Lake
Lake B4	538050	6987087	1997 to1998	Q, WL	Y	Newy Lake
Lake B5	538430	6987824	1998	Q, WL	Y	Bud Lake
Lake B7	537935	6989488	1998 to 2000 2008 to 2009	Q, WL	Y	Woody Lake
Lake D1	532693	6989813	2009	Q, WL	Y	-
Lake D5	535088	6989471	1997 to 1998	Q, WL	Y	-
Lake G1	537797	6991573	2009	Q	N	-

Table 4-15: Hydrometric and Rain Gauge Stations, 1997 to 2009 (continued)

Hydrometric Station	UTM Zone 15 NAD 83		Period of Record	Parameters	Automated (Y/N)	Alternate Names
	Easting (m)	Northing (m)				
Lake G2	538189	6990970	2009	Q	N	-
Control Lake	533052	6987678	1997	Q, WL	Y	-
Chickenhead Lake	553835	6981017	2009	Q, WL	Y	-
Lake A54	540417	6988473	2008 to 2009	WL	N	-
Lake A8	540728	6986693	2009 to 2009	Q, WL	N	-
Rain Gauge	542310	6989078	1997 to 2000 2008 to 2009	R	Y	-

Note: Q = discharge
WL = water level
R = rainfall
m = metres
- = no alternate names



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LEGEND

- Camp
- Hydrometric Station
- Rain Gauge
- Proposed Mine Site
- Watercourse
- Waterbody

5 0 5

SCALE 1:250,000 KILOMETRES

REFERENCE

Base data obtained from Comaplex Minerals Corporation. Hydrometric data obtained from field survey.
Projection: UTM Zone 15 Datum: NAD 83

DRAFT

PROJECT

COMAPLEX MINERALS CORP

COMAPLEX MINERALS CORPORATION
MELIADINE GOLD PROJECT
NUNAVUT

TITLE

RAIN GAUGE AND HYDROMETRIC STATION LOCATIONS

Golder Associates
Edmonton, Alberta

PROJECT NO. 09-1373-0010			PHASE No. 5000	
DESIGN	JL	27 Oct. 2009	SCALE AS SHOWN	REV. 0
GIS	CDB	27 Oct. 2009	FIGURE 4-7	
CHECK	NPS	17 Nov. 2009		
REVIEW	GA	25 Nov. 2009		

4.2.1.2 Snow Course Survey

Table 4-16 provides a summary of all snow course surveys performed in the Project area. These data were obtained from field programs in 1997, 1998, 1999, 2000, 2008, and 2009 (AEE 1998a, 1998b, 1999; AMEC 2000; Golder 2008). Data from 2009 for the Meliadine Project area are presented in Appendix A4.

Table 4-16: Snow Water Equivalent (mm), 1997 to 2000 and 2008 to 2009

Basin	Year					
	1997	1998	1999*	2000	2008	2009
A1 Lake	135.0	109.0	133.5	181.5	108.3	75.8
A6 Lake	98.0	94.2	-	-	-	-
A37 Lake	-	-	-	167.0	-	-
D5 Lake	107.0	98.0	-	-	-	77.4
G2 Lake	121.0	-	-	-	-	-
B2 Lake	-	100.9	132.4	181.8	109.2	77.3
B4 Lake	-	98.4	-	-	-	-
B5 lake	-	94.7	-	-	-	-
B7 Lake	-	93.8	128.6	171.4	105.4	75.9

Note: mm = millimetres
* = estimated values
- = no available data

4.2.1.3 Flow Regimes

This section provides a summary of all available data for each hydrometric station, including some basic statistics and key hydrological parameters for rivers. It must be noted that water surface elevations are referenced to a different non-geodetic datum from 1997 to 2000 than from 2008 to 2009. Detailed hydrometric data for all stations are available in Appendix A2.

Meliadine Lake Main Outlet

Based on hydrometric data gathered during the open water seasons of 1997 to 2000 and 2008 to 2009, the mean daily discharge at Meliadine Lake Main Outlet, which drains to the Meliadine River, varied from 0 to 19.1 m^3/s over the period of record, with a long term annual range of water surface elevation of 0.45 m. A summary of measurements for each year of available data is provided in Table 4-17.

Table 4-17: Mean Daily Hydrometric Data at Meliadine Lake Main Outlet, 1997 to 2009

Year	Discharge (m^3/s)		Annual Range of Water Surface Elevation (m)	Notes
	Maximum	Minimum		
1997	7.09	0.415	0.34	19-May to 25-Sept
1998	13.7	1.22	0.29	6-Jun to 22-Sept
1999	19.1	2.70	0.37	31-May to 20-Sept
2000	13.3	1.12	0.37	9-Jun to 18-Sept
2008	3.37	0.662	0.23	14-Jun to 17-Sept; Peak discharge not captured
2009	5.87	0.000	0.06	12-Jun to 11-Sept; Peak discharge not captured
Entire period of record	**19.1**	**0.000**	**0.45**	

Note: m^3/s = cubic metres per second
m = metres

Meliadine Lake West Outlet

Based on hydrometric data gathered during the open water seasons of 1997 to 2000 and 2008 to 2009, the mean daily discharge at Meliadine Lake West Outlet which drains to Peter Lake and the Diana River, varied from 0 to 16.4 m^3/s over the period of record, with a long term annual range of water surface elevation of 0.58 m. A summary of measurements for each year of available data is provided in Table 4-18.

Table 4-18: Mean Daily Hydrometric Data at Meliadine West Main Outlet, 1997 to 2009

Year	Discharge (m^3/s)		Annual Range of Water Surface Elevation (m)	Notes
	Maximum	Minimum		
1997	1.76	0.000	0.34	12-Jun to 10-Sept
1998	5.92	0.118	0.30	6-Jun to 22-Sept
1999	16.4	0.518	0.37	6-Jun to 20-Sept
2000	5.92	0.203	0.37	15-Jun to 23-Sept
2008	1.19	0.461	0.31	16-Jun to 18-Sept; Peak discharge not captured
2009	3.57	0.537	0.17	14-Jun to 11-Sept; Peak discharge not captured
Entire period of record	**16.4**	**0.000**	**0.58**	

Note: m^3/s = cubic metres per second
m = metres

Meliadine River near the Mouth

The Meliadine River is located southwest of the Project area and flows directly from Meliadine Lake into the Hudson Bay. The Meliadine River flows parallel to the Diana River, located approximately 10 km southwest.

The Meliadine River near the Mouth has a gross drainage area of 796 km^2, including approximately 143 km^2 of non-contributing area (AEE 1999). It is fed by Meliadine Lake and other smaller sub-watersheds. The bed material is mainly composed of boulders, cobbles, and gravels, and the bank material of organics. The regime of the Meliadine River is characterized on a monthly basis in Table 4-19 and on a mean daily basis in Table 4-20, based on 6 years of field data (AEE 1998a, 1998b, 1999; AMEC 2000; Golder 2008, 2009). Data from 1997 to

2000 were recorded continuously from June to September, and data from 2008 and 2009 only include a manual discharge measurement once a month from July to September. The mean monthly discharges presented in Table 4-19 are based on available data from years 1997 to 2000. Maximum and minimum daily discharges are based on all the field data. Mean monthly discharges for the Meliadine River varied from 0 m^3/s to 21 m^3/s over the period of record, with the high and low both recorded in June. Because the Meliadine River watershed is smaller than that of the Diana River (presented in Section 4.2.2.1), it is likely that the monthly mean discharges for the period of January to May are zero. The maximum daily discharge occurs during the snowmelt, typically in June, with a maximum recorded value of 39.2 m^3/s in June 1999. A frequency analysis was not performed due to the short period of record. The range between the minimum and maximum recorded mean daily water levels was 1.13 m over the period of record.

Table 4-19: Meliadine River Flow Regime (m^3/s), 1997 to 2009

	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly Mean Discharges	1997[a]	-	-	-	-	-	-	5.49	1.59	0.98	-	-	-
	1998[b]	-	-	-	-	-	17.5	7.05	4.12	5.10	-	-	-
	1999[c]	-	-	-	-	-	24.7	11.28	6.21	7.55	-	-	-
	2000[d]	-	-	-	-	-	20.1	9.49	4.21	3.32	-	-	-
Manual Discharge Measurements	2008[e]	-	-	-	-	-	-	9.00	4.76	2.21	-	-	-
	2009[f]	-	-	-	-	-	-	12.50	5.78	3.80	-	-	-
Mean		-	-	-	-	-	**20.8**	**8.33**	**4.03**	**4.24**	-	-	-
Maximum Daily		-	-	-	-	-	**39.2**	**20.0**	**9.95**	**9.07**	-	-	-
Minimum Daily		-	-	-	-	**0.00**	**0.692**	**3.21**	**1.25**	**0.69**	-	-	-

Note: m^3/s = cubic metres per second
- = no available data
[a]= field data from 20 June to 25 September 1997
[b]= field data from 4 June to 23 September 1998
[c]= field data from 17 June to 22 September 1999
[d]= field data from 20 June to 19 September 2000
[e]= manual discharge measurements for 9 July, 2 August, and 17 September 2008
[f]= manual discharge measurements for 13 July, 4 August, and 11 September 2009

Table 4-20: Mean Daily Hydrometric Data at Meliadine River near the Mouth, 1997 to 2009

Year	Discharge (m^3/s)		Annual Range of Water Surface Elevation (m)	Notes
	Maximum	Minimum		
1997	8.57	0.692	0.46	13-Jun to 25-Sept
1998	30.0	2.74	0.90	4-Jun to 23-Sept
1999	39.2	3.94	0.70	31-May to 22-Sept
2000	28.5	2.91	0.63	14-Jun to 19-Sept
2008	9.00	2.21	-	10-July to 17-Sept; Peak discharge not captured; No reliable water surface elevation measurements
2009	12.5	3.80	0.54	13-June to 11-Sept; Peak discharge not captured
Entire period of record	**39.2**	**0.692**	**1.13**	

Note: m^3/s= cubic metres per second
m= metres
-= not available

Meliadine Lake

Based on hydrometric data gathered during the open water seasons of 1997 to 2000 and 2008 to 2009, the long term annual range of water surface elevation at Meliadine Lake was 0.58 m over the period of record. A summary of measurements for each year of available data is provided in Table 4-21.

Table 4-21: Mean Daily Hydrometric Data at Meliadine Lake, 1997 to 2009

Year	Annual Range of Water Surface Elevation (m)	Notes
1997	0.34	12-Jun to 25-Sept
1998	0.30	6-Jun to 22-Sept
1999	0.37	16-Jun to 20-Sept
2000	0.39	1-Jan to 18-Sept
2008	0.18	14-Jun to 18-Sept
2009	0.19	12-Jun to 11-Sept
Entire period of record	**0.58**	

Note: m= metres

Diana River near Rankin Inlet

Based on hydrometric data gathered during the open water seasons of 1997 to 1999, the mean daily discharge at the Diana River near Rankin Inlet varied from 0.825 to 78.6 m^3/s over the period of record, with a long term annual range of water surface elevation of 1.06 m. Additional details on the flow regime of the Diana River near Rankin Inlet are available in Section 4.2.2.1. A summary of measurements for each year of available data is provided in Table 4-22.

Table 4-22: Mean Daily Hydrometric Data at the Diana River near Rankin Inlet, 1997 to 1999

Year	Discharge (m^3/s)		Annual Range of Water Surface Elevation (m)	Notes
	Maximum	Minimum		
1997	39.9	0.825	0.85	25-May to 24-Sept
1998	52.6	12.5	0.57	6-Jun to 22-Sept
1999	78.6	18.3	0.68	31-May to 16-Sept
Entire period of record	**78.6**	**0.825**	**1.06**	

Note: m^3/s= cubic metres per second
m= metres

Diana Lake

Based on hydrometric data gathered during the open water seasons of 1997 to 1999, the long term annual range of water surface elevation at Diana Lake was 1.10 m over the period of record. A summary of measurements for each year of available data is provided in Table 4-23.

Table 4-23: Instantaneous Hydrometric Data at Diana Lake, 1997 to 1999

Year	Annual Range of Water Surface Elevation (m)	Notes
1997	0.70	23-Jun to 24-Sept
1998	1.09	7-May to 22-Sept
1999	0.47	16-Jun to 22-Sept
Entire period of record	**1.10**	

Note: m= metres

Peter Lake

Based on hydrometric data gathered during the open water seasons of 1997 to 1999, the long term annual range of water surface elevation at Peter Lake was 0.87 m over the period of record. A summary of measurements for each year of available data is provided in Table 4-24.

Table 4-24: Instantaneous Hydrometric Data at Peter Lake, 1997 to 1999

Year	Annual Range of Water Surface Elevation (m)	Notes
1997	0.55	23-Jun to 24-Sept
1998	0.57	7-May to 22-Sept
1999	0.53	14-May to 22-Sept
Entire period of record	**0.87**	

Note: m= metres

Char River near Rankin Inlet

The Char River originates from Char Lake and flows parallel to the Meliadine River at an approximate distance of 1.5 km southwest, into Hudson Bay and has a gross drainage area of 69.0 km^2 (AMEC 2000). Observations are only available in 2000 (AMEC 2000) and report an estimated peak instantaneous discharge of 12.5 m^3/s on the fourth day of runoff in June. The measured discharge at the Char River near Rankin Inlet varied from 0 to 9.45 m^3/s over the period of record. The reported water surface elevations refer to the levels of Char Lake (as the discharge at the crossing is governed by the Char Lake outlet), with the annual range of water surface elevation of 0.37 m. The channel is moderately meandering, and the bed material consists mainly of gravels and cobbles. It must be noted that the year 2000 can be considered a dry year when compared to the rest of the years with observations from the nearby stations, and that the peak instantaneous discharge may be greater during a normal year. A summary of measurements for the year 2000 is provided in Table 4-25.

Table 4-25: Mean Daily Hydrometric Data at the Char River near Rankin Inlet, 2000

Year	Discharge (m^3/s)		Annual Range of Water Surface Elevation (m)	Note
	Maximum	Minimum		
2000	9.45	0.000	0.37	12-Jun to 19-Sept

Note: m^3/s= cubic metres per second
m= metres

Lake A1

Based on hydrometric data gathered during the open water seasons of 1997 to 2000 and 2008 to 2009, the mean daily discharge at the Lake A1 Outlet varied from 0 to 1.32 m^3/s over the period of record, with a long term annual range of water surface elevation of 0.54 m. A summary of measurements for each year of available data is provided in Table 4-26.

Table 4-26: Mean Daily Hydrometric Data at Lake A1, 1997 to 2009

Year	Discharge (m^3/s)		Annual Range of Water Surface Elevation (m)	Notes
	Maximum	Minimum		
1997	0.55	0.000	0.37	11-Jun to 25-Sept
1998	1.27	0.000	0.42	5-Jun to 12-Sept
1999	0.916	0.020	0.43	13-May to 20-Sept
2000	1.32	0.009	0.43	13-Jun to 19-Sept
2008	0.065	0.002	0.12	15-Jun to 16-Sept; Peak discharge not captured
2009	0.690	0.017	0.34	11-Jun to 10-Sept; Peak discharge not captured
Entire period of record	**1.32**	**0.000**	**0.54**	

Note: m^3/s = cubic metres per second
m = metres

Lake A6

Based on hydrometric data gathered during the open water seasons of 1997 to 1998, the mean daily discharge at the Lake A6 Outlet varied from 0.00 to 1.18 m^3/s over the period of record, with a two-year annual range of water surface elevation of 0.43 m. A summary of measurements for each year of available data is provided in Table 4-27.

Table 4-27: Mean Daily Hydrometric Data at Lake A6, 1997 to 1998

Year	Discharge (m^3/s)		Annual Range of Water Surface Elevation (m)	Notes
	Maximum	Minimum		
1997	0.221	0.000	0.30	11-Jun to 25-Sept
1998	1.18	0.002	0.33	5-Jun to 23-Sept
Entire period of record	**1.18**	**0.000**	**0.43**	

Note: m^3/s= cubic metres per second
m= metres

Lake B2

Based on hydrometric data gathered during the open water seasons of 1997 to 2000 and 2008 to 2009, the mean daily discharge at the Lake B2 Outlet varied from 0.009 to 2.57 m^3/s over the period of record, with a long term annual range of water surface elevation of 0.47 m. A summary of measurements for each year of available data is provided in Table 4-28.

Table 4-28: Mean Daily Hydrometric Data at Lake B2, 1998 to 2009

Year	Discharge (m^3/s)		Annual Range of Water Surface Elevation (m)	Notes
	Maximum	Minimum		
1998	2.29	0.010	0.38	8-Jun to 24-Sept
1999	2.06	0.040	0.43	2-Jun to 20-Sept
2000	2.57	0.023	0.41	13-Jun to 19-Sept
2008	0.210	0.009	0.16	19-Jun to 16-Sept; Peak discharge not captured
2009	2.03	0.051	0.27	11-Jun to 10-Sept; Peak discharge not captured
Entire period of record	**2.57**	**0.009**	**0.47**	

Note: m^3/s= cubic metres per second
m= metres

Lake B4

Based on hydrometric data gathered during the open water seasons of 1997 to 1998, the mean daily discharge at the Lake B4 Outlet varied from 0 to 4.68 m^3/s over the period of record, with a two-year annual range of water surface elevation of 0.59 m. A summary of measurements for each year of available data is provided in Table 4-29.

Table 4-29: Mean Daily Hydrometric Data at Lake B4, 1997 to 1998

Year	Discharge (m^3/s)		Annual Range of Water Surface Elevation (m)	Notes
	Maximum	Minimum		
1997	0.571	0.000	0.43	11-Jun to 25-Sept
1998	4.68	0.008	0.51	5-Jun to 23-Sept
Entire period of record	4.68	0.000	0.59	

Note: m^3/s= cubic metres per second
m= metres

Lake B5

Based on hydrometric data gathered during the open water season of 1998, the mean daily discharge at the Lake B5 Outlet varied from 0.001 to 0.630 m^3/s, with a water surface elevation range of 0.26 m. A summary of measurements for the year of 1998 is provided in Table 4-30.

Table 4-30: Mean Daily Hydrometric Data at Lake B5, 1998

Year	Discharge (m^3/s)		Annual Range of Water Surface Elevation (m)	Note
	Maximum	Minimum		
1998	0.630	0.001	0.26	7-Jun to 24-Sept

Note: m^3/s = cubic metres per second
m= metres

Lake B7

Based on hydrometric data gathered during the open water seasons of 1998 to 2000 and 2008 to 2009, the mean daily discharge at the Lake B7 Outlet varied from 0 to 0.330 m^3/s over the period of record, with a long term annual range of water surface elevation of 0.59 m. A summary of measurements for each year of available data is provided in Table 4-31.

Table 4-31: Mean Daily Hydrometric Data at Lake B7, 1998 to 2009

Year	Discharge (m^3/s)		Annual Range of Water Surface Elevation (m)	Notes
	Maximum	Minimum		
1998	0.282	0.000	0.30	7-Jun to 24-Sept
1999	0.231	0.008	0.36	2-Jun to 20-Sept
2000	0.330	0.000	0.40	14-Jun to 18-Sept
2008	0.033	0.004	0.18	16-Jun to 16-Sept; Peak discharge not captured
2009	0.128	0.011	0.22	11-Jun to 10-Sept; Peak discharge not captured
Entire period of record	**0.330**	**0.000**	**0.40**	

Note: m^3/s= cubic metres per second
m= metres

Lake D1

Based on hydrometric data gathered during the open water season 2009, the mean daily discharge at the Lake D1 Outlet varied from 0.031 to 0.183 m^3/s over the period of record, with a water surface elevation range of 0.33 m. A summary of measurements for the year of 2009 is provided in Table 4-32.

Table 4-32: Mean Daily Hydrometric Data at Lake D1, 2009

Year	Discharge (m^3/s)		Annual Range of Water Surface Elevation (m)	Note
	Maximum	Minimum		
2009	0.183	0.031	0.14	11-July – 10-Sept; Peak discharge not captured

Note: m^3/s= cubic metres per second
m= metres

Lake D5

Based on hydrometric data gathered during the open water seasons of 1997 to 1998, the mean daily discharge at the Lake D5 Outlet varied from 0 to 0.600 m^3/s over the period of record, with a two-year annual range of water surface elevation of 0.36 m. A summary of measurements for each year of available data is provided in Table 4-33.

Table 4-33: Mean Daily Hydrometric Data at Lake D5, 1997 to 1998

Year	Discharge (m^3/s)		Annual Range of Water Surface Elevation (m)	Notes
	Maximum	Minimum		
1997	0.104	0.020	0.24	11-Jun to 25-Sept
1998	0.600	0.000	0.27	6-Jun to 23-Sept
Entire period of record	**0.600**	**0.000**	**0.36**	

Note: m^3/s= cubic metres per second
m= metres

Lake G1

A single manual discharge measurement of 0.002 m^3/s was measured at the Lake G1 Outlet on 6 August 2009. No other data are available to characterize the lake outlet.

Lake G2

A single manual discharge measurement of 0.006 m^3/s was measured at the Lake G2 Outlet on 12 July 2009. No other data are available to characterize the lake outlet.

Control Lake

Based on hydrometric data gathered during the open water season of 1997, the mean daily discharge at Control Lake Outlet varied from 0 to 0.007 m^3/s, with a water surface elevation range of 0.29 m. A summary of measurements for the year of 1997 is provided in Table 4-34.

Table 4-34: Mean Daily Hydrometric Data at Control Lake, 1997

Year	Discharge (m^3/s)		Annual Range of Water Surface Elevation (m)	Note
	Maximum	Minimum		
1997	0.007	0.000	0.29	12-Jun to 24-Sept

Note: m^3/s= cubic metres per second
m= metres

Chickenhead Lake

Based on hydrometric data gathered during the open water season of 2009, the mean daily discharge at the Chickenhead Lake Outlet varied from 0.054 to 0.415 m^3/s, with a water surface elevation range of 0.19 m. A summary of measurements for the year of 2009 is provided in Table 4-35.

Table 4-35: Mean Daily Hydrometric Data at Chickenhead Lake, 2009

Year	Discharge (m^3/s)		Annual Range of Water Surface Elevation (m)	Note
	Maximum	Minimum		
2009	0.415	0.054	0.19	13-Jun to 13-Sept; Peak discharge not captured

Note: m^3/s= cubic metres per second
m= metres

Lake A54

Based on hydrometric data gathered during the open water seasons of 2008 to 2009, the water surface elevation range at Lake A54 was 0.37 m. A summary of measurements for each year of available data is provided in Table 4-36.

Table 4-36: Instantaneous Hydrometric Data at Lake A54, 2008 to 2009

Year	Annual Range of Water Surface Elevation (m)	Notes
2008	0.05	10-Jul to 17-Sept
2009	0.25	11-Jun to 13-Sept
Entire period of record	**0.37**	

Note: m= metres

Lake A8

Based on hydrometric data gathered during the open water seasons of 2008 to 2009, the mean daily discharge at Lake A8 varied from less than 0.001 to 0.171 m^3/s over the period of record, with a water surface elevation range of 0.19 m. A summary of measurements for each year of available data is provided in Table 4-37.

Table 4-37: Instantaneous Hydrometric Data at Lake A8, 2008 to 2009

Year	Discharge (m^3/s)		Annual Range of Water Surface Elevation (m)	Notes
	Maximum	Minimum		
2008	< 0.001	< 0.001	0.04	10-July to 16-Sept
2009	0.171	0.003	0.15	12-Jun to 13-Sept
Entire period of record	**0.171**	**< 0.001**	**0.19**	

Note: m^3/s= cubic metres per second
m= metres
<= smaller than

4.2.1.4 Water Yields

Water yields obtained from field programs in 1997, 1998, 1999, 2000, 2008 and 2009 are presented in Table 4-38 for local basins around the Project area. Wet years included 1998 and 1999 while dry years included 1997, 2000, 2008 and 2009.

Table 4-38: Water Yield Data (mm), 1997 to 2009

Basin	Basin Area (km^2)	Year of Monitoring Program						Mean Value
		1997	1998	1999	2000	2008	2009	
Meliadine River at Meliadine Lake Outlet	569	69	117	179	108	-	-	118
West Outlet of Meliadine Lake	569	-	30	60	25	-	-	38
Meliadine Lake Both Outlets	569	78	147	239	134	-	-	150
Meliadine River near the Mouth	682	63	149	231	130	-	-	143
Diana River near Rankin Inlet	1480	130	191	284	-	-	-	202
Char River near Rankin Inlet	69.0	-	-	-	125	-	-	125
Lake A1 Outlet	9.39	114	143	204	129	13.7*	56.7*	148
Lake A6 Outlet	6.49	59	144	-	-	-	-	102
Lake B2 Outlet	20.3	-	150	189	107	16.1*	94.4*	149
Lake B4 Outlet	20.6	57	149	-	-	-	-	103
Lake B5 Outlet	4.92	-	140	-	-	-	-	140
Lake B7 Outlet	2.39	-	113	159	102	27.3*	86.2*	125
Lake D1 Outlet		-	-	-	-	-	35.5*	
Lake D5 Outlet	3.69	82	136	-	-	-	-	109
Control Lake Outlet		28	-	-	-	-	-	28
Chickenhead Lake Outlet	9.86	-	-	-	-	-	106.7*	

Note: mm= millimetres
km^2= square kilometres
-= no available data
*= continuous monitoring commenced after the peak flow resulting in partial water yield data, and the presented value was calculated using recorded data only.

4.2.2 Regional Hydrometric Stations

Regional data are available from Water Survey of Canada (WSC), (Environment Canada 2009b) stations 06NC001, 06NB002, and 06OA001 located on the Diana River, the Ferguson River, and the Lorillard River. Basic information on these WSC stations, including distance and direction from the Project area, is summarized in Table 4-39 with locations illustrated in Figure 4-1.

Table 4-39: Regional WSC Hydrometric Stations within 150 km of the Project area

Station Name	WSC Station Number	Period of Record	Latitude	Longitude	Distance and Direction from the Project area
Diana River Near Rankin Inlet	06NC001	1989 - 1995	62°51'37" N	92°24'56" W	30 km SW
Ferguson River Below O'Neil Lake	06NB002	1979 - 1995	62°28'18" N	95°03'10" W	150 km SW
Lorillard River Above Daly Bay	06OA001	1978 - 1992	64°17'39" N	90°26'53" W	150 km N

4.2.2.1 *Flow Regimes*

This section provides a summary of available data for each hydrometric station, including some basic statistics and key hydrological parameters. Detailed hydrometric data for all stations are available in Appendix A2.

Diana River

The Diana River is located southwest of the Project area and flows directly into Hudson Bay from Peter Lake and other nearby minor sub-basins. Meliadine Lake has two outlets, with one of them draining to the Diana River watershed. The Diana River runs parallel to the Meliadine River, which is located approximately 10 km northeast. The Diana River near the mouth has an average top width of approximately 40 m.

The Diana River near Rankin Inlet has a gross drainage area of 1460 km^2. The flow regime for the Diana River is characterized in Table 4-40, based on 7 years of data from 1989 to 1995, recorded at Environment Canada Hydrometric Station 06NC001 (Diana River near Rankin Inlet; Environment Canada 2009b). Additional manual data were also available for the open water seasons of 1997 to 1999 from previous studies (AEE 1998a, 1998b, and 1999), but were not used in the flow regime analysis to keep the datasets separate. Mean monthly discharges varied from 0 m^3/s (due to frozen conditions) during January to May, to 37.9 m^3/s in July. The peak daily discharge typically occurs in June, with a maximum recorded value of 102 m^3/s in June 1991. A frequency analysis was not performed due the short period of record.

Table 4-40: Diana River Monthly Discharges (m^3/s), 1989 to 1995

	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Monthly Mean Discharges	1989	0.0	0.0	0.0	0.0	0.0	18.5	42.1	17.0	7.66	3.35	0.688	0.008	7.51
	1990	0.0	0.0	0.0	0.0	0.0	10.0	39.2	27.0	21.1	9.31	2.18	0.105	9.16
	1991	0.0	0.0	0.0	0.0	0.0	59.5	45.7	18.2	14.8	8.22	1.28	0.045	12.3
	1992	0.0	0.0	0.0	0.0	0.0	13.5	59.3	29.5	32.5	11.7	2.60	0.142	12.5
	1993	0.0	0.0	0.0	0.0	0.0	31.6	29.6	18.4	13.7	7.25	2.21	0.186	8.61
	1994	0.0	0.0	0.0	0.0	0.0	27.3	25.6	9.34	7.39	4.58	1.19	0.076	6.32
	1995	0.0	0.0	0.0	0.0	0.0	18.2	23.5	19.7	14.7	7.36	0.751	0.083	7.06
	1997*	-	-	-	-	-	32.2	24.3	9.24	5.16	-	-	-	-
	1998*	-	-	-	-	-	43.3	30.4	17.3	14.1	-	-	-	-
	1999*	-	-	-	-	-	59.8	47.2	25.6	25.3	-	-	-	-
Mean		**0.000**	**0.000**	**0.000**	**0.000**	**0.001**	**25.5**	**37.9**	**19.9**	**16.0**	**7.39**	**1.56**	**0.092**	**9.08**
Maximum Daily		**0.000**	**0.000**	**0.000**	**0.000**	**0.080**	**102**	**75.8**	**39.8**	**36.4**	**22.2**	**4.80**	**0.860**	**102**
Minimum Daily		**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**15.7**	**6.91**	**5.68**	**1.85**	**0.105**	**0.000**	**0.000**

Note: m^3/s= cubic metres per second
*= data from previous open water studies (AEE 1998a, 1998b, 1999), not included in the analysis
-= no available data

Ferguson River

The Ferguson River is located approximately 150 km southwest of the Project area and flows directly into Hudson Bay from Ferguson Lake.

The Ferguson River below O'Neil Lake has a gross drainage area of 12 400 km^2, and its watershed includes a large amount of lake area, including large lakes. The flow regime of the Ferguson River is characterized in

Table 4-41, based on 9 years of data from 1987 to 1995 recorded at Environment Canada Hydrometric Station 06NB002 (Ferguson River below O'Neill Lake; Environment Canada 2009b). Additional data from 1979 to 1986 are also available, but the data set is incomplete and was not included in the discharge regime analysis. Mean monthly discharges vary from 10 m^3/s in March to 314 m^3/s in July. The peak daily discharge typically occurs in June, with a maximum recorded value of 764 m^3/s in June 1987. A period of zero discharge was recorded from February to May in 1980 and from January to May in 1987 but this was not observed in subsequent years. A frequency analysis was not performed due the short period of record.

Table 4-41: Ferguson River Monthly Discharges (m^3/s), 1980 to 1995

	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Monthly Mean Discharges	1980	0.159	0.000	0.000	0.000	0.000	88.7	177	148	151	98.6	20.6	3.88	57.6
	1987	0.000	0.000	0.000	0.000	0.000	208	563	225	122	63.3	36.0	23.3	104
	1988	15.8	11.4	8.15	6.23	6.02	226	319	152	90.4	49.1	27.1	20.3	77.9
	1989	11.1	7.64	4.61	2.97	2.96	189	327	155	85.0	49.6	29.3	19.8	74.3
	1990	13.4	10.7	9.37	9.30	10.7	142	209	164	129	59.4	29.6	21.9	67.7
	1991	17.2	14.4	13.9	13.5	13.3	491	397	171	103	77.0	31.5	19.2	114
	1992	11.4	8.59	9.40	12.8	17.7	169	349	178	149	108	51.5	27.4	91.5
	1993	17.0	13.3	12.5	15.2	23.2	288	259	159	100	53.8	31.4	18.4	82.9
	1994	12.4	10.3	9.61	9.58	20.9	196	163	90.5	92.7	104	39.4	25.1	64.7
	1995	20.2	18.4	17.6	17.5	18.8	215	235	161	119	77.2	28.3	15.4	78.8
Mean		**11.9**	**9.4**	**8.5**	**8.7**	**11.4**	**221**	**300**	**160**	**114**	**74.0**	**32.5**	**19.5**	**81.3**
Maximum Daily		**21.7**	**19.0**	**17.9**	**17.9**	**80.0**	**764**	**823**	**314**	**165**	**156**	**71.0**	**36.0**	**823**
Minimum Daily		**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**122**	**72.5**	**62.8**	**22.7**	**18.9**	**13.2**	**0.0**

Note: m^3/s= cubic metres per second

Lorillard River

The Lorillard River is located approximately 150 km north of the Project area and flows directly into the Hudson Bay.

The Lorillard River above Daly Bay has a gross drainage area of 11 000 km^2 and includes less lake area than the Ferguson and the Diana basins, with no large lakes (AEE 1998a). The discharge regime of the Ferguson River is characterized in Table 4-42, based on 8 years of data from 1978 to 1992 with gaps from 1979 to 1982, recorded at Environment Canada Hydrometric Station 06OA001 (Lorillard River above Daly Bay; Environment Canada 2009b). Data from 1978 to 1992 are incomplete and were not included in the discharge regime analysis. Mean monthly discharges vary from 0.6 m^3/s in the months of January to May to 383 m^3/s in July. The peak daily flow typically occurs in June, with a maximum recorded value of 3300 m^3/s in June 1983. A period of zero discharge was recorded in April 1978 and from January to May in 1983 and 1984, and from January to April in 1991. A frequency analysis was not performed due the short period of record.

Table 4-42: Lorillard River Monthly Discharges (m^3/s), 1978 to 1992

	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Monthly Mean Discharges	1978	0.310	0.182	0.053	0.000	0.073	18.7	389	86.2	44.6	20.1	6.58	0.703	47.9
	1983	0.000	0.000	0.000	0.000	0.000	665	380	243	189.2	36.9	0.783	0.000	126.3
	1984	0.000	0.000	0.000	0.000	0.000	451	233	102	131.1	32.9	10.0	0.24	79.7
	1988	1.00	1.00	1.00	1.00	1.01	280	157	117	171.6	39.6	5.31	1.77	64.6
	1989	1.14	1.00	1.00	1.00	1.00	394	240	53.6	25.3	11.4	2.90	1.65	61.2
	1990	1.15	1.00	1.00	1.00	1.00	271	429	375	136.3	17.7	0.781	0.022	103.8
	1991	0.000	0.000	0.000	0.000	0.071	446	392	50.1	77.0	35.7	6.95	1.99	84.3
	1992	1.50	1.50	1.50	1.50	1.50	2.26	842	123	71.1	17.5	5.58	2.24	90.6
Mean		**0.64**	**0.59**	**0.57**	**0.56**	**0.58**	**316**	**383**	**144**	**105.8**	**26.5**	**4.86**	**1.07**	82.3
Maximum Daily		**1.50**	**1.50**	**1.50**	**1.50**	**1.50**	**3300**	**1980**	**1020**	**407**	**86.6**	**20.6**	**3.6**	3300
Minimum Daily		**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**63.4**	**26.1**	**18.9**	**1.85**	**0.000**	**0.000**	0.000

Note: m^3/s= cubic metres per second

4.2.2.2 Water Yields

Water yields for each basin, derived from mean daily data available from Environment Canada (Environment Canada 2009b), are presented in Table 4-43. Based on 7 years of record, the water yield of the Diana River varied from 135 mm to 267 mm, with a mean of 194 mm. Based on 10 years of record, the water yield of the Ferguson River varied from 147 mm to 289 mm, with a mean of 207 mm. Records are also available for 1979 and from 1981 to 1986, but are incomplete and, therefore were not used in the analysis. Based on 8 years of record, the water yield of the Lorillard River varied from 137 mm to 362 mm, with a mean of 236 mm. Records are also available from 1979 to 1982 and from 1985 to 1987 but are incomplete and, therefore were not used in the analysis.

Table 4-43: Regional Water Yields (mm), 1978 to 1995

Basin	Basin Area (km^2)	Year													Mean Value
		1978	1980	1983	1984	1987	1988	1989	1990	1991	1992	1993	1994	1995	
Diana River	1 460	-	-	-	-	-	-	160	196	263	267	184	135	151	194
Ferguson River	12 400	-	147	-	-	265	199	189	172	289	233	211	165	201	207
Lorillard River	11 000	137	-	362	229	-	186	175	298	242	260	-	-	-	236

Note: mm= millimetres
km^2= square kilometres
-= incomplete or no available data

4.2.3 Ice Regime

Ice thicknesses in the Project area were measured prior to spring melt during field studies in 1998, 1999, and 2000 (AEE 1998, 1999; AMEC 2000; RL&L 1999). During 2009 field program, direct ice thickness measurements were performed.

Late-winter ice thicknesses on freshwater lakes in the Project area ranged from 1.0 m to 2.4 m over the period of record. Ice covers usually appeared by the end of October and were completely formed in early November. The spring ice melt typically began in mid-June and was complete by early July. Ice was observed along the margins of waterbodies at the hydrology stations in mid-September 2008. Available ice observations are presented in Table 4-44 below, with locations illustrated in Figure 4-8.

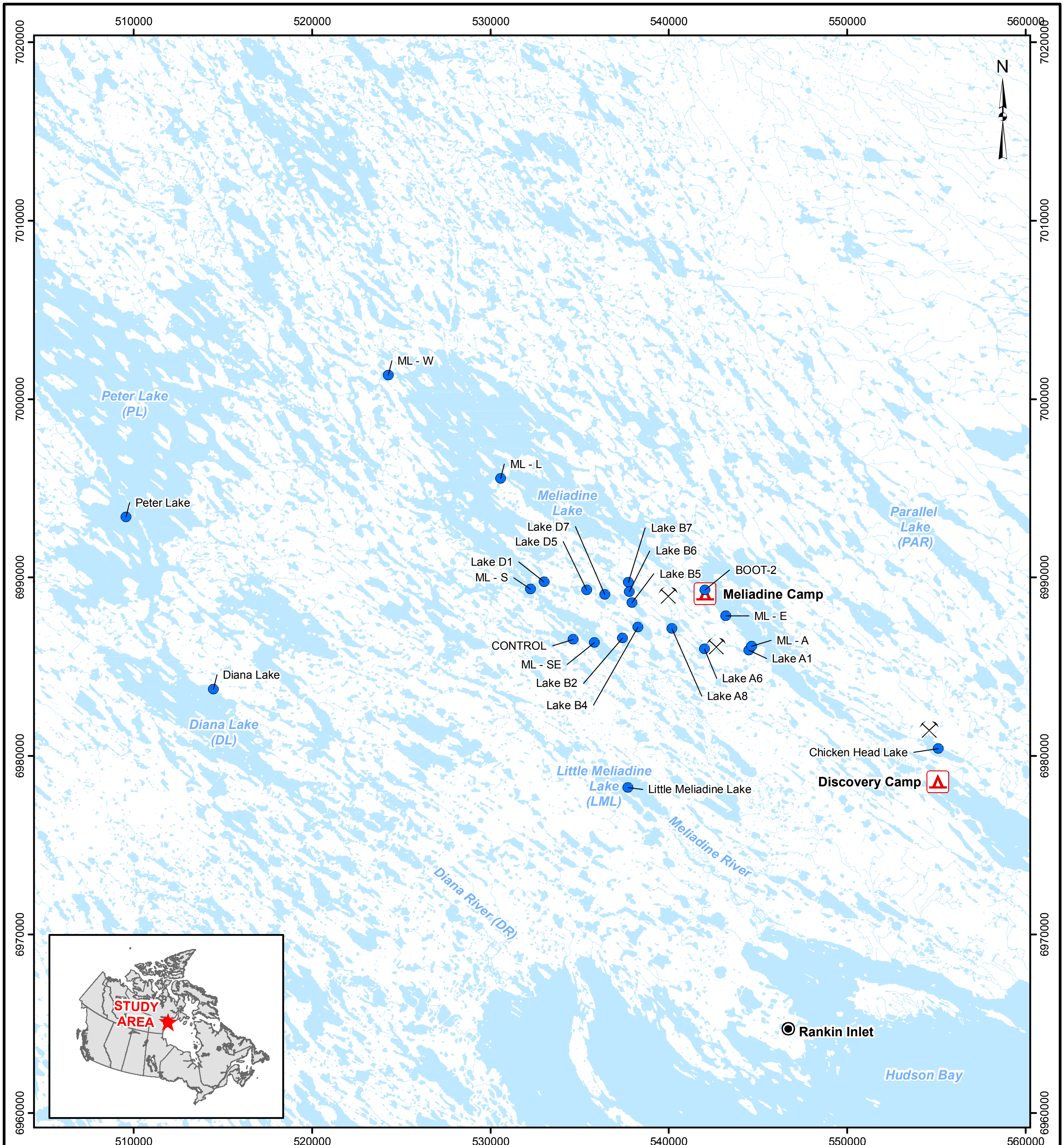
Table 4-44: Ice Thicknesses in the Meliadine River Watershed

Waterbody	Site ID	Date Sampled	UTM Zone 15V NAD83[a]		Source[b]	Ice Thickness (m)	Lake Depth (m)
			Easting	Northing			
Meliadine Lake	ML-E	Apr-98	543253	6988595	RL&L 1999	1.8	11.5
	ML-E	Apr-09	543184	6987869	Golder	1.67	5.36
	ML-A	Apr-09	544654	6986157	Golder	1.78	5.14
	BOOT-2	Apr-09	542070	6989338	Golder	1.93	10.12
	ML-W	Apr-98	524265	7001352	RL&L 1999	2.3	4.2
	ML-S	Apr-98	532241	6989347	RL&L 1999	1.8	5.0
	ML-L	May-98	530573	6995553	AEE 1998b	1.97	-
		May-00	530573	6995553	AMEC 2000	1.98	-
	ML-SE	Apr-98	535954	6986565	RL&L 1999	1.8	3.0
		Apr-09	535824	6986364	Golder	1.72	3.14
Watershed A	Lake A1	May-98	-	-	AEE 1998b	1.82	-
		May-00	-	-	AMEC 2000	1.75	-
	Lake A6	Apr-98	541998	6986004	RL&L 1999	1.7	3.8
		May-98	-	-	AEE 1998b	1.6	-
		Apr-09	541777	6985645	Golder	1.66	4.16
	Lake A8	Apr-98	540084	6987478	RL&L 1999	1.8	3.0
		Apr-09	540181	6987142	Golder	1.63	2.73
Watershed B	Lake B2	Apr-98	537412	6986604	RL&L 1999	1.8	2.5
		May-98	-	-	AEE 1998b	1.9	-
		May-99	-	-	AEE 1999	1.3	-
		May-00	-	-	AMEC 2000	1.42	-
	Lake B4	May-98	-	-	AEE 1998b	1.0	-
		May-99	-	-	AEE 1999	1.3	-
	Lake B5	Apr-98	537989	6988649	RL&L 1999	1.8	2.2
		May-98	-	-	AEE 1998b	2.09	-
		May-99	-	-	AEE 1999	1.3	-
		Apr-09	538281	6988153	Golder	1.63	2.63
	Lake B6	Apr-09	537758	6989218	Golder	1.74	3.48
	Lake B7	Apr-98	537731	6989737	RL&L 1999	1.8	3.2
		May-98	-	-	AEE 1998b	1.99	-
		May-99	-	-	AEE 1999	1.2	-
		Apr-09	537811	6989603	Golder	1.79	3.82
		May-00	-	-	AMEC 2000	2.0	-
Watershed D	Lake D1	Apr-98	533017	6989758	RL&L 1999	1.5	2.2

Table 4-44: Ice Thicknesses in the Meliadine River Watershed (continued)

Waterbody	Site ID	Date Sampled	UTM Zone 15V NAD83[a]		Source[b]	Ice Thickness (m)	Lake Depth (m)
			Easting	Northing			
	Lake D5	May-98	-	-	AEE 1998b	1.3	-
	Lake D5	May-99	-	-	AEE 1999	1.3	-
	Lake D7	Apr-98	536631	6988803	RL&L 1999	1.8	2.3
Little Meliadine Lake	LML	Apr-98	537712	6978225	RL&L 1999	1.5	14.4
Control Lake	Control	Apr-09	534632	6986546	Golder	1.84	3.01
Peter Lake	PL	Apr-98	509566	6993400	RL&L 1999	2.4	17.4
	PL	May-98	-	-	AEE 1998	2.19	-
Diana Lake	DL	May-98	-	-	AEE 1998	2.14	-
Chickenhead Lake	DI-1	Apr-09	555108	6980408	Golder	1.73	8.98

Note: m= metres
-= no available data
[a]= UTM coordinates from RL&L 1998 were converted from NAD27
[b]= Data were obtained from the following sources: RL&L (1999); AEE (1998b, 1999); AMEC (2000); and Golder (2009)



LEGEND

- Camp
- Ice Sampling Location
- Proposed Mine Site
- Watercourse
- Waterbody

6 0 6

SCALE 1:300,000 KILOMETRES

PROJECT

COMAPLEX MINERALS CORP

COMAPLEX MINERALS CORPORATION
MELIADINE GOLD PROJECT
NUNAVUT

TITLE

ICE SAMPLING LOCATIONS

DRAFT

REFERENCE

Base data obtained from Comaplex Minerals Corporation.
Projection: UTM Zone 15 Datum: NAD 83

Golder Associates
Edmonton, Alberta

PROJECT NO. 09-1373-0010			PHASE No. 5000	
DESIGN	DC	28 Oct. 2009	SCALE AS SHOWN	REV. 0
GIS	CDB	28 Oct. 2009	FIGURE 4-8	
CHECK	NPS	17 Nov. 2009		
REVIEW	GA	25 Nov. 2009		

N:\Bur-Graphics\Projects\2007\1373\07-1373-0055\Mapping\MXD\2009\Hydrology\figure-04-08_ice-sampling-locations.mxd

Long term marine ice observations at Melvin Bay near Rankin Inlet were obtained from the Canadian Ice Database (CID), (Lenormand et al. 2002) and are presented in Table 4-45 for the period of 1975 to 2000. Based on these records for the start of freeze-up and the ending of melting period, the mean duration of the marine ice-covered season at Melvin Bay is estimated to be 225 days, from 7 November to 20 June.

Table 4-45: Long Term Marine Ice Observation in Melvin Bay Area near Rankin Inlet

Season	First Observations	Freeze-up Date	Melting Date	Ice Free Date
1975/76	-	-	27-Jun-76	10-Jul-76
1976/77	-	6-Nov-76	-	-
1977/78	-	-	-	-
1980/81	-	-	10-Jun-81	13-Jul-81
1981/82	-	11-Nov-81	11-Jun-82	12-Jul-82
1982/83	-	9-Nov-82	15-Jun-83	22-Jul-83
1983/84	-	7-Nov-83	15-Jun-84	7-Jul-84
1984/85	-	8-Feb-85*	21-Jun-85	7-Jul-85
1985/86	-	5-Nov-85	9-Jul-86	17-Jul-86
1986/87	25-Oct-86	27-Oct-86	13-Jul-87	24-Jul-87
1987/88	21-Oct-87	2-Nov-87	15-Jun-88	20-Jun-88
1988/89	27-Oct-88	13-Nov-88	23-Jun-89	11-Jul-89
1989/90	27-Oct-89	1-Nov-89	26-Jun-90	12-Jul-90
1990/91	15-Oct-90	1-Nov-90	26-Jun-91	5-Jul-91
1991/92	15-Oct-91	4-Nov-91	10-Jul-92	25-Jul-92
1992/93	16-Oct-92	26-Oct-92	24-Jun-93	12-Jul-93
1993/94	18-Nov-93	20-Nov-93	10-Jun-94	8-Jul-94
1994/95	18-Nov-94	20-Nov-94	19-Jun-95	1-Jul-95
1995/96	3-Nov-95	7-Nov-95	13-Jun-96	6-Jul-96
1996/97	-	-	1-Jun-97	30-Jun-97
1997/98	17-Oct-97	3-Nov-97	25-May-98	1-Jul-98
1998/99	15-Nov-98	17-Nov-98	-	-
1999/00	7-Nov-99	20-Nov-99	-	-
Mean	**29-Oct**	**7-Nov**	**20-Jun**	**10-Jul**

Note: *= This measurement was not included in the average calculation. Temperatures were typical during that year and no evidence can be found to support such a late freezing date.
-= no available data

4.2.4 Water Balance Modeling

4.2.4.1 Water Balance Model Description

A water balance model was developed to assess mean characteristics and natural variability of flows at major waterbodies in the A, B, and Chickenhead watersheds. The model description and calibration are presented in detail in Appendix A3.

The water balance model was set up using GoldSim™ software (GoldSim 2009) on a daily time step for the period of 1982 to 2009. This time period was selected to allow use of the derived climate data discussed in

Section 4.1 of this report. In the model, the basic water balance for each watershed considered rainfall and snowmelt runoff, direct precipitation to the lake surface, inflow from upstream watersheds, changes in lake storage, lake evaporation, and outflow.

The model was calibrated using land surface runoff coefficients, stage-discharge rating curves at lake outlets, and degree-day models for snowmelt, spring ice melt and winter freeze-up in lake outlet channels. These parameters were calibrated using climate and hydrology data collected from 1997 to 2000 and in 2008 and 2009 in the Project area.

The calibrated model was used to generate a daily time step series of outflows for lakes of interest in the Project area. Frequency analyses were performed on these data sets to characterize key discharge parameters. The results of the model are summarized in the following section.

4.2.4.2 Lake Outlets Regimes

Model results for lake outflows of interest in the Project area were used as input to flood and drought frequency analyses for the following parameters:

- monthly discharges for June to September;
- maximum annual peak (mean daily);
- annual maxima of 7-day and 14-day mean discharges; and
- July and August 7-day low flow (mean daily).

Due to the highly attenuated nature of lake outflows in the Project area, derived mean outflows are similar to peak instantaneous outflows.

Lake A1

Model results for the Lake A1 Outlet are presented in Table 4-46 (maximum annual peak outflow volumes) and Table 4-47 (long duration floods and low flow discharges).

Table 4-46: Derived Monthly and Annual Outflow Volumes at the Lake A1 Outlet

Condition	Return Period (years)	Monthly Outflow Volume (m^3)				Maximum Annual Outflow Volume (m^3)	Annual Water Yield (mm)*
		Jun	Jul	Aug	Sep		
Wet	100	2 820 000	680 000	314 000	232 000	3 260 000	384
	50	2 510 000	551 000	260 000	206 000	2 970 000	346
	20	2 100 000	411 000	198 000	172 000	2 570 000	296
	10	1 790 000	324 000	156 000	145 000	2 260 000	260
	5	1 490 000	248 000	118 000	118 000	1 930 000	222
Median	2	1 040 000	161 000	71 000	75 600	1 420 000	168
Dry	5	743 000	112 000	43 900	44 800	1 030 000	130
	10	627 000	94 500	34 600	32 000	874 000	115
	20	546 000	83 100	28 600	22 900	757 000	105
	50	470 000	73 000	23 400	14 100	642 000	95.5
	100	427 000	67 600	20 600	8 830	574 000	90.8

Note: m^3= cubic metres
mm= millimetres
*= based on a drainage area of 9.39 km^2

Table 4-47: Derived Representative Discharges at the Lake A1 Outlet

Condition	Return Period (years)	Maximum Discharge			7-Day Low Flows	
		Daily (m^3/d)	7-Day (m^3/d)	14-Day (m^3/d)	July (m^3/d)	August (m^3/d)
Wet	100	403 000	196 000	140 000	5 240	5 140
	50	338 000	179 000	130 000	4 780	4 320
	20	265 000	156 000	116 000	4 170	3 380
	10	217 000	138 000	104 000	3 690	2 750
	5	174 000	119 000	91 700	3 160	2 170
Median	2	121 000	90 000	70 700	2 330	1 430
Dry	5	90 800	68 900	53 400	1 690	962
	10	80 600	59 100	45 500	1 410	771
	20	74 300	51 900	39 600	1 200	642
	50	69 200	44 600	33 500	997	522
	100	66 700	40 200	29 700	873	455

Note: m^3/d= cubic metres per day

B2 Lake

Model results for the Lake B2 Outlet are presented in Table 4-48 (maximum annual peak outflow volumes) and Table 4-49 (long duration floods and low flow discharges).

Table 4-48: Derived Monthly and Annual Outflow Volumes at the Lake B2 Outlet

Condition	Return Period (years)	Monthly Outflow Volume (m^3)				Maximum Annual Outflow Volume (m^3)	Annual Water Yield (mm)*
		Jun	Jul	Aug	Sep		
Wet	100	6 310 000	3 260 000	678 000	493 000	7 070 000	381
	50	5 440 000	2 970 000	563 000	440 000	6 390 000	343
	20	4 400 000	2 570 000	432 000	369 000	5 500 000	294
	10	3 690 000	2 260 000	346 000	314 000	4 820 000	258
	5	3 020 000	1 930 000	269 000	257 000	4 110 000	220
Median	2	2 130 000	1 420 000	173 000	171 000	3 050 000	165
Dry	5	1 570 000	1 030 000	113 000	106 000	2 270 000	127
	10	1 370 000	874 000	91 100	78 500	1 960 000	112
	20	1 230 000	757 000	76 500	58 500	1 730 000	102
	50	1 100 000	642 000	63 400	38 700	1 510 000	92.6
	100	1 030 000	574 000	56 200	26 900	1 390 000	88.0

Note: m^3= cubic metres
mm= millimetres
*= based on a drainage area of 20.3 km^2

Table 4-49: Derived Representative Discharges at the Lake B2 Outlet

Condition	Return Period (years)	Maximum Discharge			7-Day Low Flows	
		Daily (m^3/d)	7-Day (m^3/d)	14-Day (m^3/d)	July (m^3/d)	August (m^3/d)
Wet	100	1 090 000	412 000	282 000	13 200	12 000
	50	847 000	374 000	265 000	12 100	10 200
	20	602 000	323 000	239 000	10 600	8 170
	10	460 000	284 000	216 000	9 400	6 750
	5	347 000	242 000	190 000	8 120	5 430
Median	2	227 000	180 000	145 000	6 090	3 690
Dry	5	170 000	134 000	107 000	4 490	2 570
	10	153 000	114 000	90 000	3 790	2 090
	20	143 000	99 500	77 000	3 280	1 760
	50	136 000	84 800	63 400	2 770	1 440
	100	133 000	76 100	55 100	2 460	1 260

Note: m^3/d= cubic metres per day

B7 Lake

Model results for the Lake B7 Outlet are presented in Table 4-50 (maximum annual peak outflow volumes) and Table 4-51 (long duration floods and low flow discharges).

Table 4-50: Derived Extreme Annual Outflow Volumes at the Lake B7 Outlet

Condition	Return Period (years)	Monthly Outflow Volume (m^3)				Maximum Annual Outflow Volume (m^3)	Annual Water Yield (mm)*
		Jun	Jul	Aug	Sep		
Wet	100	759 000	219 000	81 000	59 000	847 000	396
	50	640 000	178 000	69 100	53 500	761 000	353
	20	504 000	133 000	55 000	45 900	649 000	298
	10	415 000	105 000	45 400	39 800	565 000	258
	5	334 000	81 700	36 400	33 300	480 000	218
Median	2	234 000	54 600	24 600	23 100	357 000	162
Dry	5	174 000	39 900	17 000	15 200	271 000	125
	10	154 000	34 500	14 000	11 700	238 000	111
	20	140 000	31 100	12 000	9 090	214 000	101
	50	129 000	28 100	10 100	6 450	192 000	91.9
	100	123 000	26 500	9 020	4 850	180 000	87.4

Note: m^3= cubic metres
mm= millimetres
*= based on a drainage area of 2.39 km^2

Table 4-51: Derived Representative Discharges at the Lake B7 Outlet

Condition	Return Period (years)	Maximum Discharge			7-Day Low Flow	
		Daily (m^3/d)	7-Day (m^3/d)	14-Day (m^3/d)	July (m^3/d)	August (m^3/d)
Wet	100	121 000	45 300	33 500	1 710	1 560
	50	90 100	40 800	30 700	1 600	1 360
	20	60 800	34 900	26 900	1 440	1 120
	10	45 200	30 400	23 900	1 310	946
	5	33 500	25 700	20 600	1 160	780
Median	2	22 100	18 900	15 400	895	552
Dry	5	17 400	13 900	11 300	676	400
	10	16 200	12 000	9 620	579	333
	20	15 700	10 600	8 410	507	285
	50	15 300	9 200	7 220	432	238
	100	15 100	8 410	6 510	386	211

Note: m^3/d= cubic metres per day

Chickenhead Lake

Model results for the Chickenhead Lake Outlet are presented in Table 4-52 (maximum annual peak outflow volumes) and Table 4-53 (long duration floods and low flow discharges).

Table 4-52: Derived Extreme Annual Outflow Volumes at the Chickenhead Lake Outlet

Condition	Return Period (years)	Monthly Outflow Volume (m^3)				Maximum Annual Outflow Volume (m^3)	Annual Water Yield (mm)*
		Jun	Jul	Aug	Sep		
Wet	100	2 990 000	673 000	566 000	414 000	3 590 000	364
	50	2 730 000	522 000	402 000	328 000	3 300 000	335
	20	2 360 000	358 000	241 000	232 000	2 910 000	295
	10	2 070 000	257 000	153 000	169 000	2 590 000	263
	5	1 750 000	173 000	88 800	115 000	2 240 000	227
Median	2	1 230 000	82 700	32 300	52 900	1 690 000	171
Dry	5	807 000	41 900	12 800	22 000	1 250 000	127
	10	619 000	30 500	8 420	12 700	1 060 000	108
	20	479 000	24 000	6 250	7 160	918 000	93.1
	50	337 000	18 900	4 740	2 640	774 000	78.5
	100	249 000	16 500	4 090	375	687 000	69.7

Note: m^3= cubic metres
mm= millimetres
*= based on a drainage area of 9.86 km^2

Table 4-53: Derived Representative Discharges at the Chickenhead Lake Outlet

Condition	Return Period (years)	Maximum Discharge			7-Day Low Flow	
		Daily (m^3/d)	7-Day (m^3/d)	14-Day (m^3/d)	July (m^3/d)	August (m^3/d)
Wet	100	391 000	200 000	153 000	1 650	2 600
	50	355 000	188 000	145 000	1 490	2 100
	20	307 000	171 000	132 000	1 290	1 530
	10	269 000	157 000	122 000	1 120	1 150
	5	229 000	141 000	109 000	939	815
Median	2	165 000	112 000	87 000	649	422
Dry	5	117 000	86 700	66 700	420	218
	10	96 300	74 200	56 700	320	154
	20	81 300	64 400	48 900	246	116
	50	66 400	53 900	40 400	172	83.8
	100	57 500	47 100	34 900	127	67.5

Note: m^3/d= cubic metres per day

A comparison of model results to monitoring data where annual data are available is provided in Table 4-54. This shows that the return periods (estimated frequencies) of annual precipitation events are consistent with the return periods of annual water yields from these watersheds in 1999 and 2000. It must be noted that these years were the only ones with a measured peak discharge for the presented basins and that water yields in 1997 and 1998 were based on estimates. Other discrepancies may be due to variations in annual precipitation between sub-watersheds. Water yields presented for the Outflow of Lakes A1, B2, and B7 in 2008 and Outflow of Lakes A1, B7, and Chickenhead Lake in 2009 are based on late measurements that do not include the peak discharge and are not reliable. For this reason, no comparison was presented.

Table 4-54: Comparison of Monitoring Data to Modeling Results

Quantity	Measure	Year					
		1997	1998	1999	2000	2008	2009
Rainfall	Annual Total (mm)	95.8	231	260	146	164	202.4
	Estimated Frequency	50 year Dry	5-10 year Wet	20 year Wet	5 year Dry	2 - 5 year Dry	5 - 10 year Wet
Snowfall	Annual Total (cm)	76.2	108	127	123	133	103
	Estimated Frequency	> 200 year Dry	2 - 5 year Dry	2 - 5 year Wet	2 year Wet	2 - 5 year Wet	5 year Dry
Precipitation to Runoff	Annual Total (mm)	168	340	385	268	295	302
	Estimated Frequency	100 year Dry	2 - 5 year Wet	5 - 10 year Wet	5 year Dry	2 - 5 year Dry	2 - 5 year Dry
Outflow of Lake A1	Annual Total (mm)	114	143	204	129	13.7	56.7
	Estimated Frequency	10 year Dry	2 - 5 year Dry	2 - 5 year Wet	5 year Dry	-	-

Table 4-54: Comparison of Monitoring Data to Modeling Results (continued)

Quantity	Measure	Year					
		1997	1998	1999	2000	2008	2009
Outflow of Lake B2	Annual Total (mm)	-	150	189	107	16.1	94.4
	Estimated Frequency	-	2 - 5 year Dry	2 - 5 year Wet	10 - 20 year Dry	-	20 - 50 year Dry
Outflow of Lake B7	Annual Total (mm)	-	113	159	102	27.3	86.2
	Estimated Frequency	-	10 year Dry	2 - 5 year Dry	20 year Dry	-	-
Outflow of Chickenhead Lake	Annual Total (mm)	-	-	-	-	-	106.7
	Estimated Frequency	-	-	-	-	-	-

Note: mm= millimetres
-= no available data

4.3 Summary and Conclusions

This section of the baseline report was commissioned to characterize the prevailing hydroclimatic and hydrological parameters in the Project area. The baseline is based on data collected by Golder in 2008 (Golder 2008) and 2009, and data reported by previous studies (AEE 1998a, 1998b, 1999; AMEC 2000).

This baseline report characterizes hydroclimatic and hydrological parameters relevant to the Project, including the following:

- precipitation based on regional data and compared to site-specific data;
- lake evaporation and evapotranspiration from land surfaces, based on regional and local data;
- hydrological regimes of local waterbodies based on an examination of site-specific and regional data;
- local lake and watercourse ice regimes;
- development of a time series runoff model for the Outlets of Lake A1, Lake B2, Lake B7, and Chickenhead Lake.

Baseline Climate Conditions

Air Temperature

Air temperature at the Project site may fall below 0°C on any day of the year. The monthly mean air temperature is typically above 0°C for the months of June to September, and is below 0°C between October and May. July has been the warmest month and January has been the coldest month. The mean annual temperature for the period of record was -10.4°C.

Precipitation

Mean annual precipitation at the Project site, based on the hydrological year from 1 October to 30 September, was estimated to be 411.7 mm after accounting for rainfall and snowfall undercatch. Approximately 51% of precipitation occurs as rain (207.1 mm) and 49% occurs as snow (199.1 mm). The 24-hour extreme rainfall intensity with 10-year return period was estimated to be 1.9 mm/h, or 45.6 mm total depth. Corresponding values for the 100-year return period are 2.6 mm/h or 62.4 mm total depth.

Evaporation

Mean annual evaporation for small lakes in the Project area is estimated to be 323 mm between June and September.

Evapotranspiration

Evapotranspiration is estimated to range from 34 mm to 38 mm annually.

Snowpack Sublimation

Based on the terrain in the Project area, the mean annual loss of snowpack to sublimation and snow redistribution is estimated to vary between 46 and 52% of the total precipitation from October to May.

Wind Speed and Direction

The recorded prevailling winds are from north and north-northwest. The wind blows from the north and north-northwest direction more than 30% of the time, and the least frequent wind direction is west-southwest, with a frequency of 2.1%. The calm frequency is 2.8% of the time. The mean values for wind speed show that the north-northwest, together with north and northwest winds, have the highest speeds and tend to be the strongest.

Relative Humidity and Solar Radiation

The mean annual relative humidity at the Project site was estimated to be 85% and is similar to the mean annual relative humidity at Rankin Inlet A (77%).

The mean monthly global solar radiation recorded at the Project site varied from 3.8 MJ/m^2/d in September 2000 to 14.3 MJ/m^2/d in June.

Baseline Hydrological Conditions

Lake Ice Regime

Late-winter ice thickness on freshwater lakes in the Project area have ranged from 1.00 m to about 2.40 m. Ice covers usually develop by the end of October and are completely formed in early November. The spring ice melt typically begins in mid-June and is complete by early July.

Water Yields

Derived mean annual water yields for Lake A1, Lake B2, Lake B7, and Chickenhead Lake vary from 162 mm (at Lake B7) to 171 mm (at Chickenhead Lake). These are similar to the long-term mean annual value of 194 mm at Diana River near Rankin Inlet.

Extreme Discharges

Flood peaks and low flow discharges of various durations and frequencies were derived for outflows of Lake A1, Lake B2, Lake B7, and Chickenhead Lake, and vary with watershed size, lake ouflow geometry, and upstream flow attenuation.

Conclusions

This ongoing climate and surface water hydrologic baseline provides a strong basis for environmental impact assessment and water management planning for the Project. The climate and hydrology characteristics described for the Project are based on long-term regional information as well as site-specific data that have been collected since 1997. The available data confirm that the Project fits within the established regional context of precipitation and runoff.