

# **OIL SANDS REGIONAL AQUATICS MONITORING PROGRAM (RAMP) 2000**

## **VOLUME II: CLIMATIC AND HYDROLOGIC MONITORING**



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**FINAL REPORT ON**

**OIL SANDS REGIONAL AQUATICS  
MONITORING PROGRAM (RAMP) 2000**

**VOLUME II: CLIMATIC AND  
HYDROLOGIC MONITORING**

**Submitted to:  
RAMP Steering Committee**

## EXECUTIVE SUMMARY

This report documents the climatic and hydrologic data collection in 2000 by Golder Associates as part of the Oil Sands Regional Aquatics Monitoring Program (RAMP). RAMP is a long-term monitoring program in the Oil Sands Region of northeastern Alberta currently jointly funded and commissioned by Syncrude, Albian, Mobil, Suncor, TrueNorth and Petro-Canada.

The 2000 program included climatic monitoring, hydrologic monitoring, a snow course survey, installation and maintenance of station equipment, and data processing and compilation.

Climatic monitoring at the Aurora Climate Station included hourly, daily and monthly data for rainfall, snowfall, air temperatures, relative humidity, solar radiation, and wind speeds and directions. Operation and maintenance included periodic site visits, inspection of monitoring equipment, some equipment improvements and exchange of the data storage module.

Hydrologic monitoring included the collection of streamflow, high water mark, lake level and total suspended solids data. Specifically, the 2000 program included the following:

- manual flow measurements, stage-discharge rating curves, and derived hourly and daily discharges at the streamflow monitoring stations including McClelland Lake Outlet (L1), Alsands Drain (S1), Jackpine Creek (S2), Muskeg River Aurora (S5A), Mills Creek (S6), Muskeg River WSC (S7), Poplar Creek (S11), Fort Creek (S12) and Albian Pond #3 (S13);
- measurements of high water marks from the flood event in late June 2000 at five staff gauges on the Muskeg River;
- hourly and daily water level measurements at the Stanley Creek (S8), McClelland Lake (L1), Kearl Lake (L2) and Isadore's Lake (L3) stations; and
- total suspended solids (TSS) sampling at streamflow and lake monitoring stations.

This report documents the work associated with installation of new water level monitoring stations on Fort Creek (S12) and Albian Pond #3 (S13). Iyininim Creek (S3), Blackfly Creek (S4), Kearl Lake Outlet (S9) and Wapasu Creek (S10) were not monitored in 2000.

The snow course survey conducted on March 12, 2000 provided data to determine the average accumulated snow depth for the watershed and snow redistribution in five representative terrain types. The 2000 program was a continuation of a five-year program that began in 1997. The results will be used to correct snowfall data recorded at the Aurora Climate Station, and to calibrate and verify the regional hydrologic model.

The 2000 program has resulted in development of a regional climatic and hydrologic database updated to the end of 2000. This database is stored on a compact disc for easy access by users.

It is recommended that the collection of climatic and hydrologic data at the existing monitoring stations be continued and that monitoring should cover the entire year including winter low flows, snowmelt and summer flows. Specific recommendations for the 2001 monitoring program include ongoing operation and maintenance of the climatic and hydrologic monitoring stations, a snow course survey for the 00/01 winter and ongoing monitoring of high water marks.

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# 1 INTRODUCTION

This report presents the methodology and data collected in the 2000 climatic and hydrologic monitoring program. This program is part of the Oil Sands Regional Aquatics Monitoring Program (RAMP), an integrated multi-disciplinary aquatic monitoring program in the Oil Sands Region of northeastern Alberta. Syncrude Canada Ltd. (Syncrude), Albian Sands Energy Inc. (Albian), ExxonMobil (Mobil), Suncor Energy Inc. (Suncor), TrueNorth Energy (TrueNorth) and Petro-Canada Oil and Gas Ltd. (Petro-Canada) provided joint funding for commissioning Golder Associates Ltd. (Golder) to conduct the 2000 monitoring program. The objectives of this monitoring program were the following:

- to undertake climatic and hydrologic monitoring required by Alberta Environment in the regulatory approvals for the Syncrude Aurora and Albian Muskeg River Mine projects;
- to undertake climatic and hydrologic monitoring recommended in the environmental impact assessments (EIA's) for the Syncrude Aurora and Albian Muskeg River Mine projects;
- to undertake baseline hydrologic monitoring for the TrueNorth Fort Hills Project EIA; and
- to expand the climatic and hydrologic database required for operational and reclamation water management planning and design of the existing and future oil sands developments in the region by Syncrude, Albian, Mobil, Suncor, TrueNorth and Petro-Canada.

The 2000 program focused on climatic and hydrologic monitoring in the Muskeg River basin. The program also included hydrologic monitoring for Mills Creek, Fort Creek, Poplar Creek, McClelland Lake and Isadore's Lake, all of which are located outside the Muskeg River basin. The 2000 program design was based on the current regulatory monitoring requirements, the long-term need for expanding the regional climatic and hydrologic database, and a thorough understanding of the historic database developed to date.

The Meteorological Service of Canada (MSC) and the Water Survey of Canada (WSC) operate long-term climatic and hydrologic monitoring networks in the Fort McMurray region. For the existing oil sands operations west of the Athabasca River, Syncrude and Suncor have installed a number of local monitoring stations that include the Mildred Lake Climate Station currently operated by MSC. In the Muskeg River basin, climatic and hydrologic monitoring initiated by oil sands developers include the following:

- **Alsands Baseline Data Collection Program (1979)**

This program resulted in the collection of miscellaneous streamflow data between 1980 and 1983, and one year of climatic data at the Alsands study area.

- **OSLO Baseline Data Collection Program (1989)**

This program resulted in collection of two years of streamflow data on five small streams in the OSLO study area and one year of climatic data in 1988 at the abandoned OSLO airstrip located by Jackpine Creek.

- **Aurora Mine Development (1995 and 1996)**

In 1995 and 1996, Syncrude collected data at five streamflow monitoring stations on the Alsands Drain, Jackpine Creek, Iyininim Creek, Blackfly Creek and the Muskeg River. In addition, Syncrude installed the Aurora Climate Station at the abandoned OSLO airstrip in May 1995.

- **Monitoring Program by Syncrude and Shell (1997)**

Syncrude and Shell (Albian) provided joint funding for the 1997 monitoring program in the Muskeg River basin and surrounding areas. The program expanded in scope to include hydrologic monitoring on Mills Creek and a snow course survey. The hydrologic monitoring on McClelland Lake and Poplar Creek outside the Muskeg River basin was also included in the program.

- **Monitoring Program by Syncrude, Shell, Mobil and Suncor (1998 and 1999)**

Syncrude, Shell (Albian), Mobil and Suncor provided joint funding for the 1998 monitoring program in the Muskeg River basin and surrounding areas. The program expanded in scope to include hydrologic monitoring on the Kearl Lake outlet. The hydrologic monitoring on McClelland Lake, Mills Creek and Poplar Creek outside the Muskeg River basin was included in the program, and the snow course survey program initiated in 1997 was continued. Hydrologic monitoring on Blackfly Creek was suspended in 1999.

- **Regional Aquatics Monitoring Program – Climate and Hydrology (2000)**

In 2000, climatic and hydrologic monitoring in the Muskeg River basin and surrounding areas was integrated into the Regional Aquatics Monitoring Program (RAMP). Continued funding was provided by



Syncrude, Albian, Mobil and Suncor, while TrueNorth and Petro-Canada joined the program as funders. The program expanded in scope to include hydrologic monitoring on Fort Creek and Albian Pond #3, and the snow course survey program initiated in 1997 was continued. The hydrologic monitoring on Iyininim Creek, Kearl Lake Outlet and Wapasu Creek were suspended in 2000.

In accordance with the draft rationale document prepared by Golder in May 2000, the scope of work for the 2000 monitoring program included the following:

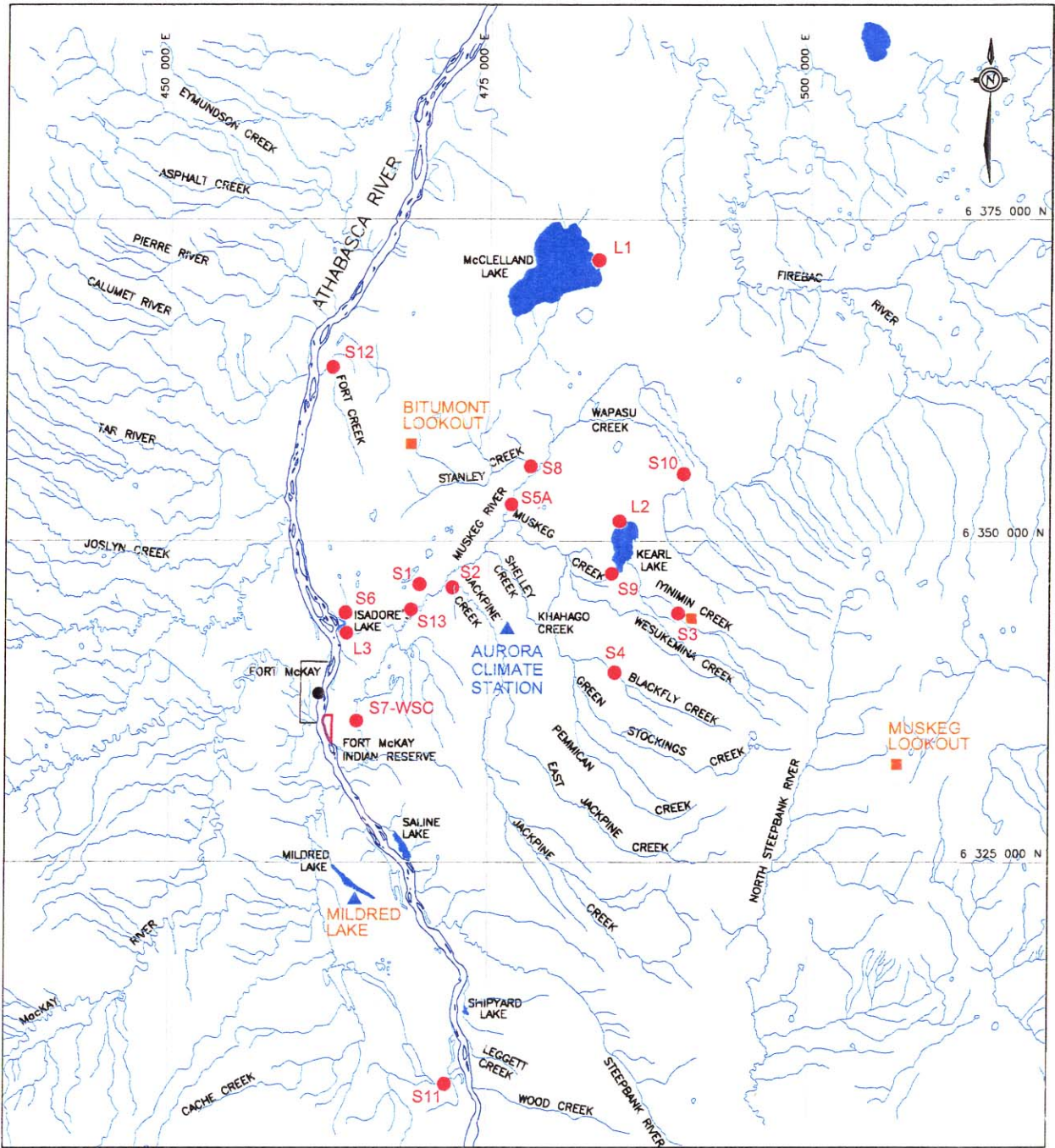
- collect and compile the climatic data recorded at the Aurora Climate Station;
- collect and compile snow course data in the Muskeg River basin;
- install an additional streamflow monitoring station at Fort Creek;
- collect, process and compile streamflow and total suspended solid (TSS) data at six streamflow monitoring stations in the Muskeg River basin, including a new station on Albian Pond #3, and three streamflow monitoring stations on Mills, Fort and Poplar creeks;
- collect, process and compile water level data at three lake-level monitoring stations at McClelland, Kearl and Isadore's lakes; and
- tie in local benchmarks to geodetic elevations and adjust database water levels accordingly.

The climatic and hydrologic data documented in this report were collected for the period from January to December 2000. Figure 1.1 shows the locations of the climatic and hydrologic monitoring stations covered in the 2000 program, which included the Aurora Climate Station and the following hydrologic stations:

- Alsands Drain (S1);
- Jackpine Creek (S2);
- Iyininim Creek (S3) (inactive in 2000);
- Blackfly Creek (S4) (inactive in 2000);
- Muskeg River Aurora (S5A);
- Mills Creek (S6);
- Muskeg River WSC (S7);
- Stanley Creek (S8);
- Kearl Lake Outlet (S9) (inactive in 2000);
- Wapasu Creek (S10) (inactive in 2000);

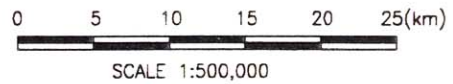
- Poplar Creek (S11);
- Fort Creek (S12);
- Albian Pond #3 (S13);
- McClelland Lake (L1);
- Kearl Lake (L2); and
- Isadore's Lake (L3).

A brief description of the climatic and hydrologic conditions in 2000 is provided in Appendix VIII.



**LEGEND**

- S1 HYDROLOGIC STATION
- ▲ CLIMATIC STATION
- RAIN GAUGE



**NOTE**

STATION S4 WAS NOT OPERATIONAL IN 1999 and 2000  
 STATION S3 S9, and S10 WERE NOT OPERATIONAL IN 2000

**REFERENCE**

DIGITAL DATA 74D, 74E, 74I, 84A, AND 84H FROM RESOURCE DATA DIVISION ALBERTA ENVIRONMENT PROTECTION, 1997.

		RAMP
<b>LOCATIONS OF CLIMATIC AND HYDROLOGIC MONITORING STATIONS</b>		
DRAWN: TVS	APPROVED:	DATE: 20 Feb. 2001
PROJECT: 002-2309.7000		FIGURE: 1.1

## 2 CLIMATIC MONITORING AT THE AURORA STATION

### 2.1 STATION DESCRIPTION

The Aurora Climate Station was initially installed for the OSLO project at the abandoned airstrip in Lease 34. The station was operated for only one year in 1988. Syncrude restored the operation of the climatic station in May 1995 as part of the baseline data collection program for the Aurora Mine Project. The Aurora Climate Station is located at 57° 14' 16" north latitude and 111° 24' 27" west longitude (SW-16-95-9-W4).

Table 2.1 summarizes the monitoring equipment installed at the climatic station. The devices for monitoring wind speed, wind direction, solar radiation and air temperature are mounted on a 10 m high tower set into a concrete base. The relative humidity meter, data logger, storage module and battery pack are mounted approximately 1.5 m above the ground level. The tipping-bucket rain and snow gauges are located away from the tower, approximately 1.0 m high on a base constructed from a section of steel culvert.

**Table 2.1 Monitoring Equipment at the Aurora Climate Station**

Type of Monitoring Equipment	Parameter Monitored or Function
Tipping-Bucket Rain Gauge (Campbell Scientific Model CS700-L)	total rainfall and rate of rainfall
Tipping-Bucket Snow Gauge (Texas Electronics TE525WS-L with CS705 snowfall conversion adaptor)	total snowfall and rate of snowfall
Anemometer (Young Model 05103-10)	wind speed and direction
Silicon Pyranometer (LI-COR Model LI200S)	solar radiation
Temperature and Relative Humidity Probe (Vaisala Model HMP45C with 41002 12-Plate Gill Radiation Shield)	ambient temperature and relative humidity
Sonic Ranger (Campbell Scientific Model SR50)	snow depth on ground
Measurement and Control Module (Campbell Scientific Model CR10)	datalogging
Solid State Storage Module (Campbell Scientific Model SM192)	storing data
Solar Panel and Battery Pack	solar panel for charging the battery pack

## 2.2 STATION OPERATION AND MAINTENANCE

The station operation and maintenance in 2000 included periodic site visits, inspection of the monitoring equipment, and exchange of the storage module containing data. The storage module was swapped and returned to the office to be downloaded without missing periods of data. The station was visited on January 11, February 21 and 22, March 10, April 2, April 20, May 15, 16 and 17, June 14, July 2, August 15, September 12, October 17 and November 8, 2000.

The station was retrofitted with a new tipping-bucket rain gauge and snowfall adapter on January 11, 2000, and the existing tipping-bucket rain gauge was returned to Calgary for maintenance and calibration. The snowfall adapter uses environmentally-friendly antifreeze to melt snowfall, and the mixture flows through the tipping-bucket mechanism. This sensor was installed to compare snowfall data against snow-on-ground data measured by the existing sonic ranger. The adapter also measures rainfall, but there is often a significant time lag between the rain or snowfall and bucket tip. The snowfall sensor is useful for measuring daily accumulations, but not for intensity-duration-frequency analysis of storms. Therefore, both precipitation gauges were operated at the Aurora Climate Station. The rain gauge with snowfall adapter can be removed for maintenance over mid-summer, and the other rain gauge without the snowfall adapter can be removed for maintenance over mid-winter.

Spare sensors for wind, temperature, relative humidity and solar radiation were exchanged for the existing sensors in 2000 to enable maintenance and calibration activities on the other climatic station sensors without losing data. The retrieved sensors were returned to Calgary for maintenance and calibration.

The Aurora Climate Station was out of service from January 11 to February 22, 2000. On January 11, the data logger program was inadvertently lost from memory during the installation of the new snowfall gauge. Due to extreme cold, the display on the computer normally used to check the logger operation was not functional and the service outage was not recognized until the next visit on February 21. The station was visited the next day, the program was reloaded and the station was once again operational.

The Aurora Climate Station was also out of service from April 2 to May 17, 2000 due to the loss of the data logger program from memory during a program upgrade. The station collected data continuously for the remainder of the year.

The two periods of missing data experienced during 2000 were inadvertent but avoidable. During the first period, extreme cold weather made it impossible to check whether data were being recorded. During the second, a check was made

to determine whether the station was operating properly. All sensors were functioning properly, but data was not properly transferred to the storage modules. The nature of the data storage system on this station means that data are only transferred to the storage module every hour, meaning that after swapping storage modules, field personnel could be forced to wait up to an hour to check that all is well. For this reason and others, this station should be considered a candidate for retrofitting with a remote data retrieval system. This is discussed further in Section 6.

## **2.3 DATA PROCESSING AND COMPILATION**

The hourly climatic data recorded in the data-logger storage modules were downloaded nine times in 2000. Continuous measurements were available from January 1 to January 11, from February 22 to April 2, and from May 17 to December 31, 2000. These hourly data were processed to derive the daily and monthly data. The daily data are presented in Appendix I. Table 2.2 presents the monthly climatic data statistics based on the recorded data, including air temperatures, rainfall, snowfall, solar radiation, and wind speeds and directions. Rainfall and snowfall values from Fort McMurray Airport (MSC Station 3062693) have been used to supplement the recorded data and provide a complete record of monthly precipitation. Recorded and processed hourly climatic data collected in 2000 are stored on a compact disc in Appendix IX.

**Table 2.2 Summary of 2000 Climatic Data Statistics Recorded at the Aurora Climate Station**

Month	Temperature			Total Rainfall (mm)	Total Snowfall* (mm)	Mean Relative Humidity (%)	Mean Daily Global Solar Radiation (kW·h/m <sup>2</sup> )	Wind Speed and Direction				
	Minimum (°C)	Mean (°C)	Maximum (°C)					Mean Daily Wind		Maximum Sustained Gusts		
								Speed (km/h)	Direction (degrees)	5 Second (km/h)	2 Minute (km/h)	10 Minute (km/h)
Jan	-38.1 <sup>‡</sup>	-8.1 <sup>‡</sup>	0.0 <sup>‡</sup>	0.0 <sup>†</sup>	21.1 <sup>†</sup>	26.9	0.32	0.7	56.1	28.4	21.4	15.8
Feb	-16.4 <sup>‡</sup>	-0.5 <sup>‡</sup>	10.7 <sup>‡</sup>	0.0 <sup>†</sup>	3.8 <sup>†</sup>	19.8 <sup>‡</sup>	2.47 <sup>‡</sup>	1.0 <sup>‡</sup>	49.7 <sup>‡</sup>	20.4 <sup>‡</sup>	13.0 <sup>‡</sup>	10.1 <sup>‡</sup>
Mar	-31.8	-4.2	13.3	1.5	7.6	65.4	3.08	4.8	173.4	36.5	22.3	17.9
Apr	-7.1 <sup>‡</sup>	1.5 <sup>‡</sup>	6.7 <sup>‡</sup>	8.0 <sup>†</sup>	6.0 <sup>†</sup>	72.4 <sup>‡</sup>	3.72 <sup>‡</sup>	7.0 <sup>‡</sup>	96.7 <sup>‡</sup>	32.3 <sup>‡</sup>	20.5 <sup>‡</sup>	14.7 <sup>‡</sup>
May	-2.8 <sup>‡</sup>	9.4 <sup>‡</sup>	22.0 <sup>‡</sup>	56.2 <sup>†</sup>	0.0 <sup>†</sup>	71.6 <sup>‡</sup>	5.27 <sup>‡</sup>	4.9 <sup>‡</sup>	189.3 <sup>‡</sup>	40.0 <sup>‡</sup>	25.4 <sup>‡</sup>	18.6 <sup>‡</sup>
Jun	-4.4	12.6	30.0	108.6	0.0	74.0	5.13	4.3	173.1	38.7	24.4	17.5
Jul	3.5	17.8	32.4	84.4	0.0	76.6	5.65	4.0	181.0	38.0	26.3	18.5
Aug	-2.1	13.6	30.8	74.8	0.0	83.6	4.32	3.8	183.8	36.1	25.8	17.0
Sep	-8.8	7.9	25.4	61.2	0.0	81.9	2.65	4.4	191.5	41.6	20.8	17.0
Oct	-12.8	2.6	16.9	5.8	0.0	72.8	1.62	5.7	189.6	44.0	25.7	20.2
Nov	-21.8	-6.6	5.7	2.6	10.0	89.0	0.52	3.9	183.3	38.2	20.4	14.6
Dec	-39.9	-22.0	-1.5	0.0	15.4	79.5	0.22	3.3	163.1	31.2	17.0	14.3

\* Snowfall is expressed as snow water equivalent, based on measured snow depth and assuming a snow density of 0.1 g/cm<sup>3</sup> for freshly deposited snow.

† Values recorded at the Aurora Climate Station have been supplemented by data from Fort McMurray Airport (MSC Station 3062693) for the periods Jan 11 to Feb 22 and Apr 2 to May 17.

‡ Statistics based on incomplete monthly data.

## **3 SNOW COURSE SURVEY**

### **3.1 PURPOSE**

The purpose of a snow course survey is to provide data for determining average, accumulated snow depth for the watershed during a winter as well as snow redistribution in various terrain types. The resulting snowpack accumulation data are correlated with recorded snowfall data at a climate station to determine the snowfall undercatch correction factor and to provide accurate snowfall input to a hydrologic model for accurate model calibration and verification.

A program of snow course survey for a number of years (e.g., five years) is recommended to collect sufficient data for accomplishing the program objectives. Snow course surveys were previously undertaken in the Muskeg River basin in 1997, 1998 and 1999. The 2000 program was a continuation of this systematic snow course survey program. Although the survey was conducted in the Muskeg River basin from 1997 to 2000, the resulting snowpack data can be extrapolated to nearby basins with similar terrain types, wind and precipitation characteristics.

### **3.2 SNOWPACK AND TERRAIN TYPES**

Snowpack accumulation is dependent on terrain type, which is a function of both topography and vegetation. In the Muskeg River basin, vegetation is the dominant feature dictating classification of the terrain types. The main terrain types defined for the snow course surveys undertaken from 1997 to 2000 included the following:

- flat low lying areas (with a mix of willow and shrub vegetation);
- mixed deciduous areas (with a mix of aspen, spruce, and other trees);
- open land areas (such as harvested areas with little vegetation);
- jack pine areas; and
- open lake areas.

Sixteen snow course survey plots were selected each year based on this terrain classification. Plots were identified by a visual assessment of the site.



### **3.3 SNOW COURSE MEASUREMENTS**

The water equivalent of a snowpack (the equivalent depth of water if the snowpack is melted) is a product of snow depth and snow density. At each snow course survey plot, snow depths and snow densities were measured as follows:

- **Snow Depth Measurements**

At each plot, 30 depth measurements were made at randomly selected locations on a large circle. These depth measurements were taken by inserting a sharp rebar into the snowpack, reading the snowline mark and then measuring it with a tape.

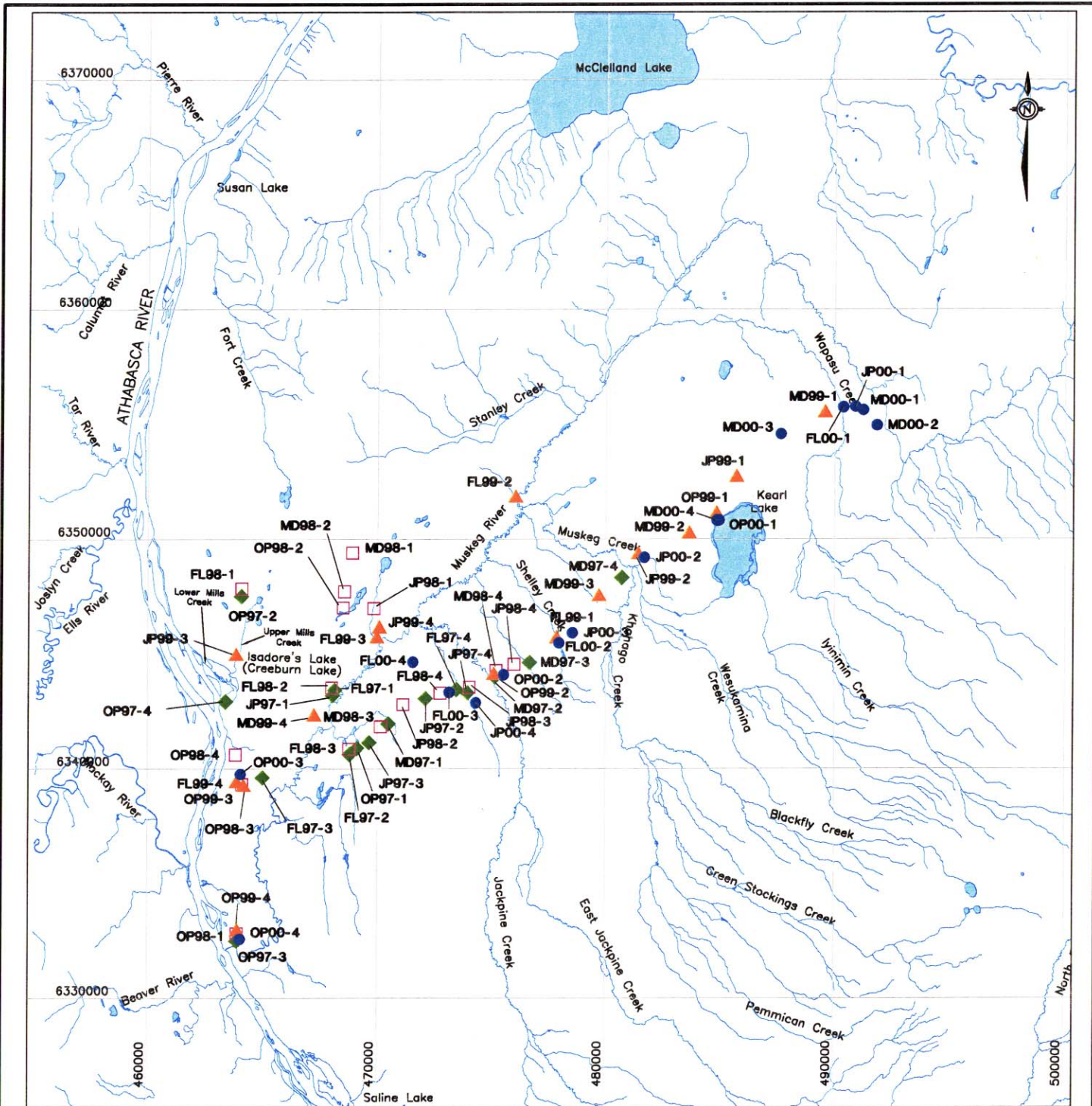
- **Snow Density Measurement**

Three density measurements were taken at each plot, using an Atmospheric Environment Services (AES) density sampler. The AES sampler was inserted carefully into the snowpack. Snow depth was read on the tube, when the corer reached the soil surface. The corer was then inserted/twisted more deeply into the ground to get a plug of soil to prevent the granular snow falling out of the bottom of the snow profile. The tube weight was measured (with and without snow) using the spring scale. The units of the spring scale directly provided the snow water equivalent (SWE) of the snowpack in centimetres.

Additional notes were taken on vegetation cover type, colour of snow surface, and snow consistency. Appendix II presents the terrain type, snow cover information and snowpack measurement data collected on March 12, 2000. For comparison with previous snow course data, the appendix includes the data collected from March 17 to 19, 1997 (Golder 1997a), March 14 to 16, 1998 (Golder 1999) and March 15 to 17, 1999 (Golder 2000). No photographs of sampling locations were taken in 2000, but photos representative of the various terrain types were provided in previous reports.

### **3.4 SUMMARY OF SNOW COURSE DATA 1997-2000**

The snow course survey sampling locations for the 1997 to 2000 programs are shown on Figure 3.1. The snow course data collected are summarized in Table 3.1 and on Figure 3.2.



**LEGEND**

- FL FLAT LOW LYING
- OP OPEN LAND OR LAKE
- MD MIXED DECIDUOUS
- JP JACKPINE
- 97 1997 SNOW COURSE SURVEY
- 98 1998 SNOW COURSE SURVEY
- 99 1999 SNOW COURSE SURVEY
- 00 2000 SNOW COURSE SURVEY

**REFERENCE**

DRAWING FROM AGRA EARTH AND ENVIRONMENTAL LIMITED  
 FIG.14.35-A3 CATCHMENT BOUNDARIES OF LOCAL STUDY AREA  
 JAN, 1996.

0 2.5 5 7.5 10 12.5 km

SCALE 1:250,000



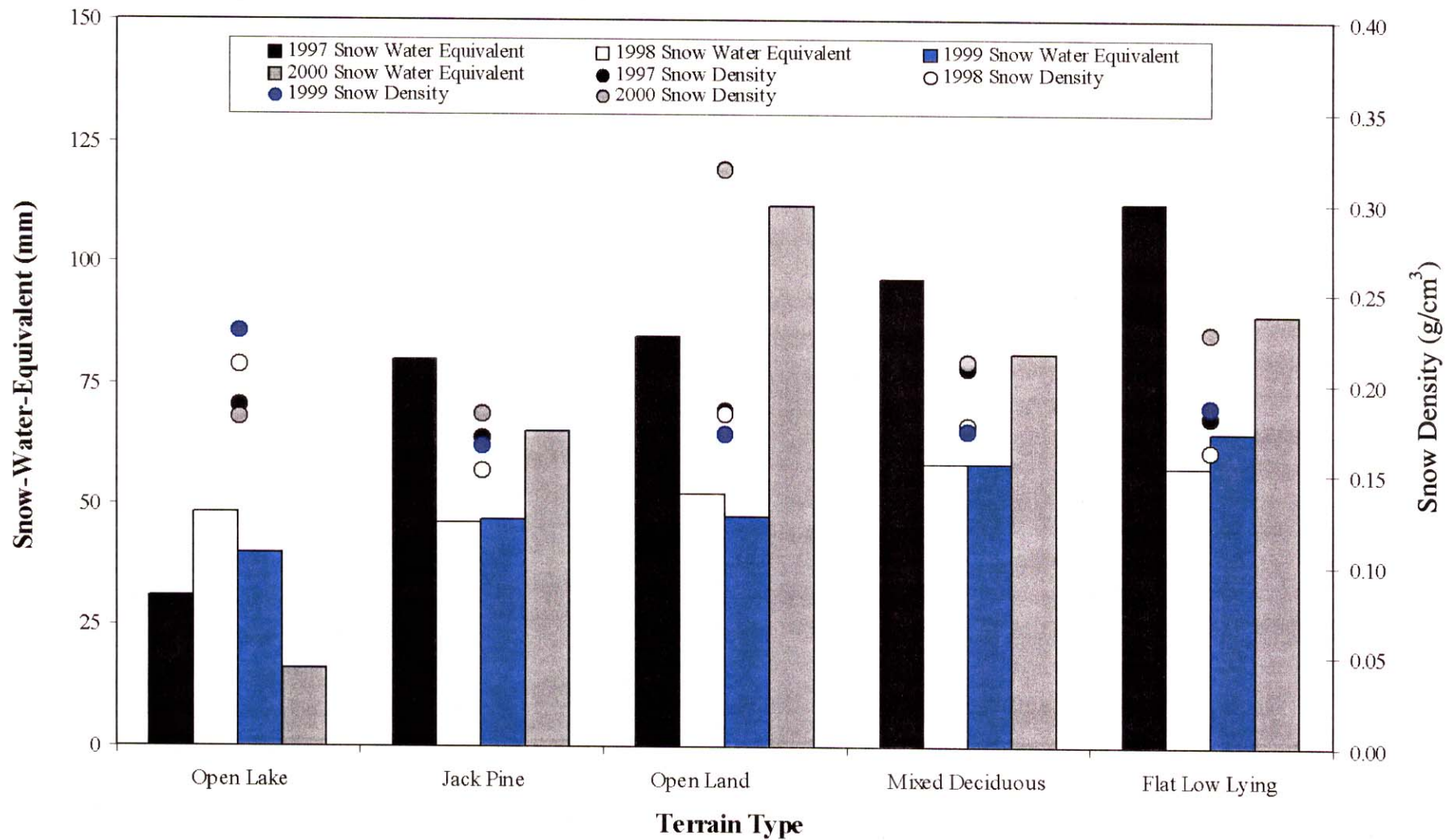
RAMP


**LOCATIONS OF SNOW COURSE SURVEY SITES**

DRAWN: TVS	APPROVED:	DATE: 16 Feb. 2001
PROJECT: 002-2309.7000		FIGURE: 3.1

**Table 3.1 Summary of 1997, 1998, 1999 and 2000 Snow Course Survey Data**

Terrain Type	1997 Snow Course Survey				1998 Snow Course Survey				1999 Snow Course Survey				2000 Snow Course Survey			
	Survey Plot No.	Snow Density (g/cm <sup>3</sup> )	Snow Depth (cm)	Snow Water Equivalent (mm)	Survey Plot No.	Snow Density (g/cm <sup>3</sup> )	Snow Depth (cm)	Snow Water Equivalent (mm)	Survey Plot No.	Snow Density (g/cm <sup>3</sup> )	Snow Depth (cm)	Snow Water Equivalent (mm)	Survey Plot No.	Snow Density (g/cm <sup>3</sup> )	Snow Depth (cm)	Snow Water Equivalent (mm)
Open Lake	OP97-1	0.175	14.6	25.6	OP98-2	0.256	16.3	41.9	OP99-1	0.231	21.2	48.8	OP00-1	0.181	9.0	16.2
	OP97-4	0.201	18.2	36.7	OP98-3	0.163	33.1	54.0	OP99-3	0.227	13.3	30.3	OP00-3	N/A	N/A	N/A
	<b>97 Mean</b>	<b>0.188</b>	<b>16.4</b>	<b>31.2</b>	<b>98 Mean</b>	<b>0.210</b>	<b>24.7</b>	<b>48.0</b>	<b>99 Mean</b>	<b>0.229</b>	<b>17.3</b>	<b>39.6</b>	<b>00 Mean</b>	<b>0.181</b>	<b>9.0</b>	<b>16.2</b>
Jack Pine	JP97-1	0.170	44.9	76.5	JP98-1	0.184	29.2	53.8	JP99-1	0.142	34.7	49.5	JP00-1	0.204	42.3	86.2
	JP97-2	0.165	48.5	80.2	JP98-2	0.163	30.8	50.3	JP99-2	0.177	30.1	53.4	JP00-2	0.180	35.3	63.4
	JP97-3	0.167	51.1	85.8	JP98-3	0.140	29.3	41.0	JP99-3	0.199	24.0	47.8	JP00-3	0.196	30.6	59.8
	JP97-4	0.178	43.2	77.1	JP98-4	0.121	31.7	38.4	JP99-4	0.146	24.8	36.8	JP00-4	0.153	33.9	52.0
	<b>97 Mean</b>	<b>0.170</b>	<b>46.9</b>	<b>79.9</b>	<b>98 Mean</b>	<b>0.152</b>	<b>30.3</b>	<b>45.9</b>	<b>99 Mean</b>	<b>0.166</b>	<b>28.4</b>	<b>46.9</b>	<b>00 Mean</b>	<b>0.183</b>	<b>35.5</b>	<b>65.4</b>
Open Land	OP97-2	0.184	44.3	81.6	OP98-1	0.151	30.8	46.6	OP99-2	0.140	36.2	50.7	OP00-2	0.356	39.1	139.3
													OP00-3	0.280	30.2	84.7
	OP97-3	0.185	47.6	88.2	OP98-4	0.214	26.9	57.5	OP99-4	0.203	21.9	44.4	OP00-4	0.354	17.8	63.0
	<b>97 Mean</b>	<b>0.185</b>	<b>46.0</b>	<b>84.9</b>	<b>98 Mean</b>	<b>0.183</b>	<b>28.9</b>	<b>52.1</b>	<b>99 Mean</b>	<b>0.172</b>	<b>29.1</b>	<b>47.6</b>	<b>00 Mean</b>	<b>0.318</b>	<b>34.7</b>	<b>112.0</b>
Mixed Deciduous	MD97-1	0.204	54.7	111.7	MD98-1	0.175	35.5	62.1	MD99-1	0.155	36.1	56.1	MD00-1	0.207	38.9	80.5
	MD97-2	0.205	37.4	77.0	MD98-2	0.211	31.8	66.9	MD99-2	0.174	36.5	63.5	MD00-2	0.232	39.5	91.6
	MD97-3	0.181	44.0	80.1	MD98-3	0.143	32.3	46.3	MD99-3	0.178	36.9	65.6	MD00-3	0.232	36.5	84.8
	MD97-4	0.240	48.6	117.1	MD98-4	0.178	32.2	57.4	MD99-4	0.187	25.3	47.3	MD00-4	0.177	38.1	67.6
	<b>97 Mean</b>	<b>0.208</b>	<b>46.2</b>	<b>96.5</b>	<b>98 Mean</b>	<b>0.177</b>	<b>33.0</b>	<b>58.2</b>	<b>99 Mean</b>	<b>0.174</b>	<b>33.7</b>	<b>58.1</b>	<b>00 Mean</b>	<b>0.212</b>	<b>38.3</b>	<b>81.1</b>
Flat Low Lying	FL97-1	0.187	54.2	101.9	FL98-1	0.181	35.9	64.8	FL99-1	0.178	36.9	65.6	FL00-1	0.255	41.7	106.5
	FL97-2	0.169	50.4	85.6	FL98-2	0.155	36.1	55.8	FL99-2	0.175	33.5	58.8	FL00-2	0.270	34.3	92.6
	FL97-3	0.189	76.5	144.6	FL98-3	0.181	34.2	61.7	FL99-3	0.204	33.9	69.0	FL00-3	0.196	48.6	95.3
	FL97-4	0.178	65.6	117.2	FL98-4	0.133	36.2	48.0	FL99-4	0.191	34.6	66.3	FL00-4	0.190	33.2	63.1
	<b>97 Mean</b>	<b>0.181</b>	<b>61.7</b>	<b>112.3</b>	<b>98 Mean</b>	<b>0.163</b>	<b>35.6</b>	<b>57.6</b>	<b>99 Mean</b>	<b>0.187</b>	<b>34.7</b>	<b>64.9</b>	<b>00 Mean</b>	<b>0.228</b>	<b>39.5</b>	<b>89.4</b>



		RAMP
<b>SNOW WATER EQUIVALENT AND SNOW DENSITY OF VARIOUS TERRAIN TYPES</b>		
DRAWN: BGM	APPROVED:	DATE: 20 Feb. 2001
PROJECT: 002-2309.7000		FIGURE: 3.2

The data in Table 3.1 show that the snow density is relatively consistent throughout the five different terrain types surveyed. Therefore, the relative differences of snow depths between terrain types and years are directly reflected in variations in snow water equivalent (SWE) as described below.

The two terrain types, jack pine and mixed deciduous, have similar snow-water-equivalent depths (80 and 97 mm in 1997; 46 and 58 mm in 1998; 58 and 47 mm in 1999; 65 and 81 mm in 2000). Forest canopies intercept a percentage of precipitation (for both rain or snow) before it reaches the ground. The interception rate is proportional to the canopy coverage. Mixed deciduous tree sites, without leaves, have a more open canopy than jack pine sites and generally have a slightly greater snow-water-equivalent.

Flat low-lying areas feature a dense shrub coverage, which has a low interception rate, yet provides a wind-sheltered, calm area that maximizes snow accumulation potential (112 mm in 1997; 58 mm in 1998; 65 mm in 1999; 89 mm in 2000).

Open lake areas have the smallest snow-water-equivalent depth (31 mm in 1997; 48 mm in 1998; 40 mm in 1999; 16 mm in 2000), due to the wind swept, open nature of the site.

Open land areas (clearings) have snow-water-equivalent similar to that of the forest covers (85 mm in 1997; 52 mm in 1998; 48 mm in 1999; 112 mm in 2000). The original survey design called for only one category of open area. However, the survey results indicate that open land and open lake sites have distinctly different snow accumulations. Interception at the two sites is zero and the difference between the sites is likely due to differences in wind exposure.

## 4 HYDROLOGIC MONITORING

### 4.1 DESCRIPTIONS OF STATIONS

Hydrologic monitoring included the collection of streamflow, TSS and lake water level data. The streamflow monitoring stations included in this program are named S1 to S13 and the lake level monitoring stations are named L1 to L3. The stations at Fort Creek (S12) and Albian Pond #3 (S13) were installed and commenced operation in 2000. The monitoring stations at Iyininim Creek (S3), Kearl Lake Outlet (S9) and Wapasu Creek (S10) were removed from service in 2000. Table 4.1 summarizes the pertinent details of the hydrologic monitoring stations included in the 2000 program. Additional information, including photographs and descriptions of equipment, is provided on each station's Factsheet in Appendix III.

**Table 4.1 Details of Hydrologic Monitoring Stations**

Station No.	Stream Name	Station Location		Basin Area (km <sup>2</sup> )	Period of Record
		Latitude (N)	Longitude (W)		
S1	Alsands Drain	57° 15' 12"	111° 29' 52"	15.8	1995 - 2000
S2 <sup>†</sup>	Jackpine Creek	57° 14' 21"	111° 24' 53"	358	1995 - 2000
S3	Iyininim Creek	57° 15' 00"	111° 10' 27"	24.5	1995 - 1999
S4	Blackfly Creek	57° 12' 20"	111° 15' 22"	38.2	1995 - 1999
S5A*	Muskeg River Aurora	57° 18' 30"	111° 23' 43"	552	1995 - 2000
S6	Mills Creek	57° 14' 44"	111° 35' 57"	23.8	1997 - 2000
S7	Muskeg River WSC	57° 11' 29"	111° 34' 10"	1,460	1975 - 2000
S8	Stanley Creek	57° 21' 06"	111° 22' 26"	71.8	1999 - 2000
S9	Kearl Lake Outlet	57° 15' 57"	111° 15' 57"	73.6	1998 - 1999
S10	Wapasu Creek	57° 20' 35"	111° 09' 40"	90.7	1997 - 1999
S11	Poplar Creek	56° 54' 46"	111° 27' 44"	422	1995 - 2000
S12	Fort Creek	57° 24' 48"	111° 37' 18"	35.5	2000 - 2000
S13	Albian Pond #3	57° 14' 47"	111° 30' 58"	disturbed	2000 - 2000
L1	McClelland Lake	57° 29' 30"	111° 16' 37"	191	1997 - 2000
L2	Kearl Lake	57° 18' 15"	111° 14' 40"	72.6	1999 - 2000
L3	Isadore's Lake	57° 13' 15"	111° 36' 24"	28.0	2000 - 2000

\* Relocated in 1998.

† Relocated in 2000.

## **4.2 STREAMFLOW MEASUREMENTS AND MONITORING**

### **4.2.1 Summary**

Manual measurements of stream discharges were performed at intervals over the winter (January to March and November to December), spring snowmelt (April) and summer months (May to October) in 2000. The water levels at these streamflow stations were continuously monitored by pressure transducers and recorded by data loggers over the summer months in 2000. The continuous monitoring period was extended at several stations where freezing to the streambed was not likely. Appendix IV presents a summary table of manual discharge measurements and the detailed calculation sheets for measurements performed in 2000.

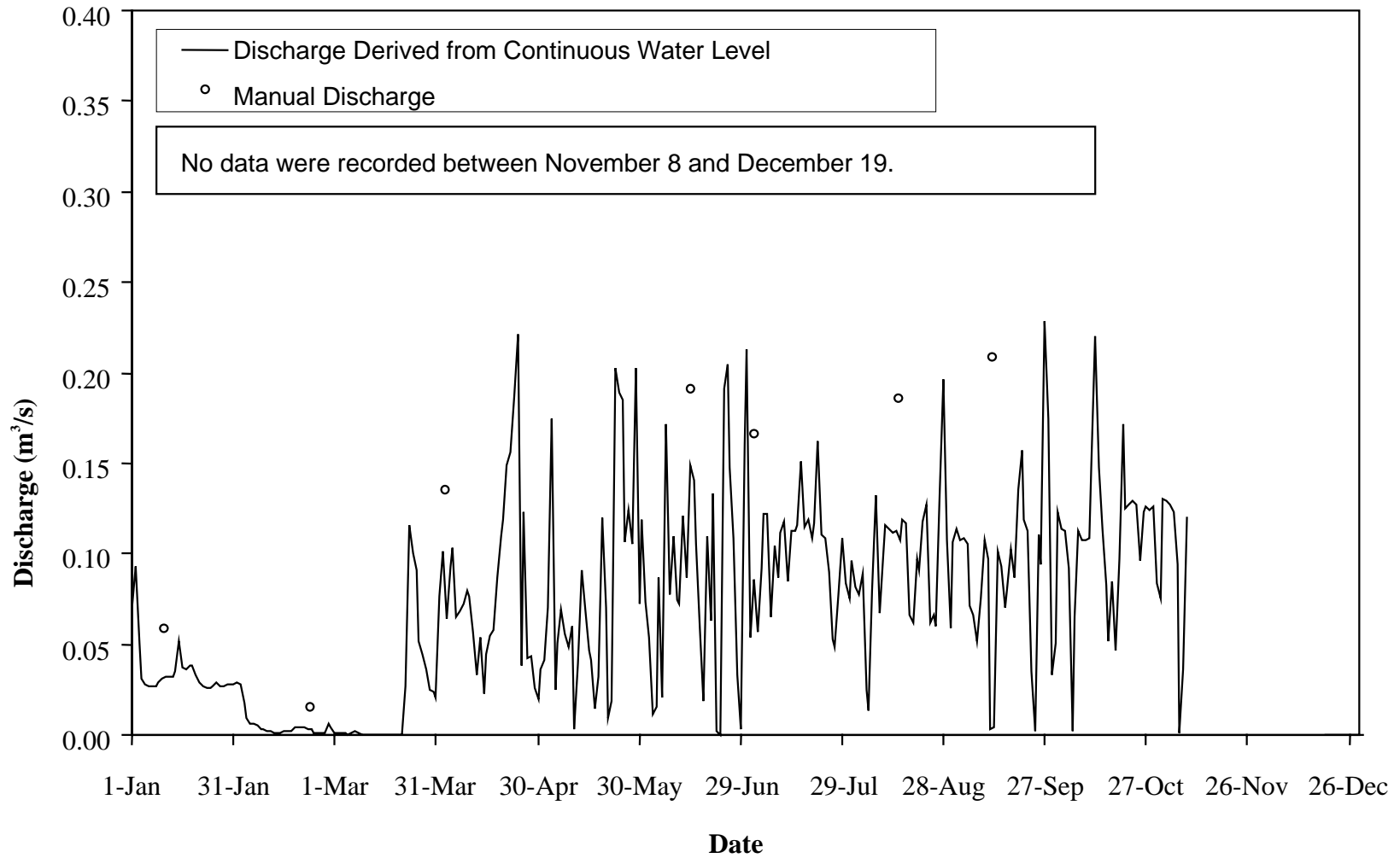
Manual discharge measurements from 2000 and, where applicable, 1997 through 1999, were used to develop stage-discharge rating curves for the streamflow monitoring stations. These rating curves were used to derive discharges from the continuous record of water level measurements. The resulting stage-discharge rating curves are presented in Appendix V. Appendix VI contains recorded daily water levels and derived stream discharges. A database containing the detailed raw and processed, water level and stream discharge data is stored on a compact disc in Appendix IX.

### **4.2.2 Alsands Drain Streamflow Monitoring Station (S1)**

The Alsands Drain weir was in service throughout 2000 except for the period from November 8 to December 19, when the data logger battery failed and no data were recorded. The recorded hydrograph for this station is presented on Figure 4.1. It shows continuous records from January 1 to November 8 and December 19 to December 31, 2000. The rating curve for the weir was verified using data from eleven manual discharge measurements performed at this station on January 10, February 22, April 2, May 17, June 14, July 2, August 14, September 11, October 17, November 8 and December 19, 2000. The measured discharges are documented in Appendix IV and the current rating curve is provided in Appendix V. Mean daily water levels and discharges are provided in Appendix VI.

Note that pumping at this station results in rapid and significant fluctuations in discharge over the course of a typical day. Therefore, on Figure 4.1, mean daily discharges are shown instead of 15-minute discharges. Most measured discharges appear high, since the mean daily data typically incorporate periods of zero discharge.

**Figure 4.1 2000 Discharge Hydrograph at Alsands Drain Station (S1)**





### **4.2.3 Jackpine Creek Streamflow Monitoring Station (S2)**

The Jackpine Creek station was relocated in April 2000 to a site just downstream of the Canterra Road bridge. This allowed road access to the site, where a helicopter was previously required. The new site is also superior because there does not appear to be a beaver dam problem, as there was at the old site. No significant tributaries enter Jackpine Creek between the two sites, so the catchment area measured by the station is essentially unchanged and data from the two sites will not require adjustment for comparison. A new rating curve was developed for the site in 2000.

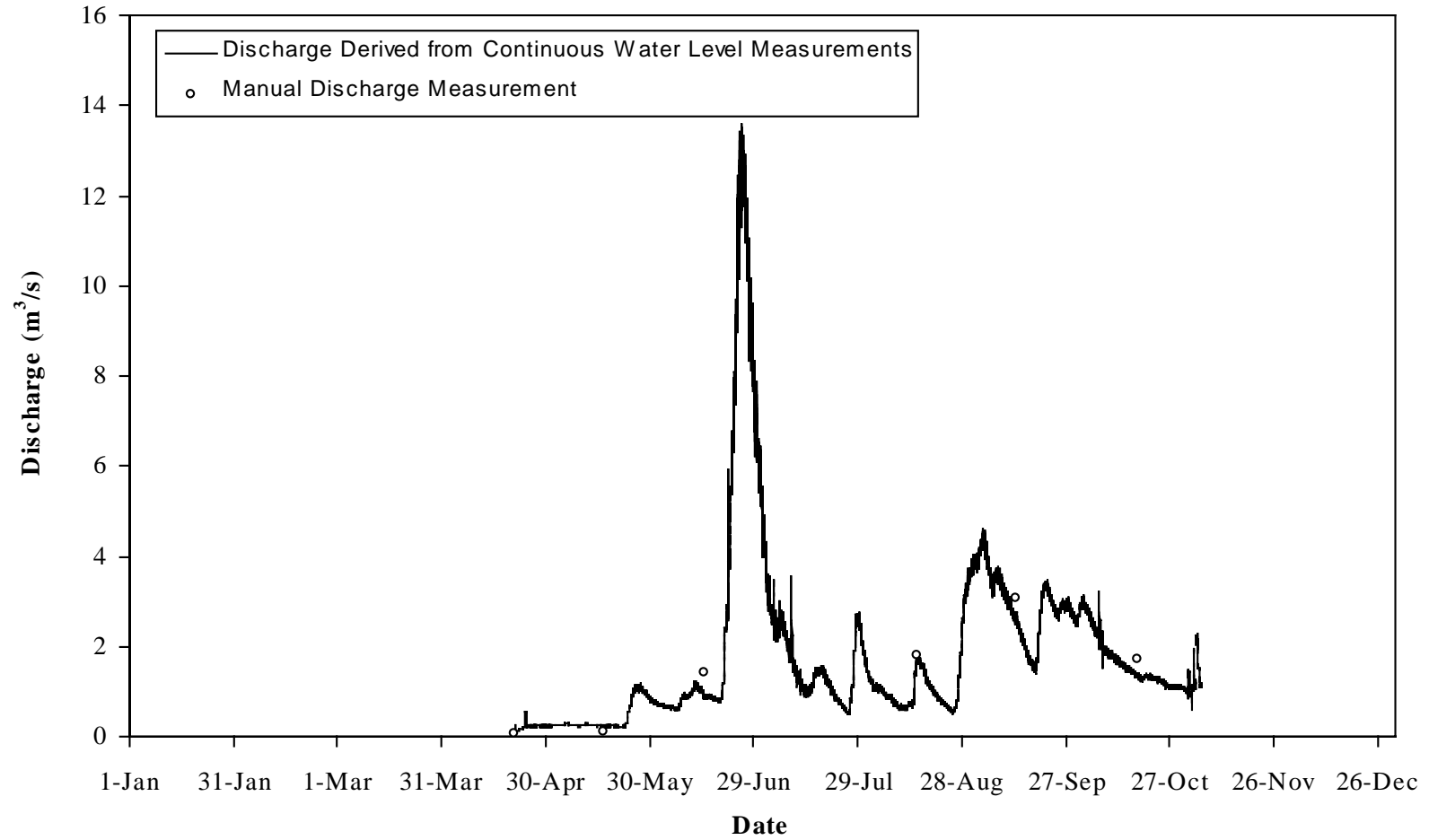
The recorded hydrograph for this station is presented on Figure 4.2. It shows a continuous record from April 20 to November 5, 2000. The pressure transducer and data logger were removed from this site in early November to prevent ice damage, as it was expected that the creek would freeze solid over the winter. Seven manual discharge measurements were performed at this station on April 20, May 16, June 14, August 14, September 12, October 17 and December 22, 2000. The site was also visited on July 2 and November 8 but discharge measurements were not performed on those dates. The measured discharges are documented in Appendix IV and the updated rating curve is provided in Appendix V. Mean daily water levels and discharges are provided in Appendix VI.

### **4.2.4 Iyininmin Creek Streamflow Monitoring Station (S3)**

This hydrometric monitoring station was not operated in 2000. It was discontinued because it lies in the Aurora South Lease area, which will not be developed in the near future. It is recommended that the station be reactivated three to five years before development commences in the Aurora South Lease. The current rating curve for the station is provided in Appendix V.

A tipping-bucket rain gauge was installed at this station in May, 1998. The rain gauge was deactivated and placed in storage after the 1999 monitoring season. It is recommended that the rain gauge be reinstalled at a yet-to-be-determined location in the spring of 2001.

**Figure 4.2 2000 Discharge Hydrograph at Jackpine Creek Station (S2)**



#### **4.2.5 Blackfly Creek Streamflow Monitoring Station (S4)**

This hydrometric monitoring station was not operated in 2000. The decision to discontinue operation was based on its location in the Aurora South Lease area, which will not be developed in the near future. It is recommended that the station be reinstalled three to five years before development commences in the Aurora South Lease. When the station is reinstalled, it may be necessary to remove several beaver dams or relocate the gauge upstream or downstream of the current site. The current rating curve for the station is provided in Appendix V.

#### **4.2.6 Muskeg River Aurora Streamflow Monitoring Station (S5A)**

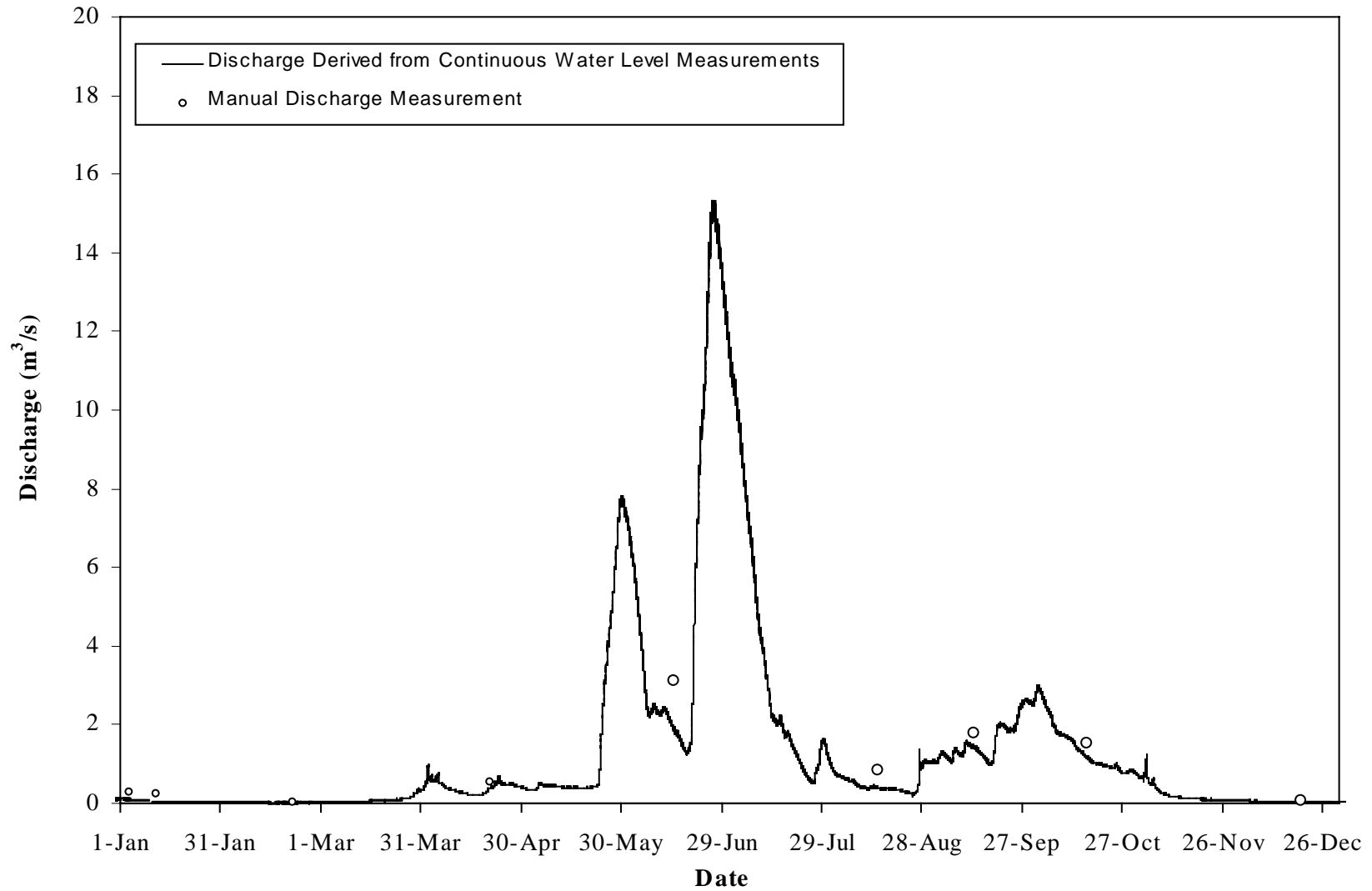
Summer and winter (ice covered) rating curves were updated for this station based on the data collected in 2000. The recorded hydrograph for this station is presented on Figure 4.3. It shows a continuous record from January 1 to December 31, 2000. Eight manual discharge measurements were performed at this station on January 11, February 21, April 20, June 14, August 14, September 12, October 17 and December 19, 2000. The station was also visited to download data on April 2, July 2 and November 10, 2000. The measured discharges are documented in Appendix IV and the updated rating curve is provided in Appendix V. Mean daily water levels and discharges are provided in Appendix VI.

The pressure transducer at this station was left in place during the winter to monitor the stage hydrograph through the winter, because the depth of water at this station protects it from potential damage due to freezing.

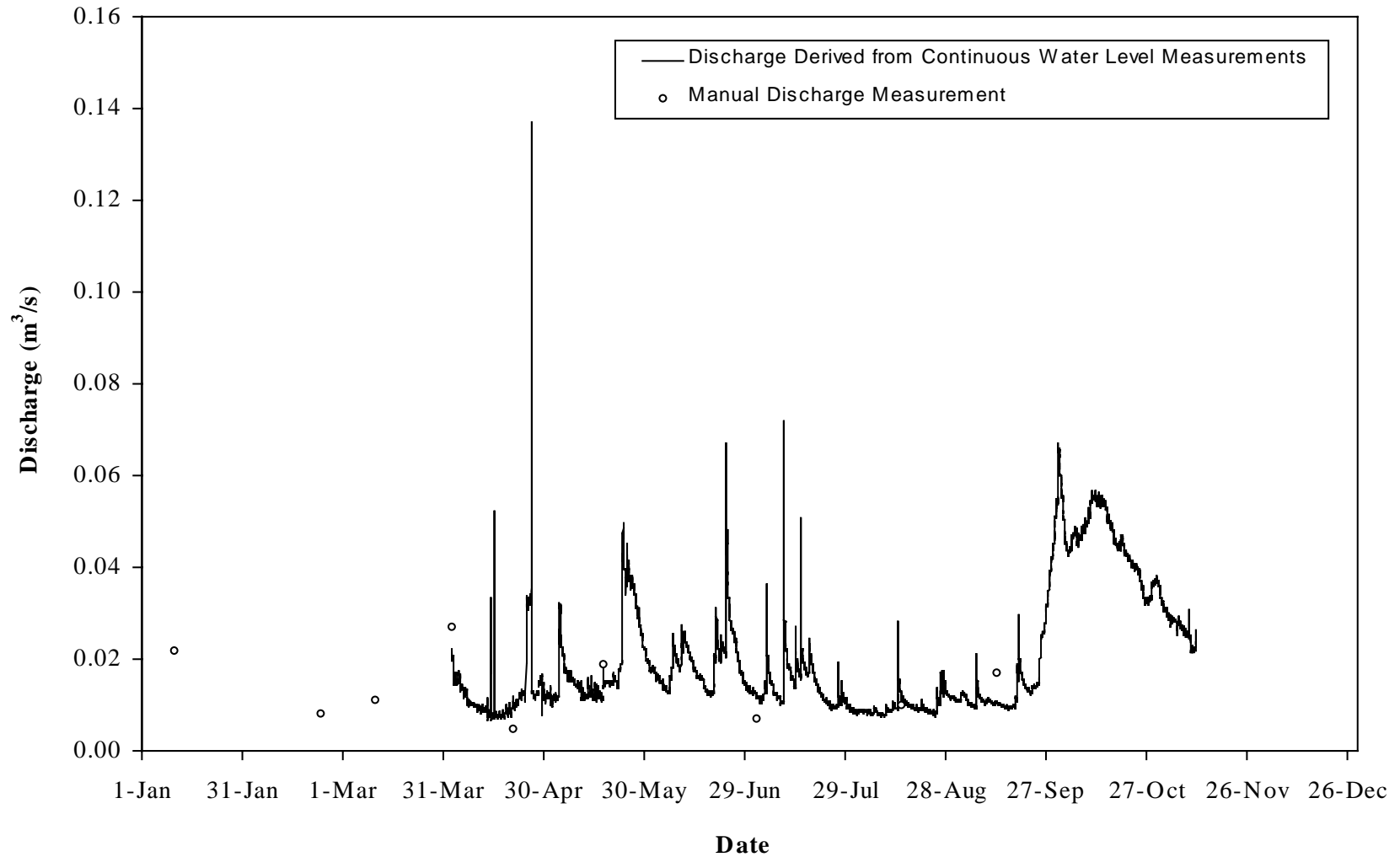
#### **4.2.7 Mills Creek Streamflow Monitoring Station (S6)**

The recorded hydrograph for this station is presented on Figure 4.4. It shows a continuous record from April 2 to November 10, 2000. Nine manual discharge measurements were performed at this station on January 10, February 23, March 10, April 2, April 20, May 17, July 2, August 14 and September 12, 2000. The station was also visited on November 10 and December 20, 2000. The measured discharges are documented in Appendix IV and the current rating curve is provided in Appendix V. Mean daily water levels and discharges are provided in Appendix VI.

**Figure 4.3 2000 Discharge Hydrograph at Muskeg River Aurora Station (S5A)**



**Figure 4.4 2000 Discharge Hydrograph at Mills Creek Station (S6)**



#### **4.2.8 Muskeg River WSC Streamflow Monitoring Station (S7)**

This station is operated by the Water Survey of Canada (WSC) during the open water season of each year. In 2000, Golder was responsible for performing winter discharge measurements and updating the winter rating curve. Monitoring equipment was left in place over the summer as a redundant measure in case WSC data were unavailable. The site was visited on January 12, February 21, March 12, April 20 and May 17, 2000 to conduct manual discharge measurements. The station was also visited on June 14, July 2, August 15, September 12, November 8 and December 20 to download data and/or perform manual water level measurements. In November 2000, a submersible pressure transducer was deployed for the duration of the winter. It will be retrieved after ice breakup to provide a continuous record of water levels for the winter months (November to February). Manual discharge measurements to provide data to update the rating curve are ongoing.

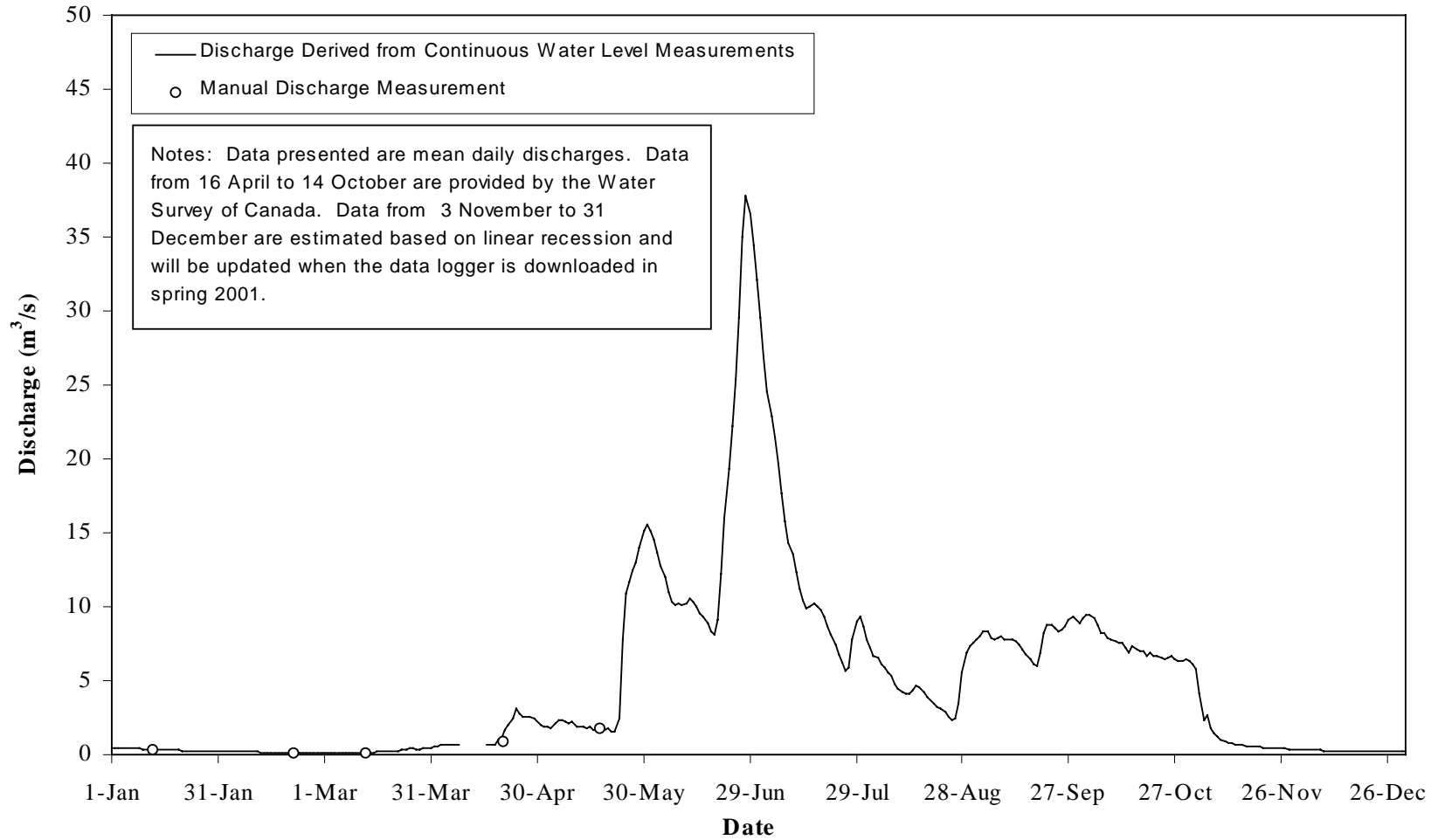
The mean daily discharge hydrograph for this station is presented on Figure 4.5. It shows a continuous record from January 1 to April 8 and April 16 to December 31, 2000. Discharges from November 3 to December 31, 2000 were estimated based a linear recession from the preceding measurements. These discharges will be recalculated when winter water level data are retrieved and the winter rating curve has been derived. The updated discharges will be presented in the 2001 RAMP Climate and Hydrology report database update. November and December 2000 data have been updated in the current database. The manual discharge measurements undertaken in 2000 are documented in Appendix IV and the current rating curve is provided in Appendix V. Mean daily discharges are provided in Appendix VI.

#### **4.2.9 Stanley Creek Streamflow Monitoring Station (S8)**

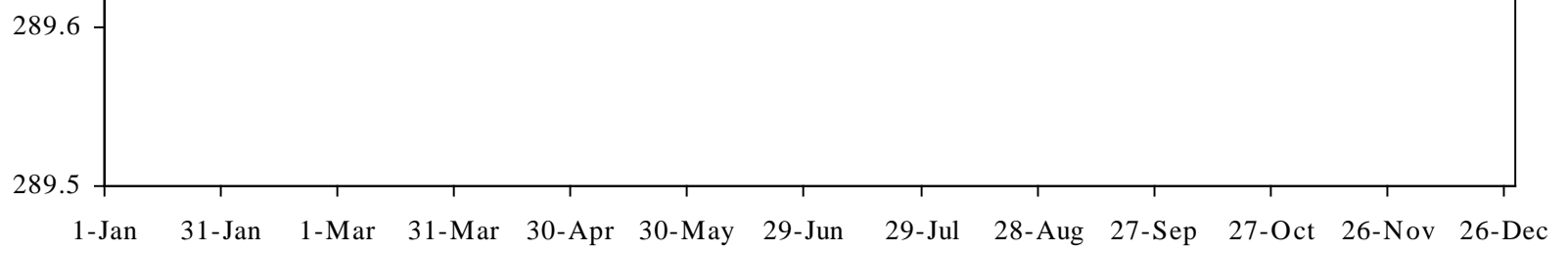
As in 1999, only water levels were monitored at this station. The station is at a site where the muskeg area narrows to less than 100 metres, but the channel is ill-defined and it is not possible to traverse the wet ground on foot. The ill-defined channel does not permit accurate discharge measurements.

The recorded water levels for this station are presented on Figure 4.6. It shows a continuous record from April 3 to November 9, 2000. Six manual water level measurements were performed at this station on April 3, May 16, July 3, September 13, October 18 and November 9, 2000. Mean daily water levels are provided in Appendix VI.

**Figure 4.5 2000 Discharge Hydrograph at Muskeg River WSC Station (S7)**



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#### **4.2.10 Kearl Lake Outlet Streamflow Monitoring Station (S9)**

This hydrometric station was not operated in 2000. The decision to discontinue operation was based on its location in an area that is not scheduled for development in the near future. This station could provide valuable data for calibrating regional hydrologic models, so consideration should be given to reactivating it, if funding is available. As a minimum, it is recommended that the station be reinstalled three to five years before development commences in Lease 31 (Syncrude Aurora South) or Lease 36 (Mobil Kearl). The current rating curve for the station is provided in Appendix V.

#### **4.2.11 Wapasu Creek Streamflow Monitoring Station (S10)**

This hydrometric station was not operated in 2000. The decision to discontinue operation was based on its location in an area that is not scheduled for development in the near future. This station could provide valuable data for calibrating regional hydrologic models, so consideration should be given to reactivating it, if funding is available. At a minimum, it is recommended that the station be reinstalled three to five years before development commences in Lease 31 (Syncrude Aurora South) or Lease 36 (Mobil Kearl). A new culvert road crossing is being constructed at this site in early 2001, so a reinstallation would not be able to use the previously installed equipment housing. The current rating curve for the station is provided in Appendix V.

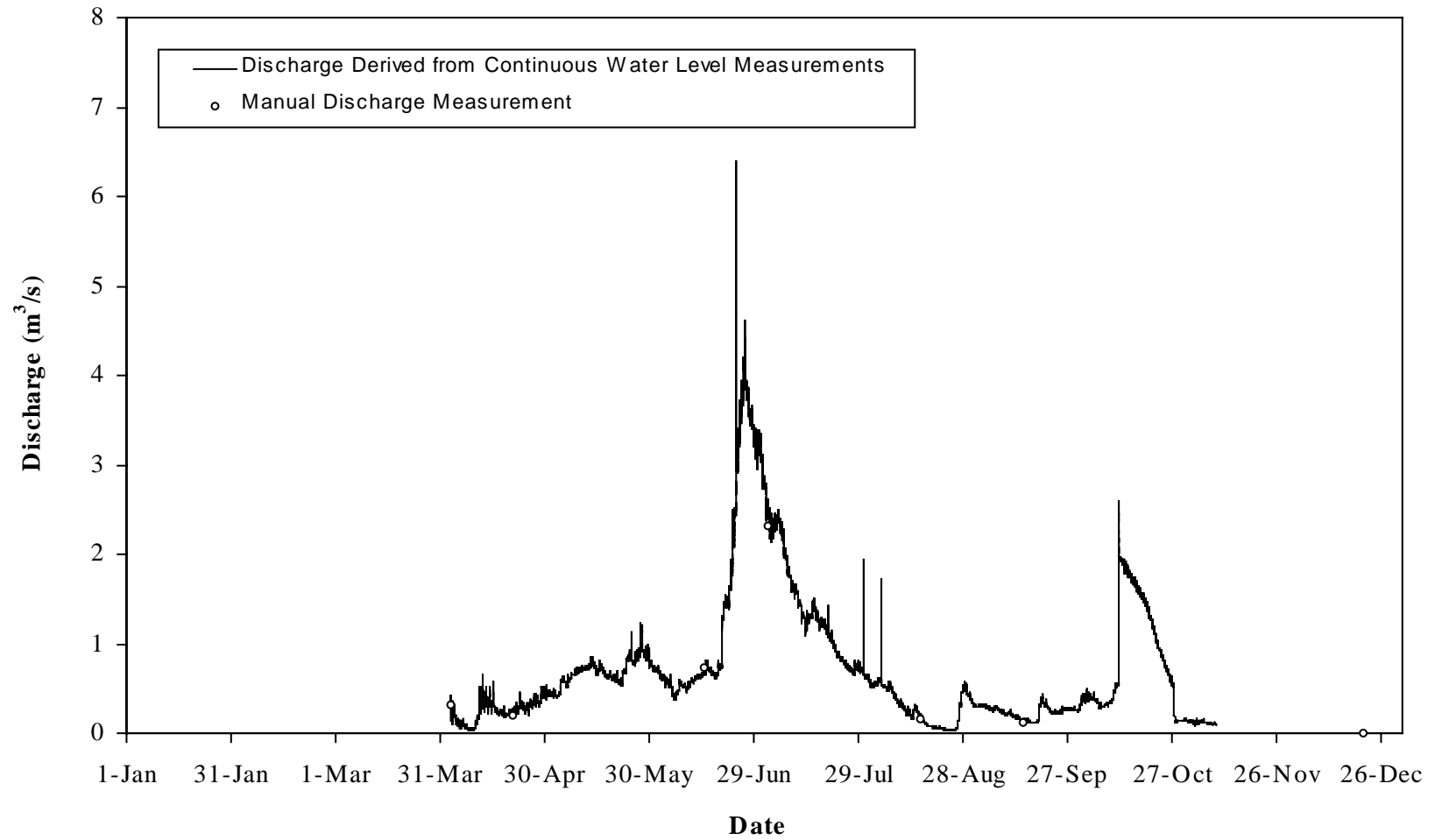
#### **4.2.12 Poplar Creek Streamflow Monitoring Station (S11)**

The recorded hydrograph for this station is presented on Figure 4.7. It shows a continuous record from April 2 to November 8, 2000. Ten manual discharge measurements were performed at this station on January 12, February 24, April 2, April 20, May 17, June 14, July 2, August 15, September 14 and December 20, 2000. The station was also visited on November 8, 2000. The measured discharges are documented in Appendix IV and the updated rating curve is provided in Appendix V. Mean daily water levels and discharges are provided in Appendix VI.

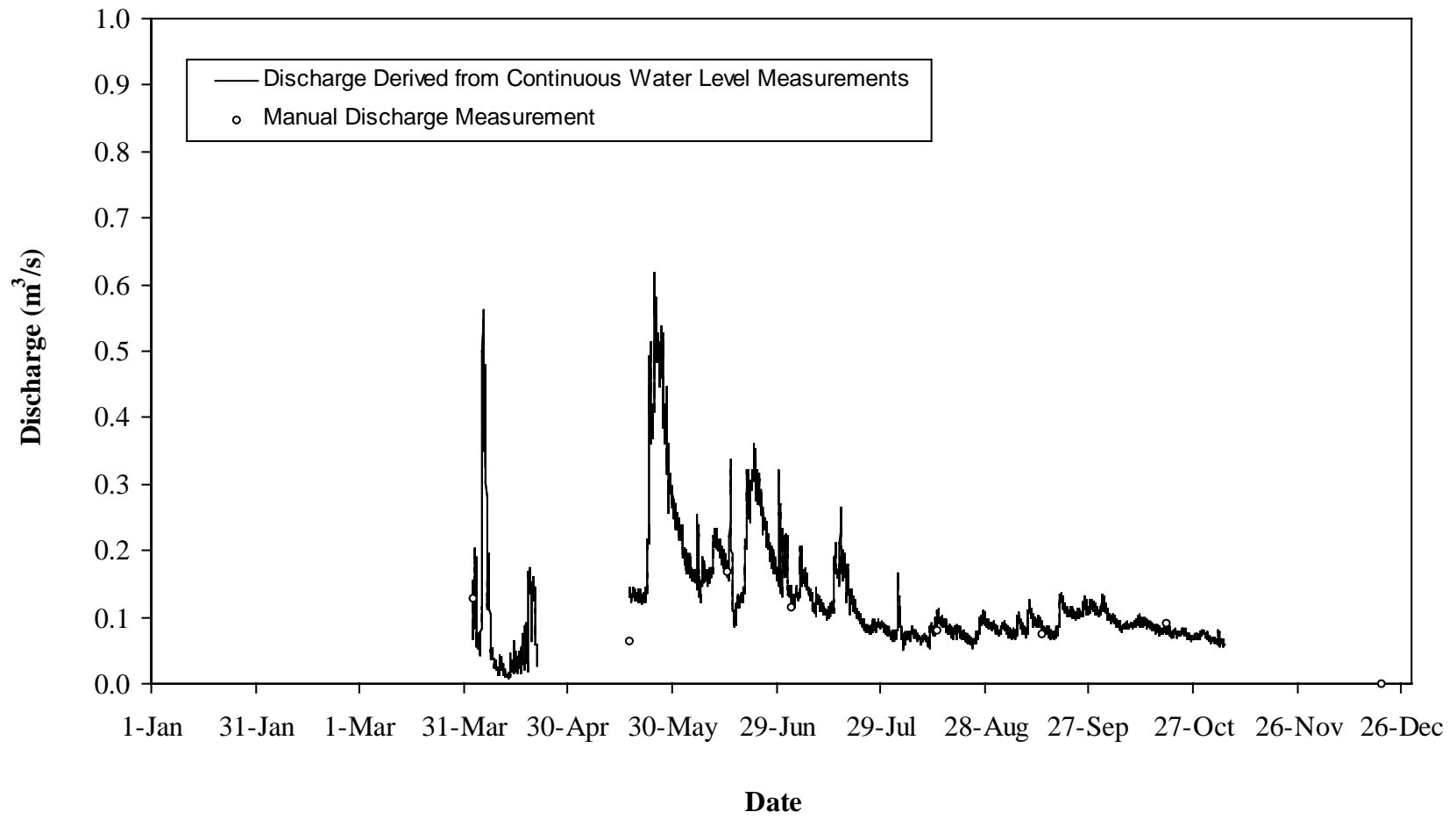
#### **4.2.13 Fort Creek Streamflow Monitoring Station (S12)**

This station was installed on Fort Creek, just downstream of Highway 63, in April 2000. A rating curve was developed using the discharge and water level data collected in 2000. The recorded hydrograph for this station is presented on Figure 4.8. It shows continuous records from April 2 to April 20 and May 17 to November 10, 2000. No data were recorded between April 20 and May 17, when

**Figure 4.7 2000 Discharge Hydrograph at Poplar Creek Station (S11)**



**Figure 4.8 2000 Discharge Hydrograph at Fort Creek Station (S12)**



water levels receded below the level of a temporarily installed pressure transducer. Eight manual discharge measurements were performed at this station on April 2, May 17, June 14, July 3, August 14, September 13, October 19 and December 20, 2000. The station was also visited on November 8, 2000. The measured discharges are documented in Appendix IV and the rating curve is provided in Appendix V. Mean daily water levels and discharges are provided in Appendix VI.

#### **4.2.14 Albion Pond #3 Streamflow Monitoring Station (S13)**

This station was installed at the outlet of Albion Polishing Pond #3 in March, 2000. A theoretical weir rating curve was derived and checked using the data collected in 2000. The recorded hydrograph for this station is presented on Figure 4.9. It shows a continuous record from March 2 to December 31, 2000. Six manual discharge measurements were performed at this station on June 14, July 2, August 14, September 11, October 17 and December 19, 2000. The station was also visited on April 2, May 15, May 17 and November 8, 2000. The measured discharges are documented in Appendix IV and the rating curve is provided in Appendix V. Mean daily water levels and discharges are provided in Appendix VI.

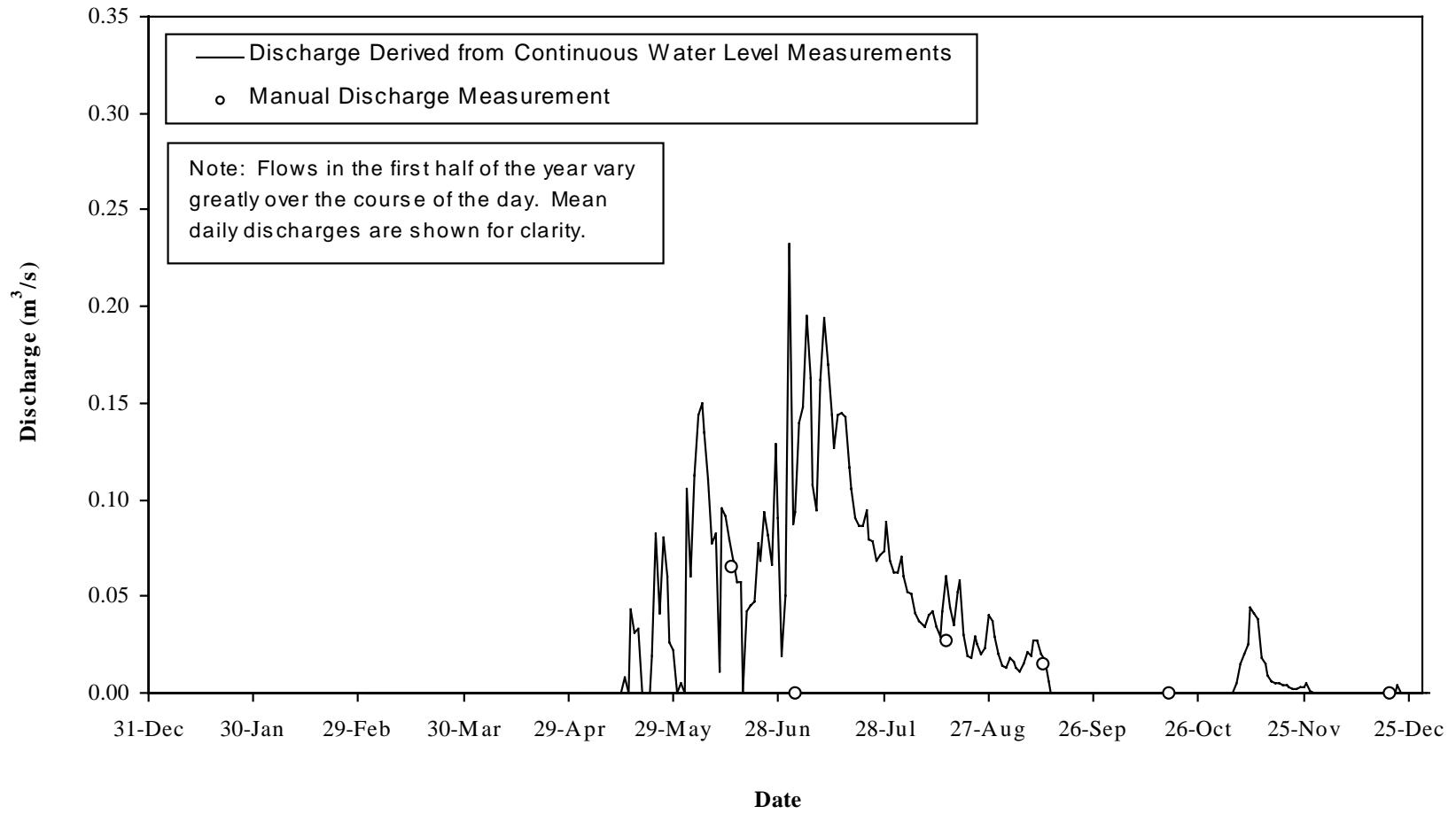
#### **4.2.15 McClelland Lake Water Level and Outflow Monitoring Station (L1)**

The recorded hydrograph for this station is presented on Figure 4.10. It shows a continuous record from May 16 to November 9, 2000. Discharges were not derived for the period from October 28 to November 9, due to ice effects at the lake outlet. Six manual discharge measurements were performed at this station on April 3, May 16, July 3, September 13, October 19 and November 9, 2000. The measured discharges are documented in Appendix IV and the outlet rating curve is provided in Appendix V. Mean daily water levels and discharges are provided in Appendix VI.

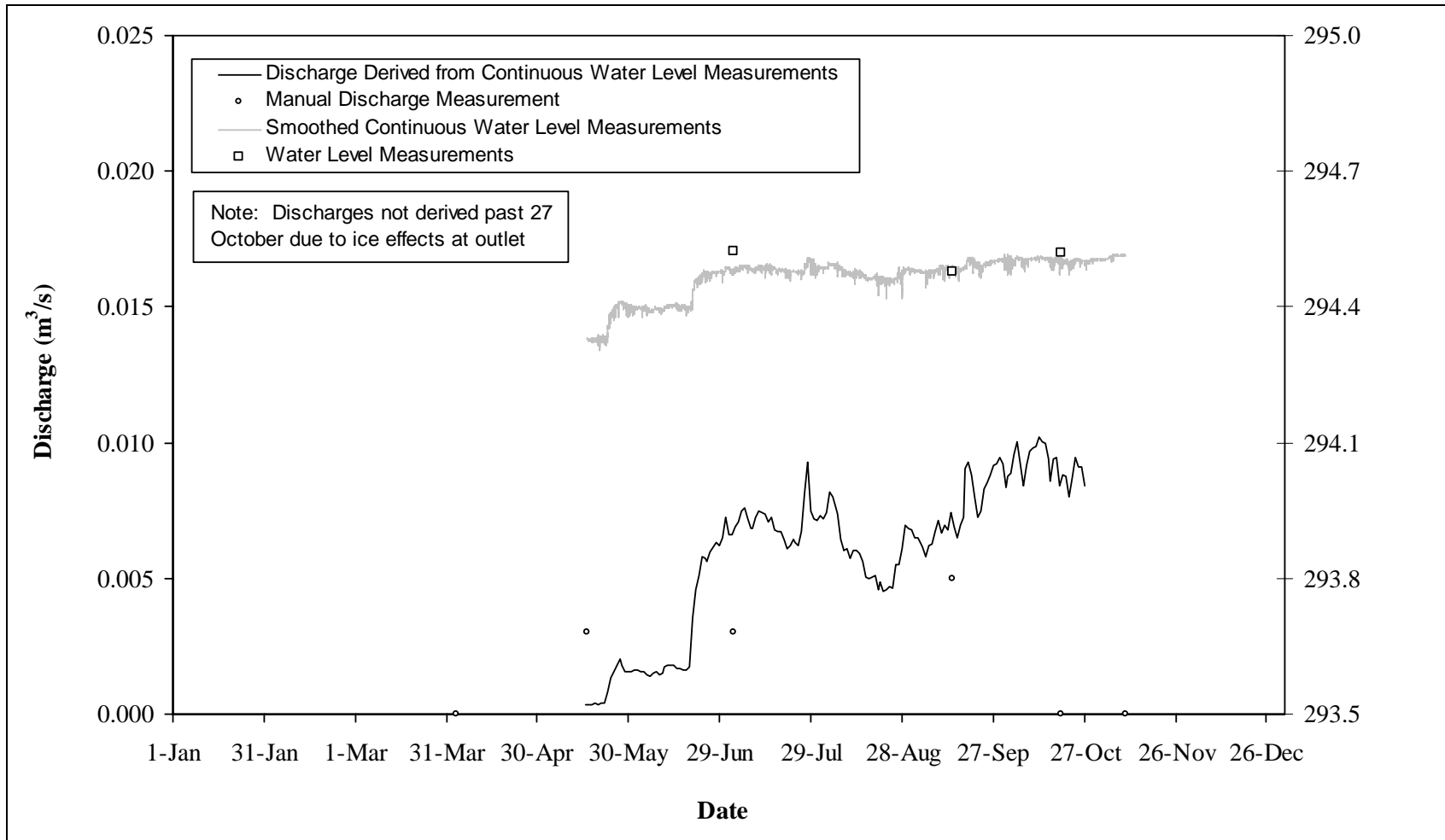
#### **4.2.16 Kearl Lake Water Level Monitoring Station (L2)**

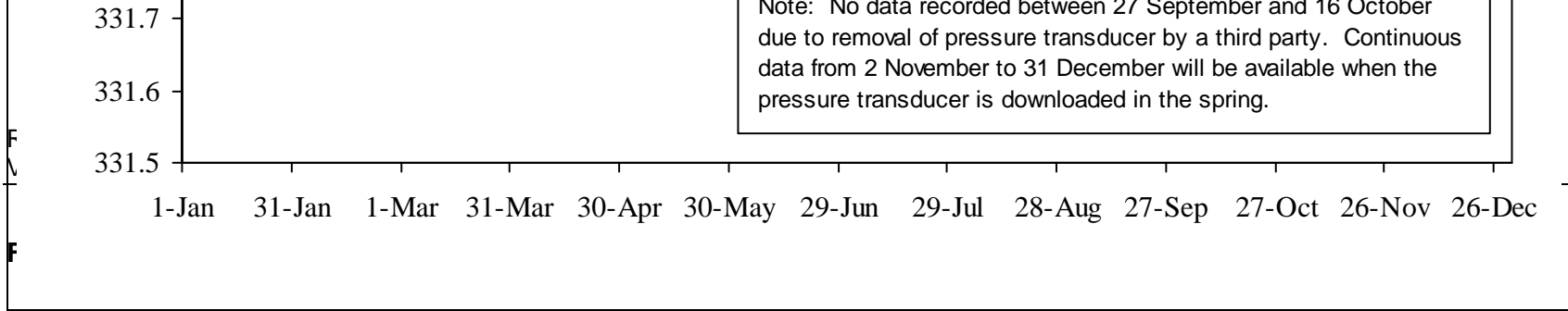
The recorded hydrograph for this station is presented on Figure 4.11. It shows a continuous record from February 22 to September 13 and from October 16 to November 2, 2000. No data were recorded between September 13 to October 16, because the pressure transducer was removed from the site by a third party. The transducer was returned and reinstalled as soon as possible after its return. The pressure transducer were left in place over the winter and data from November 2 onwards will be downloaded as soon as possible after the ice is out of the lake.

**Figure 4.9 2000 Discharge Hydrograph at Albian Pond #3 Station (S13)**



**Figure 4.10 2000 Water Level and Discharge Hydrographs at McClelland Lake Station (L1)**





Ten manual water level measurements were recorded at this station on February 22, April 2, April 20, May 17, June 14, August 15, September 12, October 17, November 8 and December 22, 2000. Raw data from the pressure transducer was corrected using atmospheric pressure data recorded at the Aurora Climate Station (C1). Mean daily water levels are provided in Appendix VI.

#### 4.2.17 Isadore’s Lake Water Level Monitoring Station (L3)

This station was installed for the first time in February 2000. The recorded hydrograph for this station is presented on Figure 4.12. It shows a continuous record from February 22 to November 2, 2000. The pressure transducer was left in place over the winter and data from November 2 onwards will be downloaded as soon as possible after the ice is out of the lake. Three manual water level measurements were recorded at this station on May 17, June 14 and November 8, 2000. The station was also visited on February 22, October 17 and November 2. Raw data from the pressure transducer was corrected using atmospheric pressure data recorded at the Aurora Climate Station (C1). Mean daily water levels are provided in Appendix VI.

### 4.3 HIGH WATER MARK SURVEY

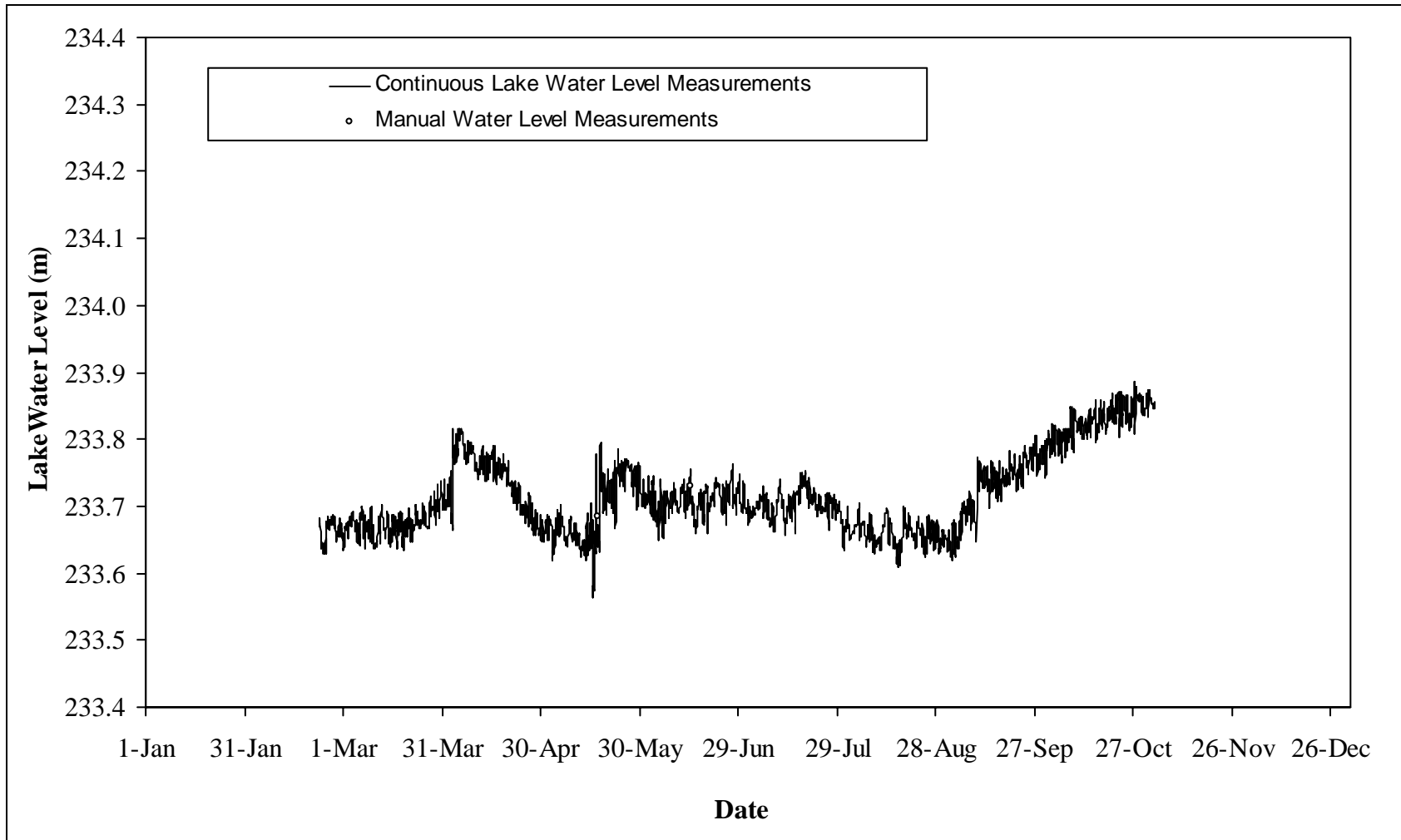
Five staff gauges were installed along the study reaches of the Muskeg River in 1999 to record high water marks. Locations of the high water mark gauges are provided in Table 4.2 and shown on Figure 4.13. Staff gauges were not deployed at sites on Jackpine Creek in 1999 or 2000, because the adjacent lease area will not be developed in the near future. It is recommended that these staff gauges be reactivated three to five years before development commences in the adjacent lease.

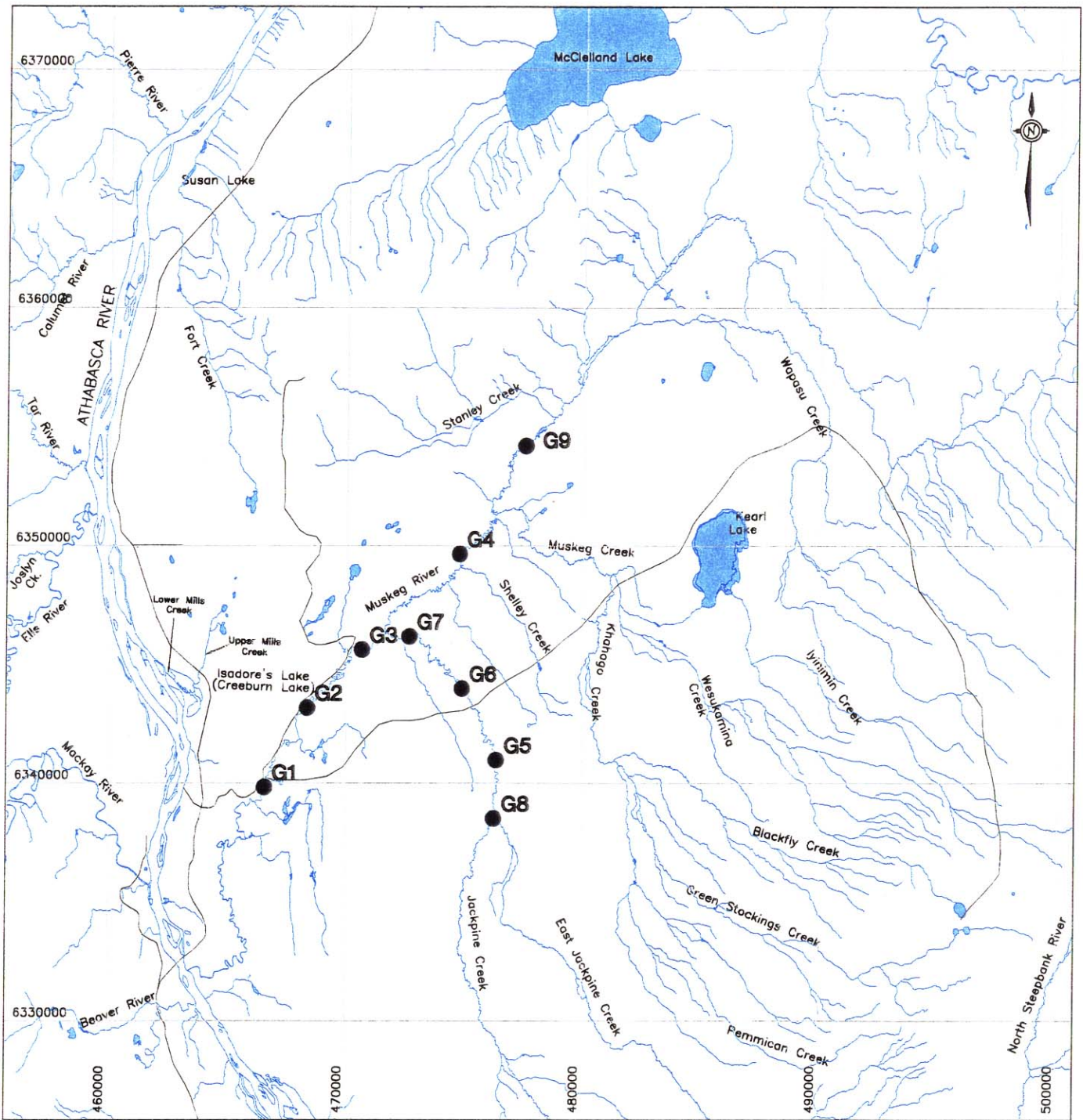
**Table 4.2 Locations of High Water Mark Gauges**

Muskeg River			Jackpine Creek (Not Installed in 1999 or 2000)		
Gauge No.	N. Latitude	W. Longitude	Gauge No.	N. Latitude	W. Longitude
G1	57° 12' 22"	111° 33' 13"	G5	57° 14' 18"	111° 24' 44"
G2	57° 14' 12"	111° 31' 20"	G6	57° 14' 21"	111° 24' 53"
G3	57° 15' 09"	111° 29' 52"	G7	57° 15' 40"	111° 28' 16"
G4	57° 17' 08"	111° 25' 13"	G8	57° 13' 58"	111° 24' 26"
G9	57° 19' 54"	111° 22' 28"			



**Figure 4.12 2000 Water Level Hydrograph at Isadore's Lake Station (L3)**





**LEGEND**

- WATER LEVEL STAFF GAUGES

**NOTE**

ONLY MUSKEG RIVER STAFF GAUGES (G1, G2, G3, G4 AND G9) WERE INSTALLED IN 1999 AND 2000

**REFERENCE**

DRAWING FROM AGRA EARTH AND ENVIRONMENTAL LIMITED  
 FIG.14.35-A3 CATCHMENT BOUNDARIES OF LOCAL STUDY AREA  
 JAN, 1996.

0 2.5 5 7.5 10 12.5km

SCALE 1:250,000



**RAMP**

**LOCATION PLAN FOR  
 HIGH WATER MARK GAUGES**

DRAWN: TVS	APPROVED:	DATE: 16 Feb. 2001
PROJECT: 002-2309.7000	FIGURE: 4.13	

The high water marks provide required data for calibration and verification of a flood hydraulic model. The model can then be used to compute flood levels for preparation of flood risk maps along the study reaches. The resulting flood risk maps are required for ensuring safety of the mining facilities located adjacent to the river floodplain and for developing appropriate erosion protection measures.

Data collected during the 1997 monitoring program were used for calibrating the HEC-RAS hydraulic model, and it was recommended that the high water mark collection program be continued for another two to four years to collect sufficient data for updating the calibration and verification of the hydraulic model. No high water mark data were acquired in 1998 because the recording method was ineffective. In 1999, the gauges were coated with a mixture of sawdust and paint and this method proved adequate. Unfortunately, 1999 was a very dry year with a very small flood peak, and the data collected are not expected to be useful for hydraulic model calibration or verification. High water marks from the flood event of late June, 2000 were successfully measured at the five staff gauges on the Muskeg River. High water mark data from 1997 to 2000 are provided in Table 4.3.

**Table 4.3 High Water Mark Data 1997 - 2000**

	19-20 August 1997	1999	26-28 June 2000
<b>Peak Discharges at Local Streamflow Gauges (m<sup>3</sup>/s)</b>			
S2 Jackpine Creek	3.2	*	12.8
S5A Muskeg River	6.1	1.33	15.1
S7 Muskeg River	13	3.84	37.8
<b>Peak Water Surface Elevations at Staff Gauges (m)</b>			
G1	273.88	272.98	274.99
G2	276.57	276.06	277.20
G3	277.90	276.51	278.15
G4	281.72	281.25	281.85
G5	299.51	*	*
G6	298.05	*	*
G7	278.82	*	*
G8	302.30	*	*
G9	*	*	285.18

\* No data collected.

#### 4.4 MEASUREMENTS OF TOTAL SUSPENDED SOLIDS

Measurements of total suspended solids (TSS) concentration are required to characterize the watershed and channel sediment yields and erosion, and to monitor streamflow water quality. Water samples were regularly collected

during site visits to each hydrologic monitoring station in 2000. These samples were tested in a laboratory to determine the concentration of TSS. Table 4.4 summarizes the TSS measurements conducted in 1997 through 2000. The derived concentration-discharge rating curves for TSS are shown on Figure 4.14, Figure 4.15 and Figure 4.16.

Figure 4.14 presents the TSS data from four stations including Jackpine Creek (S2), Iyininim Creek (S3), Blackfly Creek (S4) and Muskeg River Aurora (S5A). The basins monitored by these stations have less in-channel and off-channel storage than the basins in Figure 4.16. Tentative TSS rating curves are shown on this figure for all basins. Iyininim and Blackfly creeks have similar TSS rating curves and similar basin areas, as do Jackpine Creek and the Muskeg River. If TSS is plotted against discharge per unit area, all four curves fall very close to one another. This indicates similar basin sediment yield characteristics among these basins.

Figure 4.15 presents the TSS data from three stations including Kearl Lake Outlet (S9), Wapasu Creek (S10) and Fort Creek (S12). The Kearl Lake Outlet basin has considerable storage upstream in Kearl Lake. Fort Creek and Wapasu Creek have frequent beaver dams located in their upper reaches. The TSS rating curve shown for Kearl Lake Outlet is only tentative, since TSS at high discharges has not been measured on this stream.

Figure 4.16 presents the TSS data from other stations, including the Alsands Drain (S1), Mills Creek (S6), Poplar Creek (S11) and Albian Pond #3 (S13). The TSS characteristics at the Alsands Drain and Albian Pond #3 are affected by dewatering and polishing pond settling. The TSS characteristics at Mills Creek are affected by a weir on the channel and Poplar Creek is affected by significant lake storage upstream. The available TSS data for these stations are too scattered to enable construction of any rating curves.

**Table 4.4 Summary of Total Suspended Solids Data Collected in 1997, 1998, 1999 and 2000**

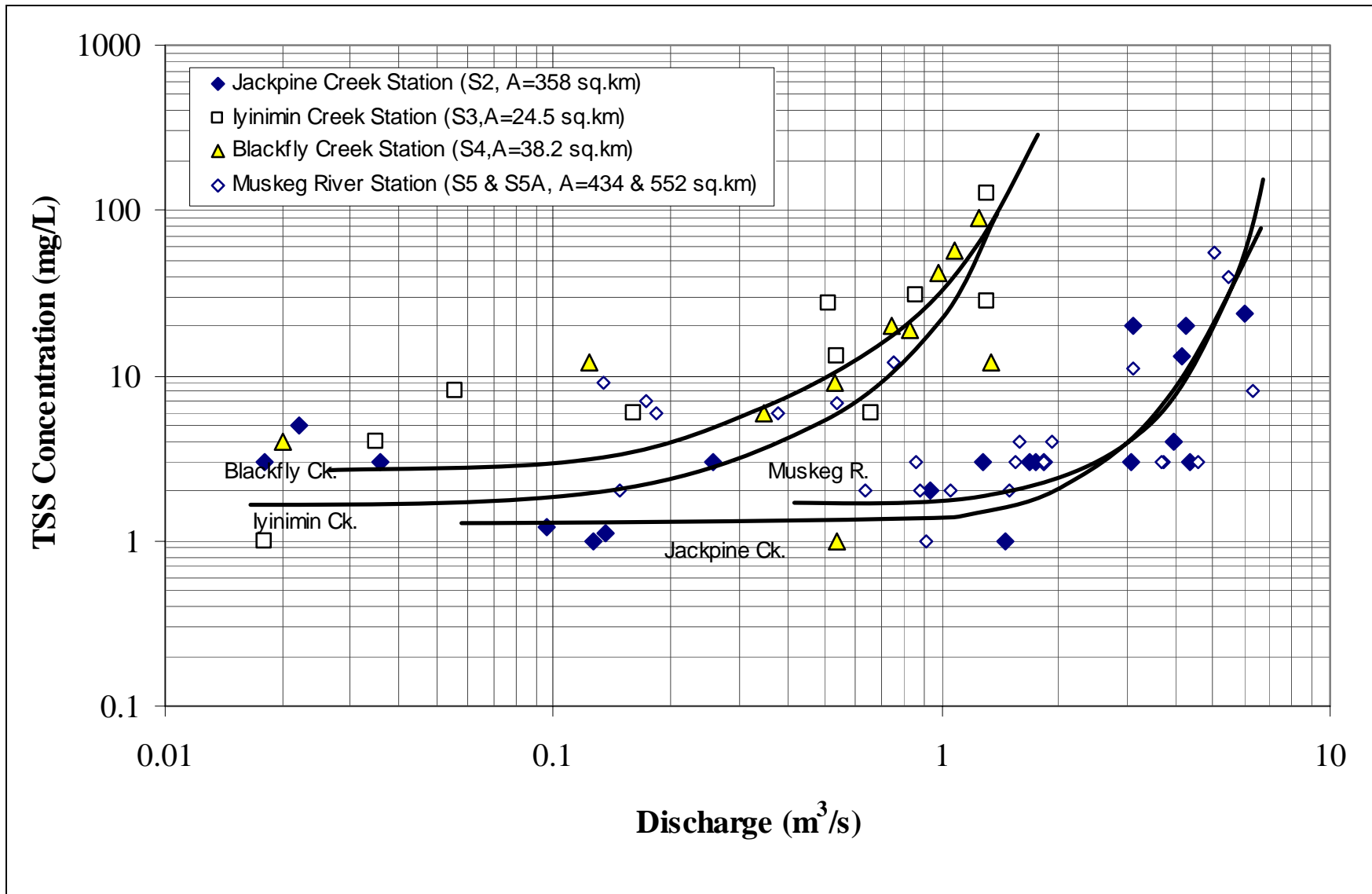
Station No.	Stream Name	TSS (mg/L)	1997 Date	TSS (mg/L)	1998 Date	TSS (mg/L)	1999 Date	TSS (mg/L)	2000 Date
S1	Alsands Drain	2	23 Apr	7	19 May	2	4 Feb	7	2 Apr
		1	30 Apr	2	24 July	4	16 Mar	2	14 Jun
		8	9 May	3	26 Oct	6	7 Apr	3	2 July
		3	3 Jun	0	14 Dec	6	29 Apr	<3	14 Aug
		2	23 Jun			2	4 Jun	3	11 Sep
		3	22 Jul			9.6	6 Jul	<3	17 Oct
		2	19 Aug			<1	23 Jul	11	8 Nov
		4	23 Sep						
		23	25 Oct						
		S2	Jackpine Creek	20	25 Apr	3	26 Jun	3	8 Apr
24	1 May			5	27 Oct	<1	5 Jun	1.1	16 May
13	8 May			5	15 Dec	3	24 Jul	1	14 Jun
3	3 Jun					1	25 Oct	4	2 July
3	21 Jun							<3	14 Aug
2	23 Jul							<3	12 Sep
20	20 Aug							<3	17 Oct
6	3 Oct							3	9 Nov
3	24 Oct								
S3	Iyininim Creek			3	4 Apr	6	17 May	2	8 Apr
		7	1 May	8	27 Jul	5	30 Apr		
		56	8 May	0	27 Oct	<1	5 Jun		
		27	3 Jun			4	24 Jul		
		13	21 Jun			<1	25 Oct		
		31	23 Jul						
		128	20 Aug						
		28	3 Oct						
6	24 Oct								
S4	Blackfly Creek	12	25 Apr	12	17 May	Station Not Operational	Station Not Operational		
		89	1 May	4	27 Jul				
		42	8 May						
		20	3 Jun						
		9	21 Jun						
		6	23 Jul						
		57	20 Aug						
		19	3 Oct						
0.4	24 Oct								
S5/S5A	Muskeg River/Aurora	3	25 Apr	1	20 May	2	4 Feb	12	2 Apr
		3	1 May	2	25 Jun	9	16 Mar	6.8	20 Apr
		3	8 May	2	26 Jul	6	29 Apr	11	14 Jun
		4	3 Jun	4	28 Oct	2	4 Jun	3	14 Aug
		2	23 Jul	8	15 Dec	7	25 Jul	3	12 Sep
		40	20 Aug					<3	17 Oct
		8	3 Oct					6	10 Nov
		55	24 Oct						
S6	Mills Creek	6	23 Apr	1	19 May	2	5 Feb	10	2 Apr
		3	30 Apr	1	24 Jul	2	15 Mar	2.4	20 Apr
		5	7 May	2	26 Oct	2	8 Apr	6	17 May
		8	4 Jun	14	15 Dec	18	29 Apr	5	2 July
		3	23 Jun			6	4 Jun	<3	14 Aug
		2	22 Jul			3.6	6 Jul	6	10 Nov
		2	19 Aug			3	23 Jul		
		5	23 Sep			2	26 Oct		
		2	25 Oct						

**Table 4.4 Summary of Total Suspended Solids Data Collected in 1997, 1998, 1999 and 2000 (continued)**

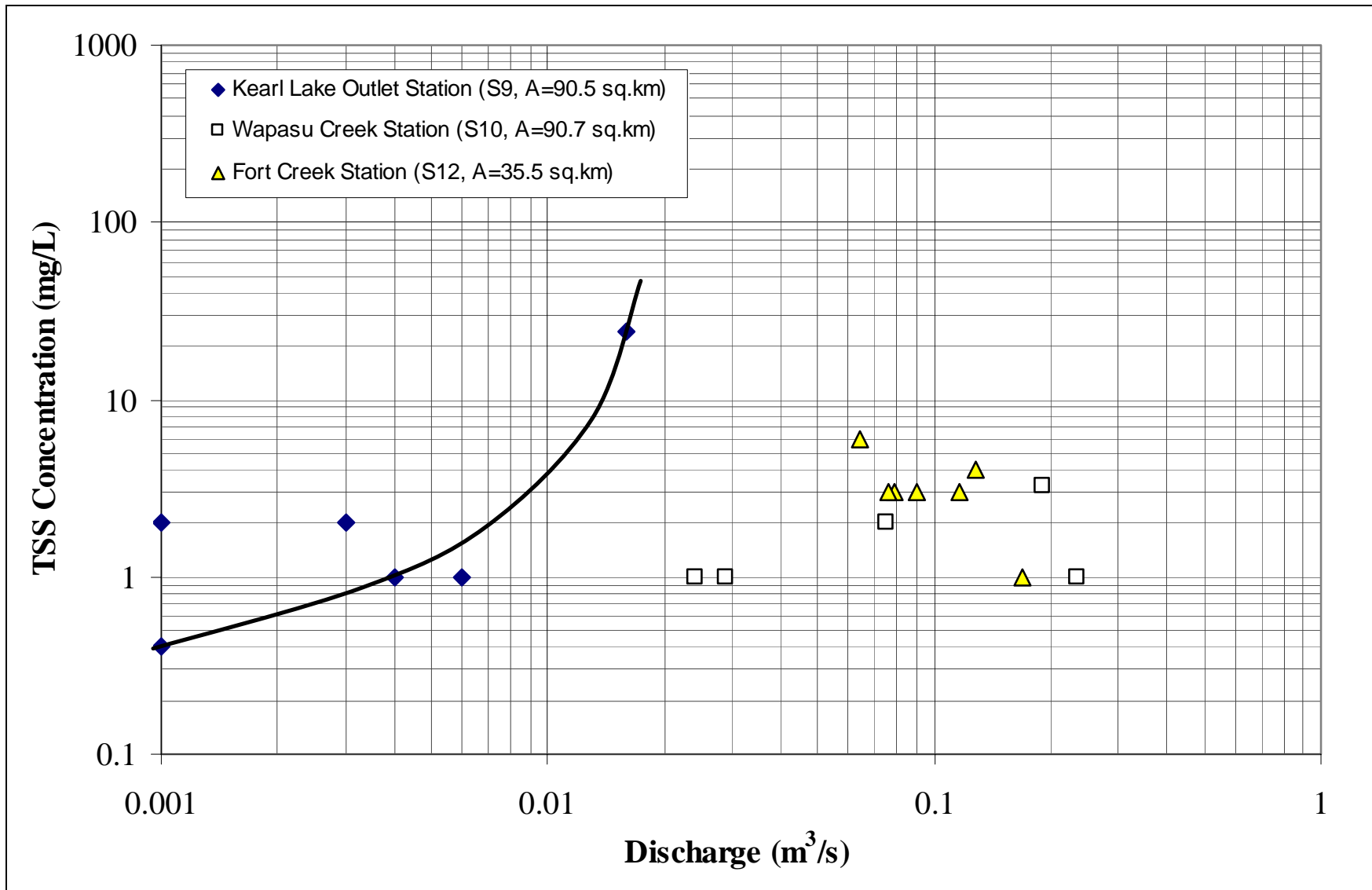
Station No.	Stream Name	TSS (mg/L)	1997 Date	TSS (mg/L)	1998 Date	TSS (mg/L)	1999 Date	TSS (mg/L)	2000 Date
S7	Muskeg River WSC			5	14 Dec	6 4 29	5 Feb 16 Mar 26 Oct	0.8 7 <1 4	20 Apr 17 May 14 Jun 9 Nov
S8	Stanley Creek					17	25 Oct		
S9	Kearl Lake Outlet			1 2 1 0.4 1.2 24	19 May 25 Jun 25 Jul 15 Sep 26 Oct 14 Dec	2 0.4 <1 2	29 Apr 5 Jul 23 Jul 26 Oct	Station Not Operational	
S10	Wapasu Creek			2 24 0.8	24 Jun 15 Sep 26 Oct	5 <1 3.3 <1 <1	29 Apr 4 Jun 5 Jul 23 Jul 26 Oct	Station Not Operational	
S11	Poplar Creek	22 5 5 5 10 1	9 Jun 23 Jun 24 Jul 19 Aug 23 Sep 25 Oct	4 8 5 19 12	20 May 24 Jun 26 Jul 16 Sep 26 Oct	10 6 2 9.6 2 2	8 Apr 29 Apr 4 Jun 5 Jul 24 Jul 26 Oct	17 9.2 5.1 22 7 <3 4	2 Apr 20 Apr 17 May 14 Jun 2 July 15 Aug 14 Sep
S12	Fort Creek							4 6 <1 <3 <3 <3 3 4	2 Apr 17 May 14 Jun 3 July 14 Aug 13 Sep 19 Oct 10 Nov
S13	Polishing Pond #3							11 <3 21	14 Jun 2 Jul 14 Aug
L1	McClelland Lake	1 17 4 2	25 Jul 20 Aug 3 Oct 24 Oct	4 12 5	17 May 26 Jun 26 Oct	2 <1 2 17	30 Apr 5 Jun 24 Jul 25 Oct	7.3 4 4	16 May 13 Sep 19 Oct
L2	Kearl Lake			9 0.8 2	24 Jun 15 Sep 26 Oct 14 Dec	4 2 7 5	29 Apr 4 Jun 23 Jul 26 Oct	29 110	2 Apr 17 May

\* Site visited but TSS sample was not collected (generally due to zero flow condition).

Figure 4.14 TSS Rating Curves for Jackpine Creek (S2), Iyininin Creek (S3), Blackfly Creek (S4) and Muskeg River Aurora (S5A) Stations Based on 1997 - 2000 Data

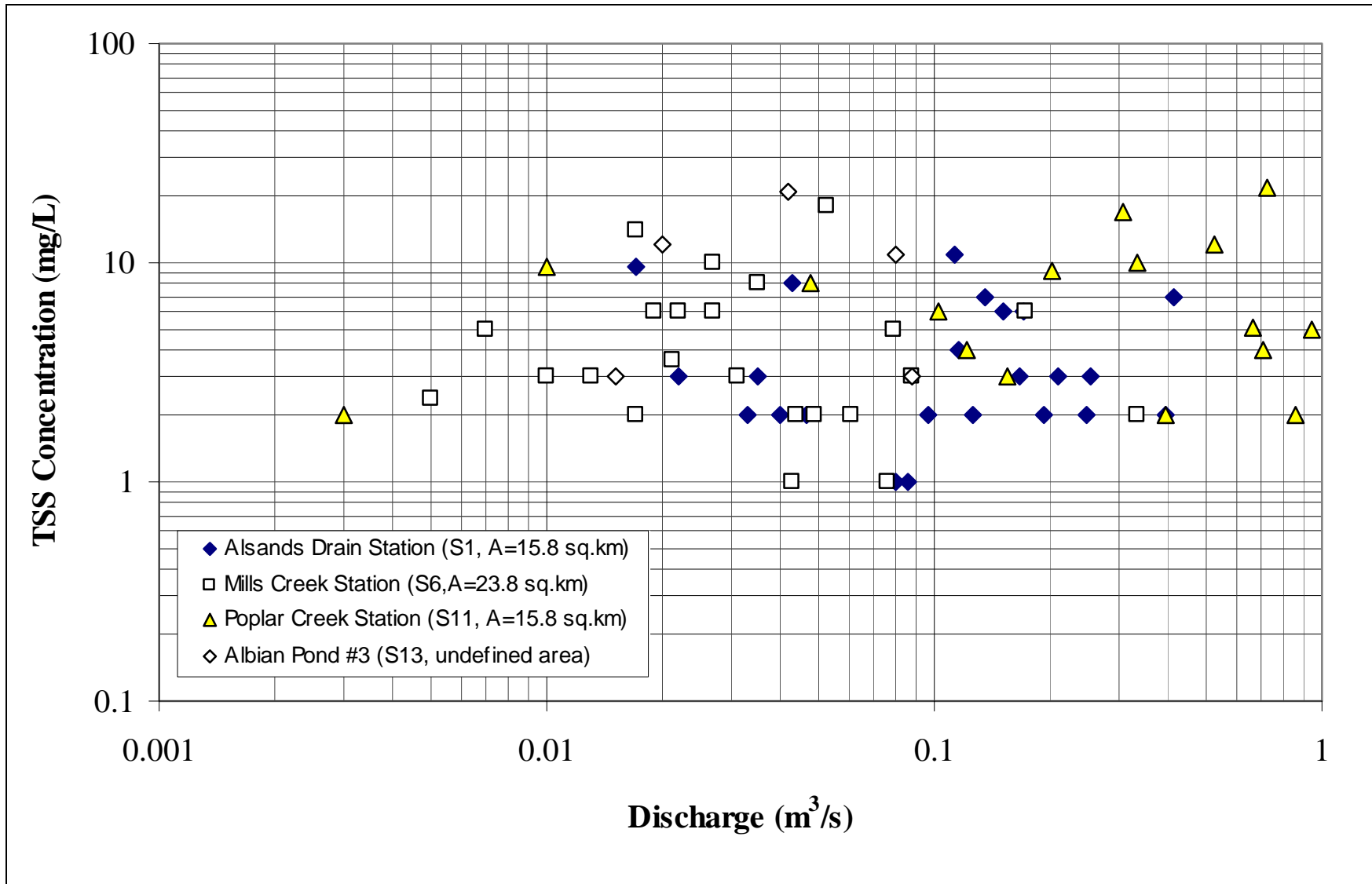


**Figure 4.15 TSS Rating Curves for Kearl Lake Outlet (S9), Wapasu Creek (S10) and Fort Creek (S12) Stations  
Based on 1997 - 2000 Data**





**Figure 4.16 TSS Rating Curves for Alsands Drain (S1), Mills Creek (S6), Poplar Creek (S11) and Albian Pond #3 (S13)  
Stations Based on 1997 - 2000 Data**



## **5 INSTALLATION AND MAINTENANCE**

### **5.1 WORK PERFORMED IN 2000**

#### **5.1.1 Aurora Climate Station (C1)**

This station was retrofitted with a new tipping-bucket snowfall gauge on January 11, 2000, and the tipping-bucket rainfall gauge was returned to Calgary for maintenance and calibration. The rainfall gauge was reinstalled on April 2, 2000 and the two gauges operated in tandem for the remainder of the year. This provided redundancy for the summer months and direct measurement of snowfall in the winter months. Mounting hardware for both tipping-bucket gauges was also upgraded in 2000.

Spare sensors for wind, temperature, relative humidity and solar radiation were purchased in November 1999 to permit regular sensor maintenance and calibration without any loss of data. The new wind sensor and solar radiation sensors were installed on May 17, 2000, using a cherry-picker provided by Syncrude. The temperature and relative humidity sensor required a data logger, program revision to accommodate a new wiring configuration, and was installed on September 12, 2000. The retrieved sensors were returned to Calgary for maintenance and calibration.

Since the Kearn Lake Outlet Station (S9) was taken out of service at the end of 1999, the data logger and barometer previously deployed there were relocated to the Aurora Climate Station. The atmospheric pressure data recorded by this barometer are essential to post-processing data from the Muskeg River WSC (S7), Kearn Lake (L2) and Isadore's Lake (L3) stations.

#### **5.1.2 Jackpine Creek Monitoring Station (S2)**

Reinstallation of the Jackpine Creek Station was previously recommended because of deterioration of the equipment housing and the presence of beaver dams at the site. The station was reinstalled at a new site, several kilometres upstream of the previous location. This site was primarily selected for ease of access. It is located immediately downstream of the Canterra Road bridge, removing the need for a helicopter to access the site. There are also no beaver dams evident in the vicinity of the station. Since there are no significant tributaries located between the new and old station locations, they have similar drainage areas. No adjustments will be required to compare discharges measured before and after the station relocation.

### **5.1.3 Fort Creek Streamflow Monitoring Station (S12)**

A pressure transducer and data logger were installed temporarily at this site on April 2, 2000. The site was surveyed for permitting in October 2000.

### **5.1.4 Albion Pond #3 Streamflow Monitoring Station (S13)**

The weir and equipment housing for this station, located on the Albion Muskeg River Mine Site, were installed by Albion Sands in March 2000. The pressure transducer and data logger were installed in the equipment housing after construction and remained for the rest of the year.

### **5.1.5 Kearn Lake Station (L2)**

Synchrude applied for a licence of occupation for the hydrometric station at Kearn Lake (L2) and this was granted on June 16, 2000. A copy of the Letter of Authority for LOC 001050 is provided in Appendix VII. The temporary installation was subsequently replaced with a more robust permanent installation on October 17, 2000.

### **5.1.6 Isadore's Lake Station (L3)**

Synchrude applied for a licence of occupation for the hydrometric station at Isadore's Lake (L3) and this was granted on June 16, 2000. A copy of the Letter of Authority for LOC 001053 is provided in Appendix VII. The temporary installation was subsequently replaced with a more robust permanent installation on October 17, 2000.

### **5.1.7 Geodetic Surveys**

All survey benchmarks associated with the RAMP climatic and hydrologic component were surveyed using GPS equipment by Can-Am Surveys Ltd. in October 2000. This allowed all water surface elevations at stream discharge, lake level and high water gauges to be referenced to geodetic elevations. Benchmark elevations for hydrometric stations S1 to S13 and L1 to L3 are summarized in Appendix V.

## **5.2 WORK RECOMMENDED FOR 2001**

### **5.2.1 Jackpine Creek Streamflow Monitoring Station (S2)**

Permitting for the relocated Jackpine Creek Station (S2) is currently being undertaken by Syncrude. When permitting is completed, a permanent equipment housing should be installed at this site.

### **5.2.2 Muskeg River WSC Streamflow Monitoring Station (S7)**

Permitting for the Muskeg River WSC Station (S7) is currently being undertaken by Syncrude. When permitting is completed, a permanent equipment housing should be installed at this site.

### **5.2.3 Fort Creek Streamflow Monitoring Station (S12)**

Permitting for the Fort Creek Station (S12) is currently being undertaken by Syncrude. When permitting is completed, a permanent equipment housing should be installed at this site.

### **5.2.4 Remote Data Retrieval Retrofitting**

The integration of hydrometric stations to monitor mine site discharges into the program has produced new scheduling requirements to accommodate monthly reporting schedules. Often, it is difficult to schedule field visits to properly meet reporting requirements. Therefore, it is recommended that selected stations be retrofitted with equipment to allow remote data retrieval via a cellular telephone interface. The Alsands Drain (S1), Albian Pond #3 (S13) and Aurora Climate (C1) stations would be prime candidates for this measure, and other stations may be considered. Besides allowing more frequent data downloads without additional travel costs, remote data retrieval systems allow system status checks and alarms with immediate notification in case of monitoring system failures. Remote data retrieval systems are commercially available from several suppliers at a reasonable cost.

## **6 UPDATE OF THE REGIONAL CLIMATIC AND HYDROLOGIC DATABASE**

The 2000 program included the important task of updating the regional climatic and hydrologic database. The updated database is stored in a compact disc (CD) for ease of data access. Development and continuing updates of this database are required to protect the monitoring investments and to provide readily-accessible data for future water management studies, characterize baseline conditions and comply with permit conditions.

The database CD included in Appendix IX of this report contains data from local monitoring programs and regional data collected by the Meteorological Services Canada (MSC) and Water Survey of Canada (WSC). Data included in the database CD are summarized in Table 6.1. Tables 6.2, 6.3, 6.4 and 6.5 present descriptions of site locations and available data for local hydrologic stations, local climatic stations, regional hydrologic stations, and regional climatic stations, respectively.

**Table 6.1 Contents of Database CD in Appendix IX**

Local Data		Regional Data	
Hydrology	Climate	Hydrology	Climate
Alsands Drain (S1)	Aurora Climate Station	Athabasca River (WSC 07DA001)	Birch Mountain. Lookout (MSC 3060700)
Jackpine Creek (S2)	Iyininim Creek Station	Beaver River (WSC 07DA005)	Bitumont Lookout (MSC 3060705)
Iyininim Creek (S3)		Steepbank River (WSC 07DA006)	Buckton Lookout (MSC 3060922)
Blackfly Creek (S4)	Snow Course Survey in the Muskeg River Basin	Poplar Creek (WSC 07DA007)	Ells Lookout (MSC 3062300)
Muskeg River Aurora (S5/S5A)		Muskeg River (WSC 07DA008)	Fort McMurray Airport (MSC 3062693)
Mills Creek (S6)		Jackpine Creek (WSC 07DA009)	Johnson Lake Lookout (MSC 3063563)
Muskeg River WSC (S7)		Ells River (WSC 07DA010)	Legend Lookout (MSC 3073792)
Stanley Creek (S8)		Unnamed Creek (WSC 07DA011)	Mildred Lake (MSC 3064531 and MSC 3064528)
Kearl Lake Outlet (S9)		Asphalt Creek (WSC 07DA012)	Muskeg Lookout (MSC 3064740)
Wapasu Creek (S10)		Pierre River (WSC 07DA013)	Richardson Lookout (MSC 3065492)
Poplar Creek (S11)		Calumet River (WSC 07DA014)	Tar Island (MSC 3066364)
Fort Creek (S12)		Tar River (WSC 07DA015)	Thickwood Lookout (MSC 3066380)
Alsands Pond #3 (S13)		Joslyn Creek (WSC 07DA016)	
McClelland Lake (L1)		Ells River (WSC 07DA017)	
Kearl Lake (L2)		Beaver River (WSC 07DA018)	
Isadore's Lake (L3)		Tar River (WSC 07DA019)	
		Mackay River (WSC 07DB001)	
		Dover River (WSC 07DB002)	
		Dunkirk River (WSC 07DB003)	
		Thickwood Creek (WSC 07DB004)	
		Mackay River (WSC 07DB005)	
		Firebag River (WSC 07DC001)	
		Lost Creek (WSC 07DC002)	

**Table 6.2 Local Hydrologic Data**

Station	Location		Basin Characteristics		Period of Record
	North	West	Drainage Area	Elevation	
Alsands Drain (S1)	57° 15' 12"	111° 29' 52"	15.8 km <sup>2</sup>	280 – 300 m	1995 – 2000
Jackpine Creek (S2)	57° 15' 31"	111° 27' 55"	358 km <sup>2</sup>	270 – 490 m	1995 – 2000
Iyininin Creek (S3)	57° 15' 00"	111° 10' 27"	32.3 km <sup>2</sup>	340 – 560 m	1995 – 1999
Blackfly Creek (S4)	57° 12' 20"	111° 15' 22"	31.1 km <sup>2</sup>	345 – 540 m	1995 – 1998
Muskeg River Aurora (S5/S5A)	57° 18' 30"	111° 23' 43"	552 km <sup>2</sup>	280 – 560 m	1995 – 2000
Mills Creek (S6)	57° 14' 44"	111° 35' 57"	23.8 km <sup>2</sup>	280 – 300 m	1997 – 2000
Muskeg River WSC (S7)	57° 11' 29"	111° 34' 10"	1,460 km <sup>2</sup>	260 – 560 m	1998 – 2000
Stanley Creek (S8)	57° 21' 06"	111° 22' 26"	71.8 km <sup>2</sup>	290 – 360 m	1999 – 2000
Kearl Lake Outlet (S9)	57° 15' 57"	111° 15' 57"	73.6 km <sup>2</sup>	330 – 560 m	1998 – 1999
Wapasu Creek (S10)	57° 20' 35"	111° 09' 40"	90.7 km <sup>2</sup>	320 – 560 m	1998 – 1999
Poplar Creek (S11)	56° 54' 46"	111° 27' 44"	422 km <sup>2</sup>	240 – 510 m	1995 – 2000
Fort Creek (S12)	57° 24' 48"	111° 37' 18"	35.5 km <sup>2</sup>	250 – 360 m	2000
Alsands Pond #3 (S13)	57° 14' 47"	111° 30' 58"	disturbed area	gauge at 279 m	2000
McClelland Lake (L1)	57° 29' 30"	111° 16' 37"	191 km <sup>2</sup>	295 – 350 m	1997 – 2000
Kearl Lake (L2)	57° 18' 15"	111° 14' 40"	72.6 km <sup>2</sup>	330 – 560 m	1999 - 2000
Isadore's Lake (L3)	57° 13' 15"	111° 36' 24"	28.0 km <sup>2</sup>	240 – 300 m	2000
TSS Data	all local hydrologic monitoring stations				1997 – 2000
ice thickness data	all local hydrologic monitoring stations				1997 – 2000

Note: Locations of these hydrometric monitoring sites are shown on Figure 1.1.

**Table 6.3 Local Climatic Data**

Station	Location	Daily Mean Data	Hourly Data
Aurora Climate Station	57° 14' 16" North 111° 24' 27" West 310 m elevation	mean daily temperature maximum daily temperature minimum daily temperature total daily rainfall total daily snowfall mean relative humidity total global solar radiation mean daily wind speed mean daily wind direction 5 second gust wind speed 5 second gust wind direction 2 minute gust wind speed 10 minute gust wind speed	air temperature relative humidity mean wind speed mean wind vector magnitude mean wind vector direction sigma theta wind speed standard deviation peak 5 second wind speed peak wind speed time peak wind speed direction maximum 2 minute wind speed TBRG precipitation instantaneous TBRG precipitation hourly accumulation snow depth mean wind speed minute 50-60 mean wind vector magnitude minute 50-60 mean wind vector direction minute 50-60 sigma theta minute 50-60 peak 5 second wind speed minute 50-60 maximum 10 minute wind speed temperature relative humidity mean wind speed 1 hour mean wind vector magnitude 1 hour mean wind vector direction 1 hour sigma theta maximum 1 minute air temperature minimum 1 minute air temperature global solar radiation
Iyininim Creek Station	57° 15' 00" North 111° 10' 27" West 340 m elevation	TBRG rainfall instantaneous TBRG rainfall hourly accumulation 1999	
Kearl Lake Outlet Station	57° 15' 57" North 111° 15' 57" West 330 m elevation	atmospheric pressure 1999 monitored in 2000 at Aurora Climate Station	
snow course survey in the Muskeg River Basin	Centred on 57° 15' North 111° 30' West	snow survey data March 1997, March 1998, March 1999, March 2000	

Note: Locations of these climatic monitoring sites are shown on Figure 1.1.



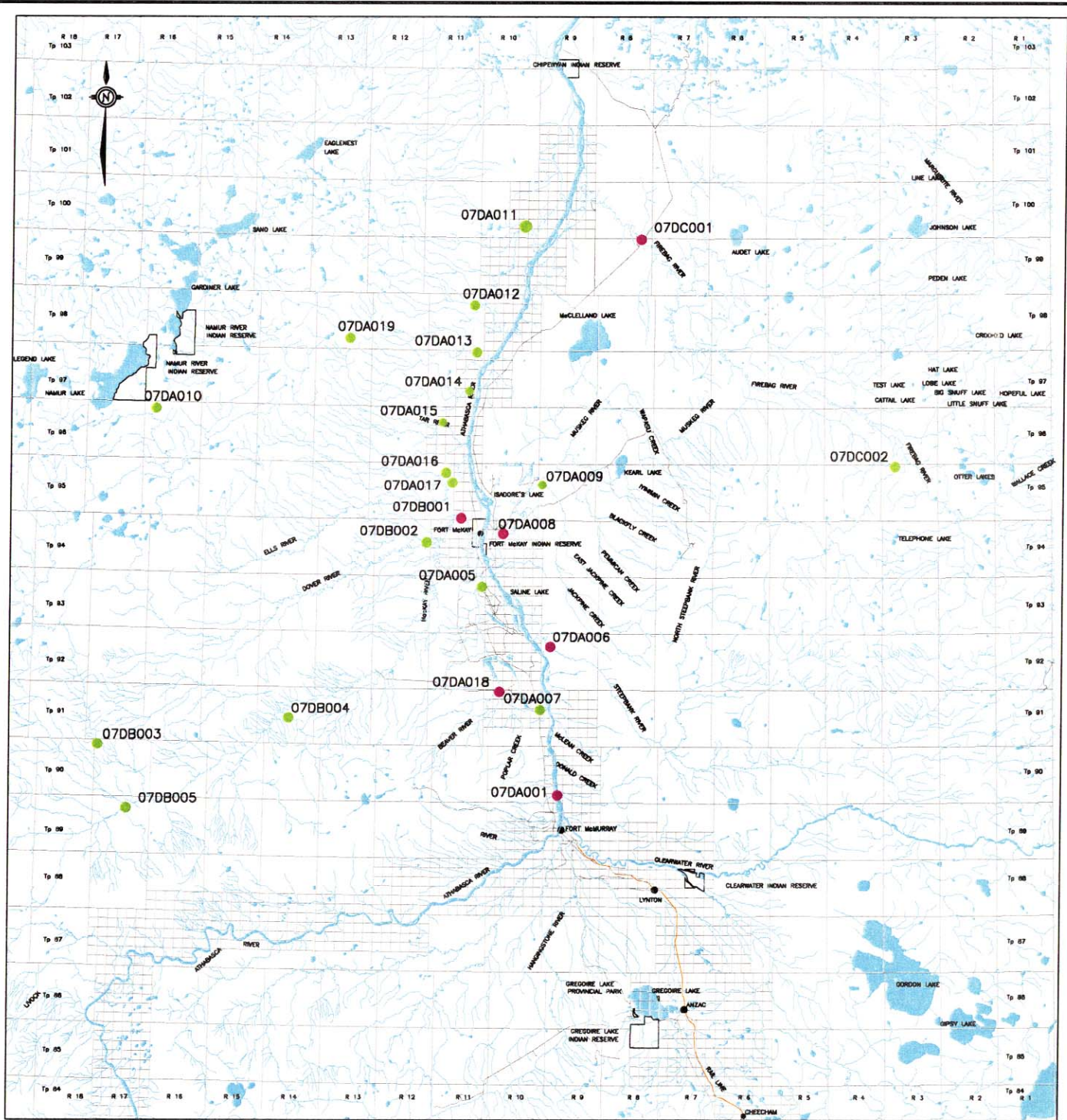
**Table 6.4 Regional Hydrologic Data**

Station	Location		Basin Characteristics		Period of Record
	North	West	Drainage Area	Elevation	
Athabasca River (WSC Station 07DA001)	56° 46' 50"	111° 24' 00"	133,000 km <sup>2</sup>	240 – 1490 m	1957 – 2000
Beaver River (WSC Station 07DA005)	57° 06' 00"	111° 38' 00"	454 km <sup>2</sup>	270 – 530 m	1961 – 1966 1972 – 1975
Steepbank River (WSC Station 07DA006)	57° 00' 14"	111° 24' 53"	1,320 km <sup>2</sup>	300 – 580 m	1972 – 2000
Poplar Creek (WSC Station 07DA007)	56° 54' 50"	111° 27' 35"	151 km <sup>2</sup>	270 – 460 m	1972 – 1986
Muskeg River <sup>1</sup> (WSC Station 07DA008)	57° 11' 30"	111° 34' 05"	1,460 km <sup>2</sup>	260 – 560 m	1974 – 2000
Jackpine Creek <sup>2</sup> (WSC Station 07DA009)	57° 15' 34"	111° 27' 53"	358 km <sup>2</sup>	270 – 490 m	1975 – 1993
Ells River (WSC Station 07DA010)	57° 22' 30"	112° 33' 40"	1,380 km <sup>2</sup>	640 – 730 m	1975 – 1979
Unnamed Creek (WSC Station 07DA011)	57° 39' 41"	111° 31' 11"	274 km <sup>2</sup>	270 – 760 m	1975 – 1993
Asphalt Creek (WSC Station 07DA012)	57° 32' 20"	111° 40' 36"	148 km <sup>2</sup>	290 – 850 m	1975 – 1977
Pierre River (WSC Station 07DA013)	57° 27' 55"	111° 39' 14"	123 km <sup>2</sup>	270 – 820 m	1975 – 1977
Calumet River (WSC Station 07DA014)	57° 24' 12"	111° 40' 57"	183 km <sup>2</sup>	250 – 610 m	1975 – 1977
Tar River (WSC Station 07DA015)	57° 21' 14"	111° 45' 29"	301 km <sup>2</sup>	270 – 810 m	1975 – 1977
Joslyn Creek (WSC Station 07DA016)	57° 16' 27"	111° 44' 30"	257 km <sup>2</sup>	270 – 760 m	1975 – 1993
Ells River (WSC Station 07DA017)	57° 16' 04"	111° 42' 51"	2,450 km <sup>2</sup>	270 – 730 m	1975 - 1986
Beaver River (WSC Station 07DA018)	56° 56' 29"	111° 33' 54"	165 km <sup>2</sup>	320 – 530 m	1975 – 2000
Tar River (WSC Station 07DA019)	57° 29' 05"	112° 01' 10"	103 km <sup>2</sup>	620 – 810 m	1976 – 1977
Mackay River (WSC Station 07DB001)	57° 12' 38"	111° 41' 36"	5,570 km <sup>2</sup>	240 – 520 m	1972 – 2000
Dover River (WSC Station 07DB002)	57° 10' 12"	111° 47' 38"	963 km <sup>2</sup>	290 – 580 m	1975 – 1977
Dunkirk River (WSC Station 07DB003)	56° 51' 20"	112° 42' 40"	1,570 km <sup>2</sup>	490 – 820 m	1975 – 1979
Thickwood Creek (WSC Station 07DB004)	56° 53' 55"	112° 10' 15"	176 km <sup>2</sup>	460 – 520 m	1976 – 1977
Mackay River (WSC Station 07DB005)	56° 45' 35"	112 ° 36' 50"	1,010 km <sup>2</sup>	470 – 520 m	1983 – 1991
Firebag River (WSC Station 07DC001)	57° 38' 30"	111° 10' 30"	5,990 km <sup>2</sup>	270 – 580 m	1971 – 2000
Lost Creek (WSC Station 07DC002)	57° 17' 20"	110° 27' 50"	418 km <sup>2</sup>	470 – 640 m	1976 – 1977

1 – This site is now monitored in winter months as part of the current program.

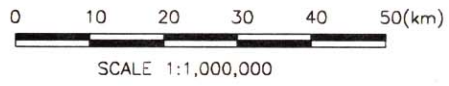
2 – This site is now monitored in open water months as part of the current program.

Note: Locations of these hydrometric monitoring sites are shown on Figure 6.1.




**LEGEND**

- ROADWAYS
- RIVERS AND STREAMS
- ACTIVE HYDROMETRIC MONITORING STATIONS
- DISCONTINUED HYDROMETRIC MONITORING STATIONS



**REFERENCE**

DIGITAL DATA SETS 74D, 74E, 74I  
84A AND 84H FROM RESOURCE DATA DIVISION  
ALBERTA ENVIRONMENTAL PROTECTION, 1997.  
DATUM: NAD83 PROJECTION: UTM ZONE 12

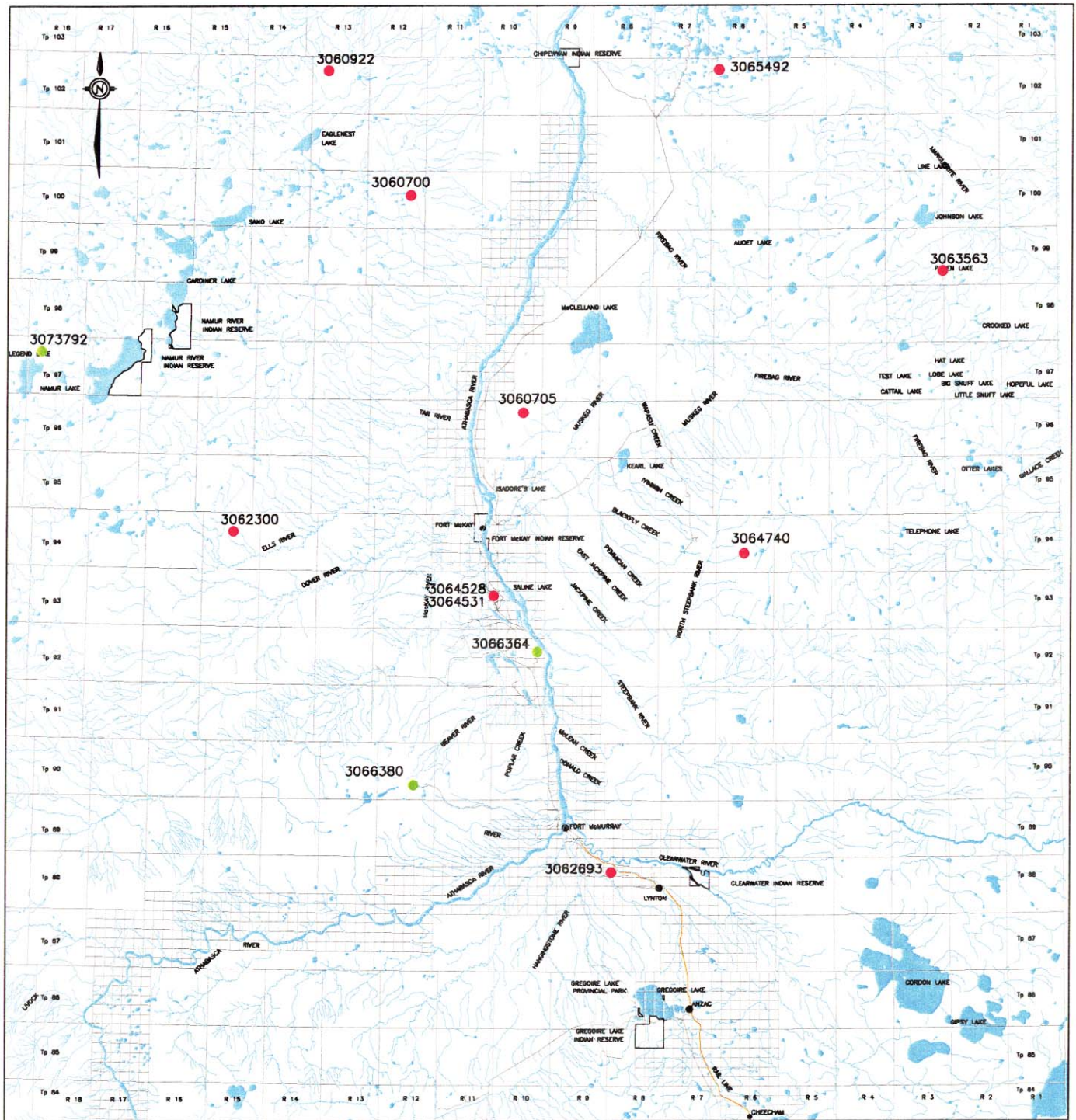
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<b>REGIONAL WSC HYDROMETRIC MONITORING STATIONS</b>		
DRAWN: TVS	APPROVED:	DATE: 20 Feb. 2001
PROJECT: 002-2309.7000		FIGURE: 6.1

**Table 6.5 Regional Climatic Data**

Station	Location		Elevation	Daily Mean Data		Hourly Data	
	North	West					
Birch Mountain Lookout (AES Station 3060700)	57° 43'	111° 51'	853 m	rainfall	1960 – 2000 <sup>1</sup>		
Bitumont Lookout (AES Station 3060705)	57° 22'	111° 32'	349 m	rainfall	1962 – 2000 <sup>1</sup>		
Buckton Lookout (AES Station 3060922)	57° 52'	112° 06'	793 m	rainfall	1965 – 2000 <sup>1</sup>		
Ells Lookout (AES Station 3062300)	57° 11'	112° 20'	610 m	rainfall	1961 – 2000 <sup>1</sup>		
Fort McMurray Airport (AES Station 3062693)	56° 39'	111° 13'	369 m	rainfall	1944 – 2000	wet bulb temperature	1953 – 2000
				snowfall	1944 – 2000	dry bulb temperature	1953 – 2000
				precipitation	1944 – 2000	wind speed	1953 – 2000
				temperature	1944 – 2000	wind direction	1959 – 2000
Johnson Lake Lookout (AES Station 3063563)	57° 35'	110° 20'	549 m	rainfall	1965 – 2000 <sup>1</sup>		
Legend Lookout (AES Station 3073792)	57° 27'	112° 53'	911 m	rainfall	1962 – 1995 <sup>1</sup>		
				temperature	1962 – 1995 <sup>1</sup>		
Mildred Lake (AES Station 3064531 and AES Station 3064528)	57° 05'	111° 36'	310 m	rainfall	1973 – 1982, 1993 – 2000	temperature	1994 – 2000 dew
				snowfall	1973 – 1982, 1993 – 2000	point temperature	1994 – 2000
				precipitation	1973 – 1982, 1993 – 2000	wind speed	1994 – 2000
				temperature	1973 – 1982, 1993 – 2000	rainfall	1995 – 1996
						snow by weight	1995 – 1996
						snow on ground	1995 – 1996
Muskeg Lookout (AES Station 3064740)	57° 08'	110° 54'	652 m	rainfall	1965 – 2000 <sup>1</sup>		
				temperature	1965 – 2000 <sup>1</sup>		
Richardson Lookout (AES Station 3065492)	57° 55'	110° 58'	305 m	rainfall	1960 – 2000 <sup>1</sup>		
				temperature	1964 – 2000 <sup>1</sup>		
Tar Island (AES Station 3066364)	56° 59'	111° 28'	240 m	rainfall	1970 – 1984 <sup>1</sup>		
Thickwood Lookout (AES Station 3066380)	56° 53'	111° 39'	604 m	rainfall	1957 – 1994 <sup>1</sup>		
				snowfall	1957 – 1991 <sup>1</sup>		
				precipitation	1957 – 1991 <sup>1</sup>		
				temperature	1957 – 1992 <sup>1</sup>		

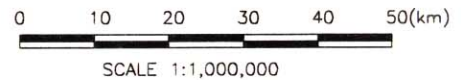
Notes: 1 – Seasonal values only.

Note: Locations of these climatic monitoring sites are shown on Figure 6.2.




**LEGEND**

- ROADWAYS
- RIVERS AND STREAMS
- ACTIVE CLIMATE MONITORING STATIONS
- DISCONTINUED CLIMATE MONITORING STATIONS



**REFERENCE**

DIGITAL DATA SETS 74D, 74E, 74I  
 84A AND 84H FROM RESOURCE DATA DIVISION  
 ALBERTA ENVIRONMENTAL PROTECTION, 1997.  
 DATUM: NAD83 PROJECTION: UTM ZONE 12

		<b>RAMP</b>
<b>REGIONAL MSC CLIMATE MONITORING STATIONS</b>		
DRAWN: TVS	APPROVED:	DATE: 20 Feb. 2001
PROJECT: 002-2309.7000		FIGURE: 6.2

## 7 CONCLUSIONS AND RECOMMENDATIONS

The 2000 monitoring program, jointly funded and commissioned by Syncrude, Albion, Mobil, Suncor, TrueNorth and Petro-Canada, has resulted in collection of the climatic and hydrologic data documented in this report. The program has fulfilled the monitoring objectives and resulted in an expansion of the climatic and hydrologic database for the Oil Sands Region, particularly for the Muskeg River basin. The specific contributions of the 2000 monitoring program are summarized below.

- Continuing operation of the Aurora Climate Station contributed to expansion of the regional climatic database and provided required climatic information for interpreting the hydrologic monitoring results. The climatic station was fitted with a new rain gauge with snowfall adapter and spare sensors were purchased to facilitate regular maintenance.
- A fourth year of snow course survey for various terrain types expanded the snowpack database necessary for determining the snowfall undercatch correction factor and providing required input to calibrate and verify a snowmelt runoff model.
- The 2000 program resulted in installation of new water level monitoring stations on Fort Creek (S12) and Albion Pond #3 (S13), and reinstallation of the Jackpine Creek streamflow monitoring station (S2).
- The 2000 streamflow measurements and monitoring were conducted to meet regulatory requirements and contributed to an expansion of the existing streamflow database that is required to develop reliable stage-discharge rating curves and discharge hydrographs at the monitoring stations.
- The 2000 water level monitoring at McClelland Lake (L1) was conducted to meet regulatory requirements and contributed to an expansion of the hydrologic database for assessing the impacts of the regional oil sands developments on the lake.
- The 2000 TSS measurements contributed to an expansion of the existing TSS database required to monitor watershed and channel erosion and streamflow water quality and to develop more reliable predictive tools to correlate TSS concentrations with streamflows. Sufficient data have been acquired for long-term stations such that TSS measurements need only be undertaken during high discharges, supplemented with a limited number of low discharge measurements.
- Ongoing operations of the monitoring stations provided a basis for identifying the maintenance needs and developing a work plan for the upcoming 2001 monitoring program.

- The 2000 program has resulted in development of a regional climatic and hydrologic database updated to the end of 2000. This database is stored on a compact disc for easy access by users.

It is recommended that the collection of climatic and hydrologic data at the existing monitoring stations be continued and that the monitoring should cover the entire year including winter low flows, snowmelt and summer flows. Continuation of the monitoring program is required for development of an improved hydrologic database, which will allow updating of previous hydrologic analyses and modelling based on site-specific data. The continuation will also provide the hydrologic data necessary for monitoring any potential impacts of the oil sands projects as required by regulatory agencies. The specific recommendations for the 2001 monitoring program, which were identified during the 2000 program, are summarized below.

- The operations and maintenance of the climatic and hydrologic monitoring stations, and the relevant data collection should be continued.
- A snow course survey in the Muskeg River basin should be conducted in early March 2001 to collect a final year of snowpack data to complete the five year program.
- Monitoring of high water marks along the study reach of the Muskeg River should be continued for one more year.
- Consideration should be given to retrofitting at least three monitoring stations (C1, S1 and S13) to allow remote data retrieval.
- The deactivated precipitation gauge from station S3 should be reinstalled at an alternate stream or lake monitoring station.
- The status of deactivated monitoring stations (S3, S4, S9 and S10) should be reviewed.

## **8 CLOSURE**

Respectfully submitted by:

**GOLDER ASSOCIATES LTD.**

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## 9 REFERENCES

- Golder Associates Ltd. 1997a. Lease 13 Surface Water Hydrology 1997 Winter Data Collection Program. Golder Project No. 972-2221, Prepared for Shell Canada Limited.
- Golder Associates Ltd. 1997b. 1997 Summer Data Collection Program and Baseline Hydrologic and Hydraulic Studies for the Muskeg River Mine Project. Golder Project No. 972-2237, Prepared for Shell Canada Limited.
- Golder Associates Ltd. 1999. Muskeg River Area Climatic and Hydrologic Monitoring Program in 1998. Golder Project No. 982-2607, Prepared for Syncrude Canada Limited, Shell Canada Limited, Mobil Oil Canada Properties and Suncor Energy Inc.
- Golder Associates Ltd. 2000. Oil Sands Area Climatic and Hydrologic Monitoring Program in 1999. Golder Project No. 992-2608, Prepared for Syncrude Canada Limited, Albian Sands Energy Limited, Mobil Oil Canada Properties Limited, Suncor Energy Inc., Koch Canada Limited and Petro-Canada Oil and Gas Limited.





**APPENDIX I**

**2000 DAILY CLIMATIC DATA AT AURORA CLIMATE STATION**

**Table I-1 Climatic Data Recorded at Aurora Climate Station, January – December, 2000**

Year	Month	Day	Temperature			Total Rainfall (mm)	Total Snowfall (cm)	Mean Relative Humidity (%)	Total Global Solar Radiation (kW-h/m <sup>2</sup> )	Wind Speed and Direction				
			Minimum (°C)	Mean (°C)	Maximum (°C)					Mean Daily Wind		Maximum Sustained Gusts		
										Speed (km/h)	Direction (degrees)	5 Second (km/h)	2 Minute (km/h)	10 Minute (km/h)
2000	January	1	-38.1	-32.7	-24.2	0.0	0.0	71.2	0.71	1.8	184.5	9.0	5.4	3.9
2000	January	2	-35.8	-31.7	-23.4	0.0	0.0	72.4	0.75	2.3	181.5	9.1	4.8	4.0
2000	January	3	-33.3	-28.0	-20.5	0.0	0.0	76.1	0.75	2.8	193.2	15.0	7.3	6.5
2000	January	4	-36.0	-29.2	-22.6	0.0	0.0	74.6	0.45	0.9	152.1	8.1	4.6	3.7
2000	January	5	-28.8	-21.0	-18.2	0.0	2.1	82.4	0.12	0.7	200.6	7.1	4.7	3.8
2000	January	6	-32.3	-25.1	-17.1	0.0	1.4	78.8	0.15	1.9	184.0	10.9	6.5	5.9
2000	January	7	-17.1	-16.3	-15.0	0.0	0.7	85.8	0.09	3.0	64.4	14.9	9.6	6.9
2000	January	8	-16.8	-12.9	-7.9	0.0	3.4	90.4	0.04	1.5	188.3	8.7	5.2	4.2
2000	January	9	-24.2	-16.2	-8.0	0.0	7.4	86.7	0.11	4.3	186.3	28.4	21.4	15.8
2000	January	10	-32.9	-26.2	-21.5	0.0	0.0	78.0	0.13	0.9	184.8	9.0	6.0	5.0
2000	January	11*												
2000	January	12*												
2000	January	13*												
2000	January	14*												
2000	January	15*												
2000	January	16*												
2000	January	17*												
2000	January	18*												
2000	January	19*												
2000	January	20*												
2000	January	21*												
2000	January	22*												
2000	January	23*												
2000	January	24*												
2000	January	25*												
2000	January	26*												
2000	January	27*												
2000	January	28*												
2000	January	29*												
2000	January	30*												
2000	January	31*												

\* No data were collected at the Aurora Climate Station from 11 January 1200h to 22 February 1300h.

**Table I-1 Climatic Data Recorded at Aurora Climate Station, January – December, 2000 (continued)**

Year	Month	Day	Temperature			Total Rainfall (mm)	Total Snowfall (cm)	Mean Relative Humidity (%)	Total Global Solar Radiation (kW-h/m <sup>2</sup> )	Wind Speed and Direction				
			Minimum (°C)	Mean (°C)	Maximum (°C)					Mean Daily Wind		Maximum Sustained Gusts		
										Speed (km/h)	Direction (degrees)	5 Second (km/h)	2 Minute (km/h)	10 Minute (km/h)
2000	February	1*												
2000	February	2*												
2000	February	3*												
2000	February	4*												
2000	February	5*												
2000	February	6*												
2000	February	7*												
2000	February	8*												
2000	February	9*												
2000	February	10*												
2000	February	11*												
2000	February	12*												
2000	February	13*												
2000	February	14*												
2000	February	15*												
2000	February	16*												
2000	February	17*												
2000	February	18*												
2000	February	19*												
2000	February	20*												
2000	February	21*												
2000	February	22*												
2000	February	23	-6.0	0.2	5.4	0.0	0.5	71.7	1.15	2.7	177.3	18.5	12.2	10.1
2000	February	24	-5.6	1.9	10.7	0.0	0.8	64.6	2.27	3.3	208.5	19.9	10.9	7.0
2000	February	25	-8.8	-2.2	9.2	0.0	0.0	67.3	2.53	3.6	195.9	15.4	9.7	6.8
2000	February	26	-12.7	-3.5	9.2	0.0	0.0	64.7	2.67	3.7	192.4	13.8	8.5	6.3
2000	February	27	-8.5	-1.0	8.3	0.0	0.0	59.6	2.62	3.6	190.7	12.9	8.1	7.0
2000	February	28	-11.4	-4.2	4.3	0.0	0.0	71.0	1.84	2.6	163.1	20.4	13.0	9.5
2000	February	29	-16.4	-6.0	3.9	0.0	0.0	74.1	2.79	4.0	189.5	17.4	10.2	8.0

\* No data were collected at the Aurora Climate Station from 11 January 1200h to 22 February 1300h.

**Table I-1 Climatic Data Recorded at Aurora Climate Station, January – December, 2000 (continued)**

Year	Month	Day	Temperature			Total Rainfall (mm)	Total Snowfall (cm)	Mean Relative Humidity (%)	Total Global Solar Radiation (kW-h/m <sup>2</sup> )	Wind Speed and Direction				
			Minimum (°C)	Mean (°C)	Maximum (°C)					Mean Daily Wind		Maximum Sustained Gusts		
										Speed (km/h)	Direction (degrees)	5 Second (km/h)	2 Minute (km/h)	10 Minute (km/h)
2000	March	1	-3.1	2.0	9.2	0.0	0.0	60.0	2.78	5.9	204.0	26.8	13.0	10.2
2000	March	2	-2.2	3.1	11.5	0.0	0.0	64.1	2.22	4.4	222.5	27.3	15.2	11.0
2000	March	3	-6.5	3.1	11.7	0.0	0.0	62.3	2.58	4.7	204.2	27.1	13.2	9.3
2000	March	4	-3.1	2.9	8.8	0.0	0.0	61.2	2.73	5.0	239.4	30.8	16.2	13.2
2000	March	5	-8.5	-1.1	5.5	0.0	0.0	70.4	2.52	4.5	214.5	26.1	18.0	14.7
2000	March	6	-7.7	-4.1	-0.1	0.0	0.0	78.4	1.87	6.6	62.7	25.8	18.5	13.9
2000	March	7	-24.2	-13.8	-7.7	0.0	0.5	61.3	2.70	8.6	42.0	28.7	17.9	13.7
2000	March	8	-28.4	-15.7	-4.4	0.0	0.0	50.6	3.51	5.1	169.9	25.4	14.5	12.1
2000	March	9	-14.2	-10.7	-5.4	0.0	0.0	56.1	2.11	5.5	151.8	23.9	13.8	11.4
2000	March	10	-21.4	-16.6	-9.8	0.0	0.1	58.1	3.43	4.8	112.9	23.1	14.3	11.5
2000	March	11	-24.3	-18.3	-6.7	0.0	0.0	56.6	3.60	2.4	160.6	11.6	9.6	7.1
2000	March	12	-29.8	-18.6	-4.3	0.0	0.3	54.3	3.84	2.8	206.3	16.0	10.5	8.0
2000	March	13	-31.6	-21.5	-10.2	0.0	0.1	61.4	3.50	3.9	107.7	25.2	12.6	9.8
2000	March	14	-31.8	-21.4	-8.0	0.0	0.0	62.0	3.70	3.7	131.4	21.9	13.8	10.4
2000	March	15	-30.1	-19.3	-5.9	0.0	0.0	64.7	3.46	4.0	115.3	23.6	15.9	13.8
2000	March	16	-30.1	-14.8	-3.2	0.0	0.0	62.5	2.61	6.2	204.4	36.5	19.3	15.2
2000	March	17	-12.1	-4.7	1.7	0.0	0.5	79.6	1.79	5.8	212.5	34.4	22.3	17.9
2000	March	18	-13.6	-0.7	11.0	0.0	0.0	64.7	3.94	4.7	186.1	19.1	12.1	9.0
2000	March	19	-4.1	0.6	6.8	5.0	0.0	74.4	1.74	5.5	66.4	31.2	16.9	15.4
2000	March	20	-5.1	-1.2	4.2	0.0	0.1	80.0	2.65	4.8	164.2	24.1	12.8	11.0
2000	March	21	-3.7	0.1	5.3	0.0	0.1	87.0	1.52	4.5	236.1	23.0	13.3	9.4
2000	March	22	-5.4	2.4	11.6	0.6	0.0	71.3	3.57	4.5	181.8	24.6	15.6	9.2
2000	March	23	-2.4	2.1	6.7	14.4	0.0	91.1	1.74	3.8	145.2	18.1	14.3	9.2
2000	March	24	-5.6	0.0	9.6	31.8	0.0	75.0	2.88	4.1	244.9	30.3	19.8	15.5
2000	March	25	-7.7	0.9	10.9	16.6	0.0	63.9	3.48	3.6	217.6	18.2	10.5	7.7
2000	March	26	-5.6	1.8	11.8	2.2	0.0	62.3	4.70	3.9	109.4	19.7	13.7	11.9
2000	March	27	-4.6	2.3	8.2	4.2	0.0	67.5	2.00	6.8	168.4	22.9	14.9	12.8
2000	March	28	-2.4	5.0	12.9	1.8	0.0	68.3	3.63	5.4	206.8	26.9	12.8	10.6
2000	March	29	-7.7	1.4	12.1	0.4	0.0	56.6	4.73	2.6	219.3	19.1	11.6	8.2
2000	March	30	-8.8	1.8	13.3	0.2	0.0	54.6	5.00	4.4	196.1	24.1	13.1	10.2
2000	March	31	1.6	5.5	12.1	0.2	0.0	48.3	5.02	6.6	271.6	28.7	20.0	15.0

**Table I-1 Climatic Data Recorded at Aurora Climate Station, January – December, 2000 (continued)**

Year	Month	Day	Temperature			Total Rainfall (mm)	Total Snowfall (cm)	Mean Relative Humidity (%)	Total Global Solar Radiation (kW-h/m <sup>2</sup> )	Wind Speed and Direction				
			Minimum (°C)	Mean (°C)	Maximum (°C)					Mean Daily Wind		Maximum Sustained Gusts		
										Speed (km/h)	Direction (degrees)	5 Second (km/h)	2 Minute (km/h)	10 Minute (km/h)
2000	April	1	-0.5	2.9	6.7	0.0	0.0	78.2	2.17	8.0	63.1	32.3	20.5	14.7
2000	April	2*												
2000	April	3*												
2000	April	4*												
2000	April	5*												
2000	April	6*												
2000	April	7*												
2000	April	8*												
2000	April	9*												
2000	April	10*												
2000	April	11*												
2000	April	12*												
2000	April	13*												
2000	April	14*												
2000	April	15*												
2000	April	16*												
2000	April	17*												
2000	April	18*												
2000	April	19*												
2000	April	20*												
2000	April	21*												
2000	April	22*												
2000	April	23*												
2000	April	24*												
2000	April	25*												
2000	April	26*												
2000	April	27*												
2000	April	28*												
2000	April	29*												
2000	April	30*												

\* No data were collected at the Aurora Climate Station from 2 April 1500h to 17 May 1100h.

**Table I-1 Climatic Data Recorded at Aurora Climate Station, January – December, 2000 (continued)**

Year	Month	Day	Temperature			Total Rainfall (mm)	Total Snowfall (cm)	Mean Relative Humidity (%)	Total Global Solar Radiation (kW-h/m <sup>2</sup> )	Wind Speed and Direction				
			Minimum (°C)	Mean (°C)	Maximum (°C)					Mean Daily Wind		Maximum Sustained Gusts		
										Speed (km/h)	Direction (degrees)	5 Second (km/h)	2 Minute (km/h)	10 Minute (km/h)
2000	May	1*												
2000	May	2*												
2000	May	3*												
2000	May	4*												
2000	May	5*												
2000	May	6*												
2000	May	7*												
2000	May	8*												
2000	May	9*												
2000	May	10*												
2000	May	11*												
2000	May	12*												
2000	May	13*												
2000	May	14*												
2000	May	15*												
2000	May	16*												
2000	May	17*												
2000	May	18	2.0	8.2	14.7	0.8	0.0	81.1	3.05	3.3	202.0	15.0	9.4	7.2
2000	May	19	0.7	12.4	21.5	0.3	0.0	60.7	5.36	4.7	238.5	37.5	18.6	13.5
2000	May	20	2.9	10.0	15.8	1.0	0.0	78.3	4.09	6.3	274.2	40.0	25.4	18.6
2000	May	21	-1.1	11.3	21.1	0.0	0.0	61.3	6.06	3.4	205.2	21.7	11.8	9.6
2000	May	22	6.2	10.2	12.6	5.8	0.0	88.2	1.88	3.3	215.3	17.6	10.7	8.8
2000	May	23	7.1	8.8	11.6	25.9	0.0	99.4	1.79	4.7	301.7	25.5	12.8	11.3
2000	May	24	5.5	8.6	14.5	4.6	0.0	93.4	3.05	2.7	254.7	18.5	12.2	8.9
2000	May	25	2.0	8.7	15.6	3.0	0.0	83.3	4.80	3.6	228.3	23.6	15.2	11.6
2000	May	26	0.4	6.7	14.0	2.3	0.0	88.4	4.15	4.5	70.4	27.2	14.8	10.8
2000	May	27	-1.3	8.9	16.8	0.0	0.0	73.4	5.43	3.7	114.5	22.3	13.1	9.5
2000	May	28	4.9	9.7	14.9	0.0	0.0	62.7	7.11	7.6	49.3	27.4	16.9	12.2
2000	May	29	-0.4	7.4	14.3	0.0	0.0	51.7	8.36	8.1	154.2	35.4	18.5	14.7
2000	May	30	-1.1	7.9	16.0	0.0	0.0	49.7	7.55	7.0	117.0	32.1	18.3	13.7
2000	May	31	-2.8	11.8	22.0	0.0	0.0	46.2	8.74	5.5	217.4	28.3	17.0	12.7

\* No data were collected at the Aurora Climate Station from 2 April 1500h to 17 May 1100h

**Table I-1 Climatic Data Recorded at Aurora Climate Station, January – December, 2000 (continued)**

Year	Month	Day	Temperature			Total Rainfall (mm)	Total Snowfall (cm)	Mean Relative Humidity (%)	Total Global Solar Radiation (kW-h/m <sup>2</sup> )	Wind Speed and Direction				
			Minimum (°C)	Mean (°C)	Maximum (°C)					Mean Daily Wind		Maximum Sustained Gusts		
										Speed (km/h)	Direction (degrees)	5 Second (km/h)	2 Minute (km/h)	10 Minute (km/h)
2000	June	1	-0.2	7.4	11.5	1.0	0.0	72.5	3.69	4.0	99.9	20.7	12.4	10.2
2000	June	2	-4.4	9.7	21.5	0.0	0.0	55.4	8.87	2.7	160.0	17.4	11.7	8.1
2000	June	3	0.9	13.7	23.8	2.0	0.0	57.5	6.34	4.4	201.9	32.7	24.4	14.8
2000	June	4	4.5	16.5	26.1	0.0	0.0	57.4	7.98	5.3	132.4	38.4	22.2	16.8
2000	June	5	5.3	10.7	17.5	0.0	0.0	60.1	7.01	8.6	70.1	34.9	17.6	13.2
2000	June	6	6.3	8.7	11.0	4.6	0.0	78.9	2.09	4.6	95.0	21.0	12.2	8.9
2000	June	7	5.7	7.2	9.2	8.6	0.0	98.8	1.97	2.5	58.6	14.6	10.4	9.1
2000	June	8	4.9	9.2	13.0	0.0	0.0	80.3	3.20	4.7	121.6	22.3	14.4	10.4
2000	June	9	2.8	10.2	15.6	2.0	0.0	65.2	4.26	7.7	121.4	38.7	21.2	16.5
2000	June	10	5.6	7.1	8.5	4.8	0.0	92.2	1.58	7.0	128.5	31.2	17.9	14.7
2000	June	11	6.3	8.8	13.1	2.0	0.0	82.2	3.47	7.3	145.9	38.6	19.5	13.4
2000	June	12	5.7	9.7	14.3	0.3	0.0	73.5	4.15	2.6	130.9	20.3	11.0	8.9
2000	June	13	6.3	11.9	16.8	0.0	0.0	70.0	4.03	3.0	204.4	19.5	10.3	6.6
2000	June	14	0.0	12.3	18.9	0.0	0.0	67.8	4.46	3.3	177.0	22.1	13.1	10.2
2000	June	15	5.8	11.0	16.2	4.8	0.0	78.9	4.01	5.5	129.3	27.0	14.7	11.2
2000	June	16	-0.3	12.3	21.7	0.2	0.0	55.6	8.79	3.5	130.2	25.7	15.7	9.8
2000	June	17	1.5	15.6	25.8	0.0	0.0	50.1	8.70	5.2	199.9	26.1	12.9	10.8
2000	June	18	10.3	17.3	25.5	0.6	0.0	64.9	6.02	4.4	192.8	26.3	15.4	10.8
2000	June	19	10.9	13.8	18.3	12.4	0.0	98.1	2.16	3.4	275.7	16.7	11.4	9.1
2000	June	20	10.4	15.0	23.7	33.8	0.0	92.4	3.79	3.6	255.0	17.1	10.0	7.0
2000	June	21	5.1	12.7	21.9	16.4	0.0	87.8	4.13	3.3	192.7	24.0	13.3	10.4
2000	June	22	9.9	13.4	19.9	2.4	0.0	86.0	4.84	3.2	229.8	29.9	19.3	14.8
2000	June	23	6.0	12.3	16.9	4.2	0.0	88.1	4.38	3.3	248.3	21.2	10.9	8.5
2000	June	24	3.3	11.1	19.9	1.8	0.0	83.3	4.79	3.5	235.0	35.9	20.7	17.5
2000	June	25	5.7	11.1	15.4	0.4	0.0	80.0	4.36	4.9	211.6	24.0	14.4	10.4
2000	June	26	6.0	15.1	23.7	0.2	0.0	68.5	7.21	2.5	242.3	18.4	10.9	7.4
2000	June	27	4.5	17.3	27.1	0.0	0.0	62.6	7.53	3.1	226.3	17.4	12.3	7.8
2000	June	28	7.0	19.5	30.0	0.0	0.0	61.5	6.89	3.0	192.3	17.7	13.1	8.5
2000	June	29	9.1	19.1	29.8	5.8	0.0	69.6	6.77	4.7	198.6	31.1	15.4	10.5
2000	June	30	11.4	17.6	23.5	0.2	0.0	81.5	6.33	3.8	187.0	22.4	11.9	9.1



**Table I-1 Climatic Data Recorded at Aurora Climate Station, January – December, 2000 (continued)**

Year	Month	Day	Temperature			Total Rainfall (mm)	Total Snowfall (cm)	Mean Relative Humidity (%)	Total Global Solar Radiation (kW-h/m <sup>2</sup> )	Wind Speed and Direction				
			Minimum (°C)	Mean (°C)	Maximum (°C)					Mean Daily Wind		Maximum Sustained Gusts		
										Speed (km/h)	Direction (degrees)	5 Second (km/h)	2 Minute (km/h)	10 Minute (km/h)
2000	July	1	12.8	18.2	25.5	0.0	0.0	76.7	4.92	3.3	163.1	21.4	11.5	8.4
2000	July	2	8.4	16.9	23.7	0.0	0.0	69.7	7.04	5.9	145.3	28.9	18.8	14.5
2000	July	3	11.1	18.8	27.6	2.0	0.0	72.6	6.42	5.8	177.4	37.2	21.3	16.0
2000	July	4	13.0	16.3	22.2	4.6	0.0	85.6	2.10	4.2	121.2	31.5	20.1	17.4
2000	July	5	8.9	15.6	23.0	2.4	0.0	87.8	4.33	3.5	141.7	21.9	11.4	9.6
2000	July	6	5.9	15.2	23.6	0.2	0.0	82.4	6.27	3.2	205.3	21.2	12.8	9.6
2000	July	7	7.3	18.5	26.9	0.0	0.0	71.3	7.57	3.7	232.8	25.2	15.2	11.1
2000	July	8	12.4	18.1	24.5	0.0	0.0	80.6	4.45	3.4	58.0	21.2	11.6	8.5
2000	July	9	11.0	19.6	28.6	0.8	0.0	68.8	7.30	4.3	67.0	33.3	13.9	11.1
2000	July	10	10.6	17.2	22.6	20.6	0.0	88.2	3.16	3.5	143.7	24.4	15.0	10.6
2000	July	11	13.9	18.9	25.8	0.4	0.0	82.0	5.32	2.7	200.0	15.2	10.9	7.0
2000	July	12	11.5	19.2	28.1	0.0	0.0	75.3	5.64	2.7	191.9	19.8	12.1	10.0
2000	July	13	9.6	20.7	30.2	0.0	0.0	67.5	7.84	2.5	209.8	17.6	11.4	8.4
2000	July	14	14.7	19.8	26.4	9.4	0.0	78.6	5.34	4.2	248.1	27.7	14.2	12.0
2000	July	15	10.0	14.3	19.5	12.6	0.0	86.1	4.33	5.1	252.7	32.4	16.9	13.4
2000	July	16	9.5	11.4	14.2	1.2	0.0	91.4	2.68	4.5	110.3	20.7	12.5	8.6
2000	July	17	9.0	13.0	17.2	0.2	0.0	83.5	3.25	5.1	163.4	29.4	15.8	10.5
2000	July	18	6.7	11.9	17.0	4.4	0.0	87.9	3.84	4.8	154.8	20.3	12.1	8.9
2000	July	19	3.5	13.8	23.3	0.2	0.0	77.2	7.44	3.9	176.4	20.6	11.7	8.9
2000	July	20	9.2	19.5	28.1	0.0	0.0	69.9	6.56	6.1	178.4	26.7	13.4	9.5
2000	July	21	12.8	21.3	28.1	0.0	0.0	71.4	6.58	5.1	188.8	27.2	15.5	12.5
2000	July	22	7.4	19.0	29.2	0.0	0.0	65.2	8.02	2.7	236.9	17.5	11.7	7.7
2000	July	23	7.6	20.0	32.0	0.0	0.0	66.3	6.48	2.9	159.8	22.4	12.4	8.9
2000	July	24	11.0	21.1	32.4	0.0	0.0	66.2	6.71	2.8	191.1	23.6	14.6	13.3
2000	July	25	14.1	19.4	27.8	0.0	0.0	78.9	3.59	3.1	182.1	18.1	10.7	8.2
2000	July	26	11.7	17.7	27.7	7.8	0.0	88.7	3.98	3.8	185.3	16.4	10.2	6.8
2000	July	27	10.0	19.9	30.5	10.6	0.0	77.9	6.89	3.7	192.5	38.0	26.3	18.5
2000	July	28	12.7	21.3	29.7	0.2	0.0	75.6	6.73	3.1	234.8	20.1	12.3	7.8
2000	July	29	12.2	19.4	25.6	6.8	0.0	64.2	7.27	5.7	243.0	34.9	18.6	13.1
2000	July	30	9.0	18.3	26.0	0.0	0.0	60.5	6.15	5.5	276.2	33.3	18.0	14.7
2000	July	31	8.8	18.0	25.8	0.0	0.0	75.2	6.90	4.1	179.0	24.6	13.5	10.4

**Table I-1 Climatic Data Recorded at Aurora Climate Station, January – December, 2000 (continued)**

Year	Month	Day	Temperature			Total Rainfall (mm)	Total Snowfall (cm)	Mean Relative Humidity (%)	Total Global Solar Radiation (kW-h/m <sup>2</sup> )	Wind Speed and Direction				
			Minimum (°C)	Mean (°C)	Maximum (°C)					Mean Daily Wind		Maximum Sustained Gusts		
										Speed (km/h)	Direction (degrees)	5 Second (km/h)	2 Minute (km/h)	10 Minute (km/h)
2000	August	1	8.2	19.4	30.8	0.0	0.0	74.8	5.79	2.8	202.5	19.1	11.6	8.4
2000	August	2	15.2	17.8	21.8	1.6	0.0	92.9	2.30	3.2	123.5	16.9	10.4	8.6
2000	August	3	14.6	18.4	25.4	1.6	0.0	89.7	4.25	3.2	73.7	19.0	11.6	8.0
2000	August	4	9.5	18.4	26.9	0.2	0.0	85.6	4.62	2.1	201.6	12.3	7.3	5.5
2000	August	5	11.6	19.6	28.6	0.2	0.0	79.8	6.42	3.4	191.1	22.4	12.8	10.4
2000	August	6	9.3	15.7	20.7	4.0	0.0	96.8	2.53	2.9	188.7	18.8	11.5	9.7
2000	August	7	8.8	15.6	22.0	0.2	0.0	79.2	5.79	4.9	174.0	27.4	15.4	10.5
2000	August	8	5.7	13.6	20.9	0.0	0.0	80.6	5.47	4.9	117.0	29.7	14.9	11.5
2000	August	9	3.9	12.9	20.2	0.0	0.0	73.8	6.28	4.3	91.3	21.0	12.0	8.1
2000	August	10	9.9	14.2	20.8	5.0	0.0	89.3	3.44	2.7	177.5	12.8	7.8	5.3
2000	August	11	7.5	13.3	18.7	0.6	0.0	91.9	2.33	3.0	74.9	16.1	9.4	6.1
2000	August	12	8.9	13.3	20.5	7.0	0.0	85.2	4.82	3.1	258.1	18.4	10.0	7.5
2000	August	13	5.2	12.1	20.7	5.4	0.0	88.9	4.07	2.8	232.9	35.2	18.2	14.9
2000	August	14	7.1	12.2	19.6	1.8	0.0	79.4	6.16	4.1	280.6	23.1	12.5	9.3
2000	August	15	5.5	13.8	24.9	0.0	0.0	79.3	5.44	5.4	146.9	30.1	16.4	12.9
2000	August	16	3.8	11.2	16.9	0.0	0.0	75.6	5.05	4.5	64.1	24.8	13.5	10.5
2000	August	17	1.3	12.3	20.9	0.0	0.0	73.5	5.78	4.3	188.5	22.6	13.7	10.4
2000	August	18	11.8	17.5	25.6	1.0	0.0	75.0	5.62	4.8	166.3	23.9	12.6	9.7
2000	August	19	7.8	15.8	22.3	0.2	0.0	81.9	3.91	4.0	225.6	26.0	16.0	11.8
2000	August	20	6.6	13.4	23.5	3.8	0.0	83.4	4.58	3.5	226.1	25.5	13.6	11.1
2000	August	21	5.2	12.7	22.2	0.2	0.0	80.6	5.60	3.8	210.5	21.0	13.9	9.4
2000	August	22	4.5	15.6	26.3	0.2	0.0	75.0	5.20	5.2	216.8	32.2	15.2	11.4
2000	August	23	11.5	18.0	25.8	0.0	0.0	69.4	6.06	4.6	242.4	30.3	14.7	10.1
2000	August	24	6.6	15.1	23.1	0.0	0.0	73.9	6.05	3.6	162.2	22.6	14.3	11.9
2000	August	25	3.0	9.9	16.2	7.2	0.0	99.8	1.27	2.1	154.9	18.4	9.7	7.8
2000	August	26	6.3	11.9	14.9	24.2	0.0	100.9	0.71	2.9	193.1	22.2	13.9	11.2
2000	August	27	4.3	7.4	9.8	8.0	0.0	98.8	1.08	4.7	255.6	22.6	13.4	9.5
2000	August	28	2.0	7.2	12.6	1.0	0.0	84.1	3.22	7.7	307.1	36.1	25.8	17.0
2000	August	29	-2.1	5.3	12.6	0.6	0.0	87.0	4.06	2.6	204.3	18.7	11.4	8.7
2000	August	30	3.7	7.4	12.6	0.0	0.0	86.0	3.00	2.3	196.2	17.0	9.0	6.4
2000	August	31	0.7	9.5	16.5	0.8	0.0	79.2	3.03	4.5	149.3	21.9	13.2	9.6

**Table I-1 Climatic Data Recorded at Aurora Climate Station, January – December, 2000 (continued)**

Year	Month	Day	Temperature			Total Rainfall (mm)	Total Snowfall (cm)	Mean Relative Humidity (%)	Total Global Solar Radiation (kW-h/m <sup>2</sup> )	Wind Speed and Direction				
			Minimum (°C)	Mean (°C)	Maximum (°C)					Mean Daily Wind		Maximum Sustained Gusts		
										Speed (km/h)	Direction (degrees)	5 Second (km/h)	2 Minute (km/h)	10 Minute (km/h)
2000	September	1	6.5	8.7	11.9	4.4	0.0	98.7	0.88	5.7	64.4	20.7	12.6	9.2
2000	September	2	7.2	10.0	16.4	3.2	0.0	92.0	1.40	4.2	84.6	18.3	11.5	8.0
2000	September	3	5.8	11.5	18.5	0.2	0.0	62.7	5.00	6.1	156.8	30.3	16.5	14.0
2000	September	4	7.0	9.7	12.5	0.0	0.0	87.3	1.63	3.0	189.4	20.0	8.8	7.1
2000	September	5	6.7	13.8	21.7	0.0	0.0	77.0	4.81	5.6	213.0	27.5	14.4	10.0
2000	September	6	2.6	10.5	17.0	8.6	0.0	85.2	3.58	5.0	287.5	27.0	14.2	11.8
2000	September	7	2.3	11.5	22.5	0.0	0.0	79.3	4.51	4.3	194.3	24.3	12.1	8.9
2000	September	8	5.6	12.4	20.8	0.0	0.0	81.5	4.28	3.2	255.4	24.7	17.4	11.7
2000	September	9	6.5	9.1	11.0	3.0	0.0	97.9	1.27	2.9	205.8	17.2	9.9	7.9
2000	September	10	1.5	7.0	10.0	0.2	0.0	82.5	2.73	6.4	312.1	30.2	19.8	15.6
2000	September	11	-2.5	6.9	15.9	1.2	0.0	75.0	4.83	3.1	251.5	24.4	13.8	9.5
2000	September	12	4.0	10.2	16.8	3.0	0.0	83.3	3.25	4.0	262.1	30.0	18.3	14.9
2000	September	13	-0.8	8.1	18.4	0.2	0.0	81.4	4.08	2.2	199.0	14.8	9.3	7.8
2000	September	14	-0.9	12.3	25.4	0.0	0.0	69.2	3.69	5.1	193.4	26.0	13.4	11.0
2000	September	15	4.0	13.0	20.5	0.0	0.0	62.1	4.32	5.0	275.7	27.8	16.1	12.9
2000	September	16	0.5	9.0	16.7	0.0	0.0	69.6	1.98	2.9	166.5	23.4	13.7	8.5
2000	September	17	8.8	13.1	20.7	1.0	0.0	85.4	2.48	3.4	158.7	21.0	11.8	8.3
2000	September	18	8.4	9.8	11.3	18.0	0.0	99.3	0.70	2.7	190.0	21.4	11.7	7.6
2000	September	19	-1.0	7.1	10.9	0.8	0.0	89.9	1.93	5.1	266.7	27.7	17.4	11.6
2000	September	20	-1.2	2.7	6.2	0.2	0.0	78.6	1.93	5.3	178.7	26.9	15.7	12.3
2000	September	21	-6.2	0.1	2.9	0.0	0.0	75.1	1.49	5.8	186.4	25.8	14.6	10.9
2000	September	22	-8.8	0.3	8.3	0.0	0.0	66.7	3.55	5.1	194.1	33.0	14.1	10.4
2000	September	23	0.7	6.4	16.1	0.0	0.0	65.2	2.58	4.3	170.6	23.8	13.6	9.3
2000	September	24	0.8	7.7	14.8	1.4	0.0	83.0	2.55	4.5	137.7	28.9	15.4	11.6
2000	September	25	-5.0	1.9	5.9	8.0	0.0	88.4	2.05	5.0	69.1	28.5	17.4	13.6
2000	September	26	-7.3	-0.8	4.4	0.6	0.0	88.1	1.70	3.6	162.9	17.7	10.8	8.3
2000	September	27	2.1	5.1	9.8	0.0	0.0	94.8	1.32	4.0	175.9	15.5	9.6	7.6
2000	September	28	0.0	6.5	20.1	0.4	0.0	88.7	2.46	4.4	155.1	29.4	18.6	14.4
2000	September	29	-1.4	6.7	12.1	0.0	0.0	84.5	1.76	4.2	167.4	19.6	12.8	10.5
2000	September	30	2.2	7.5	10.9	6.8	0.0	83.4	0.86	6.6	220.9	41.6	20.8	17.0

**Table I-1 Climatic Data Recorded at Aurora Climate Station, January – December, 2000 (continued)**

Year	Month	Day	Temperature			Total Rainfall (mm)	Total Snowfall (cm)	Mean Relative Humidity (%)	Total Global Solar Radiation (kW-h/m <sup>2</sup> )	Wind Speed and Direction				
			Minimum (°C)	Mean (°C)	Maximum (°C)					Mean Daily Wind		Maximum Sustained Gusts		
										Speed (km/h)	Direction (degrees)	5 Second (km/h)	2 Minute (km/h)	10 Minute (km/h)
2000	October	1	-1.5	2.5	6.8	0.0	0.0	56.6	3.33	11.1	304.8	44.0	23.3	20.2
2000	October	2	-1.8	-1.2	0.3	0.0	0.0	61.6	1.18	13.5	320.1	41.8	25.7	20.0
2000	October	3	-3.6	-2.0	0.4	0.0	0.0	72.7	1.73	9.1	321.5	28.5	17.5	15.3
2000	October	4	-3.8	-2.5	-0.6	0.0	0.0	65.2	1.17	6.9	320.6	24.0	15.1	11.6
2000	October	5	-10.3	-4.9	0.6	0.0	0.0	80.5	2.78	2.9	112.9	15.2	11.4	8.5
2000	October	6	-12.0	-1.0	9.2	0.0	0.0	55.5	3.28	7.5	188.1	33.7	20.3	14.0
2000	October	7	-0.5	6.7	16.9	0.0	0.0	33.7	3.07	8.3	189.4	29.1	18.4	12.9
2000	October	8	-1.8	5.8	16.6	0.0	0.0	47.1	2.97	5.5	187.1	19.9	11.8	10.2
2000	October	9	-0.9	6.3	14.9	0.0	0.0	70.1	1.87	3.7	193.6	16.0	10.1	7.0
2000	October	10	3.6	6.8	11.3	0.4	0.0	84.6	1.24	4.7	59.7	23.5	15.1	12.0
2000	October	11	1.6	6.6	11.1	0.0	0.0	78.6	1.96	3.7	152.9	14.8	10.2	7.8
2000	October	12	-3.2	4.2	14.2	0.0	0.0	77.0	2.32	3.6	108.6	16.4	10.4	7.1
2000	October	13	-3.6	4.2	13.0	0.0	0.0	70.1	2.59	4.3	86.6	25.4	15.8	12.5
2000	October	14	-2.6	6.5	11.5	0.0	0.0	65.3	1.33	5.2	201.9	33.1	16.9	13.5
2000	October	15	-4.1	3.4	12.1	0.0	0.0	75.7	1.61	4.9	187.8	17.9	10.7	7.7
2000	October	16	-0.5	7.9	13.8	0.0	0.0	56.3	2.33	6.0	223.8	29.8	15.6	12.3
2000	October	17	-5.0	2.2	12.4	0.0	0.0	68.2	2.02	4.1	198.6	16.2	8.7	6.8
2000	October	18	0.0	8.2	11.6	0.0	0.0	56.2	0.90	6.3	186.6	27.8	16.4	14.3
2000	October	19	-1.7	2.6	8.8	2.8	0.0	88.3	0.65	6.0	200.8	27.0	15.9	12.3
2000	October	20	-6.3	-1.4	1.9	0.0	0.0	85.5	0.67	6.6	143.4	29.4	21.1	15.8
2000	October	21	-0.5	1.8	4.3	0.0	0.0	85.6	0.62	3.7	210.7	21.3	13.1	11.2
2000	October	22	-2.7	4.6	10.3	0.2	0.0	71.3	1.09	4.5	216.2	19.5	10.6	7.3
2000	October	23	5.6	9.2	13.6	0.0	0.0	70.8	0.78	3.6	216.8	15.4	8.2	6.7
2000	October	24	-3.4	4.7	11.0	0.0	0.0	90.0	1.20	1.9	210.3	7.6	5.1	4.3
2000	October	25	-7.8	-0.9	10.6	0.0	0.0	82.3	2.01	5.3	148.0	34.2	19.7	15.4
2000	October	26	-12.8	-4.8	2.2	0.0	0.0	77.3	1.03	4.5	146.4	33.5	20.5	15.8
2000	October	27	-0.9	4.4	8.2	0.2	0.0	62.3	0.93	11.3	173.8	35.8	21.6	18.1
2000	October	28	0.7	1.4	3.5	2.0	0.0	94.9	0.16	7.9	44.9	26.7	17.7	13.3
2000	October	29	-0.3	3.0	5.4	0.2	0.0	98.3	0.34	3.4	178.2	14.9	9.9	7.4
2000	October	30	-5.5	-1.8	1.8	0.0	0.0	84.3	1.33	3.3	248.3	15.8	9.6	7.3
2000	October	31	-9.4	-3.0	5.7	0.0	0.0	89.7	1.65	2.2	196.6	13.2	8.8	7.8

**Table I-1 Climatic Data Recorded at Aurora Climate Station, January – December, 2000 (continued)**

Year	Month	Day	Temperature			Total Rainfall (mm)	Total Snowfall (cm)	Mean Relative Humidity (%)	Total Global Solar Radiation (kW-h/m <sup>2</sup> )	Wind Speed and Direction				
			Minimum (°C)	Mean (°C)	Maximum (°C)					Mean Daily Wind		Maximum Sustained Gusts		
										Speed (km/h)	Direction (degrees)	5 Second (km/h)	2 Minute (km/h)	10 Minute (km/h)
2000	November	1	-5.1	-0.5	5.4	0.0	0.0	95.2	0.60	3.8	199.2	16.4	8.0	6.9
2000	November	2	-9.7	-2.9	5.1	0.0	0.0	86.2	1.46	2.8	194.5	12.8	6.5	5.3
2000	November	3	-12.0	-4.3	2.0	2.6	0.0	95.0	0.71	3.1	184.8	25.3	12.6	11.1
2000	November	4	-7.7	-1.9	0.6	0.0	0.8	97.2	0.21	6.8	99.4	38.2	20.4	14.6
2000	November	5	-10.4	-9.5	-7.7	0.0	0.5	82.3	0.63	4.3	179.4	27.3	13.7	11.1
2000	November	6	-10.2	-9.2	-7.8	0.0	0.1	86.2	0.37	3.1	107.9	11.1	8.6	5.7
2000	November	7	-17.5	-9.8	-4.8	0.0	0.4	86.8	0.90	2.4	131.4	13.6	10.1	6.9
2000	November	8	-13.9	-8.7	-6.0	0.0	0.3	85.2	0.54	4.7	77.3	18.4	11.2	10.3
2000	November	9	-21.8	-14.1	-10.3	0.0	0.1	88.6	0.55	2.1	194.9	11.3	7.0	5.1
2000	November	10	-17.5	-13.5	-11.8	0.0	1.8	88.7	0.60	3.4	245.9	16.9	10.3	6.9
2000	November	11	-15.3	-10.5	-6.6	0.0	0.0	83.3	0.29	7.2	191.7	27.9	14.2	11.2
2000	November	12	-10.3	-6.0	0.6	0.0	0.1	87.9	1.18	5.4	184.4	21.8	12.4	9.0
2000	November	13	-11.9	-6.5	-1.9	0.0	0.0	95.2	0.70	2.9	188.4	14.0	8.5	6.5
2000	November	14	-14.2	-7.0	-3.4	0.0	0.0	87.0	0.77	3.4	149.1	22.0	11.2	8.7
2000	November	15	-18.2	-11.9	-7.1	0.0	0.0	87.8	0.70	3.6	184.9	17.4	10.2	8.4
2000	November	16	-15.9	-8.9	-4.9	0.0	0.4	92.2	0.40	3.0	225.7	17.2	10.0	8.0
2000	November	17	-8.3	-4.0	-1.5	0.0	2.1	94.7	0.59	4.1	202.4	23.4	14.8	10.0
2000	November	18	-7.3	-3.5	-1.2	0.0	2.2	90.8	0.09	4.7	276.9	23.3	15.1	11.3
2000	November	19	-9.9	-7.9	-6.5	0.0	0.0	89.8	0.19	3.7	182.6	19.3	10.9	9.5
2000	November	20	-18.5	-11.1	-4.1	0.0	0.0	88.1	0.28	3.3	202.7	17.7	10.0	7.9
2000	November	21	-19.6	-10.1	-3.4	0.0	0.0	91.0	0.24	4.1	194.3	17.8	10.5	7.8
2000	November	22	-8.8	-3.2	1.8	0.0	0.0	95.3	0.63	5.5	186.3	18.6	10.2	7.8
2000	November	23	-4.2	0.2	3.4	0.0	0.7	86.6	0.45	5.5	184.0	17.6	10.1	8.1
2000	November	24	-5.1	1.1	5.7	0.0	0.3	70.9	0.82	4.5	234.7	19.6	10.7	7.3
2000	November	25	-8.1	-1.1	4.4	0.0	0.0	76.2	0.45	5.1	183.7	17.2	10.6	8.8
2000	November	26	-7.5	-1.8	0.8	0.0	0.0	88.1	0.30	2.8	218.6	16.8	7.7	6.3
2000	November	27	-15.1	-9.9	-6.2	0.0	0.0	93.9	0.52	0.9	233.3	8.6	4.6	3.9
2000	November	28	-7.3	-6.4	-5.9	0.0	0.0	97.8	0.13	2.3	159.3	11.1	6.7	5.2
2000	November	29	-8.5	-7.2	-5.9	0.0	0.2	93.6	0.14	3.2	123.0	13.1	7.5	5.7
2000	November	30	-8.2	-7.3	-6.3	0.0	0.0	88.7	0.21	5.4	178.3	21.9	12.8	10.3

**Table I-1 Climatic Data Recorded at Aurora Climate Station, January – December, 2000 (continued)**

Year	Month	Day	Temperature			Total Rainfall (mm)	Total Snowfall (cm)	Mean Relative Humidity (%)	Total Global Solar Radiation (kW-h/m <sup>2</sup> )	Wind Speed and Direction				
			Minimum (°C)	Mean (°C)	Maximum (°C)					Mean Daily Wind		Maximum Sustained Gusts		
										Speed (km/h)	Direction (degrees)	5 Second (km/h)	2 Minute (km/h)	10 Minute (km/h)
2000	December	1	-6.6	-5.0	-4.0	0.0	0.0	84.2	0.23	7.6	195.9	27.2	14.8	10.9
2000	December	2	-7.8	-4.4	-1.5	0.0	0.0	87.7	0.51	5.8	154.3	28.1	16.9	13.3
2000	December	3	-29.6	-17.7	-7.8	0.0	0.0	72.8	0.26	5.8	94.8	29.6	16.2	13.3
2000	December	4	-33.0	-24.3	-14.8	0.0	0.2	73.5	0.52	2.9	182.2	13.1	7.7	6.3
2000	December	5	-14.8	-13.7	-13.0	0.0	1.3	81.7	0.27	2.7	167.4	14.6	10.3	8.6
2000	December	6	-14.2	-10.7	-8.3	0.0	0.1	90.6	0.07	4.8	121.7	28.9	15.2	11.1
2000	December	7	-19.8	-16.6	-14.2	0.0	0.0	84.6	0.22	2.3	94.0	20.9	12.6	9.1
2000	December	8	-32.3	-25.0	-18.8	0.0	0.0	76.5	0.29	3.6	42.8	19.3	14.1	8.2
2000	December	9	-39.9	-34.3	-29.2	0.0	0.0	68.7	0.39	0.9	153.6	9.2	5.5	4.2
2000	December	10	-34.4	-28.7	-22.9	0.0	0.0	73.4	0.27	0.8	218.4	6.1	4.4	3.4
2000	December	11	-35.4	-29.6	-22.9	0.0	0.0	73.3	0.34	2.7	183.8	13.5	7.8	5.6
2000	December	12	-35.9	-31.4	-26.1	0.0	0.0	73.3	0.33	1.5	156.9	11.7	7.8	5.7
2000	December	13	-39.4	-36.4	-30.7	0.0	0.0	67.4	0.28	0.8	202.5	6.9	5.2	3.8
2000	December	14	-39.8	-36.5	-30.4	0.0	0.2	67.0	0.30	1.3	175.9	9.8	6.3	5.4
2000	December	15	-39.9	-35.6	-29.4	0.0	0.3	67.8	0.15	0.4	195.0	4.5	3.2	2.4
2000	December	16	-38.2	-30.2	-22.0	0.0	0.3	70.1	0.16	5.5	175.7	28.9	17.0	13.2
2000	December	17	-32.7	-24.5	-20.2	0.0	3.4	78.9	0.32	3.2	199.6	24.6	15.9	12.0
2000	December	18	-34.0	-25.3	-18.9	0.0	1.4	79.9	0.17	2.5	131.1	11.4	8.4	7.2
2000	December	19	-35.2	-21.5	-16.9	0.0	4.6	82.9	0.09	5.0	128.7	31.2	16.2	14.3
2000	December	20	-37.8	-27.9	-18.9	0.0	0.0	76.5	0.15	5.6	185.7	22.7	12.6	9.6
2000	December	21	-26.5	-17.7	-14.6	0.0	0.0	85.6	0.04	5.9	99.8	23.3	13.9	10.6
2000	December	22	-38.4	-33.0	-26.5	0.0	0.0	72.3	0.17	1.9	153.1	11.2	7.2	6.2
2000	December	23	-34.8	-29.2	-21.3	0.0	0.0	75.3	0.16	2.3	220.9	14.5	7.5	5.6
2000	December	24	-25.0	-20.5	-19.0	0.0	0.1	80.1	0.06	3.1	181.0	18.4	10.6	6.9
2000	December	25	-24.4	-20.1	-17.1	0.0	0.0	80.2	0.06	3.2	173.7	15.7	10.5	8.3
2000	December	26	-17.1	-13.8	-10.8	0.0	3.5	86.4	0.08	6.0	184.1	27.2	16.6	12.6
2000	December	27	-18.3	-13.4	-11.3	0.0	0.0	91.0	0.07	2.2	121.0	24.8	12.9	9.9
2000	December	28	-20.2	-15.3	-13.5	0.0	0.0	89.6	0.10	2.1	133.9	17.3	8.7	8.0
2000	December	29	-18.1	-14.2	-11.6	0.0	0.0	91.1	0.12	1.5	223.5	13.8	6.6	5.5
2000	December	30	-19.6	-13.8	-10.1	0.0	0.0	91.0	0.28	3.1	209.3	16.0	8.0	6.7
2000	December	31	-14.6	-11.1	-5.0	0.0	0.0	91.7	0.48	4.6	195.9	14.9	8.9	7.4

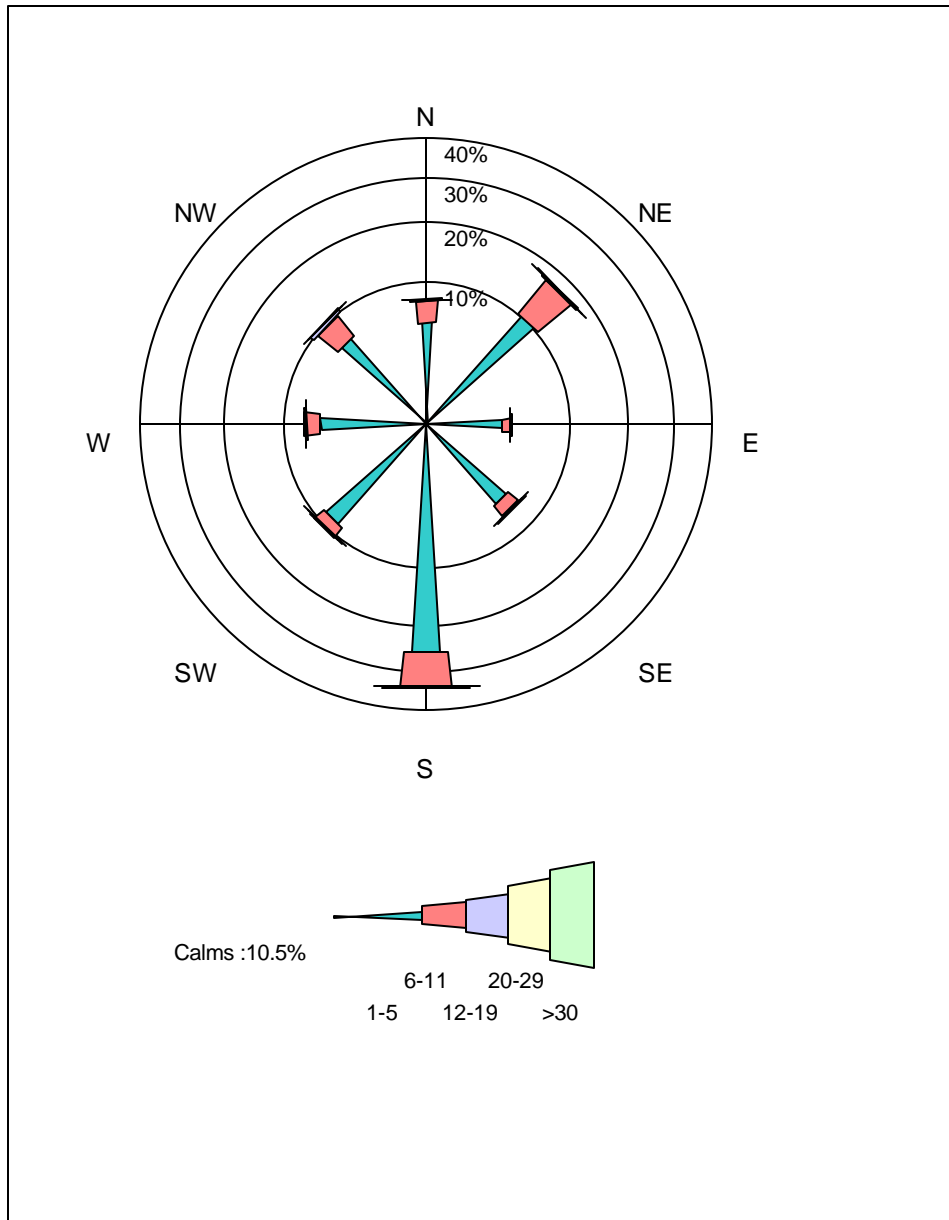
**Table I-2 2000 Mean Daily Atmospheric Pressure (kPa) at Aurora Climate Station**

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	97.73	97.07	97.91	98.06	97.16	98.81	97.48	97.95	98.61	96.51	97.91	98.14
2	98.18	98.60	97.54	99.59	97.17	98.66	97.58	97.85	98.80	97.52	97.99	97.06
3	98.68	99.67	97.34	97.72	96.90	98.38	97.51	97.76	98.69	98.34	97.31	99.07
4	98.00	99.43	97.12	96.53	95.94	98.19	97.44	97.55	98.15	98.85	96.73	99.57
5	97.34	99.05	98.02	97.78	96.77	98.53	97.28	97.19	97.07	99.48	98.40	98.62
6	97.89	99.46	98.80	97.98	97.59	97.89	97.20	97.18	97.43	99.19	99.32	97.19
7	96.65	98.03	99.65	98.47	97.92	97.86	96.78	97.40	96.43	98.19	99.19	98.69
8	96.45	99.12	100.13	98.53	97.83	97.94	97.56	97.60	95.42	97.23	98.74	99.15
9	95.37	99.78	99.12	98.68	97.44	97.76	97.89	98.09	95.89	97.57	99.34	99.81
10	96.48	99.67	99.97	98.94	97.49	98.01	97.59	97.94	96.72	97.77	99.00	99.85
11	98.57	98.79	99.90	98.74	97.91	97.90	97.18	97.94	96.92	98.09	97.67	99.41
12	99.01	98.79	99.18	98.79	98.08	97.53	97.39	97.65	96.90	98.20	97.73	99.02
13	100.15	97.68	99.24	99.51	98.74	97.64	97.69	97.39	97.98	98.36	98.10	98.67
14	100.85	98.16	99.18	98.64	98.56	96.94	97.28	97.68	97.65	97.69	98.05	98.40
15	100.05	99.57	99.45	98.01	97.84	97.51	97.16	98.18	97.41	97.35	98.37	99.13
16	99.48	99.07	98.55	97.59	98.38	98.21	98.45	98.91	97.93	96.94	98.00	98.71
17	98.92	98.69	96.89	97.29	98.37	97.32	98.49	98.54	96.89	97.58	97.67	98.11
18	99.53	98.23	97.18	97.04	97.75	96.55	98.40	97.32	96.74	96.59	97.80	98.70
19	99.37	97.82	96.90	96.98	97.25	96.59	98.38	96.74	97.96	97.47	99.00	98.15
20	99.20	97.16	98.04	97.59	96.98	96.80	97.82	97.17	98.44	97.42	98.48	99.20
21	97.74	96.74	97.12	97.26	96.79	96.80	97.37	97.32	99.12	96.76	98.04	98.58
22	98.47	97.51	97.88	96.24	96.25	97.10	97.78	97.18	98.56	97.27	97.56	99.46
23	97.89	97.45	97.47	97.09	96.57	97.23	97.41	97.28	97.65	97.56	96.63	99.23
24	98.34	-	97.69	97.77	97.37	97.75	97.46	98.05	98.16	98.08	96.96	99.29
25	98.00	97.61	97.36	97.96	97.28	98.42	97.39	97.81	98.54	98.58	96.31	99.53
26	97.80	97.61	97.70	98.56	97.39	98.67	97.23	96.62	98.35	98.65	96.86	98.27
27	98.57	97.58	97.32	98.69	97.32	98.15	97.33	96.21	97.79	97.17	97.42	98.34
28	98.13	97.40	97.02	97.17	97.50	97.56	97.29	97.36	97.14	97.31	98.44	99.47
29	98.12	98.27	98.33	97.25	98.08	96.95	97.45	98.25	96.78	97.42	98.88	99.25
30	98.54	-	98.79	97.70	98.64	97.01	97.71	98.14	95.70	98.07	99.10	98.43
31	97.98	-	98.67	-	98.74	-	98.18	97.99	-	97.79	-	97.58
<b>min</b>	<b>95.37</b>	<b>96.74</b>	<b>96.89</b>	<b>96.24</b>	<b>95.94</b>	<b>96.55</b>	<b>96.78</b>	<b>96.21</b>	<b>95.42</b>	<b>96.51</b>	<b>96.31</b>	<b>97.06</b>
<b>mean</b>	<b>98.31</b>	<b>98.36</b>	<b>98.24</b>	<b>97.94</b>	<b>97.58</b>	<b>97.69</b>	<b>97.59</b>	<b>97.62</b>	<b>97.53</b>	<b>97.77</b>	<b>98.03</b>	<b>98.78</b>
<b>max</b>	<b>100.85</b>	<b>99.78</b>	<b>100.13</b>	<b>99.59</b>	<b>98.74</b>	<b>98.81</b>	<b>98.49</b>	<b>98.91</b>	<b>99.12</b>	<b>99.48</b>	<b>99.34</b>	<b>99.85</b>

Notes: P - partial daily average.

**Table I-3 Hourly Wind Rose [km/h] at Aurora Climate Station (1995-1999)**

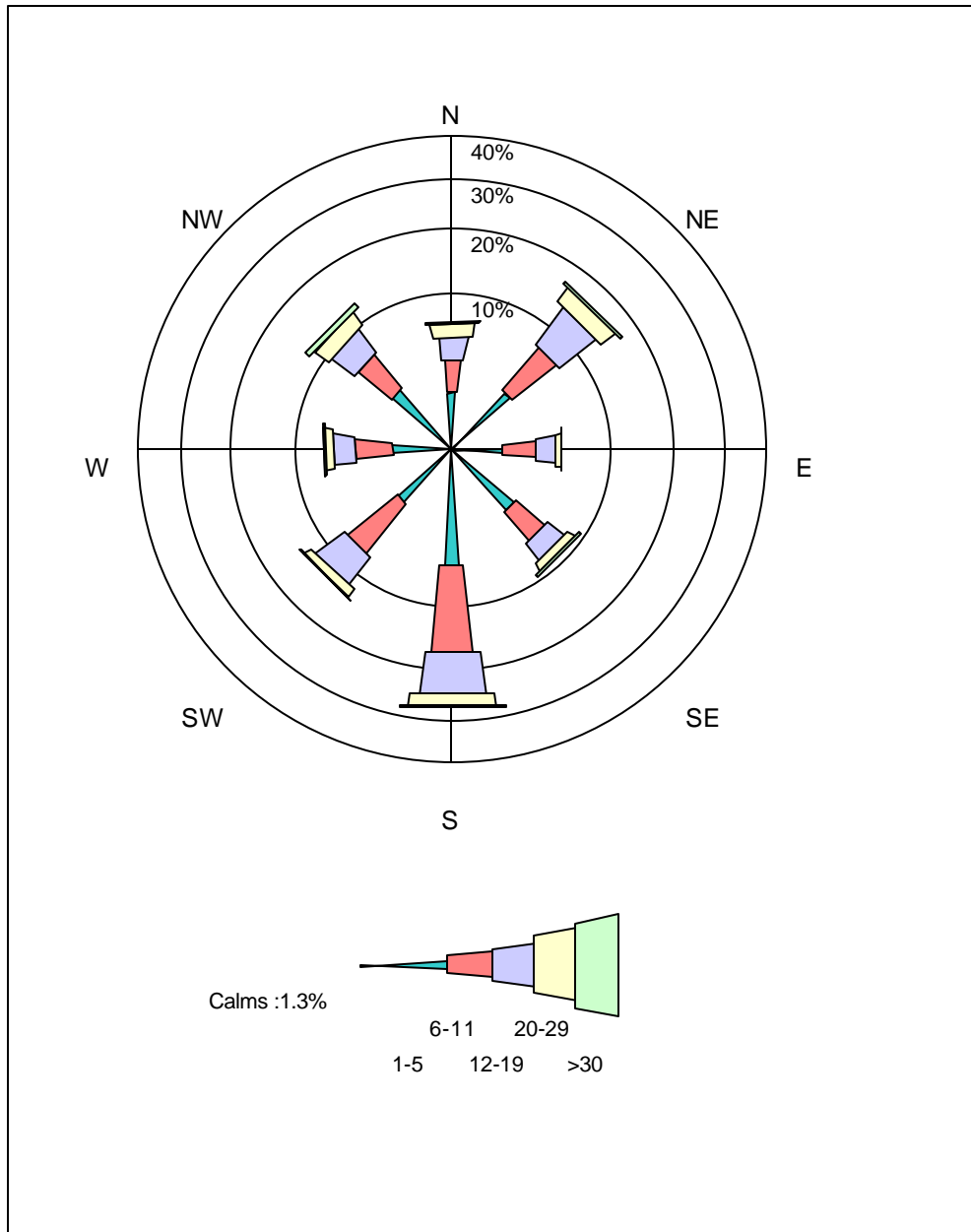
Bins	N	NE	E	SE	S	SW	W	NW
<1	689	463	216	474	1140	554	467	462
6	1997	3898	1067	2091	9774	3316	2118	2425
12	930	2766	286	593	3268	676	662	1246
20	55	166	13	76	205	2	16	289
29	1	0	0	2	0	0	0	22
100	0	0	0	0	0	0	0	0
minimum	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
maximum	20.8	19.1	14.1	21.4	19.1	15.5	15.7	28.2
average	4.9	5.7	4.4	4.6	4.8	4.1	4.3	5.9





**Table I-4 5 Second Gust Wind Rose [km/h] at Aurora Climate Station (1995-1999)**

Bins	N	NE	E	SE	S	SW	W	NW
<1	54	57	36	62	144	77	54	48
6	548	1009	417	1106	2328	848	619	1060
12	811	2062	742	1340	4766	2252	1000	1493
20	874	2487	650	922	3316	1906	850	1425
29	562	1261	258	460	1134	561	383	905
100	166	228	38	110	197	78	109	370
minimum	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
maximum	56.7	49.2	41.8	51.4	53.4	41.8	52.5	60.4
average	14.2	14.1	12.1	11.4	11.6	12.2	12.6	14.2



**APPENDIX II**

**1997-2000 SNOW COURSE SURVEY DATA**

**Table II-1 Summary of 2000 Snow Course Survey Data**

Terrain Type	Survey Plot No	Date of Survey	GPS Location	Snow Density (g/cm <sup>3</sup> )	Snow Depth (cm)	Snow Water Equivalent (mm)	Description of Vegetation	Snow Cover Appearance
flat low lying	FL-00-1	12-Mar-00	6355733 N 490343 E	0.255	41.7	106.5	- 80% covered with willow av. ht. 2.0m	- white, hard crust (15 cm), coarse grained, no snow underneath willows
	FL-00-2	12-Mar-00	6345470 N 477936 E	0.270	34.3	92.6	- willow (3m tall) 80% - understory - dead willow and grass	- white, hard crust 10 cm on top, coarse grained, no or some snow underneath willows
	FL-00-3	12-Mar-00	6343322 N 473105 E	0.196	48.6	95.3	- willow (3m tall) 50% alder -10%, fireweed 18% area surrounded by jackpine	- white, hard crust (15 cm), coarse grained
	FL-00-4	12-Mar-00	6344638 N 471511 E	0.190	33.2	63.1	- dead tamarack, grass jackpine (5 cm dia. 3m ht.) - 1%	- white, clean, crust on top very coarse grained
open land	OP-00-2	12-Mar-00	6344085 N 475525 E	0.356	39.1	139.3	- previously cleared area, surrounded by spruce (5 to berry 70%, alder 10%	- white, clean, wet, medium to coarse grained
	OP-00-3	12-Mar-00	6339755 N 464040 E	0.280	30.2	84.7	- poplar 2m ht., dia. 7 cm clover/buffaloberry/fireweed willows with slightly vegetation grass	- white, very compact, dry coarse grained
	OP-00-4	12-Mar-00	6332571 N 464026 E	0.354	17.8	63.0	- surrounded by spruce along the shoreline	- slightly dirty, wet, coarse grained
open lake	OP-00-1	12-Mar-00	6350817 N 484916 E	0.181	9.0	16.2	- surrounded by spruce and willows along the shoreline	- white, compact to ice cover, coarse grained clean
mixed deciduous	MD-00-1	12-Mar-00	6355611 N 491214 E	0.207	38.9	80.5	- aspen 65% canopy with 20m, dia.20 cm, white spruce 3m -5m, understory 20%, alder 2m ht.	- white, compact, coarse grained hard crust at top.
	MD-00-2	12-Mar-00	6354947 N 491807 E	0.232	39.5	91.6	- canopy 80%, poplar aspen av. ht 25m dia. 15 cm, spruce 2%, ht. 5m dia. 10 cm understory 20 % alder av. ht. 2m	- white, compact, coarse grained hard crust at top.
	MD-00-3	12-Mar-00	6354569 N 487617 E	0.232	36.5	84.8	- poplar - 65%, av. ht.25 m, dia. 20 cm white spruce 34% av. ht. 15m dia. 10 cm understory - alder 60%	- white, sticky, wet coarse grained no crust on top
	MD-00-4	12-Mar-00	6350813 N 484827 E	0.177	38.1	67.6	- canopy 60%. poplar - 95%, av. ht.20 m, dia. 18 cm, spruce 5% ht. 12m dia, 7 cm. understory birch/wild rose and fireweed	- white, dry coarse grained
jack pine	JP-00-1	12-Mar-00	6355758 N 490867 E	0.204	42.3	86.2	- jack pine - 70%, av. ht.-20m, dia. 15 cm. understory - white spruce 5% alder 10% moss floor	- white, compact, coarse grained
	JP-00-2	12-Mar-00	6349196 N 481670 E	0.180	35.3	63.4	- jack pine - 85%, av. ht. 18m, dia.20 cm. white spruce 15%, ht. 15m, dia. 15 cm. understory - alder 5% dead/dry	- white, clean, wet, coarse grained. no base
	JP-00-3	12-Mar-00	6345913 N 478532 E	0.196	30.6	59.8	- canopy 80%, jack pine -100%, av. ht. 14m, dia. 10 cm. understory - birch/alder 30% low creeping berry/dead wood	- white, crust on top, wet and coarse grained
	JP-00-4	12-Mar-00	6342862 N 474290 E	0.153	33.9	52.0	- canopy 80%. jack pine - 80%, ht. 22m, dia. 25 cm. aspen 20%, ht 20m, dia.10 cm. understory - ledum, moss and wild rose	- white, wet, coarse grained

**Table II-2 Summary of 1999 Snow Course Survey Data**

Terrain Type	Survey Plot No	Date of Survey	GPS Location	Snow Density (g/cm <sup>3</sup> )	Snow Depth (cm)	Snow Water Equivalent (mm)	Description of Vegetation	Snow Cover Appearance
flat low lying	FL99-1	15-Mar-99	6345649 N 477842 E	0.178	36.9	65.6	- 80% covered with willow av. ht. 2.5m	- white, wet, loose coarse grained
	FL99-2	16-Mar-99	6351787 N 476015 E	0.175	33.5	58.8	- understory of willow (5m tall) 80% understory - dead willow and grass	- white, dry, 2 cm crust on top, loose, coarse grained
	FL99-3	16-Mar-99	6345664 N 469948 E	0.204	33.9	69.0	- understory willow (3m tall) 80% tall dead tree - 2%, tamarack 18%	- dust on surface, wet, compact, granular
	FL99-4	17-Mar-99	6339360 N 463875 E	0.191	34.6	66.3	- canopy 30%, spruce 5m ht. willow 2m ht. mosses and willow 40% cover understory	- white, clean, crust on top, coarse grained
open land	OP99-2	15-Mar-99	6344064 N 475112 E	0.140	36.2	50.7	- previously cleared area berry 70%, alder 10%	- white, clean, wet, medium to coarse grained
	OP99-4	17-Mar-99	6332905 N 463915 E	0.203	21.9	44.4	- poplar 2m ht., dia. 7 cm clover/buffaloberry/fireweed willows with slightly vegetation grass	- white, very compact, dry coarse grained
open lake	OP99-1	15-Mar-99	6351076 N 484823 E	0.231	21.2	48.8	- surrounded by spruce along the shoreline	- white, compact, coarse grained hard crust at top.
	OP99-3	15-Mar-99	6339198 N 464191 E	0.227	13.3	30.3	- surrounded by spruce along the shoreline	- slightly dirty, wet, coarse grained
mixed deciduous	MD99-1	15-Mar-99	6355474 N 489559 E	0.155	36.1	56.1	- aspen 65% canopy with 20m, dia. 20 cm, white spruce 3m-5m, understory 20%, alder 2m ht.	- white, compact, coarse grained hard crust at top.
	MD99-2	15-Mar-99	6350203 N 483640 E	0.174	36.5	63.5	- canopy 80%, poplar aspen av. ht 25m dia. 15 cm, spruce 2% , ht. 5m dia. 10 cm understory 20 % alder av. ht. 2m	- white, compact, coarse grained hard crust at top.
	MD99-3	15-Mar-99	6347482 N 479714 E	0.178	36.9	65.6	- poplar - 65%, av. ht.25 m, dia. 20 cm white spruce 34% av. ht. 15m dia. 10 cm understory – alder 60%	- white, sticky, wet coarse grained no crust on top
	MD99-4	16-Mar-99	6342273 N 467232 E	0.187	25.3	47.3	- canopy 60%. poplar - 95%, av. ht.20 m, dia. 18 cm, spruce 5% ht. 12m dia, 7 cm. understory birch/wild rose and fireweed	- white, dry coarse grained
jack pine	JP99-1	15-Mar-99	6352668 N 485708 E	0.142	34.7	49.5	- jack pine - 70%, av. ht.-20m, dia. 15 cm. understory - white spruce 5% alder 10% moss floor	- white, compact, coarse grained
	JP99-2	15-Mar-99	6349312 N 481427 E	0.177	30.1	53.4	- jack pine - 85%, av. ht. 18m, dia.20 cm. white spruce 15%, ht. 15m, dia. 15 cm. understory - alder 5% dead/dry	- white, clean, wet, coarse grained. no base
	JP99-3	16-Mar-99	6344912 N 463861 E	0.199	24	47.8	- canopy 80%, jack pine -100%, av. ht. 14m, dia. 10 cm. understory - birch/alder 30% low creeping berry/dead wood	- white, crust on top, wet and coarse grained
	JP99-4	16-Mar-99	6346099 N 470078 E	0.146	24.8	36.8	- canopy 80%. jack pine - 80%, ht. 22m, dia. 25 cm. aspen 20%, ht 20m, dia.10 cm. understory – labrador tea, moss and wild rose	- white, wet, coarse grained

**Table II-3 Summary of 1998 Snow Course Survey Data**

Terrain Type	Survey Plot No	Date of Survey	GPS Location	Snow Density (g/cm <sup>3</sup> )	Snow Depth (cm)	Snow Water Equivalent (mm)	Description of Vegetation	Snow Cover Appearance
flat low lying	FL98-1	14-Mar-98	6347847 N 464071 E	0.181	35.9	64.8	- previously cleared understory - dogwood 10%, wild rose 30% bunch of grass (1m to 1.5m tall) 40% aspen poplar (less 0.6m tall) 10%	- white, dry, powdery loose to compacted coarse grained
	FL98-2	16-Mar-98	6343515 N 467980 E	0.155	36.1	55.8	- understory of willow (2m tall) 80% dead spruce (along edge) 5%	- white, dry, crust on top, loose, coarse grained
	FL98-3	16-Mar-98	6340847 N 468745 E	0.181	34.2	61.7	- understory willow (3m tall) 95% ice sheet hanging in willows	- white, clean, wet, loose coarse grained
	FL98-4	16-Mar-98	6343284 N 472707 E	0.133	36.2	48.0	- understory willow clusters (1.5m tall) 60% grass (0.5m tall) 2% tamarack 10%	- white, clean, crust on top coarse grained
open land	OP98-1	16-Mar-98	6332814 N 463896 E	0.151	30.8	46.6	- old gravel pit with some slight vegetation grass	- white, clean, wet, medium to coarse grained
	OP98-4	16-Mar-98	6340599 N 463824 E	0.214	26.9	57.5	- existing gravel pit topography - slightly rolling with slightly vegetation grass	- slight discolouration on surface due to dust, crust. wet and coarse grained
open lake	OP98-2	16-Mar-98	6347005 N 468474 E	0.256	16.3	41.9	- surrounded by tamarack 90%, spruce white/black and shrub 10% along the shoreline	- slightly discoloured 30m from the road, wet snow on surface, powdery underneath coarse grained
	OP98-3	16-Mar-98	6339309 N 464098 E	0.163	33.1	54.0	- surrounded by spruce along the shoreline	- crust on top, clean, coarse grained uniform
mixed deciduous	MD98-1	16-Mar-98	6349399 N 468873 E	0.175	35.5	62.1	- flat forested, shallow snow under dripline of tree, white spruce 60% ht. 20m, dia. 15 cm poplar 40% ht. 17m, dia. 20 cm. understory wild rose 1%, shrub cover and moss	- white, dry, coarse grained
	MD98-2	16-Mar-98	6347709 N 468527 E	0.211	31.8	66.9	- slightly sloping west. white spruce 60% ht. 20m, dia. 15 cm, jackpine 30% ht. 25m, dia. 22 cm, poplar 20% ht 15m dia. 12 cm understory wild rose 60% white spruce ht <1m ht. 15%, moss floor	- white, dry, coarse grained
	MD98-3	16-Mar-98	6341819 N 470113 E	0.143	32.3	46.3	- poplar - 98%, av. ht.20 m, dia. 15 cm white spruce 2% av. ht. 15m dia. 15 cm understory - wild rose 60%, moss floor	- white, dry coarse grained
jack pine	JP98-1	16-Mar-98	6346976 N 469812 E	0.184	29.2	53.8	- jack pine - 100%, av. ht.-22m, dia. 18 cm. understory <5m white spruce and poplar whips shrubs - alder wild rose moss floor	- white, dry coarse grained pine needles
	JP98-2	16-Mar-98	6342784 N 471093 E	0.163	30.8	50.3	- jack pine - 80%, av. ht. 25m, dia.17 cm. white spruce 20%, ht. 15m, dia. 10 cm. understory - labrador tea 75% and floor moss	- white, clean, wet, coarse grained
	JP98-3	16-Mar-98	6343536 N 473997 E	0.140	29.3	41.0	- jack pine -100%, av. ht. 25m, dia. 20 cm. understory - ledum 70%, deadfall tree 20% labrador tea and floor moss	- white, crust on top, wet and coarse grained
	JP98-4	16-Mar-98	6344532 N 475975 E	0.121	31.7	38.4	- jack pine - 99%, ht. 30m, dia. 30 cm. white spruce 1%, ht 25m understory - labrador tea, moss and wild rose	- white, wet, coarse grained

**Table II-4 Summary of 1997 Snow Course Survey Data**

Terrain Type	Survey Plot No	Date of Survey	GPS Location	Snow Density (g/cm <sup>3</sup> )	Snow Depth (cm)	Snow Water Equivalent (mm)	Description of Vegetation	Snow Cover Appearance
flat low lying	FL97-1	17-Mar-97	6343422.6N 468114.7E	0.188	54.2	101.9	- understory of dead willow - 30%	- white loose to compacted coarse granular
	FL97-2	17-Mar-97	6340621.5N 468767.5E	0.170	50.4	85.6	- understory of willow - 50% av. ht. - 3m	- white, clean loose, coarse granular
	FL97-3	17-Mar-97	6339612.9N 464993.0E	0.189	76.5	144.6	- understory willow - 40%, av. ht.-2m, black spruce - < 2%, av. ht. - 2m	- white, clean, loose coarse granular
	FL97-4	19-Mar-97	6343441.8N 473432.3E	0.179	65.6	117.2	- understory willow - 60% to 65%, av. ht. - 3m to 3.5m bog birch - 5%, av. ht. - <1m	- deep, white, loose, coarse granular
open land	OP97-2	17-Mar-97	6347510.7N 464053.8E	0.184	44.3	81.6	- cut block/gravel pit. site cleared with some forbes vegetation	- white, clean, hard crust 3" below wind swept surface
	OP97-3	17-Mar-97	6332502.4N 463884.5E	0.185	47.6	88.2	- gravel pit/pipeline crossing. topography slightly rolling towards Athabasca river. area surrounded by mixed deciduous (aspen & spruce)	- slightly dirty with dust particles from road, hard crust 6 cm below wind swept surface, coarse granular
open lake	OP97-1	17-Mar-97	6340889.0N 469084.5E	0.176	14.6	25.6	- surrounded by willow at shoreline, trembling aspen 90% and white spruce 10%.	- compacted, hard, wind swept, clean, white, coarse granular
	OP97-4	18-Mar-97	6342927.1N 463378.2E	0.201	18.2	36.7	- surrounded by black spruce, white birch, trembling aspen and white spruce	- compacted, clean, hard, wind fetch from north, white, coarse granular
mixed deciduous	MD97-1	17-Mar-97	6341953.2N 470450.4E	0.204	54.7	111.8	- white spruce - 30%, av. ht.- 17m, dia.- 20 cm. trembling aspen - 60%, av. ht.- 18m, dia.-15 cm. understory – green alder - 60%, wild rose <1%, white spruce 5%.	- white, loose to compacted, coarse granular
	MD97-2	19-Mar-97	6344001.4N 475141.1E	0.206	37.4	77.0	- white spruce - 30%, av. ht.-18m, dia.- 18 cm. trembling aspen - 55%, av. ht. - 24m, dia.-20 cm. understory – green alder-20%, ht. 2m - trembling aspen- 15%, ht. 0.5m - white spruce 10%, ht. 2m to 2.5m	- loose to slightly compacted hard crust at 6 cm below new loose snow, fairly clean with some leaves and snow fleas
	MD97-3	19-Mar-97	6344618.0N 476660.4E	0.182	44.0	80.1	- white spruce - 20%, av. ht.-20m, dia.- 19 cm. trembling aspen - 70%, av. ht. - 23m, dia.-20 cm. understory - green alder 40%, ht. 2.5m - trembling aspen -5%, ht.- 1.0m	- loose to slightly compacted coarse granular and lots of snow fleas
	MD97-4	19-Mar-97	6348323.5N 480690.9E	0.241	48.6	117.1	- white spruce - 25%, av. ht.-18m, dia.- 15 cm. trembling aspen - 50%, av. ht.-20m, dia.-18 cm. white birch <2%, ht. 14m. understory - green alder 20%, ht.- 2m -white birch 15%, ht. 3.5m -willow 5%, ht.1.5 m - white spruce 13%, ht. 3m	- slightly compacted and 'sticky' due to warmer temperature, coarse granular, some snow fleas
jack pine	JP97-1	17-Mar-97	6343202.0N 468016.4E	0.171	44.9	76.5	- jack pine - 80%, av. ht.-18m, dia. 18 cm. trembling aspen - 5%, av. ht.-16m, dia.- 10 cm. understory - buffaloberry 10%, trembling aspen 2%	- white, loose, granular with pine needles
	JP97-2	17-Mar-97	6343054.4N 472067.6E	0.165	48.5	80.2	- jack pine - 60%, av. ht. 20m, dia.17 cm. understory - white spruce 5%	- white, clean, loose, coarse granular
	JP97-3	19-Mar-97	6341137.3N 469621.3E	0.168	51.1	85.8	- jack pine -70%, av. ht. 20m, dia. 16 cm. trembling aspen - 2%, av. ht. 20m, dia. 11 cm. understory – buffaloberry 10%, white spruce 1%	- white, loose to compacted, coarse granular with lot of fine needles
	JP97-4	19-Mar-97	6343295.0N 473911.2E	0.179	43.2	77.1	- jack pine - 75%, av. ht. 21m, dia. 19 cm. understory - green alder 35%, ht. 1m to 1.5m. - labrador tea <2%	- white, loose to slightly compacted, clean, coarse granular with pine needles interspersed among snow

**APPENDIX III**  
**CLIMATIC AND HYDROLOGIC MONITORING STATION**  
**FACTSHEETS**

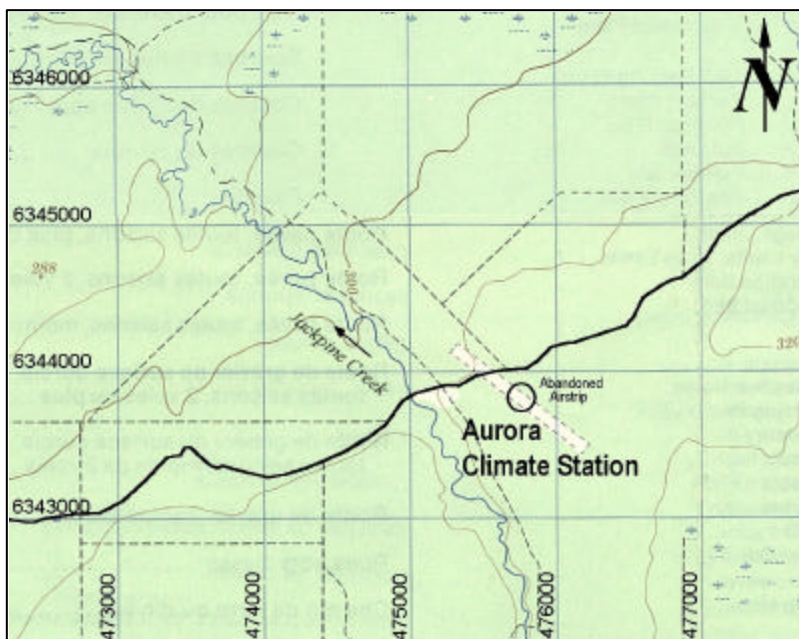
# AURORA CLIMATE STATION

# C1 FACTSHEET

## LOCATION AND PURPOSE

Established in May, 1995 to monitor climate conditions in the Muskeg River basin. Formerly Station 271 for the OSLO project – 1988 data available.

Access: 400 m long 4WD track south of 2WD road  
 Benchmark: n/a  
 Elevation: 310 m  
 Coordinates: UTM: 475800 E, 6343750 N Lat/Long: 57°14'16" N, 111°24'27" W  
 LSD: SW-16-95-9-W4 NTS Map: 74E/3



## EQUIPMENT

Component	Function	Serial No.
Young 05103-10 Wind Monitor*	Measure wind speed and direction	Sensor 1: WM20208 Sensor 2: WM39214
LI-COR LI200S Silicon Pyranometer*	Measure solar radiation	Sensor 1: PY22490 Sensor 2: PY34148
Vaisala HMP35/45C Temperature and Relative Humidity Sensor with 41002 Radiation Shield*	Measure temperature and relative humidity	HMP35C: C1419 HMP45C: C1119
Hydrological Services TBS Tipping Bucket Rain Gauge	Measure rainfall rate (Summer)	
Texas Electronics TE-525USW Tipping Bucket Rain Gauge With CS-705 Snowfall Adapter	Measure snowfall rate (Winter)	24792-999
Campbell Scientific SR50-45 Sonic Ranger	Measure snowfall accumulation	C1035
Campbell Scientific CR10 Data Logger	Record data	
Campbell Scientific SM192 Storage Module	Store data	Module 1: Module 2: 12367
MSX20 20 Watt Solar Panel with BP12PS 12 A-h 12 VDC Rechargeable Battery and CH12R 12 VDC Charger/Regulator	Power supply	

\* Spares are available for these components to facilitate regular servicing/calibration. One sensor is deployed at any given time. Other components can be serviced seasonally.



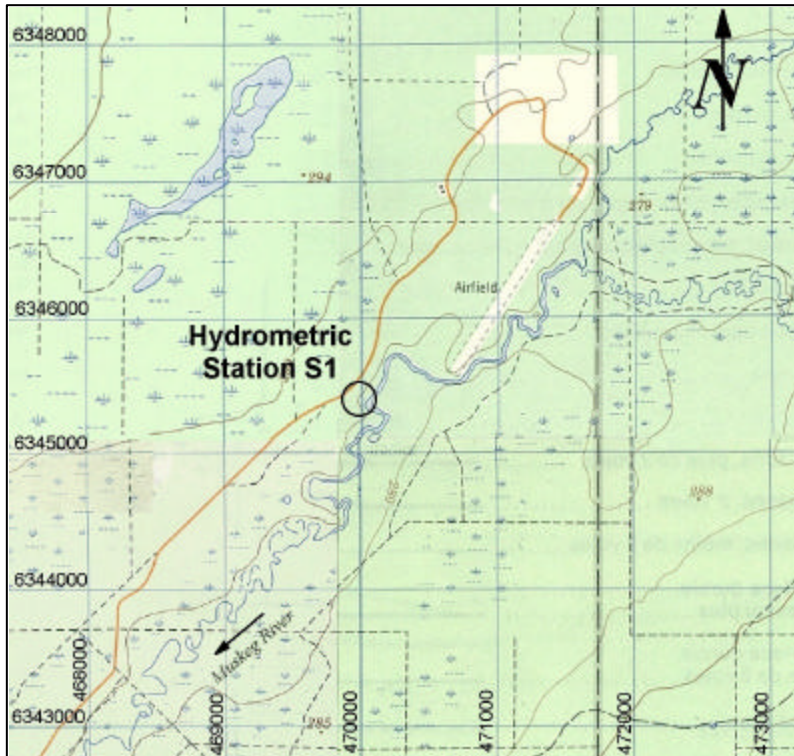
# ALSANDS DRAIN HYDROMETRIC STATION

# S1 FACTSHEET

## LOCATION AND PURPOSE

Established in August, 1995 to monitor discharge from the Alsands settling pond. Reinstalled with new weir by Syncrude in September, 1998 on new outlet channel.

Access: 2WD road access through Muskeg River Mine  
 Benchmark: Top of pile support on right hand side of weir, elevation 280.015 m (geodetic)  
 Drainage Area: 15.8 km<sup>2</sup>  
 Coordinates: UTM: 470006 E, 6345534 N      Lat/Long: 57°15'12" N, 111°29'52" W  
 LSD: SE-23-95-10-W4      NTS Map: 74E/6



## EQUIPMENT

Component	Function	Serial No.
Lakewood UltraLogger RX-E	Record data	94908-08
Keller 8363K 8 psi Pressure Transducer	Measure water levels	971021

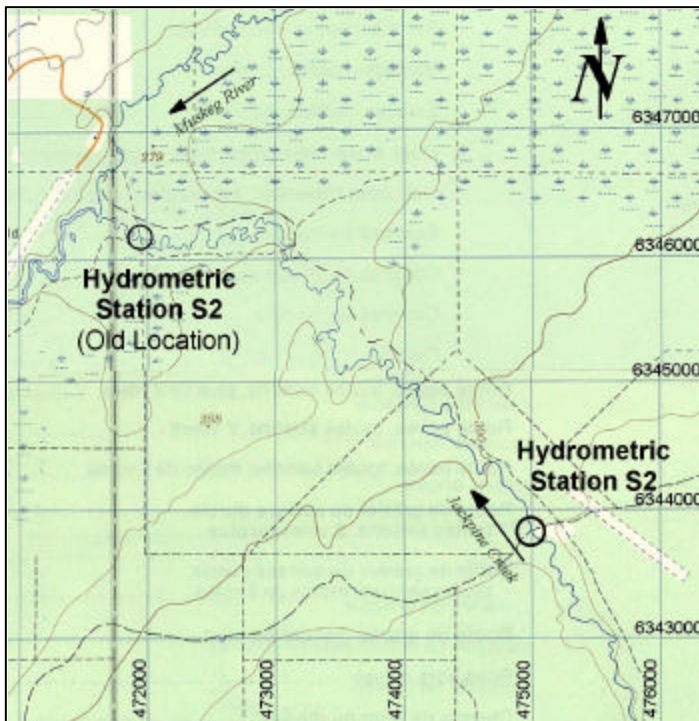
# JACKPINE CREEK HYDROMETRIC STATION

# S2 FACTSHEET

## LOCATION AND PURPOSE

Established in May, 1995 to monitor discharge on Jackpine Creek upstream of the Muskeg River. Replaced a Water Survey of Canada gauging station (07DA009) that previously operated at the original site from 1975 to 1993. Station was moved to present location in 2000 to allow road access and avoid beaver dams.

Access: Helicopter  
 Benchmark: Present Location: Steel bar in PVC housing, elevation 297.99 m (geodetic).  
 Old Location: Brass cap in concrete base of cableway anchor, elevation 280.98 m (geodetic); 99.640 m (local)  
 Drainage Area: 358 km<sup>2</sup>  
 Coordinates: UTM: 475132 E, 6343680 N      Lat/Long: 57°14'21" N, 111°24'53" W  
                   LSD: SE-17-95-9-W4            NTS Map: 74E/3  
 Old Coordinates: UTM: 471952 E, 6346165 N      Lat/Long: 57°15'31" N, 111°27'55" W  
                   LSD: NW-19-95-9-W4            NTS Map: 74E/6



## EQUIPMENT

Component	Function	Serial No.
Lakewood UltraLogger RX-1A	Record data	94834-08
Keller 8363K 8 psi Pressure Transducer	Measure water levels	971024

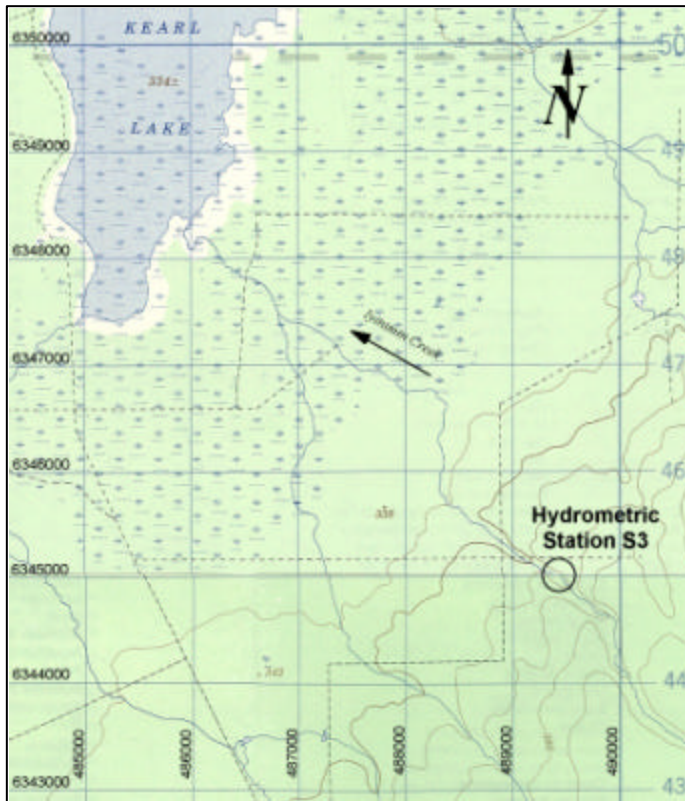
# IYINIMIN CREEK HYDROMETRIC STATION

# S3 FACTSHEET

## LOCATION AND PURPOSE

Established in May, 1995 to monitor discharge on Iyininim Creek upstream of Kears Lake. A rain gauge was added to the station in 1998. This station was taken out of service at the end of 1999 and may be reactivated in advance of local lease development.

Access: Helicopter  
 Benchmark: Rebar in 100 mm PVC housing, elevation 360.61 m (geodetic)  
 Drainage Area: 32.3 km<sup>2</sup>  
 Coordinates: UTM: 489491 E, 6345029 N      Lat/Long: 57°15'00" N, 111°10'27" W  
 LSD: NE-14-95-8-W4      NTS Map: 74E/6



## EQUIPMENT

Component	Function	Serial No.
Lakewood UltraLogger RX-1A	Record data	41174-08
Keller 8363K 8 psi Pressure Transducer	Measure water levels	971025
Lakewood RG-306 Tipping Bucket Rain Gauge	Measure rainfall	69127

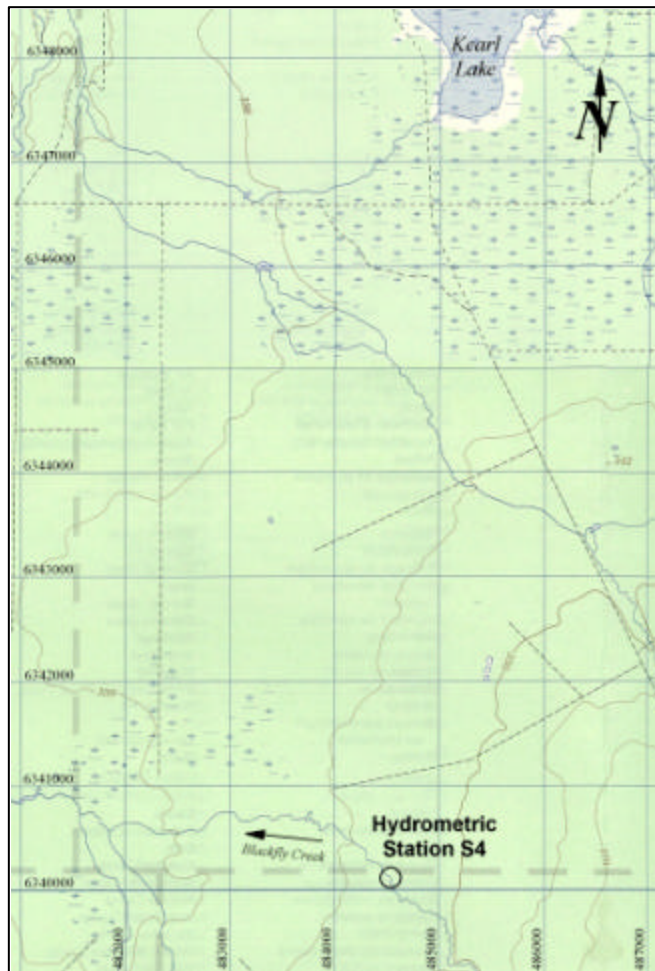
# BLACKFLY CREEK HYDROMETRIC STATION

# S4 FACTSHEET

## LOCATION AND PURPOSE

Established in May, 1995 to monitor discharge on Blackfly Creek, which is an upland tributary of the Muskeg River. The station was operated until 1998 and may be recommissioned at a future date.

Access: Helicopter  
 Benchmark: Rebar in 100 mm PVC housing, elevation 340.16 m (geodetic)  
 Drainage Area: 31.1 km<sup>2</sup>  
 Coordinates: UTM: 484469 E, 6340172 N      Lat/Long: 57°12'20" N, 111°15'22" W  
 LSD: NW-32-94-8-W4      NTS Map: 74E/3



## EQUIPMENT

Component	Function	Serial No.
Lakewood UltraLogger RX-2	Record data	94834-08
Keller 8363K 8 psi Pressure Transducer	Measure water levels	971022

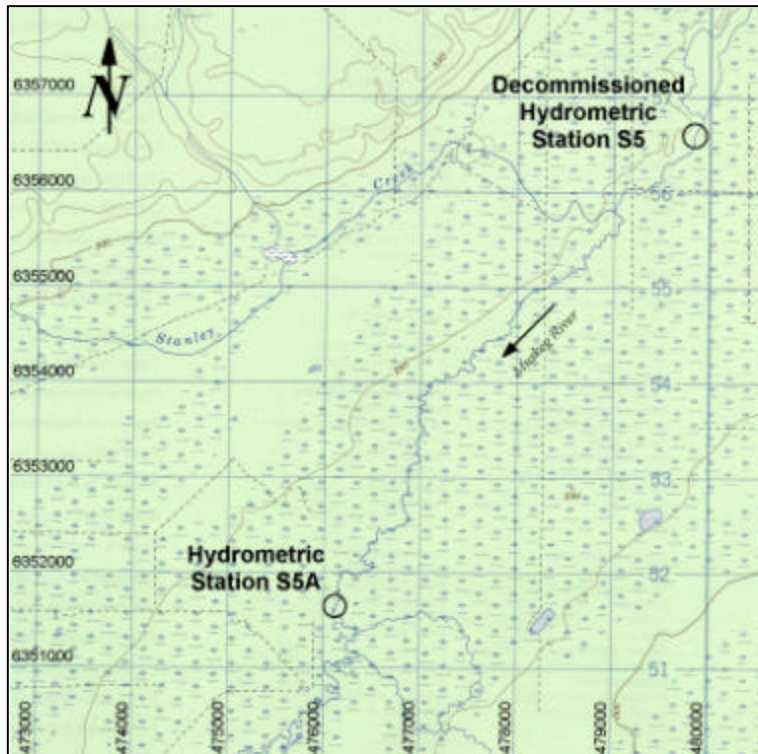
# MUSKEG RIVER AURORA HYDROMETRIC STATION

# S5A FACTSHEET

## LOCATION AND PURPOSE

Established in August, 1995 to monitor discharge on the Muskeg River upstream of disturbed watersheds. The station was relocated in 1998 to allow road access.

Access: 2WD road via the Syncrude Aurora mine site  
 Benchmark: Present Location: Rebar in 100 mm PVC housing, elevation 282.38 m (geodetic)  
 Old Location: Iron cap below ground surface, elevation 285.25 m (geodetic)  
 Drainage Area: 552 km<sup>2</sup> (was 390 km<sup>2</sup> until 1998)  
 Coordinates: UTM: 6351600 N, 476100 E Lat/Long: 57°18'30" N, 111°23'43" W  
 LSD: SE-9-96-9-W4 NTS Map: 74E/6  
 Old Coordinates: UTM: 6356600 N, 479850 E Lat/Long: 57°21'11" N, 111°20'03" W  
 LSD: SE-26-96-9-W4



## EQUIPMENT

Component	Function	Serial No.
Lakewood UltraLogger RX-1A	Record data	95185-05
Keller 8363K 8 psi Pressure Transducer	Measure water levels	971023

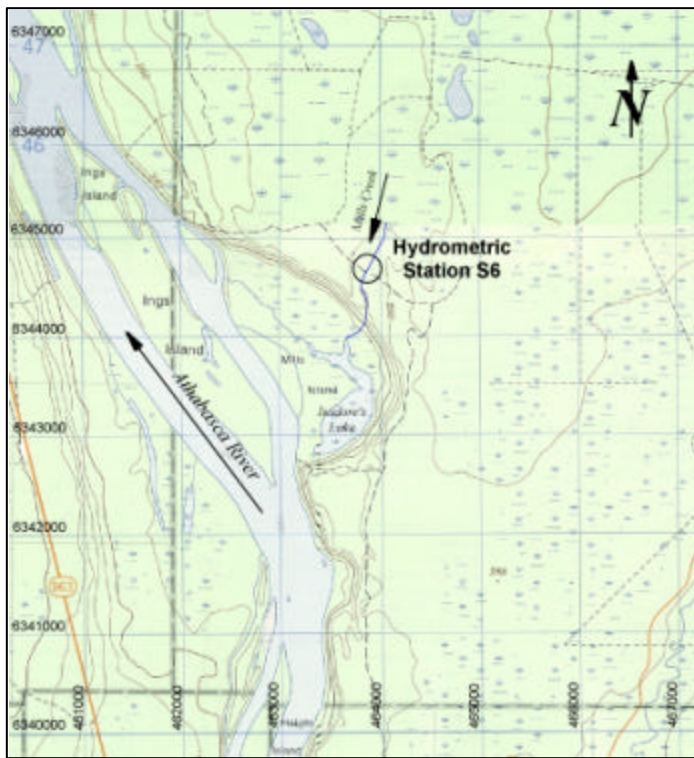
# MILLS CREEK HYDROMETRIC STATION

# S6 FACTSHEET

## LOCATION AND PURPOSE

Established in May, 1997 to monitor discharge on Mills Creek upstream of Isadore's Lake.

Access: 2WD road access along start of Ft. Chipewyan winter road  
 Benchmark: Rebar in 100 mm PVC housing, elevation 273.60 m (geodetic)  
 Drainage Area: 23.8 km<sup>2</sup>  
 Coordinates: UTM: 463829 E, 6344743 N      Lat/Long: 57°14'44" N, 111°35'57" W  
 LSD: NW-17-95-10-W4      NTS Map: 74E/4



## EQUIPMENT

Component	Function	Serial No.
Lakewood UltraLogger RX-1A	Record data	703126
Keller 8363K 3 psi Pressure Transducer	Measure water levels	97610

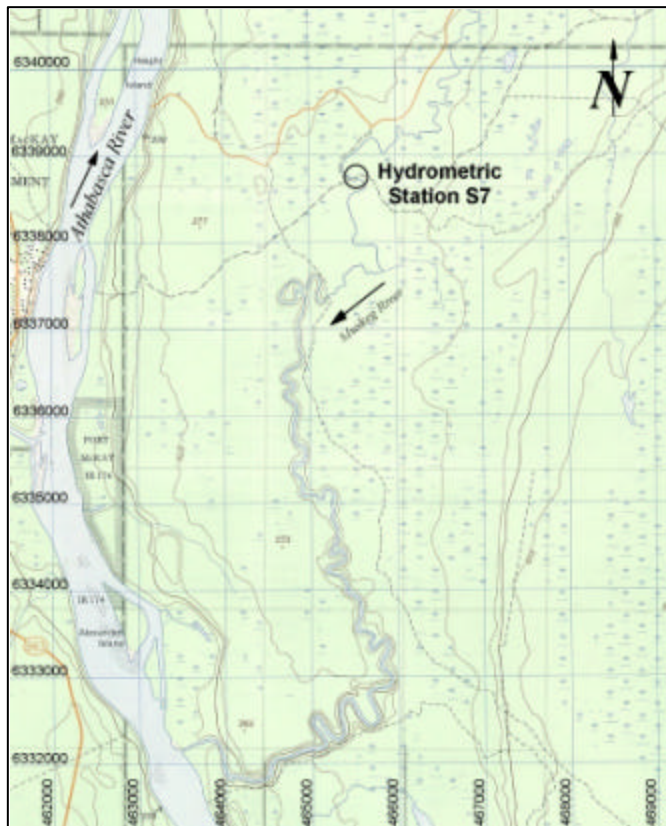
# MUSKEG RIVER WSC HYDROMETRIC STATION

# S7 FACTSHEET

## LOCATION AND PURPOSE

Established in October, 1999 to monitor winter discharge on the Muskeg River at the Water Survey of Canada gauging station 07DA008. The WSC station has operated since 1975 but discharges are only published for the March-October period.

Access: Footpath access from spur road (approximately 400 m walk, all-weather)  
 Benchmark: Unhoused temporary rebar, elevation 273.72 m (geodetic)  
 Drainage Area: 1460 km<sup>2</sup>  
 Coordinates: UTM: 6338750 N, 465550 E      Lat/Long: 57°11'29" N, 111°34'10" W  
 LSD: SE-32-94-10-W4      NTS Map: 74E/4



## EQUIPMENT

Component	Function	Serial No.
Solinst Levellogger M5 #3001 L*	Measure and record water levels	4414

\* This unit does not compensate for variations in atmospheric pressure and data must be processed using barometric data from a nearby local station

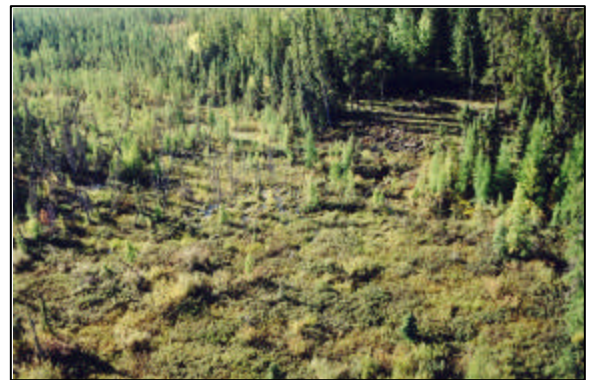
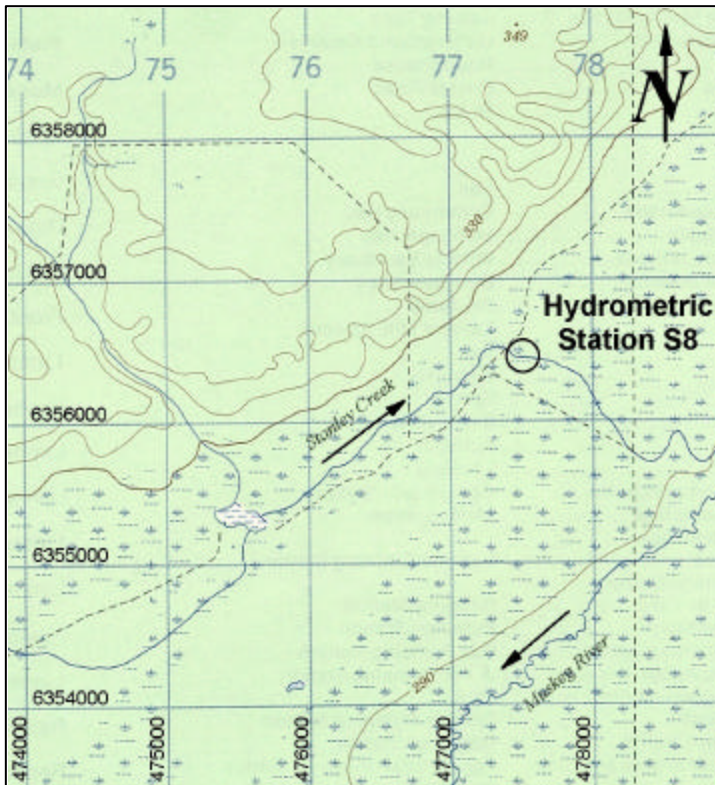
# STANLEY CREEK HYDROMETRIC STATION

# S8 FACTSHEET

## LOCATION AND PURPOSE

Established in September, 1999 to monitor discharges on Stanley Creek upstream of the Muskeg River. The creek has an ill-defined channel flowing through muskeg, so the water level is currently monitored, but discharges cannot be calculated without a well-defined rating curve.

Access: Helicopter  
 Benchmark: Rebar in PVC housing, elevation 292.15 m (geodetic)  
 Drainage Area: 71.8 km<sup>2</sup>  
 Coordinates: UTM: 477500 E, 6356450 N      Lat/Long: 57°21'06" N, 111°22'26" W  
                   LSD: NW-22-96-9-W4            NTS Map: 74E/6



## EQUIPMENT

Component	Function	Serial No.
Lakewood UltraLogger RX-2	Record data	96303-02
Keller LE8363K 2 psi Pressure Transducer	Measure water level	964165



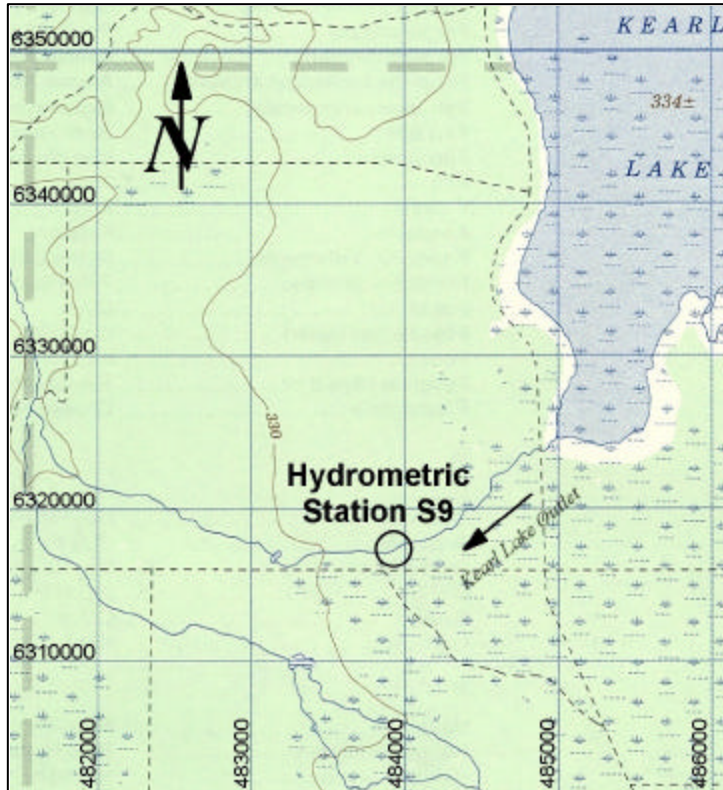
# KEARL LAKE OUTLET HYDROMETRIC STATION

# S9 FACTSHEET

## LOCATION AND PURPOSE

Established in March, 1998 to monitor discharge on the Kearl Lake Outlet channel. The station is located just upstream of a twin culvert installation. This station was taken out of service at the end of 1999 and may be reactivated in advance of local lease development. The barometric sensor is currently deployed at the Aurora Climate Station (C1).

Access: 2WD road  
 Benchmark: Rebar in PVC housing, elevation 330.40 m (geodetic)  
 Drainage Area: 73.6 km<sup>2</sup>  
 Coordinates: UTM: 483980 E, 6346750 N      Lat/Long: 57°15'57" N, 111°15'57" W  
                   LSD: SE-29-95-8-W4              NTS Map: 74E/6



## EQUIPMENT

Component	Function	Serial No.
Lakewood UltraLogger RX-2	Record data	701010
Keller LE8363K 4 psi Pressure Transducer	Measure water level	964638
Vaisala PTB 101B Barometric Sensor	Measure atmospheric pressure	

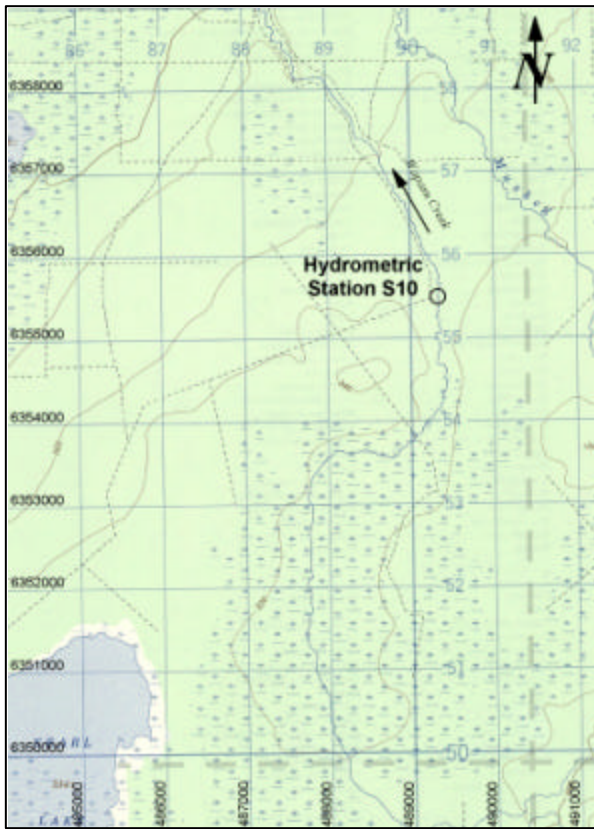
# WAPASU CREEK HYDROMETRIC STATION

# S10 FACTSHEET

## LOCATION AND PURPOSE

Established in May, 1997 to monitor discharge on Wapasu Creek upstream of the Muskeg River. The station was reinstalled in 1999 to ensure that low water levels could be measured. This station was taken out of service at the end of 1999 and may be reactivated in advance of local lease development.

Access: 2WD road access  
 Benchmark: Rebar in PVC housing, elevation 320.16 m (geodetic)  
 Drainage Area: 90.7 km<sup>2</sup>  
 Coordinates: UTM: 490350 E, 6355500 N      Lat/Long: 57°20'35" N, 111°09'40" W  
                   LSD: NW-24-96-8-W4              NTS Map: 74E/6



## EQUIPMENT

Component	Function	Serial No.
Lakewood UltraLogger RX-1A	Record data	41036-08
Keller 8363K 4 psi Pressure Transducer	Measure water levels	964640

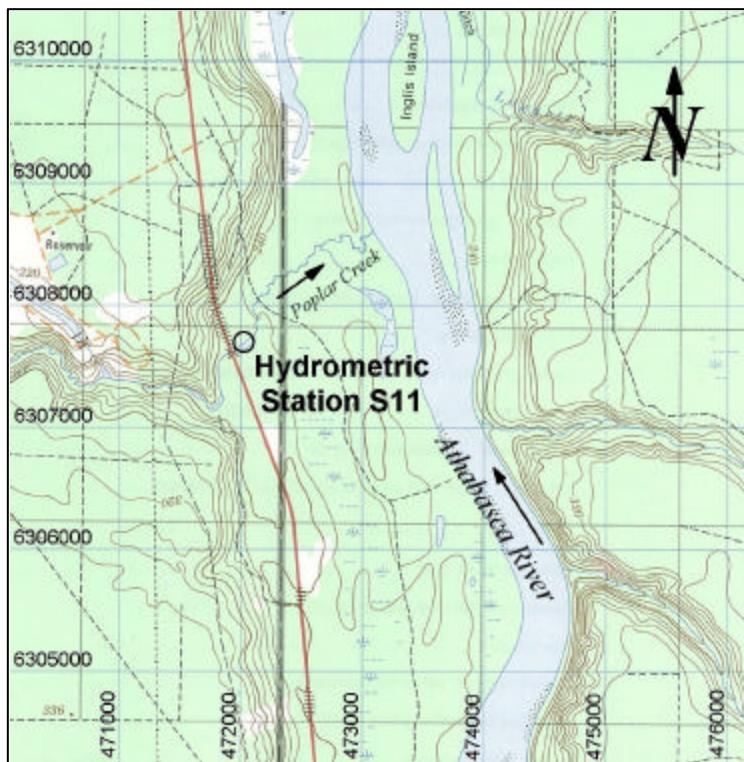
# POPLAR CREEK HYDROMETRIC STATION

# S11 FACTSHEET

## LOCATION AND PURPOSE

Established in May, 1997 to monitor discharge on Poplar Creek upstream of the Athabasca River. The station is at the site of a Water Survey of Canada gauging station (07DA007) that operated from 1973 to 1986.

Access: 2WD access on Hwy 63  
 Benchmark: Brass cap on southeast bridge abutment, elevation 245.55 m (geodetic)  
 Drainage Area: 422 km<sup>2</sup>  
 Coordinates: UTM: 472000 E, 6307650 N      Lat/Long: 56°54'46" N, 111°27'44" W  
 LSD: NE-24-91-19-W4      NTS Map: 74D/14



## EQUIPMENT

Component	Function	Serial No.
Lakewood UltraLogger RX-1A	Record data	41157-08
Keller 8363K 6 psi Pressure Transducer	Measure water levels	971889

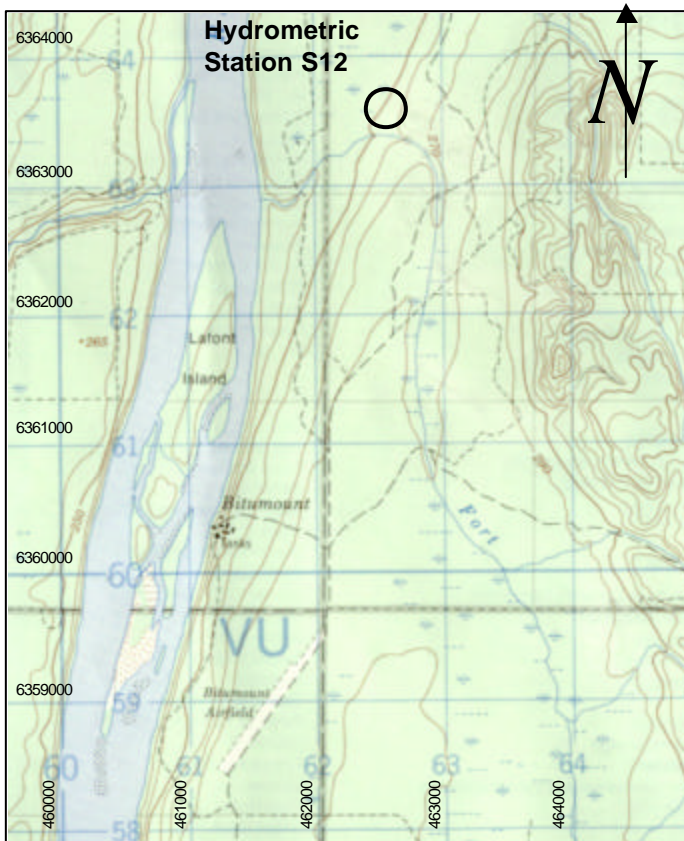
# FORT CREEK HYDROMETRIC STATION

# S12 FACTSHEET

## LOCATION AND PURPOSE

Established in May, 2000 to monitor discharge on Fort Creek upstream of the Athabasca River. The station is located just downstream of the Ft. Chipewyan winter road.

Access: 2WD road access along start of Ft. Chipewyan winter road  
 Benchmark: Temporary benchmark nail in tree, elevation 253.44 m (geodetic).  
 Alternative benchmark top of bolt at d/s end of culvert, elevation 253.80 m (geodetic).  
 Drainage Area: 45.6 km<sup>2</sup>  
 Coordinates: UTM: 462600 E, 6363400 N      Lat/Long: 57°24'48" N, 111°37'18" W  
 LSD: SW-18-97-10-W4      NTS Map: 74E/5



## EQUIPMENT

Component	Function	Serial No.
Lakewood UltraLogger RX-1	Record data	703013
Keller 8363K 10 psi Pressure Transducer	Measure water levels	971332

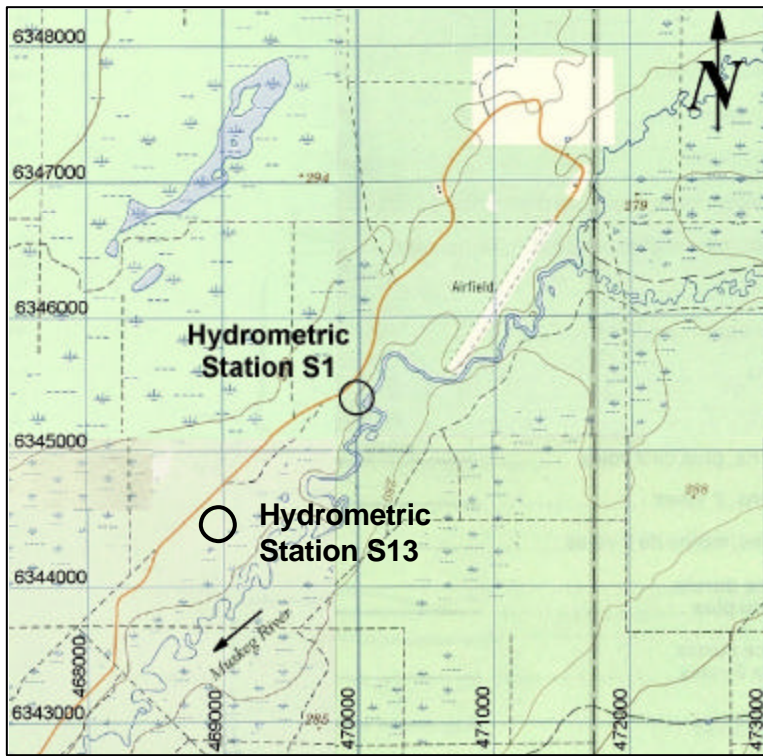
# ALBIAN POND #3 OUTLET HYDROMETRIC STATION

# S13 FACTSHEET

## LOCATION AND PURPOSE

Established in March, 2000 to monitor discharge from Albian Sands Polishing Pond #3. The outlet is routed through an engineered channel and has a 135° V-notch weir installed.

Access: 2WD from Muskeg River Mine access road  
 Benchmark: Top of pile support on right hand side of weir, elevation 279.59 m (geodetic)  
 Drainage Area: Mine drainage; disturbed area subject to diversions  
 Coordinates: UTM: 468854 E, 6344688 N      Lat/Long: 57°14'47" N, 111°30'58" W  
 LSD: NW-14-95-10-W4      NTS Map: 74E/4



## EQUIPMENT

Component	Function	Serial No.
Lakewood UltraLogger RX-1	Record data	
Keller 8363K 10 psi Pressure Transducer	Measure water levels	996022

# MCCLELLAND LAKE HYDROMETRIC STATION

# L1 FACTSHEET

## LOCATION AND PURPOSE

Established in July, 1997 to monitor water levels on McClelland Lake. Discharges from the lake outlet channel are also measured to construct a stage-discharge rating curve and a continuous record of discharge is thus derived.

Access: Helicopter  
 Benchmark: Rebar in PVC housing, elevation 295.84 m (geodetic)  
 Drainage Area: 191 km<sup>2</sup>  
 Coordinates: UTM: 483430 E, 6371950 N Lat/Long: 57°29'30" N, 111°16'37" W



LSD: NW-12-98-9-W4

NTS Map: 74E/6

## EQUIPMENT

Component	Function	Serial No.
Lakewood UltraLogger RX-2	Record data	703013
Keller 8363K 10 psi Pressure Transducer	Measure water levels	971332

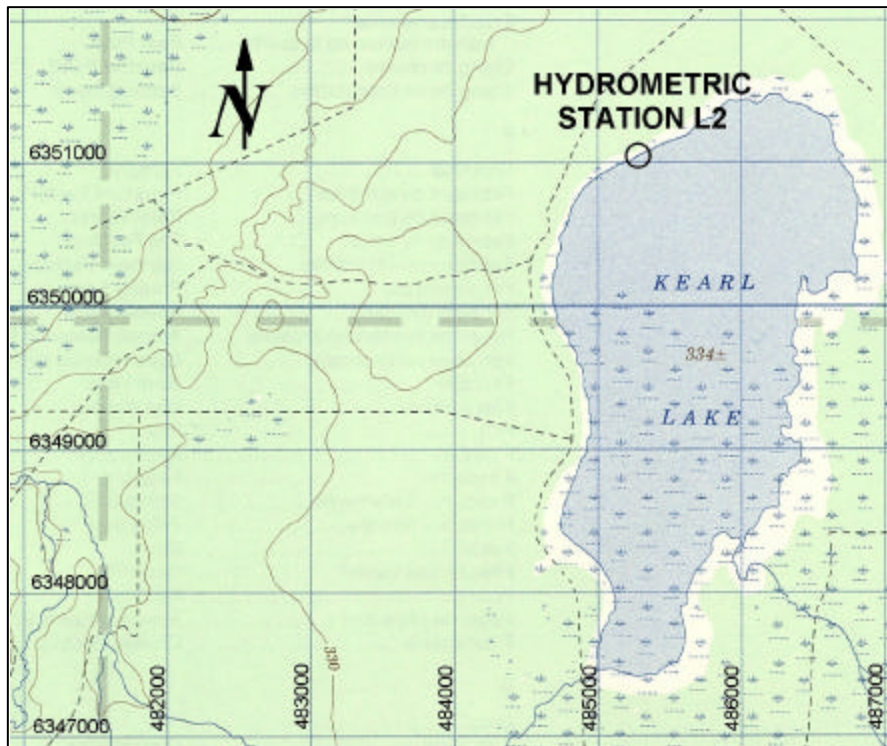
# KEARL LAKE HYDROMETRIC STATION

# L2 FACTSHEET

## LOCATION AND PURPOSE

Established in April, 1999 to monitor water levels on Kearl Lake.

Access: 4WD road access  
 Benchmark: Rebar in PVC housing, elevation 333.41 m (geodetic)  
 Drainage Area: 72.6 km<sup>2</sup>  
 Coordinates: UTM: 485250 E, 6351050 N      Lat/Long: 57°18'15" N, 111°14'40" W  
                   LSD: NW-4-96-8-W4              NTS Map: 74E/6



## EQUIPMENT

Component	Function	Serial No.
Solinst Levelogger F15/M5 #3001 LT*	Measure and record water level and temperature	4307

\* This unit does not compensate for variations in atmospheric pressure and data must be processed using barometric data from a nearby local station

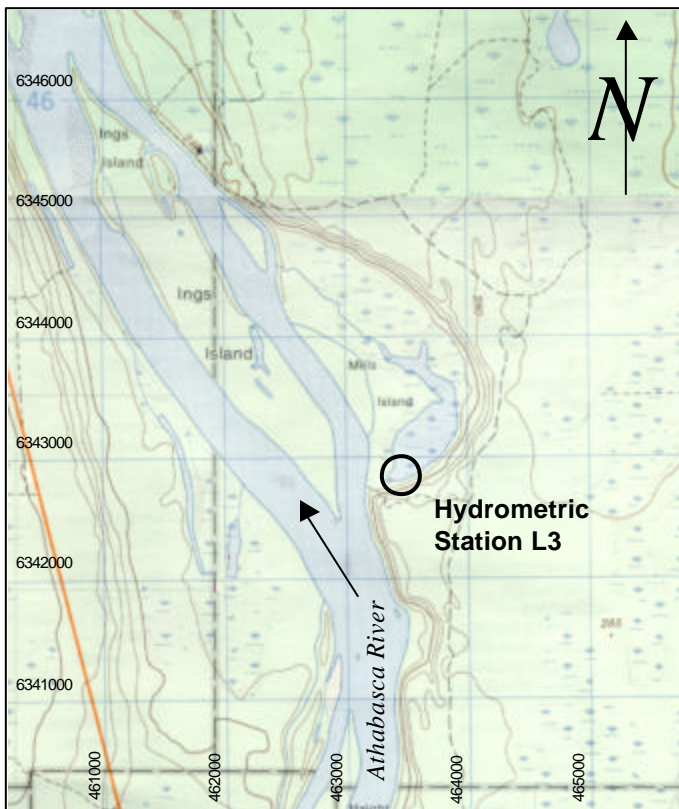
# ISADORE'S LAKE HYDROMETRIC STATION

## L3 FACTSHEET

### LOCATION AND PURPOSE

Established in February 2000 to monitor water levels on Isadore's Lake.

Access: 4WD road access off Ft. Chipewyan winter road; foot access down slope  
 Benchmark: Temporary benchmark nail in tree, elevation 235.91 m (geodetic)  
 Drainage Area: 28.0 km<sup>2</sup>  
 Coordinates: UTM: 6343250 N, 463400 E      Lat/Long: 57°13'58" N, 111°36'24" W  
 LSD: 16-7-95-10-W4      NTS Map: 74E/4



### EQUIPMENT

Component	Function	Serial No.
Solinst Levellogger LT*	Measure and record water levels	

\* This unit does not compensate for variations in atmospheric pressure and data must be processed using barometric data from a nearby local station



**APPENDIX IV**

**2000 MANUAL DISCHARGE MEASUREMENTS  
FOR DEVELOPING STAGE-DISCHARGE  
RATING CURVES AT HYDROLOGIC STATIONS**

**Table IV-1 Summary of 2000 Manual Discharge Measurements**

Station No.	Stream Name	Winter Discharge (m <sup>3</sup> /s)	Date	Snowmelt Discharge (m <sup>3</sup> /s)	Date	Summer Discharge (m <sup>3</sup> /s)	Date
S1	Alsands Drain	0.059 0.015 0.113 No Flow	Jan 10 Feb 22 Nov 8 Dec 19	0.135 No Flow	Apr 2 May 17	0.191 0.166 0.186 0.209 0.093	Jun 14 Jul 2 Aug 14 Sep 11 Oct 17
S2	Jackpine Creek	* No Flow	Nov 8 Dec 22	0.096 0.137	Apr 20 May 16	1.450 * 1.840 3.069 1.754	Jun 14 Jul 2 Aug 14 Sep 12 Oct 17
S3	Iyininim Creek	station not operational in 2000					
S4	Blackfly Creek	station not operational in 2000					
S5A	Muskeg River Aurora	0.276 0.025 * 0.082	Jan 11 Feb 21 Nov 10 Dec 19	* 0.537	Apr 2 Apr 20	3.124 * 0.854 1.823 1.554	Jun 14 Jul 2 Aug 14 Sep 12 Oct 17
S6	Mills Creek	0.022 0.008 0.011 *	Jan 10 Feb 23 Mar 10 Nov 10	0.027 0.005 0.019	Apr 2 Apr 20 May 17	0.007 0.010 0.017	Jul 2 Aug 14 Sep 12
S7	Muskeg River WSC	0.356 0.093 0.128 * *	Jan 12 Feb 21 Mar 12 Nov 8 Dec 20	0.888 1.790 *	Apr 20 May 17 Jun 14	* * *	Jul 2 Aug 15 Sep 12
S8	Stanley Creek	no stream discharges measured at this station					
S9	Kearl Lake Outlet	station not operational in 2000					
S10	Wapasu Creek	station not operational in 2000					
S11	Poplar Creek	No Flow No Flow * No Flow	Jan 12 Feb 24 Nov 8 Dec 20	0.308 0.201 0.665 0.725	Apr 2 Apr 20 May 17 Jun 14	2.320 0.154 0.121	Jul 2 Aug 15 Sep 14
S12	Fort Creek	* No Flow	Nov 10 Dec 20	0.128 0.064 0.168	Apr 2 May 17 Jun 14	0.116 0.079 0.076 0.090	Jul 3 Aug 14 Sep 13 Oct 19
S13	Albian Pond #3	No Flow	Dec 19	* 0.065	May 17 Jun 14	No Flow 0.027 0.015 No Flow	Jul 2 Aug 14 Sep 11 Oct 17
L1	McClelland Lake	*	Nov 9	No Flow No Flow	Apr 3 May 16	0.003 0.005 No Flow	Jul 3 Sep 13 Oct 19
L2	Kearl Lake	no stream discharges measured at this station					
L3	Isadore's Lake	no stream discharges measured at this station					

\* Site visited but manual streamflow measurement was not performed (generally due to thin ice, blocked access or equipment malfunction).

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-209-7000**  
**DISCHARGE DATA**

**STREAM NAME: Alsands Drain**  
**LOCATION: S1**  
**COORDINATES: 470006.2E/6345533.7N**

**MEASUREMENT DATE: 10 January 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL/CO**  
**COMPUTATIONS BY: LL/LW**

**MEASUREMENT START TIME: 1315 hrs.**  
**MEASUREMENT END TIME: 1400 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00	0.10	0.00			0.000	0.1	0.000
1	0.20	0.10	0.11			0.260	0	0.005
2	0.40	0.10	0.13			0.300	0.2	0.007
3	0.60	0.11	0.14			0.510	0.2	0.013
4	0.80	0.11	0.18			0.590	0.2	0.020
5	1.00	0.15	0.14			0.430	0.25	0.014
Right Bank	1.30	0.10	0.00			0.000	-0.5	0.000

**0.059**

Note: Flow underneath ice cover

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-209-7000**  
**DISCHARGE DATA**

**STREAM NAME: Alsands Drain**  
**LOCATION: S1**  
**COORDINATES: 470006.2E/6345533.7N**

**MEASUREMENT DATE: 22 February 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL/CO**  
**COMPUTATIONS BY: LL/NS**

**MEASUREMENT START TIME: 1406 hrs.**  
**MEASUREMENT END TIME: 1530 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00	0.13	0.00			0.000	0.1	0.000
1	0.20	0.13	0.10			0.320	0	0.006
2	0.40	0.13	0.10			0.130	0.2	0.002
3	0.60	0.13	0.08			0.050	0.2	0.001
4	0.80	0.13	0.06			0.360	0.2	0.004
5	1.00	0.13	0.06			0.150	0.2	0.002
6	1.20	0.13	0.06			0.040	0.2	0.000
7	1.40	0.13	0.06			0.022	0.2	0.000
Right Bank	1.60	0.13	0.00			0.000	-0.7	0.000

**0.015**

Note: 1. Water was flowing underneath the ice cover.  
 2. Data was downloaded battery replaced.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-209-7000**  
**DISCHARGE DATA**

**STREAM NAME: Alsands Drain**  
**LOCATION: S1**  
**COORDINATES: 470006.2E/6345533.7N**

**MEASUREMENT DATE: 02 April 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL**  
**COMPUTATIONS BY: LL/LW**

**MEASUREMENT START TIME: 1400 hrs.**  
**MEASUREMENT END TIME: 1435 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.1	0.000
1	0.20		0.06			0.320	0	0.004
2	0.40		0.15			0.270	0.2	0.007
3	0.60		0.18			0.550	0.2	0.018
4	0.80		0.14			0.470	0.2	0.012
5	1.00		0.14			0.610	0.2	0.016
6	1.20		0.10			0.340	0.2	0.006
7	1.40		0.16			0.350	0.2	0.010
8	1.60		0.14			0.730	0.2	0.019
9	1.80		0.16			0.840	0.2	0.025
10	2.00		0.10			0.640	0.2	0.012
11	2.20		0.08			0.390	0.2	0.006
Right Bank	2.40		0.00			0.000	-1.1	0.000

**0.135**

- Note: 1. Polishing pond at the upstream was under construction.  
2. Water was diverted through a pipe into the Alsands Drain.  
3. Water sample was collected for TSS.  
4. Water level data was downloaded and survey of the W.L taken.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-209-7000**  
**DISCHARGE DATA**

**STREAM NAME: Alsands Drain**  
**LOCATION: S1**  
**COORDINATES: 470006.2E/6345533.7N**

**MEASUREMENT DATE: 14 June 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL/CO**  
**COMPUTATIONS BY: LL/NS**

**MEASUREMENT START TIME: 0805 hrs.**  
**MEASUREMENT END TIME: 0920 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.00	0.10	0.000
1	0.20		0.12			0.25	0.20	0.006
2	0.40		0.14			0.51	0.20	0.014
3	0.60		0.18			0.48	0.20	0.017
4	0.80		0.12			0.77	0.20	0.018
5	1.00		0.16			0.49	0.20	0.016
6	1.20		0.10			0.37	0.20	0.007
7	1.40		0.18			0.59	0.20	0.021
8	1.60		0.24			0.67	0.20	0.032
9	1.80		0.16			0.81	0.20	0.026
10	2.00		0.14			0.77	0.20	0.022
11	2.20		0.10			0.55	0.20	0.011
Right Bank	2.40		0.00			0.00	-1.10	0.000

**0.191**

- Note: 1. When driving through site at 0800 hrs, not flow was observed. The 12 inch outfall pipe was not flowing.  
2. At 0820 hrs, Noreen Easterbrook phoned contractor to check whether water will be flowing.  
3. Arrived at the site by 0830 hrs and water was flowing over the weir.  
4. Discharge measured downstream of the weir.  
5. TSS sample taken.  
6. Downloaded data from the datalogger.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-209-7000**  
**DISCHARGE DATA**

**STREAM NAME: Alsands Drain**  
**LOCATION: S1**  
**COORDINATES: 470006.2E/6345533.7N**

**MEASUREMENT DATE: 02 July 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL/CL**  
**COMPUTATIONS BY: LL/NS**

**MEASUREMENT START TIME: 1720 hrs.**  
**MEASUREMENT END TIME: 1724 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.00	0.10	0.000
1	0.20		0.02			0.16	0.20	0.001
2	0.40		0.08			0.28	0.20	0.004
3	0.60		0.12			0.40	0.20	0.010
4	0.80		0.18			0.88	0.20	0.032
5	1.00		0.18			0.34	0.20	0.012
6	1.20		0.14			0.55	0.20	0.015
7	1.40		0.14			0.93	0.20	0.026
8	1.60		0.28			0.38	0.20	0.021
9	1.80		0.14			0.81	0.20	0.023
10	2.00		0.14			0.07	0.20	0.002
11	2.20		0.08			0.64	0.40	0.020
Right Bank	2.80		0.00			0.00	-1.10	0.000

**0.166**

- Note: 1. Water was flowing from the 12 inch outfall pipe into the drain.  
2. High water in the Muskeg River, the water was back up quite a way - approx. 30 m d/s of weir.  
3. TSS sample taken.  
4. Discharge measured downstream of the weir.  
5. Downloaded data from the datalogger.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-209-7000**  
**DISCHARGE DATA**

**STREAM NAME: Alsands Drain**  
**LOCATION: S1**  
**COORDINATES: 470006.2E/6345533.7N**

**MEASUREMENT DATE: 14 August 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL/NC**  
**COMPUTATIONS BY: LL/NS**

**MEASUREMENT START TIME: 1515 hrs.**  
**MEASUREMENT END TIME: 1615 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.00	0.15	0.000
1	0.30		0.10			0.40	0.25	0.010
2	0.50		0.12			0.42	0.20	0.010
3	0.70		0.14			0.62	0.20	0.017
4	0.90		0.14			0.43	0.20	0.012
5	1.10		0.16			0.75	0.20	0.024
6	1.30		0.10			0.62	0.20	0.012
7	1.50		0.10			0.61	0.20	0.012
8	1.70		0.18			0.82	0.20	0.030
9	1.90		0.16			0.98	0.20	0.031
10	2.10		0.14			0.75	0.20	0.021
11	2.30		0.10			0.29	0.20	0.006
Right Bank	2.50		0.00			0.00	-1.15	0.000

**0.186**

- Note: 1. Water was flowing from the 12 inch outfall pipe into the drain.  
2. TSS sample taken.  
3. Discharge measured downstream of the weir.  
4. Downloaded data from the datalogger.



PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray  
 PROJECT NO.: 002-209-7000  
 DISCHARGE DATA

STREAM NAME: Alsands Drain  
 LOCATION: S1  
 COORDINATES: 470006.2E/6345533.7N

MEASUREMENT DATE: 11 September 2000  
 METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL  
 COMPUTATIONS BY: LL/NS

MEASUREMENT START TIME: 0910 hrs.  
 MEASUREMENT END TIME: 1000 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth (m/sec)	0.8 Depth (m/sec)	0.6 Depth (m/sec)		
Left Bank	0.00		0.00			0.000	0.05	0.000
1	0.10		0.06			0.320	0.1	0.002
2	0.20		0.10			0.510	0.1	0.005
3	0.30		0.12			0.540	0.1	0.006
4	0.40		0.13			0.530	0.1	0.007
5	0.50		0.17			0.630	0.1	0.011
6	0.60		0.18			0.650	0.1	0.012
7	0.70		0.12			0.770	0.1	0.009
8	0.80		0.12			0.950	0.1	0.011
9	0.90		0.14			0.920	0.1	0.013
10	1.00		0.08			0.750	0.1	0.006
11	1.10		0.10			0.670	0.1	0.007
12	1.20		0.06			0.620	0.1	0.004
13	1.30		0.16			0.440	0.1	0.007
14	1.40		0.09			0.560	0.1	0.005
15	1.50		0.12			0.730	0.1	0.009
16	1.60		0.16			0.830	0.1	0.013
17	1.70		0.18			1.020	0.1	0.018
18	1.80		0.18			1.140	0.1	0.021
19	1.90		0.16			0.960	0.1	0.015
20	2.00		0.16			0.790	0.1	0.013
21	2.10		0.11			0.870	0.1	0.010
22	2.20		0.08			0.590	0.1	0.005
23	2.30		0.04			0.290	0.1	0.001
24	2.40		0.02			0.070	0.125	0.000
Right Bank	2.55		0.00			0.000	-1.2	0.000

**0.209**

- Note: 1. Water was flowing from the 12 inch outfall pipe into the drain.  
 2. TSS sample taken.  
 3. Discharge measured downstream of the weir.  
 4. Downloaded data from the datalogger.  
 5. The old B.M. (original B.M. used by Agra) was destroyed - noticed a path was made by dozer through the B.M. location.  
 6. A new B.M. (top of the weir plate R.H.S. marked) was established to measure the water level.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-209-7000**  
**DISCHARGE DATA**

**STREAM NAME: Alsands Drain**  
**LOCATION: S1**  
**COORDINATES: 470006.2E/6345533.7N**

**MEASUREMENT DATE: 17 October 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL**  
**COMPUTATIONS BY: LL/NS**

**MEASUREMENT START TIME: 0900 hrs.**  
**MEASUREMENT END TIME: 1020 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m3/sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.1	0.000
1	0.20		0.08			0.470	0.2	0.008
2	0.40		0.12			0.490	0.2	0.012
3	0.60		0.10			0.410	0.2	0.008
4	0.80		0.12			0.590	0.2	0.014
5	1.00		0.05			0.370	0.2	0.004
6	1.20		0.06			0.400	0.2	0.005
7	1.40		0.10			0.810	0.2	0.016
8	1.60		0.10			0.700	0.2	0.014
9	1.80		0.08			0.660	0.2	0.011
10	2.00		0.04			0.220	0.2	0.002
Right Bank	2.20		0.00			0.000	-1	0.000

**0.093**

- Note: 1. Water was flowing from the 12 inch outfall pipe into the drain.  
2. TSS sample taken.  
3. Discharge measured downstream of the weir.  
4. Downloaded data from the datalogger.  
5. A new B.M. (top of the weir plate R.H.S. marked) was surveyed by Shell Elevation 280.015m

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-209-7000**  
**DISCHARGE DATA**

**STREAM NAME: Alsands Drain**  
**LOCATION: S1**  
**COORDINATES: 470006.2E/6345533.7N**

**MEASUREMENT DATE: 8 November 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate Analog**

**MEASUREMENT BY: LL**  
**COMPUTATIONS BY: NS**

**MEASUREMENT START TIME: 1110 hrs.**  
**MEASUREMENT END TIME: 1118 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m3/sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.1	0.000
1	0.20		0.08			0.180	0.2	0.003
2	0.40		0.13			0.300	0.2	0.008
3	0.60		0.09			0.420	0.2	0.008
4	0.80		0.16			0.420	0.2	0.013
5	1.00		0.17			0.360	0.2	0.012
6	1.20		0.15			0.340	0.2	0.010
7	1.40		0.14			0.180	0.2	0.005
8	1.60		0.20			0.320	0.2	0.013
9	1.80		0.16			0.600	0.2	0.019
10	2.00		0.11			0.540	0.2	0.012
11	2.20		0.10			0.480	0.2	0.010
12	2.40		0.07			0.080	0.15	0.001
Right Bank	2.50		0.00			0.000	-1.2	0.000

**0.113**

- Note: 1. Water was flowing from the 12 inch outfall pipe into the drain.  
2. TSS sample taken.  
3. Discharge measured downstream of the weir.  
4. Downloaded data from the datalogger.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Jackpine Creek**  
**LOCATION: S2A**  
**COORDINATES: 111°24'53"W/57°14'21"N**

**MEASUREMENT DATE: 20 April 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL/CO**  
**COMPUTATIONS BY: LL/NS**

**MEASUREMENT START TIME: 1250 hrs.**  
**MEASUREMENT END TIME: 1330 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.1	0.000
1	0.20		0.07			0.110	0	0.002
2	0.60		0.09			0.100	0.3	0.002
3	0.80		0.15			0.120	0.3	0.005
4	1.20		0.20			0.220	0.4	0.016
5	1.60		0.22			0.180	0.4	0.015
6	2.00		0.18			0.200	0.4	0.013
7	2.40		0.19			0.170	0.45	0.013
8	2.90		0.20			0.100	0.45	0.008
9	3.30		0.14			0.170	0.4	0.009
10	3.70		0.14			0.110	0.4	0.006
11	4.10		0.07			0.020	0.4	0.001
12	4.50		0.06			0.160	0.4	0.004
13	4.90		0.05			0.100	0.5	0.002
Right Bank	5.50		0.00			0.000	-2.45	0.000

**0.096**

- Note: 1. Transducer and logger were still temporary installed - transducer s/n971022.  
2. Water sample was collected for TSS.  
3. No ice covered in the creek.  
4. Used top of pin (steel rod) by logger as temporary B.M.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Jackpine Creek**  
**LOCATION: S2A**  
**COORDINATES: 111°24'53"W/57°14'21"N**

**MEASUREMENT DATE: 16 May 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL/CO**  
**COMPUTATIONS BY: LL/NS**

**MEASUREMENT START TIME: 1455 hrs.**  
**MEASUREMENT END TIME: 1550 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.25	0.000
1	0.50		0.16			-0.030	1	-0.002
2	1.00		0.25			-0.010	0.5	-0.001
3	1.50		0.36			0.010	0.5	0.002
4	2.00		0.48			0.000	0.5	0.000
5	2.50		0.52			0.020	0.5	0.005
6	3.00		0.55			0.050	0.5	0.013
7	3.50		0.54			0.040	0.5	0.010
8	4.00		0.54			0.060	0.5	0.015
9	4.50		0.38			0.080	0.5	0.014
10	5.00		0.20			0.080	0.5	0.007
11	5.50		0.10			0.080	0.5	0.004
12	6.00		0.33			0.070	0.5	0.011
13	6.50		0.40			0.070	0.5	0.013
14	7.00		0.35			0.070	0.5	0.011
15	7.50		0.18			0.080	0.5	0.007
16	8.00		0.28			0.090	0.5	0.012
17	8.50		0.26			0.060	0.5	0.007
18	9.00		0.28			0.070	0.5	0.009
19	9.50		0.25			0.020	0.45	0.002
Right Bank	9.90		0.00			0.000	-4.75	0.000
								<b>0.137</b>

Note: 1. Transducer and logger were still temporary installed.  
2. Water sample was collected for TSS.

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray  
 PROJECT NO.: 002-2309-7000  
 DISCHARGE DATA

STREAM NAME: Jackpine Creek  
 LOCATION: S2A  
 COORDINATES: 111°24'53"W/57°14'21"N

MEASUREMENT DATE: 14 June 2000  
 METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/CO  
 COMPUTATIONS BY: LL/NS  
 MEASUREMENT START TIME: 1215 hrs.  
 MEASUREMENT END TIME: 1300 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth (m/sec)	0.8 Depth (m/sec)	0.6 Depth (m/sec)		
Left Bank	0.00		0.00			0.000	0.25	0.000
1	0.50		0.14			0.230	0.50	0.016
2	1.00		0.16			0.220	0.50	0.018
3	1.50		0.22			0.510	0.50	0.056
4	2.00		0.18			-0.030	0.50	-0.003
5	2.50		0.20			0.290	0.50	0.029
6	3.00		0.15			0.740	0.50	0.056
7	3.50		0.20			0.500	0.50	0.050
8	4.00		0.18			0.730	0.50	0.066
9	4.50		0.18			0.470	0.50	0.042
10	5.00		0.16			0.540	0.50	0.043
11	5.50		0.25			0.210	0.50	0.026
12	6.00		0.25			0.640	0.50	0.080
13	6.50		0.26			0.630	0.50	0.082
14	7.00		0.32			0.320	0.50	0.051
15	7.50		0.43			0.450	0.50	0.097
16	8.00		0.44			0.150	0.50	0.033
17	8.50		0.50			0.300	0.50	0.075
18	9.00		0.48			0.520	0.50	0.125
19	9.50		0.45			0.550	0.50	0.124
20	10.00		0.38			0.260	0.50	0.049
21	10.50		0.35			0.620	0.50	0.109
22	11.00		0.32			0.480	0.50	0.077
23	11.50		0.26			0.430	0.50	0.056
24	12.00		0.24			0.400	0.50	0.048
25	12.50		0.15			0.400	0.50	0.030
26	13.00		0.20			0.160	0.50	0.016
27	13.50		0.06			0.000	0.35	0.000
Right Bank	13.70		0.00			0.000	-6.75	0.000

**1.450**

- Note: 1. Transducer and logger were still temporary installed.  
 2. Water sample was collected for TSS.  
 3. Data was downloaded and surveyed the water level.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**

**PROJECT NO.: 002-2309-7000**

**DISCHARGE DATA**

**STREAM NAME: Jackpine Creek**

**LOCATION: S2A**

**COORDINATES: 111°24'53"W/57°14'21"N**

**MEASUREMENT BY: LL**

**COMPUTATIONS BY: LL**

**MEASUREMENT DATE: 02 July 2000**

**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT START TIME: 1550 hrs.**

**MEASUREMENT END TIME: 1650 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank								
1								
2								
3								
4								
5								
6								
7								
8								
9								
Right Bank								

- Note: 1. Due to fast flow - unsafe to carry out the discharge measurement.  
2. Water sample was collected for TSS.  
3. Data was downloaded and surveyed the water level.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**

**PROJECT NO.: 002-2309-7000**

**DISCHARGE DATA**

**STREAM NAME: Jackpine Creek**

**LOCATION: S2A**

**COORDINATES: 111°24'53"W/57°14'21"N**

**MEASUREMENT BY: LL/NC**

**COMPUTATIONS BY: LL/LW**

**MEASUREMENT DATE: 14 August 2000**

**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT START TIME: 1700 hrs.**

**MEASUREMENT END TIME: 1735 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.5	0.000
1	1.00		0.15			0.330	1.00	0.050
2	2.00		0.22			0.540	1.00	0.119
3	3.00		0.30			0.460	1.00	0.138
4	4.00		0.36			0.580	1.00	0.209
5	5.00		0.40			0.480	1.00	0.192
6	6.00		0.40			0.500	1.00	0.200
7	7.00		0.48			0.440	1.00	0.211
8	8.00		0.30			0.400	1.00	0.120
9	9.00		0.50			0.420	1.00	0.210
10	10.00		0.44			0.500	1.00	0.220
11	11.00		0.28			0.370	1.00	0.104
12	12.00		0.22			0.410	0.75	0.068
Right Bank	12.50		0.00			0.000	0.25	0.000

**1.840**

Note: 1. Transducer and logger were still temporary installed.

2. Water sample was collected for TSS.

3. Data was downloaded and surveyed the water level.

4. Kanterra road side ditches were reshaped for better drainage - at the bridge crossing.



PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray  
 PROJECT NO.: 002-2309-7000  
 DISCHARGE DATA

STREAM NAME: Jackpine Creek  
 LOCATION: S2A  
 COORDINATES: 111°24'53"W/57°14'21"N

MEASUREMENT DATE: 12 September 2000  
 METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL  
 COMPUTATIONS BY: LL/LW

MEASUREMENT START TIME: 1217 hrs.  
 MEASUREMENT END TIME: 1300 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth (m/sec)	0.8 Depth (m/sec)	0.6 Depth (m/sec)		
Left Bank	0.00		0.00			0.000	0.25	0.000
1	0.50		0.26			0.540	0.50	0.070
2	1.00		0.28			0.390	0.50	0.055
3	1.50		0.32			0.240	0.50	0.038
4	2.00		0.32			0.410	0.50	0.066
5	2.50		0.28			0.510	0.50	0.071
6	3.00		0.30			0.600	0.50	0.090
7	3.50		0.35			0.740	0.50	0.130
8	4.00		0.37			0.670	0.50	0.124
9	4.50		0.46			0.550	0.50	0.127
10	5.00		0.52			0.600	0.50	0.156
11	5.50		0.55			0.660	0.50	0.182
12	6.00		0.52			0.600	0.50	0.156
13	6.50		0.52			0.800	0.50	0.208
14	7.00		0.54			0.680	0.50	0.184
15	7.50		0.50			0.810	0.50	0.203
16	8.00		0.45			0.820	0.50	0.185
17	8.50		0.48			0.870	0.50	0.209
18	9.00		0.50			0.830	0.50	0.208
19	9.50		0.44			0.710	0.50	0.156
20	10.00		0.46			0.860	0.50	0.198
21	10.50		0.40			0.390	0.50	0.078
22	11.00		0.37			0.360	0.50	0.067
23	11.50		0.28			0.490	0.50	0.069
24	12.00		0.24			0.360	0.50	0.043
25	12.50		0.16			0.000	0.55	0.000
Right Bank	13.10		0.00			0.000	0.30	0.000

**3.069**

- Note: 1. Transducer and logger were still temporary installed.  
 2. Water sample was collected for TSS.  
 3. Data was downloaded and surveyed the water level.  
 4. A new B.M. was installed (permanent B.M. with steel pin and PVC casing).The new B.M elevation was 100.272m

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Jackpine Creek**  
**LOCATION: S2A**

**COORDINATES: 111°24'53"W/57°14'21"N**

**MEASUREMENT BY: LL**  
**COMPUTATIONS BY: LL/LW**

**MEASUREMENT DATE: 17 October 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT START TIME: 1300 hrs.**  
**MEASUREMENT END TIME: 1400 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	1.10		0.00			0.000	0.75	0.000
1	1.50		0.12			0.420	0.45	0.023
2	2.00		0.22			0.400	0.50	0.044
3	2.50		0.26			0.180	0.50	0.023
4	3.00		0.26			0.180	0.50	0.023
5	3.50		0.20			0.230	0.50	0.023
6	4.00		0.14			0.250	0.50	0.018
7	4.50		0.14			0.350	0.50	0.025
8	5.00		0.30			0.330	0.50	0.050
9	5.50		0.38			0.400	0.50	0.076
10	6.00		0.43			0.330	0.75	0.106
11	7.00		0.43			0.550	1.00	0.237
12	8.00		0.46			0.640	1.00	0.294
13	9.00		0.48			0.740	1.00	0.355
14	10.00		0.48			0.520	1.00	0.250
15	11.00		0.40			0.490	1.00	0.196
16	12.00		0.28			0.030	1.00	0.008
17	13.00		0.13			0.030	0.90	0.004
Right Bank	13.80		0.00			0.000	0.40	0.000

**1.754**

- Note: 1. Transducer and logger were still temporary installed.  
2. Water sample was collected for TSS.  
3. Data was downloaded and surveyed the water level.  
4. Construction of the road near the bridge in progress - informed by Contractor the bridge will be completed within 3 to 4 weeks.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**

**PROJECT NO.: 002-2309-7000**

**DISCHARGE DATA**

**STREAM NAME: Jackpine Creek**

**LOCATION: S2A**

**COORDINATES: 111°24'53"W/57°14'21"N**

**MEASUREMENT BY: LL**

**COMPUTATIONS BY: LL/LW**

**MEASUREMENT DATE: 22 December 2000**

**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT START TIME: 1200 hrs.**

**MEASUREMENT END TIME: 1330 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00	0.30	0.00			0.000	0.25	0.000
1	0.50	0.31	0.05			-0.040	0.45	-0.001
2	0.90	0.28	0.05			0.000	0.55	0.000
3	1.60	0.30	0.08			0.010	0.70	0.001
4	2.30	0.31	0.05			0.010	0.60	0.000
5	2.80	0.31	0.06			0.020	0.55	0.001
6	3.40	0.31	0.04			-0.040	0.50	-0.001
Right Bank	3.80	0.31	0.00			0.000	-1.70	0.000

**0.000**

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Muskeg River**  
**LOCATION: S5A**  
**COORDINATES: 6351833N/476052E**

**MEASUREMENT DATE: 11 Jan 00**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL/CO**  
**COMPUTATIONS BY: NS**

**MEASUREMENT START TIME: 1400 hrs.**  
**MEASUREMENT END TIME: 1530 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00	0.25	0.00			0.000	0.90	0.000
2	1.80	0.23	0.74			0.040	2.00	0.059
3	4.00	0.27	1.30			0.010	2.15	0.028
4	6.10	0.30	1.40			0.050	2.15	0.151
5	8.30	0.30	1.30			0.010	2.10	0.027
6	10.30	0.25	0.60			0.010	1.85	0.011
Right Bank	12.00	0.25	0.00			0.000	-5.15	0.000

**0.276**

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Muskeg River**  
**LOCATION: S5A**  
**COORDINATES: 6351833N/476052E**

**MEASUREMENT DATE: 21 February 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL/CO**  
**COMPUTATIONS BY: LL/NS**

**MEASUREMENT START TIME: 1341 hrs.**  
**MEASUREMENT END TIME: 1530 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00	0.31	0.00			0.000	0.4	0.000
1	0.80	0.31	0.69			-0.020	1.25	-0.016
2	2.50	0.40	0.86	-0.01	-0.01	-0.010	1.6	-0.013
3	4.00	0.42	1.14	0.00	0.00	0.000	1.075	0.000
4	4.65	0.48	1.15	0.00	-0.01	-0.005	0.7	-0.004
5	5.40	0.60	1.13	0.01	0.01	0.010	0.775	0.008
6	6.20	0.50	1.12	0.02	0.01	0.015	0.75	0.012
7	6.90	0.45	1.09	0.02	0.02	0.020	1	0.020
8	8.20	0.39	1.01	0.02	0.02	0.020	1.35	0.025
9	9.60	0.29	0.87	-0.01	-0.01	-0.010	0.9	-0.007
Right Bank	10.00	0.29	0.00			0.000	-4.8	0.000

**0.025**

**Note:** 1. Raw data was downloaded from the datalogger.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Muskeg River**  
**LOCATION: S5A**  
**COORDINATES: 6351833N/476052E**

**MEASUREMENT DATE: 20 April 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL/CO**  
**COMPUTATIONS BY: NS**

**MEASUREMENT START TIME: 1515 hrs.**  
**MEASUREMENT END TIME: 1630 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.75	0.000
1	1.50		0.65			0.030	1.25	0.022
2	2.50		0.80	0.02	0.08	0.050	1	0.037
3	3.50		0.90	0.03	0.03	0.030	1	0.025
4	4.50		0.80	0.02	0.09	0.055	1	0.040
5	5.50		0.70			0.030	1	0.019
6	6.50	refer	0.65			0.090	1	0.054
7	7.50	to	0.65			0.070	1	0.042
8	8.50	note 4	0.50			0.090	1	0.041
9	9.50		0.60			0.060	1	0.033
10	10.50		0.55			0.100	1	0.051
11	11.50		0.63			0.080	1	0.046
12	12.50		0.90	0.07	0.10	0.085	1	0.070
13	13.50		1.10	0.03	0.11	0.070	1	0.071
14	14.50		1.30	-0.02	0.05	0.015	1	0.018
15	15.50		1.40	-0.03	0.01	-0.010	1	-0.013
16	16.50		1.40	-0.01	-0.01	-0.010	1.6	-0.021
Right Bank	18.70		0.00			0.000	1.1	0.000

**0.537**

- Note:**
1. Raw data was not downloaded from the datalogger.
  2. Ice at edges of RDB and LDB
  3. Discharge taken at only open location in vicinity
  4. Open water just downstream of ice covered reach: apply ice cover correction factor

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Muskeg River**  
**LOCATION: S5A**  
**COORDINATES: 6351833N/476052E**

**MEASUREMENT DATE: 14 June 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL/CO**  
**COMPUTATIONS BY: NS**

**MEASUREMENT START TIME: 1415 hrs.**  
**MEASUREMENT END TIME: 1615 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	1.2	0.000
1	2.40		1.03	0.00	-0.04	-0.020	1.7	-0.035
2	3.40		1.55	0.01	0.01	0.010	1	0.016
3	4.40		1.80	0.04	0.11	0.075	1	0.135
4	5.40		1.92	0.08	0.16	0.120	1	0.230
5	6.40		1.93	0.16	0.13	0.145	1	0.280
6	7.40		1.80	0.19	0.10	0.145	1	0.261
7	8.40		1.55	0.23	0.10	0.165	1	0.256
8	9.40		1.65	0.26	0.19	0.225	1	0.371
9	10.40		1.60	0.29	0.12	0.205	1	0.328
10	11.40		1.65	0.19	0.15	0.170	1	0.281
11	12.40		1.60	0.20	0.18	0.190	1.25	0.380
12	13.90		1.45	0.22	0.08	0.150	1.75	0.381
13	15.90		1.40	0.09	0.14	0.115	1.5	0.242
Right Bank	16.90		0.00			0.000	0.5	0.000

**3.124**

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Muskeg River**  
**LOCATION: S5A**  
**COORDINATES: 6351833N/476052E**

**MEASUREMENT DATE: 14 Aug 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL/NC**  
**COMPUTATIONS BY: LL/LW**

**MEASUREMENT START TIME: 1230 hrs.**  
**MEASUREMENT END TIME: 1430 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.55	0.000
1	1.10		0.43			-0.010	1.8	-0.008
2	3.60		1.50	0.05	0.06	0.055	2.25	0.186
3	5.60		1.71	0.01	0.01	0.010	1.75	0.030
4	7.10		1.60	0.05	0.04	0.045	1.25	0.090
5	8.10		1.30	0.01	0.05	0.030	1	0.039
6	9.10		1.12	0.02	0.01	0.015	1	0.017
7	10.10		1.00	0.07	0.09	0.080	1	0.080
8	11.10		0.98	0.11	0.10	0.105	1	0.103
9	12.10		1.00	0.10	0.02	0.060	1	0.060
10	13.10		1.08	0.12	0.07	0.095	1	0.103
11	14.10		0.90	0.07	0.06	0.065	1	0.059
12	15.10		0.82	0.08	0.10	0.090	1	0.074
13	16.10		1.20	0.02	0.01	0.015	1.25	0.023
Right Bank	17.60		0.00			0.000	0.75	0.000

**0.854**

**Note:** 1. Raw data was downloaded from the datalogger  
2. Water sample taken for TSS.



**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Muskeg River**  
**LOCATION: S5A**  
**COORDINATES: 6351833N/476052E**

**MEASUREMENT DATE: 12 September 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL**  
**COMPUTATIONS BY: LL/LW**

**MEASUREMENT START TIME: 1330 hrs.**  
**MEASUREMENT END TIME: 1530 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.5	0.000
1	1.00		1.02	0.00	-0.02	-0.010	1	-0.010
2	2.00		1.70	0.05	0.06	0.055	1	0.094
3	3.00		2.10	0.06	0.12	0.090	1	0.189
4	4.00		2.20	0.13	0.11	0.120	1	0.264
5	5.00		2.10	0.10	0.13	0.115	1	0.242
6	6.00		2.30	0.05	0.16	0.105	1	0.242
7	7.00		2.30	0.06	0.16	0.110	1	0.253
8	8.00		2.00	0.08	0.15	0.115	1	0.230
9	9.00		2.00	0.06	0.12	0.090	1	0.180
10	10.00		1.85	0.03	0.08	0.055	1	0.102
11	11.00		1.55	0.03	0.02	0.025	1	0.039
12	12.00		0.86	-0.02	0.02	0.000	1.05	0.000
Right Bank	13.10		0.00	0.00	0.00	0.000	0.55	0.000

**1.823**

**Note:** 1. Raw data was downloaded from the datalogger  
2. Water sample taken for TSS.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Muskeg River**  
**LOCATION: S5A**  
**COORDINATES: 6351833N/476052E**

**MEASUREMENT DATE: 17 October 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL**  
**COMPUTATIONS BY: LL/LW**

**MEASUREMENT START TIME: 1400 hrs.**  
**MEASUREMENT END TIME: 1630 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	2.40		0.00			0.000	0.3	0.000
1	3.00		0.13			-0.040	0.8	-0.004
2	4.00		0.90	-0.05	-0.02	-0.035	1	-0.032
3	5.00		1.61	0.01	0.04	0.025	1	0.040
4	6.00		1.85	0.14	0.10	0.120	1	0.222
5	7.00		2.00	0.10	0.09	0.095	1	0.190
6	8.00		2.00	0.14	0.09	0.115	1	0.230
7	9.00		2.05	0.15	0.11	0.130	1	0.267
8	10.00		2.12	0.15	0.08	0.115	1	0.244
9	11.00		2.10	0.11	0.07	0.090	1	0.189
10	12.00		2.02	0.11	0.05	0.080	1	0.162
11	13.00		1.86	0.01	0.03	0.020	1.25	0.047
Right Bank	14.50		0.00	0.00	0.00	0.000	0.75	0.000

**1.554**

**Note:** 1. Raw data was downloaded from the datalogger - new battery was installed.  
2. Water sample taken for TSS.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Muskeg River**  
**LOCATION: S5A**  
**COORDINATES: 6351833N/476052E**

**MEASUREMENT DATE: 19 December 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL/CO**  
**COMPUTATIONS BY: LL/LW**

**MEASUREMENT START TIME: 1200 hrs.**  
**MEASUREMENT END TIME: 1500 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00	0.25	0.00			0.000	0.75	0.000
1	1.50	0.23	0.65			-0.020	1.6	-0.019
2	3.20	0.27	1.12	0.02	0.01	0.015	1.85	0.029
3	5.20	0.23	1.13	0.03	0.01	0.020	1.5	0.031
4	6.20	0.30	1.09	0.02	0.00	0.010	1.75	0.018
5	8.70	0.30	1.01	0.01	0.01	0.010	1.95	0.018
6	10.10	0.30	0.87	0.01	0.00	0.005	1.35	0.005
Right Bank	11.40	0.25	0.00			0.000	-5.05	0.000

**0.082**

**Note:** 1. Raw data was downloaded from the datalogger.

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray  
 PROJECT NO.: 002-2309-7000  
 DISCHARGE DATA

STREAM NAME: Mills Creek  
 LOCATION: S6  
 COORDINATES: 463829E/6344743N

MEASUREMENT DATE: 10 January 2000  
 METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/CO  
 COMPUTATIONS BY: LL/NS

MEASUREMENT START TIME: 1200 hrs.  
 MEASUREMENT END TIME: 1300 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00	0.10	0.00			0.000	0.1	0.000
1	0.20	0.10	0.10			0.040	0.2	0.001
2	0.40	0.10	0.16			0.080	0.2	0.003
3	0.60	0.10	0.18			0.120	0.2	0.004
4	0.80	0.10	0.18			0.130	0.2	0.005
5	1.00	0.10	0.14			0.080	0.2	0.002
6	1.20	0.10	0.17			0.080	0.2	0.003
7	1.40	0.10	0.14			0.080	0.2	0.002
8	1.60	0.10	0.14			0.070	0.25	0.002
Right Bank	1.90	0.10	0.00			0.000	-0.8	0.000

**0.022**

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray  
 PROJECT NO.: 002-2309-7000  
 DISCHARGE DATA

STREAM NAME: Mills Creek  
 LOCATION: S6  
 COORDINATES: 463828.7E/6344743.3N

MEASUREMENT DATE: 23 February 2000  
 METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/CO  
 COMPUTATIONS BY: LL/NS

MEASUREMENT START TIME: 0810 hrs.  
 MEASUREMENT END TIME: 0830 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00	0.12	0.00			0.000	0.1	0.000
1	0.20	0.12	0.15			0.000	0.2	0.000
2	0.40	0.12	0.18			0.010	0.2	0.000
3	0.60	0.12	0.15			0.020	0.2	0.001
4	0.80	0.12	0.18			0.020	0.2	0.001
5	1.00	0.12	0.18			0.030	0.2	0.001
6	1.20	0.12	0.20			0.050	0.2	0.002
7	1.40	0.12	0.19			0.050	0.2	0.002
8	1.60	0.12	0.18			0.060	0.2	0.002
9	1.80	0.12	0.18			0.030	0.2	0.001
10	2.00	0.12	0.16			-0.010	0.2	0.000
11	2.20	0.12	0.16			-0.020	0.15	0.000
Right Bank	2.30	0.12	0.00			0.000	-1.1	0.000

**0.008**

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Mills Creek**  
**LOCATION: S6**  
**COORDINATES: 463828.7E/6344743.3N**

**MEASUREMENT DATE: 10 March 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL**  
**COMPUTATIONS BY: LL/NS**

**MEASUREMENT START TIME: 1620 hrs.**  
**MEASUREMENT END TIME: 1710 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00	0.05	0.00			0.000	0.1	0.000
1	0.20	0.05	0.16			0.010	0.2	0.000
2	0.40	0.05	0.19			0.030	0.2	0.001
3	0.60	0.05	0.23			0.050	0.2	0.002
4	0.80	0.05	0.25			0.050	0.2	0.002
5	1.00	0.05	0.23			0.060	0.2	0.003
6	1.20	0.05	0.24			0.040	0.2	0.002
7	1.40	0.05	0.15			0.030	0.2	0.001
8	1.60	0.05	0.12			0.020	0.2	0.000
9	1.80	0.05	0.10			-0.010	0.2	0.000
10	2.00	0.05	0.08			-0.020	0.2	0.000
Right Bank	2.20	0.05	0.00			0.000	-1	0.000

**0.011**

Note: 1. Ice cover was broken up where discharge was measured - water was flowing underneath the ice at downstream.  
2. Water was flowing freely over the weir.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Mills Creek**  
**LOCATION: S6**  
**COORDINATES: 463828.7E/6344743.3N**

**MEASUREMENT DATE: 02 April 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL**  
**COMPUTATIONS BY: LL/NS**

**MEASUREMENT START TIME: 1230 hrs.**  
**MEASUREMENT END TIME: 1320 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.1	0.000
1	0.20		0.08			-0.020	0.2	0.000
2	0.40		0.12			0.100	0.2	0.002
3	0.60		0.24			0.120	0.2	0.005
4	0.80		0.25			0.110	0.2	0.005
5	1.00		0.24			0.150	0.2	0.007
6	1.20		0.26			0.100	0.2	0.005
7	1.40		0.27			0.060	0.2	0.003
8	1.60		0.26			0.050	0.2	0.002
9	1.80		0.26			0.020	0.2	0.001
10	2.00		0.26			0.020	0.2	0.001
11	2.20		0.27			0.000	0.2	0.000
12	2.40		0.26			-0.010	0.2	0.000
13	2.60		0.26			-0.030	0.2	-0.001
14	2.80		0.25			-0.010	0.2	0.000
15	3.00		0.22			-0.020	0.2	-0.001
16	3.20		0.21			-0.010	0.4	-0.001
Right Bank	3.80		0.00			0.000	-1.6	0.000

**0.027**

- Note: 1. Water sample was taken for TSS  
 2. Surveyed the water level.  
 3. The transducer was temporary installed and the logger was programmed to daylight saving time.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Mills Creek**  
**LOCATION: S6**  
**COORDINATES: 463828.7E/6344743.3N**

**MEASUREMENT DATE: 20 April 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL/CO**  
**COMPUTATIONS BY: LL/NS**

**MEASUREMENT START TIME: 1630 hrs.**  
**MEASUREMENT END TIME: 1700 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.15	0.000
1	0.30		0.05			-0.030	0.3	0.000
2	0.60		0.17			0.050	0.3	0.002
3	0.90		0.17			0.050	0.3	0.002
4	1.20		0.22			0.040	0.3	0.002
5	1.50		0.24			0.030	0.3	0.002
6	1.80		0.24			0.020	0.3	0.001
7	2.10		0.20			0.000	0.3	0.000
8	2.40		0.23			-0.010	0.3	-0.001
9	2.70		0.22			-0.030	0.3	-0.002
10	3.00		0.22			-0.020	0.3	-0.001
11	3.30		0.17			-0.030	0.3	-0.001
Right Bank	3.60		0.00			0.000	-1.65	0.000

**0.005**

- Note: 1. Water sample was taken for TSS  
2. Surveyed the water level.  
3. The transducer was removed after surveyed but had to reinstall temporary as the housing pipe was still frozen.



**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Mills Creek**  
**LOCATION: S6**  
**COORDINATES: 463828.7E/6344743.3N**

**MEASUREMENT DATE: 17 May 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL/CO**  
**COMPUTATIONS BY: LL/NS**

**MEASUREMENT START TIME: 1610 hrs.**  
**MEASUREMENT END TIME: 1730 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.15	0.000
1	0.30		0.07			-0.070	0.3	-0.001
2	0.60		0.19			0.120	0.3	0.006
3	0.90		0.19			0.110	0.3	0.006
4	1.20		0.21			0.110	0.3	0.006
5	1.50		0.21			0.070	0.3	0.004
6	1.80		0.20			0.020	0.3	0.001
7	2.10		0.18			0.000	0.3	0.000
8	2.40		0.16			-0.020	0.4	-0.001
9	2.90		0.10			-0.040	0.5	-0.002
Right Bank	3.40		0.00			0.000	-1.45	0.000

**0.019**

- Note: 1. Arrived at the site, noticed somebody had placed a board across the V-notch, constraining the flow. Removed the board and waited for at least 3/4 of an hour before doing the discharge.
2. Surveyed the water level before installing the transducer permanently inside housing.
3. The transducer was permanently installed inside the housing.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Mills Creek**  
**LOCATION: S6**  
**COORDINATES: 463828.7E/6344743.3N**

**MEASUREMENT DATE: 02 July 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL**  
**COMPUTATIONS BY: LL/NS**

**MEASUREMENT START TIME: 1700 hrs.**  
**MEASUREMENT END TIME: 1845 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.15	0.000
1	0.30		0.07			-0.050	0.3	-0.001
2	0.60		0.13			0.070	0.3	0.003
3	0.90		0.14			0.070	0.3	0.003
4	1.20		0.20			0.070	0.3	0.004
5	1.50		0.20			0.050	0.3	0.003
6	1.80		0.18			-0.030	0.3	-0.001
7	2.10		0.16			-0.010	0.3	0.000
8	2.40		0.14			-0.010	0.3	0.000
9	2.70		0.12			-0.040	0.45	-0.002
Right Bank	3.30		0.00			0.000	0.3	0.000

**0.007**

Note: 1. Water sample taken for TSS.  
2. Downloaded the raw data.

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray  
 PROJECT NO.: 002-2309-7000  
 DISCHARGE DATA

STREAM NAME: Mills Creek  
 LOCATION: S6  
 COORDINATES: 463828.7E/6344743.3N

MEASUREMENT DATE: 14 August 2000  
 METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/NC  
 COMPUTATIONS BY: LL/LW

MEASUREMENT START TIME: 1415 hrs.  
 MEASUREMENT END TIME: 1515 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.15	0.000
1	0.30		0.16			-0.010	0.25	0.000
2	0.50		0.18			-0.010	0.15	0.000
3	0.60		0.16			0.020	0.15	0.000
4	0.80		0.22			0.040	0.2	0.002
5	1.00		0.17			0.080	0.2	0.003
6	1.20		0.20			0.050	0.2	0.002
7	1.40		0.18			0.060	0.2	0.002
8	1.60		0.20			0.010	0.2	0.000
9	1.80		0.22			0.030	0.2	0.001
10	2.00		0.20			0.000	0.25	0.000
11	2.30		0.14			0.000	0.35	0.000
Right Bank	2.70		0.00			0.000	0.2	0.000

**0.010**

Note: 1. Water sample taken for TSS.  
 2. Downloaded the raw data.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Mills Creek**  
**LOCATION: S6**  
**COORDINATES: 463828.7E/6344743.3N**

**MEASUREMENT DATE: 12 September 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL**  
**COMPUTATIONS BY: LL/LW**

**MEASUREMENT START TIME: 0900 hrs.**  
**MEASUREMENT END TIME: 0935 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.15	0.000
1	0.30		0.12			0.000	0.3	0.000
2	0.60		0.16			0.070	0.3	0.003
3	0.90		0.17			0.070	0.3	0.004
4	1.20		0.21			0.060	0.3	0.004
5	1.50		0.20			0.070	0.3	0.004
6	1.80		0.19			0.010	0.3	0.001
7	2.10		0.16			0.020	0.3	0.001
8	2.40		0.14			0.010	0.3	0.000
9	2.70		0.11			0.000	0.3	0.000
10	3.00		0.08			0.000	0.3	0.000
Right Bank	3.30		0.00			0.000	0.15	0.000

**0.017**

Note: 1. Water sample taken for TSS.  
2. Downloaded the raw data.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Muskeg River WSC**  
**LOCATION: S7**  
**COORDINATES: E/N**

**MEASUREMENT DATE: 12 January 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL/CO**  
**COMPUTATIONS BY: LL/LW**

**MEASUREMENT START TIME: 0900 hrs.**  
**MEASUREMENT END TIME: 1030 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00	0.27	0.00			0.000	1.15	0.000
1	2.30	0.27	0.50			0.065	2.2	0.066
2	4.40	0.33	0.50			0.055	2.25	0.057
3	6.80	0.35	0.46			0.080	2.25	0.076
4	8.90	0.33	0.52			0.075	2.1	0.075
5	11.00	0.30	0.56			0.055	2.25	0.064
6	13.40	0.25	0.57			0.020	1.75	0.018
Right Bank	14.50	0.25	0.00			0.000	-6.7	0.000

**0.356**

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray  
 PROJECT NO.: 002-2309-7000  
 DISCHARGE DATA

STREAM NAME: Muskeg River WSC  
 LOCATION: S7  
 COORDINATES: E/N

MEASUREMENT DATE: 21 February 2000  
 METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/CO  
 COMPUTATIONS BY: LL/LW

MEASUREMENT START TIME: 1130 hrs.  
 MEASUREMENT END TIME: 1215 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00	0.67	0.00			0.000	0.6	0.000
1	1.20	0.67	0.04			0.020	1.65	0.001
2	3.30	0.70	0.11			0.030	2.2	0.007
3	5.60	0.73	0.16			0.040	2.2	0.013
4	7.70	0.69	0.17			0.070	2.1	0.023
5	9.80	0.66	0.25			0.060	1.7	0.023
6	11.10	0.64	0.35			0.040	1.2	0.015
7	12.20	0.59	0.29			0.030	1.3	0.010
8	13.70	0.86	0.04			0.000	1.15	0.000
Right Bank	14.50	0.86	0.00			0.000	-6.85	0.000

**0.093**

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Muskeg River WSC**  
**LOCATION: S7**  
**COORDINATES: E/N**

**MEASUREMENT DATE: 12 March 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL**  
**COMPUTATIONS BY: LL/LW**

**MEASUREMENT START TIME: 1400 hrs.**  
**MEASUREMENT END TIME: 1500 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00	0.60	0.00			0.000	0.3	0.000
1	0.60	0.60	0.29			0.040	1.25	0.013
2	2.50	0.66	0.20			0.050	2.05	0.019
3	4.70	0.76	0.12			0.030	2.25	0.007
4	7.00	0.73	0.19			0.060	2.15	0.023
5	9.00	0.74	0.18			0.070	2.05	0.024
6	11.10	0.97	0.19			0.060	1.7	0.018
7	12.40	0.97	0.19			0.050	1.15	0.010
8	13.40	0.97	0.19			0.040	1.3	0.009
9	15.00	0.81	0.12			0.040	1.05	0.005
Right Bank	15.50	0.81	0.00			0.000	-7.5	0.000

**0.128**

Note: 1. Bottom of the river was frozen.

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray  
 PROJECT NO.: 002-2309-7000  
 DISCHARGE DATA

STREAM NAME: Muskeg River WSC  
 LOCATION: S7  
 COORDINATES: E/N

MEASUREMENT DATE: 20 April 2000  
 METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/CO  
 COMPUTATIONS BY: LL/LW

MEASUREMENT START TIME: 1400 hrs.  
 MEASUREMENT END TIME: 1500 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00	0.00	0.00			0.000	0.45	0.000
1	0.90	0.00	0.05			0.160	0.7	0.006
2	1.40	0.00	0.06			0.220	0.4	0.005
3	1.70	0.00	0.12			0.600	0.35	0.025
4	2.10	0.00	0.17			0.840	0.3	0.043
5	2.30	0.00	0.19			0.900	0.2	0.034
6	2.50	0.00	0.20			0.960	0.2	0.038
7	2.70	0.00	0.20			0.950	0.2	0.038
8	2.90	0.00	0.21			1.020	0.25	0.054
9	3.20	0.00	0.22			0.940	0.3	0.062
10	3.50	0.00	0.22			0.900	0.3	0.059
11	3.80	0.00	0.22			0.810	0.3	0.053
12	4.10	0.00	0.25			0.770	0.3	0.058
13	4.40	0.00	0.27			0.660	0.3	0.053
14	4.70	0.00	0.26			0.780	0.3	0.061
15	5.00	0.00	0.26			0.690	0.4	0.072
16	5.50	0.00	0.24			0.350	0.5	0.042
17	6.00	0.00	0.24			0.360	0.5	0.043
18	6.50	0.00	0.24			0.360	0.5	0.043
19	7.00	0.00	0.18			0.410	1	0.074
20	8.50	0.00	0.12			0.160	1	0.019
21	9.00	0.00	0.12			0.110	0.35	0.005
Right Bank	9.20	0.00	0.00			0.000	-4.5	0.000
								<b>0.888</b>

- Note: 1. No ice covered at the discharge measurement.  
 2. Water collected for TSS.  
 3. Surveyed the water level at the Solinst transducer.



**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Muskeg River WSC**  
**LOCATION: S7**  
**COORDINATES: E/N**

**MEASUREMENT DATE: 17 May 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL/CO**  
**COMPUTATIONS BY: LL/LW**

**MEASUREMENT START TIME: 1430 hrs.**  
**MEASUREMENT END TIME: 1530 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00	0.00	0.00			0.000	0.5	0.000
1	1.00	0.00	0.12			0.590	1	0.071
2	2.00	0.00	0.18			1.180	1	0.212
3	3.00	0.00	0.20			1.160	1	0.232
4	4.00	0.00	0.23			1.080	1	0.248
5	5.00	0.00	0.28			1.100	1	0.308
6	6.00	0.00	0.27			1.170	1	0.316
7	7.00	0.00	0.22			1.090	1	0.240
8	8.00	0.00	0.18			0.660	1	0.119
9	9.00	0.00	0.11			0.400	1	0.044
10	10.00	0.00	0.05			-0.010	0.75	0.000
Right Bank	10.50	0.00	0.00			0.000	-5	0.000

**1.790**

- Note: 1. Water sample collected for TSS.  
2. Not able to download Solinst transducer due to laptop not working.

PROJECT NAME: RAMP/Climate & Hydrology /Ft. McMurray  
 PROJECT NO.: 002-2309-7000  
 DISCHARGE DATA

STREAM NAME: Poplar Creek  
 LOCATION: S11  
 COORDINATES: 471998E/6307667N

MEASUREMENT DATE: 02 April 2000  
 METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL  
 COMPUTATIONS BY: LL/LW

MEASUREMENT START TIME: 1805 hrs.  
 MEASUREMENT END TIME: 1930 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth (m/sec)	0.8 Depth (m/sec)	0.6 Depth (m/sec)		
Left Bank	0.00		0.000			0.000	0.05	0.000
1	0.10		0.100			0.760	0.1	0.008
2	0.20		0.100			0.810	0.1	0.008
Right Bank	0.30		0.000			0.000	-0.1	0.000
								<b>0.016</b>

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth (m/sec)	0.8 Depth (m/sec)	0.6 Depth (m/sec)		
Left Bank	0.00		0.000			0.000	0.05	0.000
1	0.10		0.060			0.520	0.1	0.003
2	0.20		0.100			1.060	0.1	0.011
3	0.30		0.120			1.090	0.1	0.013
4	0.40		0.100			1.250	0.1	0.013
5	0.50		0.140			1.360	0.1	0.019
6	0.60		0.120			1.520	0.1	0.018
7	0.70		0.100			1.450	0.1	0.015
8	0.80		0.120			1.320	0.1	0.016
9	0.90		0.120			1.240	0.1	0.015
10	1.00		0.120			1.060	0.1	0.013
11	1.10		0.100			0.790	0.1	0.008
Right Bank	1.20		0.000			0.000	-0.55	0.000
								<b>0.142</b>

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth (m/sec)	0.8 Depth (m/sec)	0.6 Depth (m/sec)		
Left Bank	0.00		0.000			0.000	0.1	0.000
1	0.20		0.120			0.460	0.2	0.011
2	0.40		0.200			0.710	0.2	0.028
3	0.60		0.140			0.690	0.2	0.019
4	0.80		0.140			0.850	0.2	0.024
5	1.00		0.180			1.040	0.2	0.037
6	1.20		0.140			1.070	0.2	0.030
Right Bank	1.40		0.000			0.000	-0.6	0.000
								<b>0.150</b>

Total Discharge: 0.308m<sup>3</sup>/sec

PROJECT NAME: RAMP/Climate & Hydrology /Ft. McMurray

PROJECT NO.: 002-2309-7000

DISCHARGE DATA

STREAM NAME: Poplar Creek

LOCATION: S11

COORDINATES: 471998E/6307667N

MEASUREMENT DATE: 20 April 2000

METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/CO

COMPUTATIONS BY: LL/LW

MEASUREMENT START TIME: 1715 hrs.

MEASUREMENT END TIME: 1830 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.45	0.000
1	0.90		0.18			-0.030	1	-0.003
2	1.20		0.18			0.200	0.3	0.011
3	1.50		0.16			0.150	0.3	0.007
4	1.80		0.18			0.020	0.3	0.001
5	2.10		0.18			0.150	0.3	0.008
6	2.40		0.24			0.130	0.3	0.009
7	2.70		0.26			0.350	0.3	0.027
8	3.00		0.24			0.320	0.3	0.023
9	3.30		0.25			0.390	0.3	0.029
10	3.60		0.24			0.280	0.3	0.020
11	3.90		0.26			0.240	0.3	0.019
12	4.20		0.30			0.320	0.3	0.029
13	4.50		0.22			0.230	0.3	0.015
14	4.80		0.20			0.100	0.35	0.007
15	5.20		0.18			0.140	0.45	0.011
16	5.70		0.16			0.000	0.65	0.000
17	6.50		0.18			0.000	0.9	0.000
18	7.50		0.17			-0.010	1	-0.002
19	8.50		0.14			-0.020	1	-0.003
20	9.50		0.12			-0.030	1	-0.004
21	10.50		0.09			0.030	1	0.003
22	11.50		0.13			-0.040	1	-0.005
23	12.50		0.08			-0.040	0.75	-0.002
Right Bank	13.00		0.00			0.000	-6.25	0.000
								<b>0.201</b>

Note: 1. Water sample was collected for TSS.

PROJECT NAME: RAMP/Climate & Hydrology /Ft. McMurray

PROJECT NO.: 002-2309-7000

DISCHARGE DATA

STREAM NAME: Poplar Creek

LOCATION: S11

COORDINATES: 471998E/6307667N

MEASUREMENT DATE: 17 May 2000

METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/CO

COMPUTATIONS BY: LL/LW

MEASUREMENT START TIME: 1750 hrs.

MEASUREMENT END TIME: 1850 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.5	0.000
1	1.00		0.12			-0.030	1	-0.004
2	2.00		0.08			-0.030	1	-0.002
3	3.00		0.14			0.040	1	0.006
4	4.00		0.12			0.030	1	0.004
5	5.00		0.15			0.130	1	0.020
6	6.00		0.18			0.230	1	0.041
7	7.00		0.16			0.250	1	0.040
8	8.00		0.18			0.080	1	0.014
9	9.00		0.22			0.330	1	0.073
10	10.00		0.22			0.230	1	0.051
11	11.00		0.30			0.390	1	0.117
12	12.00		0.27			0.570	1	0.154
13	13.00		0.28			0.310	1	0.087
14	14.00		0.26			0.270	1	0.070
15	15.00		0.28			-0.020	0.75	-0.004
Right Bank	15.50		0.00			0.000	-7.5	0.000

**0.665**

Note: 1. Water sample was collected for TSS.

PROJECT NAME: RAMP/Climate & Hydrology /Ft. McMurray

PROJECT NO.: 002-2309-7000

DISCHARGE DATA

STREAM NAME: Poplar Creek

LOCATION: S11

COORDINATES: 471998E/6307667N

MEASUREMENT DATE: 14 June 2000

METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/CO

COMPUTATIONS BY: LL/LW

MEASUREMENT START TIME: 1800 hrs.

MEASUREMENT END TIME: 1900 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.5	0.000
1	1.00		0.13			-0.010	1	-0.001
2	2.00		0.16			0.060	1	0.010
3	3.00		0.16			0.050	1	0.008
4	4.00		0.18			0.090	1	0.016
5	5.00		0.20			0.190	1	0.038
6	6.00		0.22			0.170	1	0.037
7	7.00		0.20			0.140	1	0.028
8	8.00		0.26			0.150	1	0.039
9	9.00		0.26			0.300	1	0.078
10	10.00		0.30			0.420	1	0.126
11	11.00		0.30			0.550	1	0.165
12	12.00		0.28			0.360	1	0.101
13	13.00		0.26			0.300	1	0.078
14	14.00		0.28			0.010	0.85	0.002
Right Bank	14.70		0.00			0.000	-7	0.000

0.725

Note: 1. Water sample was collected for TSS.

PROJECT NAME: RAMP/Climate & Hydrology /Ft. McMurray

PROJECT NO.: 002-2309-7000

DISCHARGE DATA

STREAM NAME: Poplar Creek

LOCATION: S11

COORDINATES: 471998E/6307667N

MEASUREMENT DATE: 02 July 2000

METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/CO

COMPUTATIONS BY: LL/LW

MEASUREMENT START TIME: 0715 hrs.

MEASUREMENT END TIME: 0745 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.5	0.000
1	1.00		0.34			0.290	1	0.099
2	2.00		0.44			0.270	1	0.119
3	3.00		0.43			0.330	1	0.142
4	4.00		0.42			0.320	1	0.134
5	5.00		0.44			0.340	1	0.150
6	6.00		0.46			0.310	1	0.143
7	7.00		0.36			0.390	1	0.140
8	8.00		0.39			0.390	1	0.152
9	9.00		0.42			0.360	1	0.151
10	10.00		0.34			0.400	1	0.136
11	11.00		0.35			0.380	1	0.133
12	12.00		0.40			0.390	1	0.156
13	13.00		0.40			0.290	1	0.116
14	14.00		0.40			0.330	1	0.132
15	15.00		0.39			0.380	1	0.148
16	16.00		0.42			0.340	1	0.143
17	17.00		0.37			0.260	1	0.096
18	18.00		0.23			0.140	0.95	0.031
Right Bank	18.90		0.00			0.000	0.45	0.000

2.320

Note: 1. Water sample was collected for TSS.

PROJECT NAME: RAMP/Climate & Hydrology /Ft. McMurray

PROJECT NO.: 002-2309-7000

**DISCHARGE DATA**

STREAM NAME: Poplar Creek

LOCATION: S11

COORDINATES: 471998E/6307667N

MEASUREMENT DATE: 15 August 2000

METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/NC

COMPUTATIONS BY: LL/LW

MEASUREMENT START TIME: 1400 hrs.

MEASUREMENT END TIME: 1530 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.15	0.000
1	0.30		0.06			-0.010	0	0.000
2	0.50		0.10			0.050	0.25	0.001
3	0.80		0.06			0.040	0.3	0.001
4	1.10		0.10			0.340	0.3	0.010
5	1.40		0.12			0.160	0.25	0.005
6	1.60		0.10			0.620	0.2	0.012
7	1.80		0.10			0.500	0.2	0.010
8	2.00		0.09			0.040	0.2	0.001
9	2.20		0.14			0.140	0.2	0.004
10	2.40		0.14			0.300	0.2	0.008
11	2.60		0.17			0.820	0.2	0.028
12	2.80		0.18			0.440	0.2	0.016
13	3.00		0.06			0.690	0.2	0.008
14	3.20		0.06			0.640	0.2	0.008
15	3.40		0.24			0.580	0.2	0.028
16	3.60		0.12			0.470	0.2	0.011
17	3.80		0.10			0.090	0.3	0.003
Right Bank	4.20		0.00			0.000	0.2	0.000

**0.154**

Note: 1. Water sample was collected for TSS.

2. Construction of the bridge (2nd bridge - twinning of highway) at u/s of the station.

PROJECT NAME: RAMP/Climate & Hydrology /Ft. McMurray  
**PROJECT NO.:** 002-2309-7000  
**DISCHARGE DATA**

**STREAM NAME:** Poplar Creek  
**LOCATION:** S11  
**COORDINATES:** 471998E/6307667N

**MEASUREMENT DATE:** 14 September 2000  
**METER NUMBER:** Marsh-McBirney Flo-Mate 2000

**MEASUREMENT BY:** LL  
**COMPUTATIONS BY:** LL/LW

**MEASUREMENT START TIME:** 1000 hrs.  
**MEASUREMENT END TIME:** 1130 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.15	0.000
1	0.30		0.06			0.100	0	0.002
2	0.60		0.16			0.130	0.3	0.006
3	0.90		0.14			0.070	0.3	0.003
4	1.20		0.14			0.220	0.3	0.009
5	1.50		0.09			0.210	0.3	0.006
6	1.80		0.16			0.120	0.3	0.006
7	2.10		0.14			0.290	0.3	0.012
8	2.40		0.12			0.610	0.3	0.022
9	2.70		0.20			0.310	0.3	0.019
10	3.00		0.16			0.260	0.3	0.012
11	3.30		0.20			0.220	0.3	0.013
12	3.60		0.08			0.400	0.3	0.010
13	3.90		0.06			0.110	0.225	0.001
Right Bank	4.05		0.00			0.000	0.075	0.000

**0.121**

- Note: 1. Water sample was collected for TSS.  
 2. Construction of the bridge (2nd bridge - twinning of highway) at u/s of the station.



**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Fort Creek**  
**LOCATION: S14**  
**COORDINATES: 462641E/6363543N**

**MEASUREMENT DATE: 02 April 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL**  
**COMPUTATIONS BY: LL/NS**

**MEASUREMENT START TIME: 0940 hrs.**  
**MEASUREMENT END TIME: 1100 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.15	0.000
1	0.30		0.10			-0.020	0.30	-0.001
2	0.60		0.10			-0.020	0.30	-0.001
3	0.90		0.14			0.000	0.30	0.000
4	1.20		0.17			-0.020	0.30	-0.001
5	1.50		0.16			0.190	0.30	0.009
6	1.80		0.14			-0.030	0.30	-0.001
7	2.10		0.11			0.050	0.30	0.002
8	2.40		0.20			0.360	0.30	0.022
9	2.70		0.25			0.760	0.30	0.057
10	3.00		0.25			0.490	0.30	0.037
11	3.30		0.22			0.110	0.30	0.007
12	3.60		0.15			-0.040	0.25	-0.002
Right Bank	3.80		0.00			0.000	-1.8	0.000

**0.128**

- Note: 1. Surveyed the water level for the first time, used top of d/s culvert as B.M.  
2. Transducer and logger temporary installed - programmed to daylight saving time.  
3. Water sample was collected for TSS.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Fort Creek**  
**LOCATION: S14**  
**COORDINATES: 462641E/6363543N**

**MEASUREMENT DATE: 17 May 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL/CO**  
**COMPUTATIONS BY: LL/NS**

**MEASUREMENT START TIME: 1530 hrs.**  
**MEASUREMENT END TIME: 1630 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.20	0.000
1	0.40		0.08			0.150	0.30	0.004
2	0.60		0.12			0.490	0.20	0.012
3	0.80		0.13			0.450	0.20	0.012
4	1.00		0.13			0.470	0.20	0.012
5	1.20		0.10			0.430	0.20	0.009
6	1.40		0.12			0.370	0.20	0.009
7	1.60		0.11			0.200	0.20	0.004
8	1.80		0.08			0.170	0.20	0.003
9	2.00		0.04			0.000	0.20	0.000
Right Bank	2.20		0.00			0.000	-1.00	0.000

**0.064**

Note: 1. The temporary transducer was above the water level when arrived at the site.  
2. Water sample was collected for TSS.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Fort Creek**  
**LOCATION: S14**  
**COORDINATES: 462641E/6363543N**

**MEASUREMENT DATE: 14 June 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL/CO**  
**COMPUTATIONS BY: LL/NS**

**MEASUREMENT START TIME: 1600 hrs.**  
**MEASUREMENT END TIME: 1700 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.10	0.000
1	0.20		0.12			0.410	0.20	0.010
2	0.40		0.20			0.680	0.20	0.027
3	0.60		0.18			0.880	0.20	0.032
4	0.80		0.18			0.940	0.20	0.034
5	1.00		0.18			0.880	0.20	0.032
6	1.20		0.14			0.680	0.20	0.019
7	1.40		0.10			0.370	0.20	0.007
8	1.60		0.10			0.270	0.20	0.005
9	1.80		0.07			0.110	0.20	0.002
10	2.00		0.04			0.060	0.20	0.000
Right Bank	2.20		0.00			0.000	-1.00	0.000

**0.168**

Note: 1. Datalogger/transducer are still temporary installed.  
2. Water sample was collected for TSS.  
3. Data downloaded and surveyed the water level.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Fort Creek**  
**LOCATION: S14**  
**COORDINATES: 462641E/6363543N**

**MEASUREMENT DATE: 03 July 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL**  
**COMPUTATIONS BY: LL/NS**

**MEASUREMENT START TIME: 1100 hrs.**  
**MEASUREMENT END TIME: 1300 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.10	0.000
1	0.20		0.04			0.000	0.15	0.000
2	0.30		0.06			0.060	0.15	0.001
3	0.50		0.08			0.340	0.20	0.005
4	0.70		0.08			0.370	0.20	0.006
5	0.90		0.14			0.620	0.20	0.017
6	1.10		0.20			0.690	0.20	0.028
7	1.30		0.18			0.820	0.20	0.030
8	1.50		0.18			0.680	0.20	0.024
9	1.70		0.12			0.200	0.20	0.005
10	1.90		0.04			0.100	0.15	0.001
Right Bank	2.00		0.00			0.000	0.05	0.000

**0.116**

- Note: 1. Datalogger/transducer are still temporary installed.  
2. Water sample was collected for TSS.  
3. Data downloaded and surveyed the water level.

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray

PROJECT NO.: 002-2309-7000

DISCHARGE DATA

STREAM NAME: Fort Creek

LOCATION: S14

COORDINATES: 462641E/6363543N

MEASUREMENT DATE: 14 August 2000

METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/NC

COMPUTATIONS BY: LL/LW

MEASUREMENT START TIME: 0930 hrs.

MEASUREMENT END TIME: 1200 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.10	0.000
1	0.20		0.04			0.020	0.20	0.000
2	0.40		0.06			0.260	0.15	0.002
3	0.50		0.07			0.380	0.10	0.003
4	0.60		0.07			0.430	0.10	0.003
5	0.70		0.10			0.170	0.10	0.002
6	0.80		0.12			0.610	0.10	0.007
7	0.90		0.10			0.710	0.10	0.007
8	1.00		0.12			0.420	0.10	0.005
9	1.10		0.12			0.520	0.10	0.006
10	1.20		0.15			0.650	0.10	0.010
11	1.30		0.13			0.810	0.10	0.011
12	1.40		0.14			0.600	0.10	0.008
13	1.50		0.12			0.620	0.10	0.007
14	1.60		0.12			0.520	0.10	0.006
15	1.70		0.08			0.160	0.10	0.001
16	1.80		0.06			0.020	0.10	0.000
Right Bank	1.90		0.00			0.000	0.05	0.000

**0.079**

Note: 1. Datalogger/ransducer are still temporary installed.

2. Water sample was collected for TSS.

3. Data downloaded and surveyed the water level.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Fort Creek**  
**LOCATION: S14**  
**COORDINATES: 462641E/6363543N**

**MEASUREMENT DATE: 13 September 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL**  
**COMPUTATIONS BY: LL/LW**

**MEASUREMENT START TIME: 1300 hrs.**  
**MEASUREMENT END TIME: 1500 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.10	0.000
1	0.20		0.04			0.080	0.15	0.000
2	0.30		0.04			0.190	0.10	0.001
3	0.40		0.07			0.180	0.10	0.001
4	0.50		0.06			0.340	0.10	0.002
5	0.60		0.07			0.560	0.10	0.004
6	0.70		0.12			0.580	0.10	0.007
7	0.80		0.12			0.510	0.10	0.006
8	0.90		0.16			0.580	0.10	0.009
9	1.00		0.16			0.730	0.10	0.012
10	1.10		0.16			0.770	0.10	0.012
11	1.20		0.12			0.600	0.10	0.007
12	1.30		0.13			0.610	0.10	0.008
13	1.40		0.08			0.740	0.10	0.006
14	1.50		0.06			0.050	0.10	0.000
15	1.60		0.04			0.060	0.10	0.000
Right Bank	1.70		0.00			0.000	0.05	0.000

**0.076**

- Note: 1. Datalogger/ransducer are still temporary installed.  
 2. Water sample was collected for TSS.  
 3. Data downloaded and surveyed the water level.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Fort Creek**  
**LOCATION: S14**  
**COORDINATES: 462641E/6363543N**

**MEASUREMENT DATE: 19 October 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL**  
**COMPUTATIONS BY: LL/LW**

**MEASUREMENT START TIME: 1200 hrs.**  
**MEASUREMENT END TIME: 1230 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.10	0.000
1	0.20		0.04			0.100	0.20	0.001
2	0.40		0.05			0.240	0.20	0.002
3	0.60		0.10			0.220	0.20	0.004
4	0.80		0.11			0.740	0.20	0.016
5	1.00		0.12			0.740	0.20	0.018
6	1.20		0.14			0.750	0.20	0.021
7	1.40		0.12			0.770	0.20	0.018
8	1.60		0.11			0.410	0.20	0.009
9	1.80		0.04			0.030	0.14	0.000
Right Bank	1.88		0.00			0.000	0.04	0.000

**0.090**

- Note: 1. Datalogger/transducer are still temporary installed.  
2. Water sample was collected for TSS.  
3. Data downloaded and surveyed the water level.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Albion Pond #3**  
**LOCATION: S13**  
**COORDINATES:**

**MEASUREMENT DATE: 14 June 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL/CO**  
**COMPUTATIONS BY: LL/NS**

**MEASUREMENT START TIME: 0930 hrs.**  
**MEASUREMENT END TIME: 1000 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.10	0.000
1	0.20		0.04			-0.020	0.20	0.000
2	0.40		0.04			0.020	0.20	0.000
3	0.60		0.10			0.100	0.20	0.002
4	0.80		0.07			0.120	0.20	0.002
5	1.00		0.10			0.210	0.20	0.004
6	1.20		0.10			0.270	0.20	0.005
7	1.40		0.12			0.280	0.20	0.007
8	1.60		0.12			0.310	0.20	0.007
9	1.80		0.14			0.370	0.20	0.010
10	2.00		0.16			0.290	0.20	0.009
11	2.20		0.13			0.340	0.20	0.009
12	2.40		0.15			0.220	0.20	0.007
13	2.60		0.13			0.090	0.20	0.002
14	2.80		0.06			0.000	0.25	0.000
Right Bank	3.10		0.00			0.000	-1.4	0.000

**0.065**

- Note: 1. TSS sample taken.  
 2. Downloaded data from logger - the housing was completed prior to this visit.  
 3. Surveyed the elevation of the weir and V-notch.



**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Albian Pond #3**  
**LOCATION: S13**  
**COORDINATES: 468854E/6344688N**

**MEASUREMENT DATE: 02 July 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL/CL**  
**COMPUTATIONS BY: LL/NS**

**MEASUREMENT START TIME: 1800 hrs.**  
**MEASUREMENT END TIME: 1830 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank							0.00	0.000
1							0.00	0.000
2							0.00	0.000
3							0.00	0.000
4							0.00	0.000
5							0.00	0.000
6							0.00	0.000
7							0.00	0.000
8							0.00	0.000
9							0.00	0.000
10							0.00	0.000
11							0.00	0.000
12							0.00	0.000
13							0.00	0.000
14							0.00	0.000
Right Bank							0.00	0.000

**0.000**

- Note: 1. TSS sample taken.  
 2. Downloaded data from logger.  
 3. No discharge carried out as there was no flow over the weir.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Albion Pond #3**  
**LOCATION: S13**  
**COORDINATES: 468854E/6344688N**

**MEASUREMENT DATE: 14 August 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL/NC**  
**COMPUTATIONS BY: LL/NS**

**MEASUREMENT START TIME: 1600 hrs.**  
**MEASUREMENT END TIME: 1700 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.15	0.000
1	0.30		0.06			0.050	0.25	0.001
2	0.50		0.06			0.150	0.20	0.002
3	0.70		0.08			0.170	0.20	0.003
4	0.90		0.06			0.180	0.20	0.002
5	1.10		0.09			0.230	0.20	0.004
6	1.30		0.08			0.220	0.15	0.003
7	1.40		0.12			0.230	0.10	0.003
8	1.50		0.15			0.230	0.10	0.003
9	1.60		0.12			0.230	0.10	0.003
10	1.70		0.14			0.060	0.10	0.001
11	1.80		0.12			-0.030	0.10	0.000
12	1.90		0.11			-0.040	0.15	-0.001
13	2.10		0.13			0.070	0.20	0.002
14	2.30		0.12			0.080	0.20	0.002
15	2.50		0.04			-0.040	0.15	0.000
Right Bank	2.60		0.00			0.000	-1.25	0.000

**0.027**

Note: 1. TSS sample taken.  
2. Downloaded data from logger.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Albion Pond #3**  
**LOCATION: S13**  
**COORDINATES: E/N**

**MEASUREMENT DATE: 11 September 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL**  
**COMPUTATIONS BY: LL/NS**

**MEASUREMENT START TIME: 1045 hrs.**  
**MEASUREMENT END TIME: 1130 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m3/sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.05	0.000
1	0.10		0.08			0.070	0.1	0.001
2	0.20		0.11			0.010	0.1	0.000
3	0.30		0.10			0.010	0.1	0.000
4	0.40		0.10			0.180	0.1	0.002
5	0.50		0.10			0.180	0.1	0.002
6	0.60		0.07			0.180	0.1	0.001
7	0.70		0.06			0.170	0.1	0.001
8	0.80		0.06			0.170	0.1	0.001
9	0.90		0.05			0.160	0.1	0.001
10	1.00		0.06			0.220	0.1	0.001
11	1.10		0.07			0.230	0.1	0.002
12	1.20		0.06			0.150	0.1	0.001
13	1.30		0.08			0.150	0.1	0.001
14	1.40		0.05			0.140	0.1	0.001
15	1.50		0.06			0.120	0.1	0.001
16	1.60		0.04			0.070	0.1	0.000
17	1.70		0.04			0.040	0.1	0.000
18	1.80		0.04			0.000	0.155	0.000
Right Bank	2.01		0.00			0.000	-0.9	0.000

**0.015**

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: Albion Pond #3**  
**LOCATION: S13**  
**COORDINATES: E/N**

**MEASUREMENT DATE: 17 October 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL**  
**COMPUTATIONS BY: LL/NS**

**MEASUREMENT START TIME: 1025 hrs.**  
**MEASUREMENT END TIME: 1055 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m3/sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank							0	0.000
1							0	0.000
2							0	0.000
3							0	0.000
4							0	0.000
5							0	0.000
6							0	0.000
7							0	0.000
8							0	0.000
9							0	0.000
10							0	0.000
11							0	0.000
12							0	0.000
13							0	0.000
14							0	0.000
15							0	0.000
16							0	0.000
17							0	0.000
18							0	0.000
Right Bank							0	0.000

**0.000**

Note: No flow in the creek and data was downloaded.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: McClelland Lake Outlet**  
**LOCATION: L1**  
**COORDINATES: 483409E/6372174N**

**MEASUREMENT DATE: 16 May 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL/CO**  
**COMPUTATIONS BY: LL/LW**

**MEASUREMENT START TIME: 0950 hrs.**  
**MEASUREMENT END TIME: 1045 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.000	0.000
1	0.30		0.08			-0.010	0.25	0.000
2	0.50		0.12			-0.010	0.2	0.000
3	0.70		0.20			-0.010	0.2	0.000
4	0.90		0.18			-0.030	0.2	-0.001
5	1.10		0.16			-0.030	0.15	-0.001
6	1.20		0.20			-0.030	0.1	-0.001
7	1.30		0.20			-0.020	0.1	0.000
8	1.40		0.22			0.040	0.1	0.001
9	1.50		0.20			0.060	0.1	0.001
10	1.60		0.20			0.050	0.1	0.001
11	1.70		0.18			0.020	0.10	0.000
12	1.80		0.20			0.000	0.20	0.000
13	2.10		0.16			0.000	0.30	0.000
Right Bank	2.40		0.00			0.000	0.15	0.000
								<b>0.000</b>

Note: 1. Transducer and logger were installed inside the housing - transducer s/n 964640.  
2. Water sample was collected for TSS.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: McClelland Lake Outlet**  
**LOCATION: L1**  
**COORDINATES: 483409E/6372174N**

**MEASUREMENT DATE: 03 July 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL**  
**COMPUTATIONS BY: LL/LW**

**MEASUREMENT START TIME: 1130 hrs.**  
**MEASUREMENT END TIME: 1240 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.05	0.000
1	0.10		0.32			-0.040	0.30	-0.004
2	0.60		0.30			0.000	0.35	0.000
3	0.80		0.44			0.000	0.20	0.000
4	1.00		0.42			0.000	0.15	0.000
5	1.10		0.37			0.070	0.10	0.003
6	1.20		0.42			0.050	0.10	0.002
7	1.30		0.40			0.060	0.10	0.002
8	1.40		0.38			0.000	0.15	0.000
9	1.60		0.30			-0.010	0.25	-0.001
Right Bank	1.90		0.24			0.000	0.15	0.000

**0.003**

- Note: 1. Transducer and logger were installed inside the housing - transducer s/n 964640.  
2. Discharge was taken from the centre of the flood plain - noticed slight flow in this area.  
3. The flood plain is approx. 30 m wide - no flow except where the discharge was taken.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: McClelland Lake Outlet**  
**LOCATION: L1**  
**COORDINATES: 483409E/6372174N**

**MEASUREMENT DATE: 13 September 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL**  
**COMPUTATIONS BY: LL/LW**

**MEASUREMENT START TIME: 1130 hrs.**  
**MEASUREMENT END TIME: 1245 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.50	0.000
1	1.00		0.40			0.000	0.65	0.000
2	1.30		0.36			0.000	0.25	0.000
3	1.50		0.50			0.000	0.15	0.000
4	1.60		0.42			0.000	0.10	0.000
5	1.70		0.44			0.010	0.10	0.000
6	1.80		0.48			0.020	0.10	0.001
7	1.90		0.42			0.060	0.10	0.003
8	2.00		0.40			0.010	0.10	0.000
9	2.10		0.40			0.010	0.10	0.000
10	2.20		0.40			0.000	0.10	0.000
Right Bank	2.30		0.26			0.000	0.05	0.000

**0.005**

- Note: 1. Transducer and logger were installed inside the housing - transducer s/n 964640.  
2. Discharge was taken from the centre of the flood plain - noticed slight flow in this area.  
3. The flood plain is approx. 30 m wide - no flow except where the discharge was taken.  
4. TSS sample taken at the lake.  
5. Downloaded the data and surveyed the water level.

**PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray**  
**PROJECT NO.: 002-2309-7000**  
**DISCHARGE DATA**

**STREAM NAME: McClelland Lake Outlet**  
**LOCATION: L1**  
**COORDINATES: 483409E/6372174N**

**MEASUREMENT DATE: 19 October 2000**  
**METER NUMBER: Marsh-McBirney Flo-Mate 2000**

**MEASUREMENT BY: LL**  
**COMPUTATIONS BY: LL/lw**

**MEASUREMENT START TIME: 1015 hrs.**  
**MEASUREMENT END TIME: 1300 hrs.**

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m <sup>3</sup> /sec)
				0.2 Depth	0.8 Depth	0.6 Depth		
				(m/sec)	(m/sec)	(m/sec)		
Left Bank	0.00		0.00			0.000	0.10	0.0000
1	0.20		0.23			0.010	0.20	0.0005
2	0.40		0.24			0.000	0.20	0.0000
3	0.60		0.20			0.020	0.20	0.0008
4	0.80		0.20			0.000	0.20	0.0000
5	1.00		0.34			0.010	0.20	0.0007
6	1.20		0.32			-0.020	0.20	-0.0013
7	1.40		0.24			-0.030	0.20	-0.0014
8	1.60		0.16			-0.020	0.20	-0.0006
Right Bank	1.80		0.00			0.000	0.10	0.000
								<b>0.00</b>

- Note: 1. Transducer and logger were installed inside the housing - transducer s/n 964640.  
2. Discharge was taken from the centre of the flood plain - noticed slight flow in this area.  
3. The flood plain is approx. 30 m wide - no flow except where the discharge was taken.  
4. TSS sample taken at the lake.  
5. Downloaded the data and surveyed the water level.



**APPENDIX V**  
**STAGE-DISCHARGE RATING CURVES**

## UPDATED STAGE-DISCHARGE RATING CURVES

Most stage-discharge rating curves were updated in 2000 to consider new data and to accommodate the tying-in of local, permanent benchmarks to geodetic elevations. A summary of benchmark elevations and locations is provided in the following table. The datum for each station is arbitrarily selected and referenced to the geodetic benchmark elevation.

Station	Benchmark Elevation (m)	Benchmark Location
S1 – Alsands Drain	280.015	right weir support adjacent to V-notch
S2 – Jackpine Creek	297.990	steel rod in PVC housing on right bank
S3 – Iyininim Creek	360.610	steel rod in PVC housing on right bank
S4 – Blackfly Creek	340.160	steel rod in PVC housing on left bank
S5A – Muskeg River Aurora	282.380	steel rod in PVC housing on right bank
S6 – Mills Creek	273.600	steel rod in PVC housing on right bank
S7 – Muskeg River WSC	273.720	steel rod on right bank
S8 – Stanley Creek	292.150	steel rod in PVC housing near chopper pad
S9 – Kearl Lake Outlet	330.400	steel rod in PVC housing on right bank
S10 – Wapasu Creek	320.160	steel rod in PVC housing on right bank
S11 – Poplar Creek	245.550	ASCM cap on southeast bridge abutment
S12 – Fort Creek	253.440	nail in tree on left bank (temporary)
S13 – Albion Pond #3	279.590	right weir support adjacent to V-notch
L1 – McClelland Lake	295.840	steel rod in PVC housing at treeline to southeast
L2 – Kearl Lake	333.410	steel rod in PVC housing at treeline to west
L3 – Isadore's Lake	235.910	nail in tree to south (temporary)

Figure V-1 Stage-Discharge Rating Curve at Alsands Drain Station (S1)

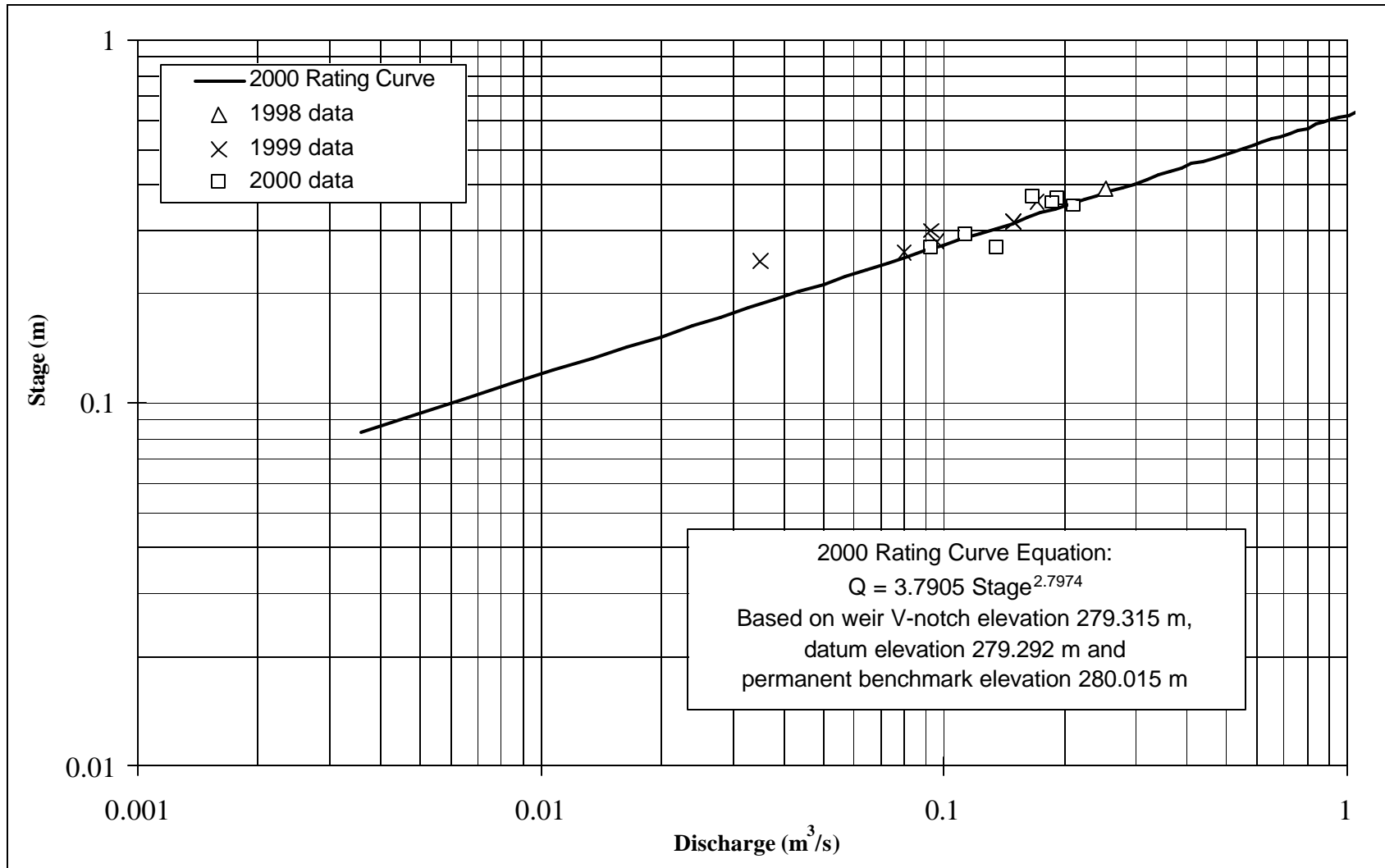


Figure V-2 Stage-Discharge Rating Curve at Jackpine Creek Station (S2)

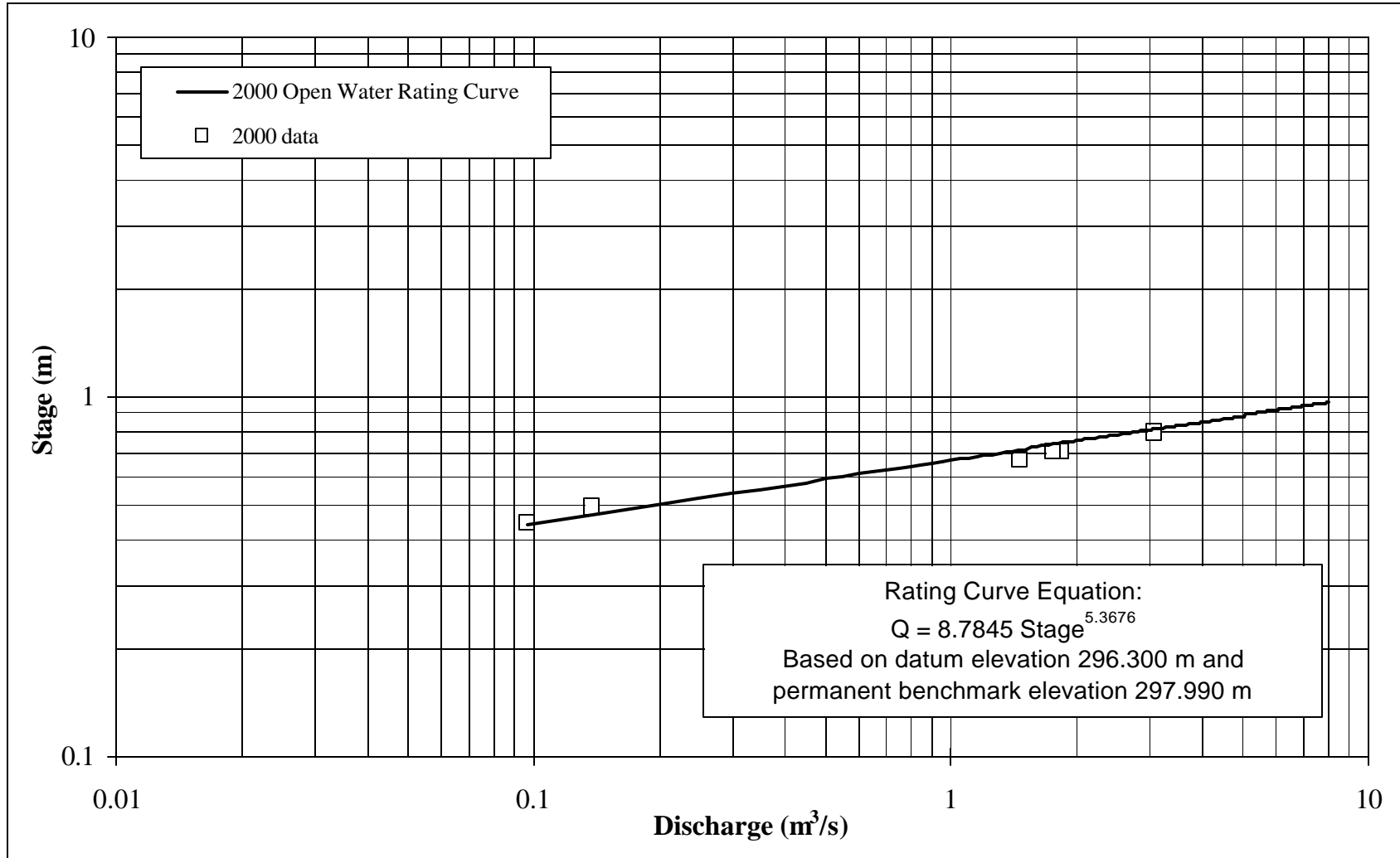


Figure V-3 Stage-Discharge Rating Curve at Iyininim Creek Station (S3)

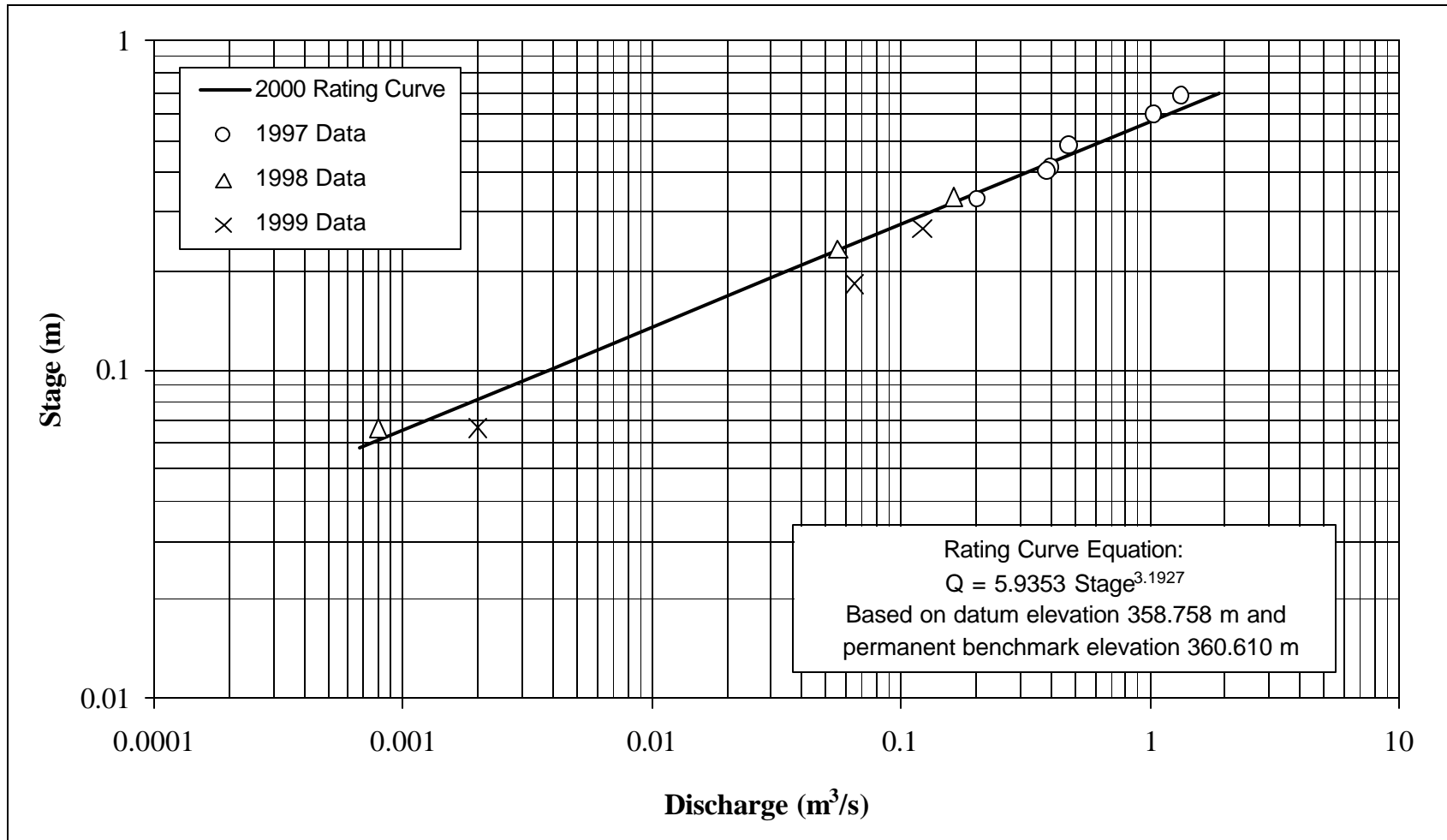


Figure V-4 Stage-Discharge Rating Curve at Blackfly Creek Station (S4)

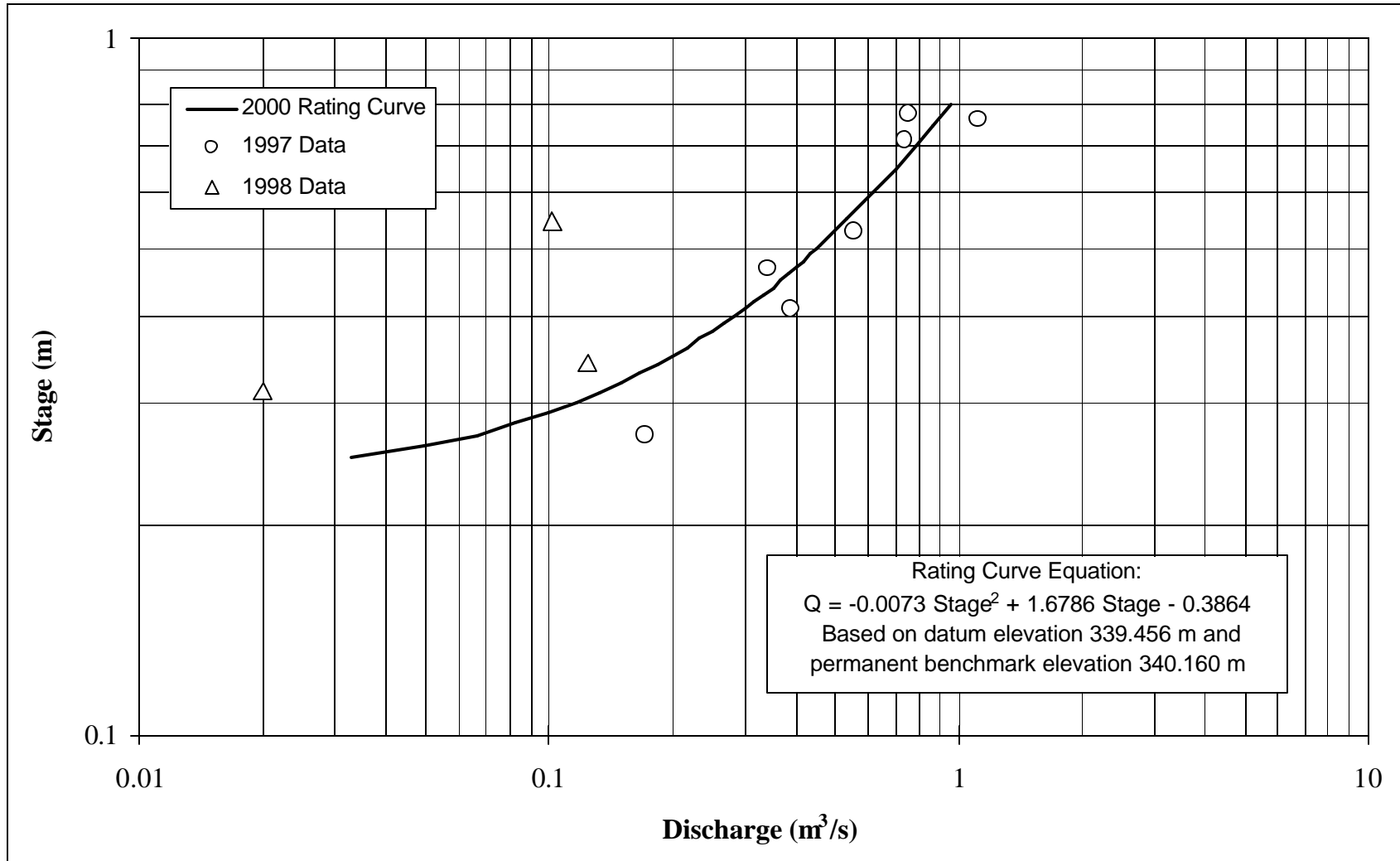


Figure V-5 Stage-Discharge Rating Curve at Muskeg River Aurora Station (S5A)

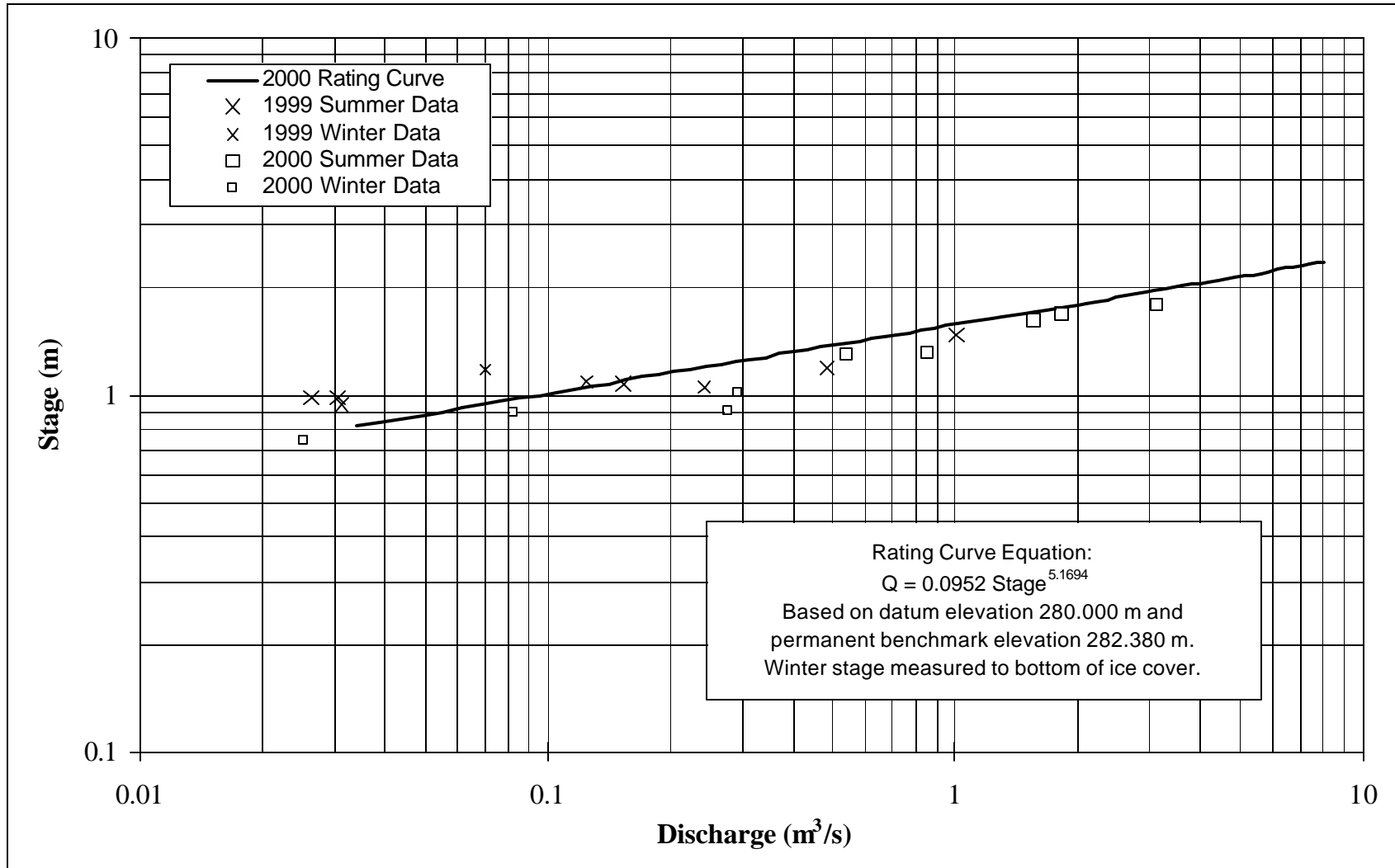


Figure V-6 Stage-Discharge Rating Curve at Mills Creek Station (S6)

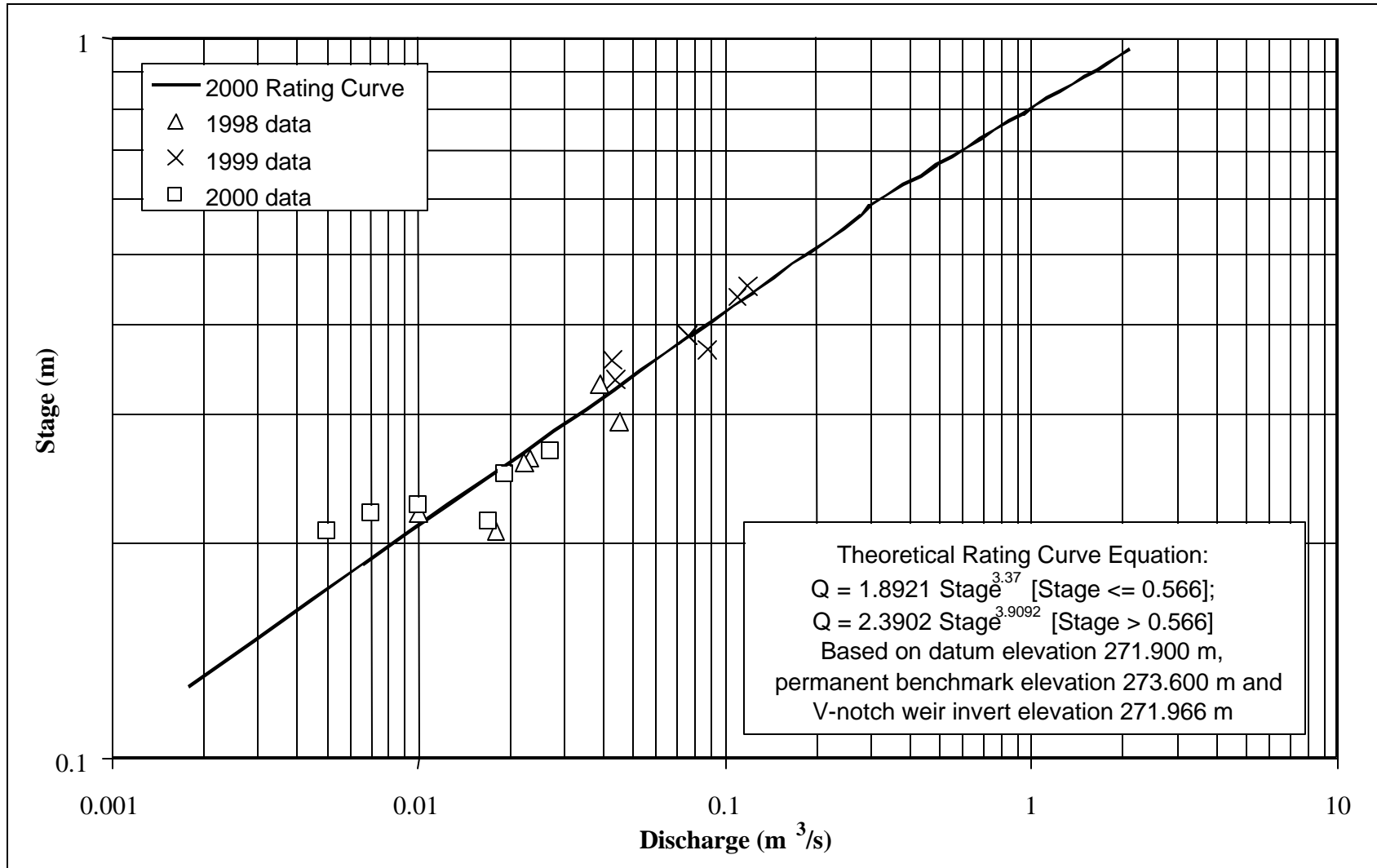




Figure V-7 Stage-Discharge Rating Curve at Muskeg River WSC Station (S7)

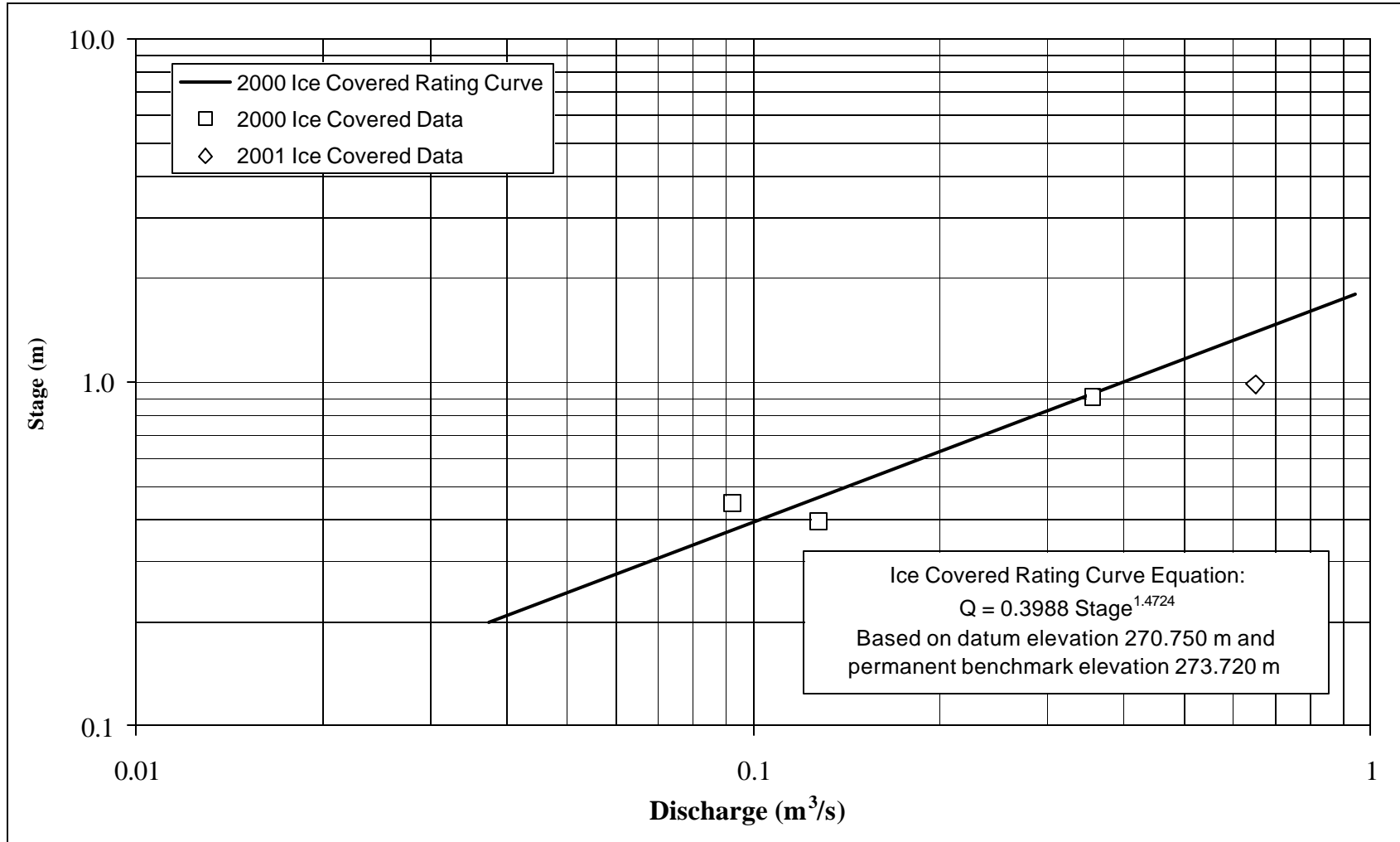


Figure V-8 Stage-Discharge Rating Curve at Kearl Lake Outlet Station (S9)

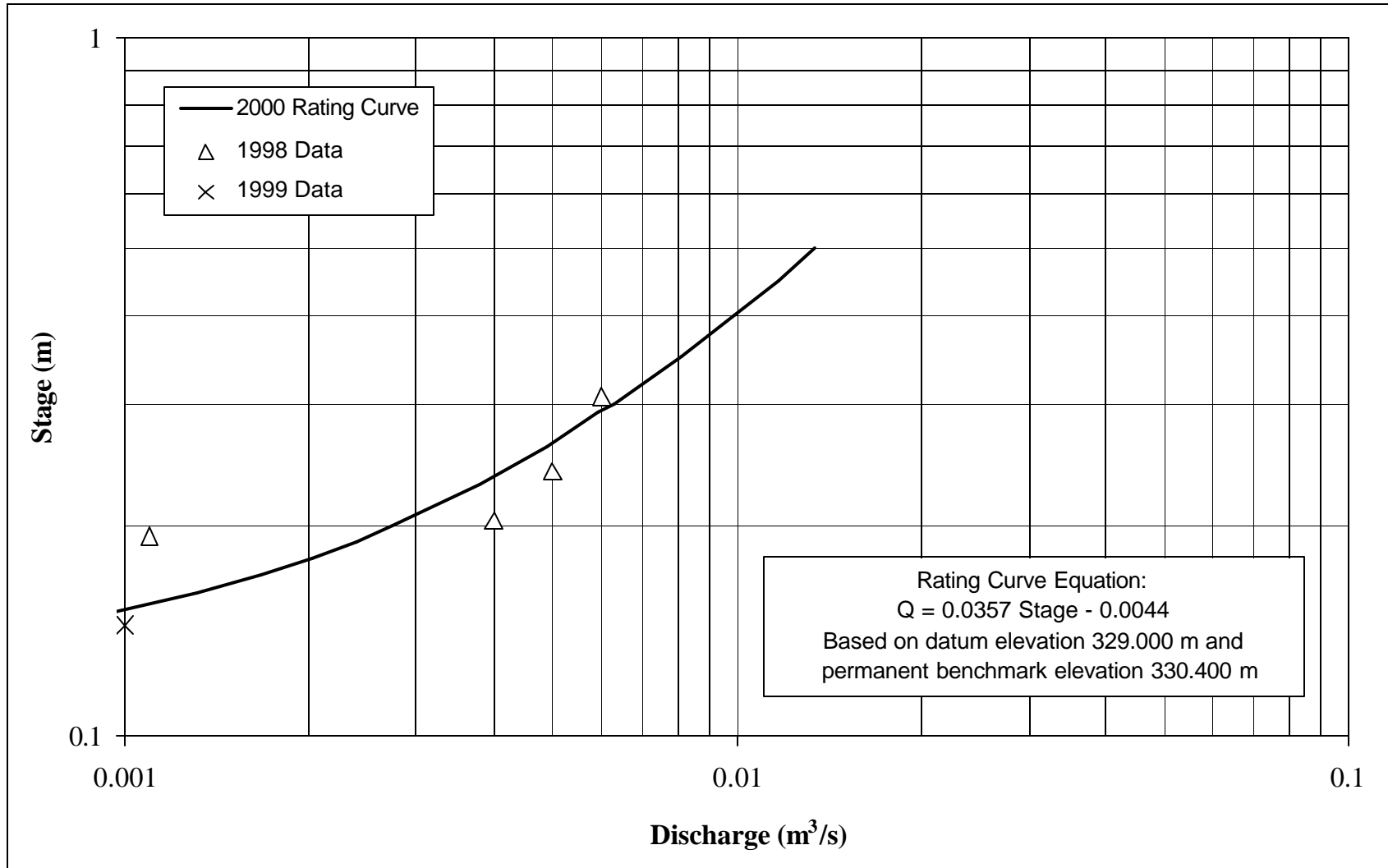


Figure V-9 Stage-Discharge Rating Curve at Wapasu Creek Station (S10)

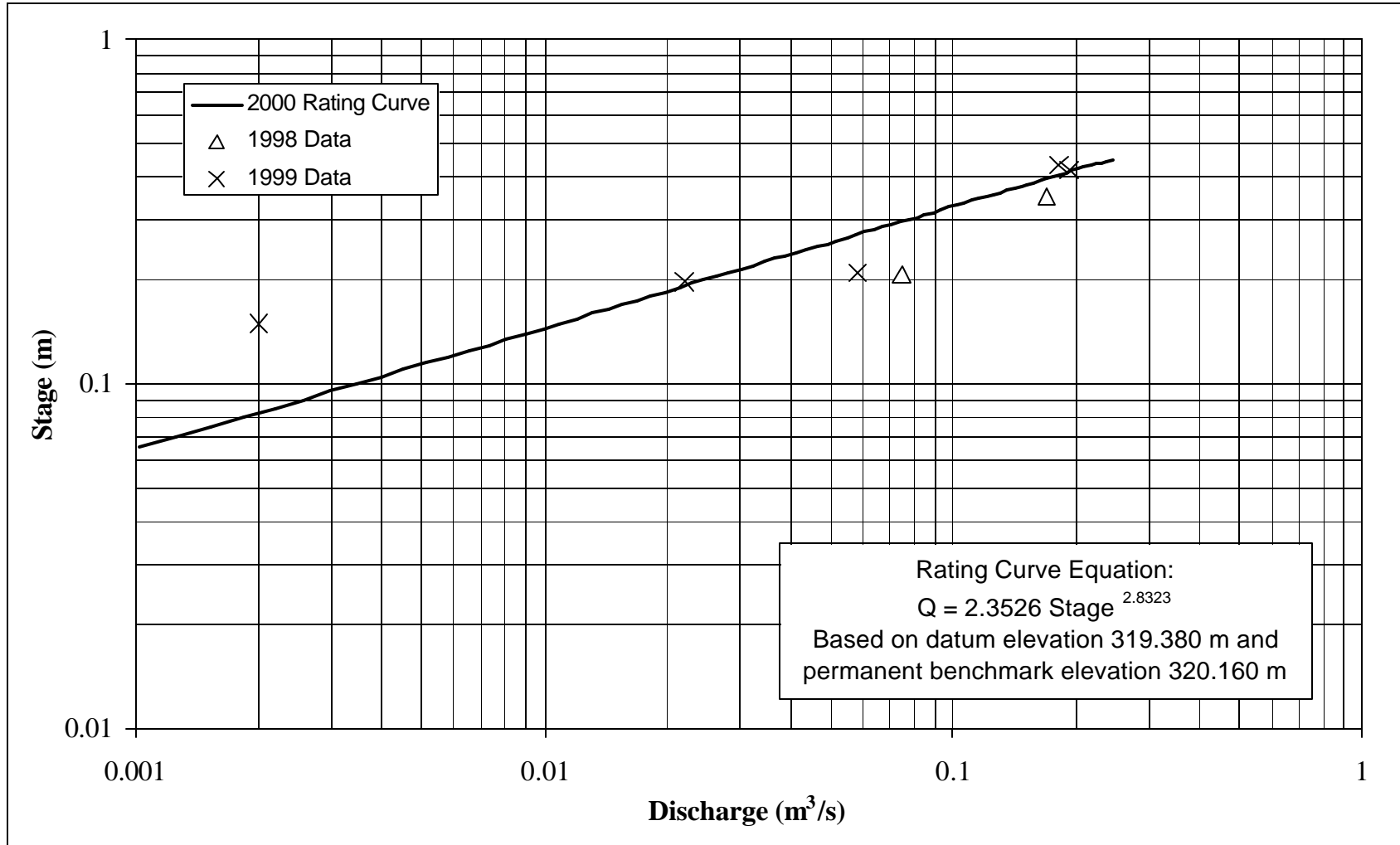


Figure V-10 Stage-Discharge Rating Curve at Poplar Creek Station (S11)

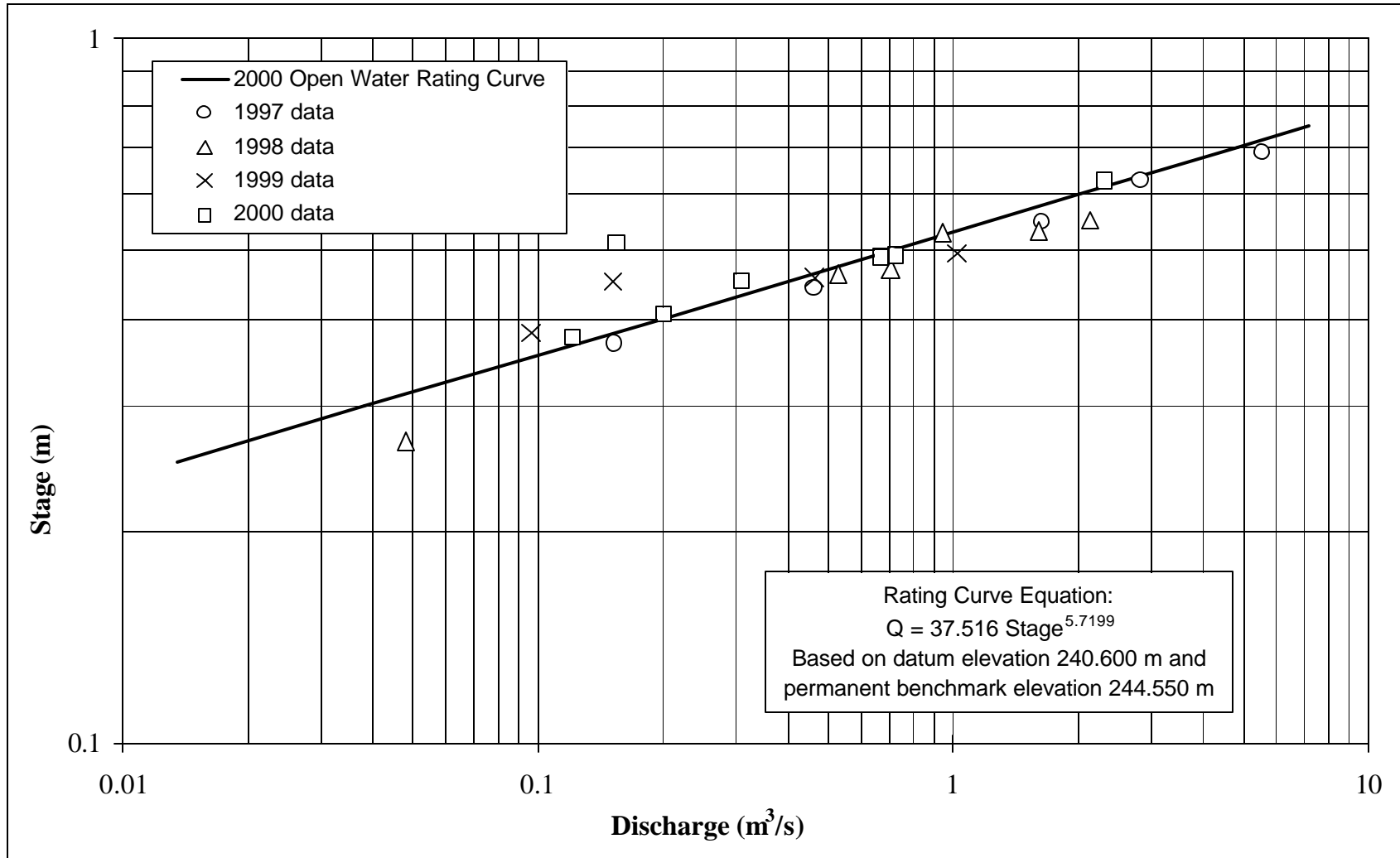


Figure V-11 Stage-Discharge Rating Curve at Fort Creek Station (S12)

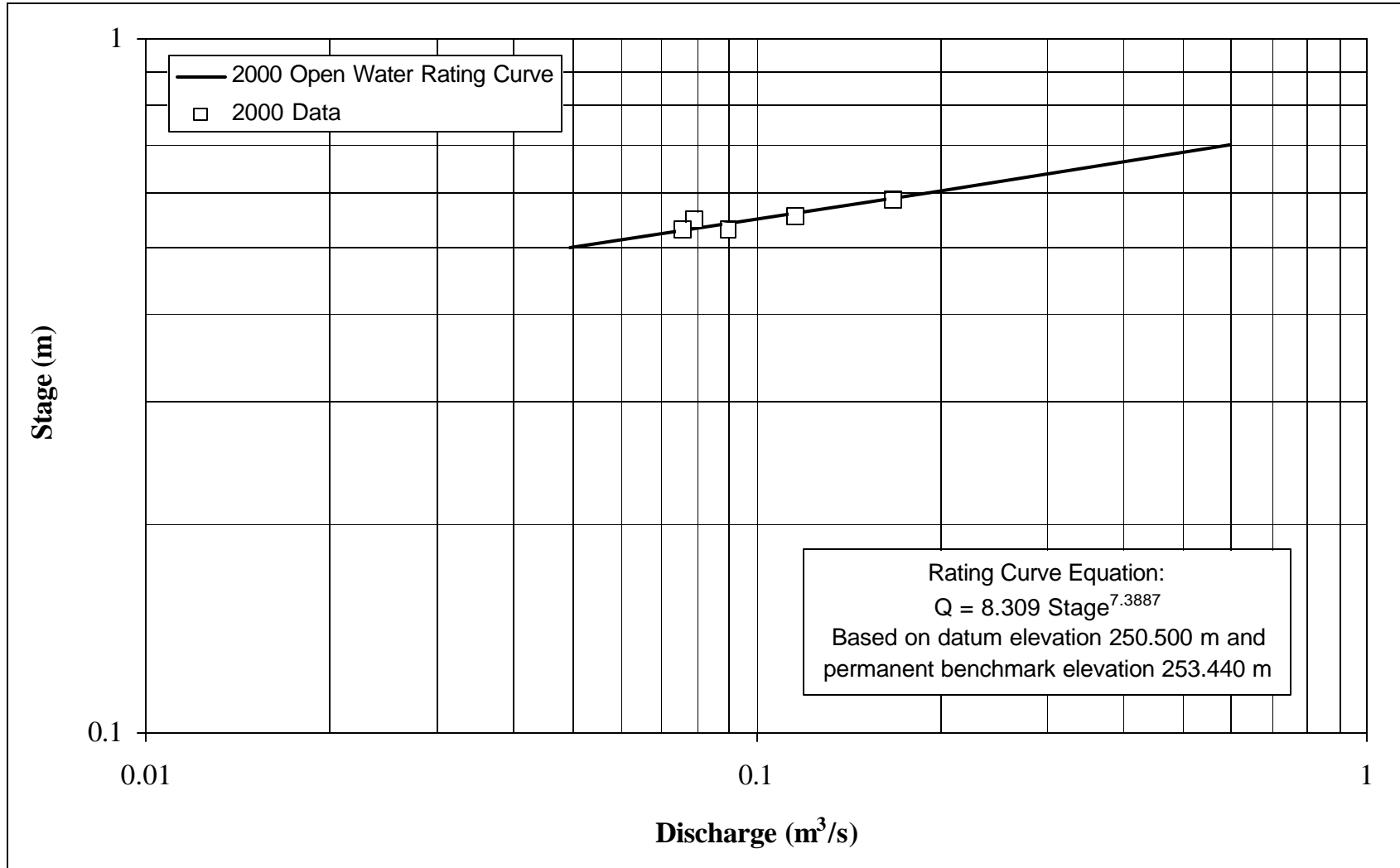


Figure V-12 Stage-Discharge Rating Curve at Albian Pond #3 Station (S13)

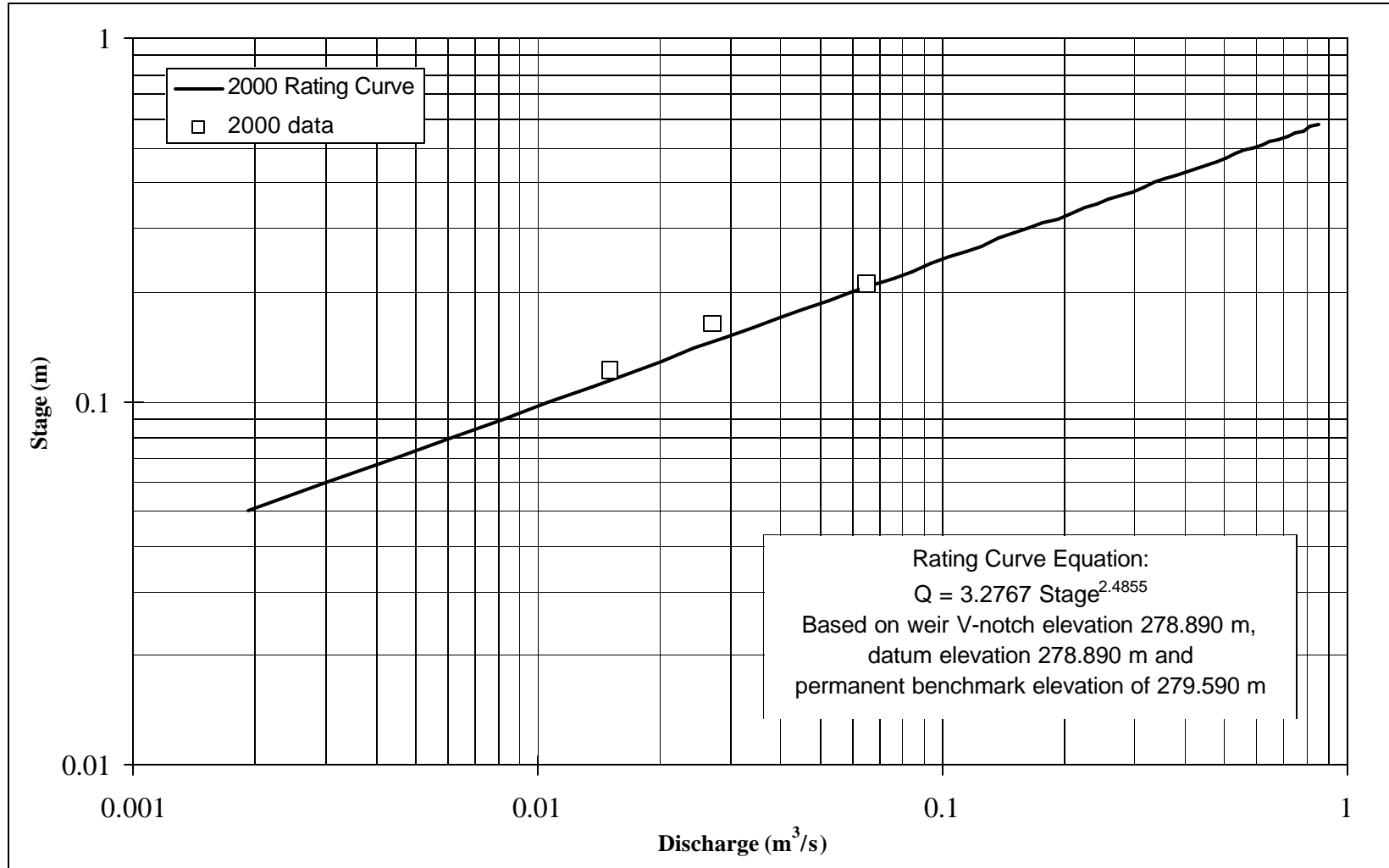
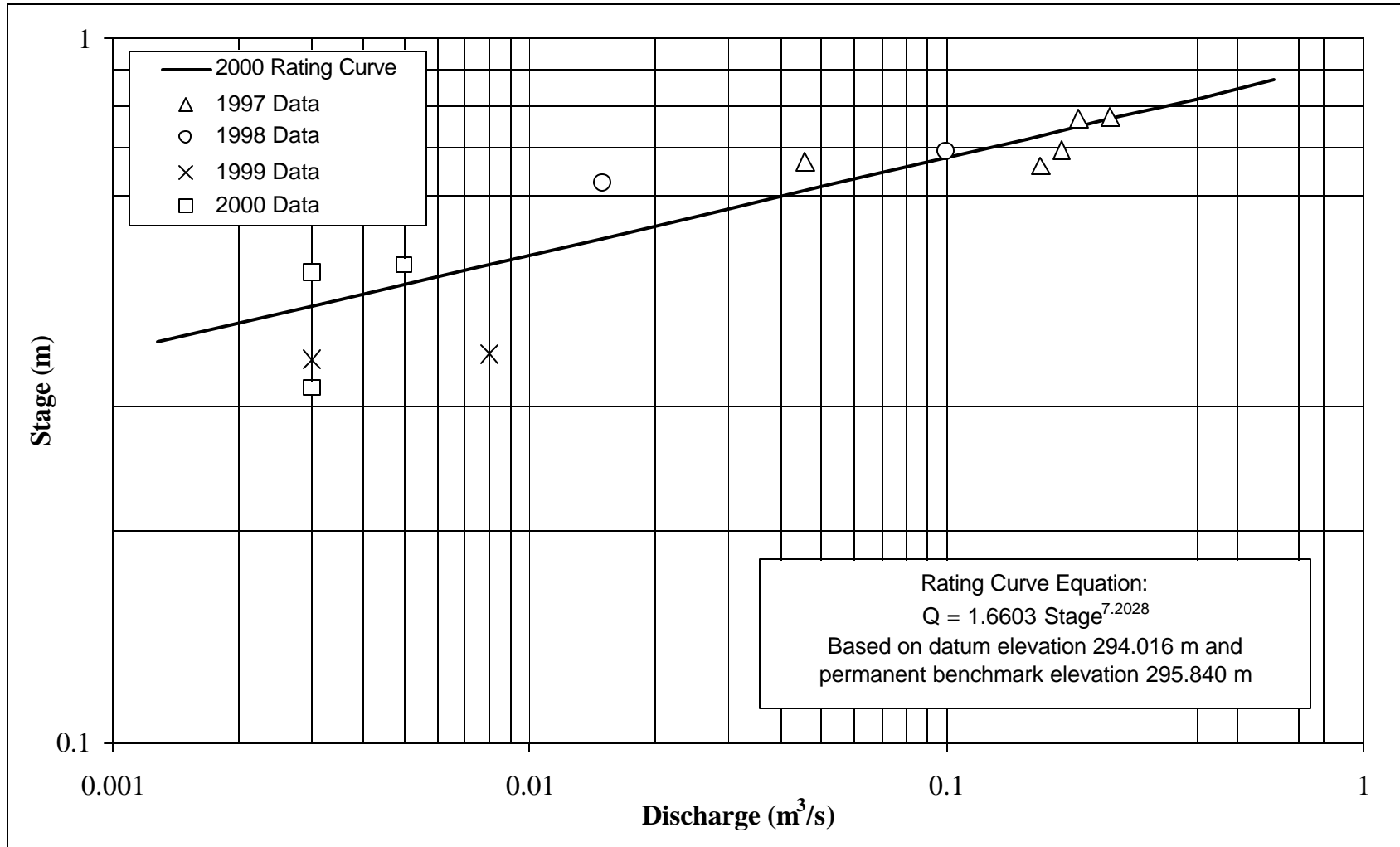


Figure V-13 Stage-Discharge Rating Curve at McClelland Lake Station (L1)



**APPENDIX VI**

**2000 RECORDED MEAN DAILY  
DISCHARGES AND WATER LEVELS  
AT HYDROMETRIC STATIONS**



**Table VI-1 S1 Alsands Drain Mean Daily Discharges (m<sup>3</sup>/s), 2000**

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	0.069	0.029	0.002	0.076	0.036	0.073	0.213	0.096	0.113	0.123	0.131	-
2	0.093	0.027	0.001	0.101	0.041	0.054	0.054	0.082	0.108	0.114	0.129	-
3	0.050	0.017	0.001	0.064	0.070	0.011	0.085	0.078	0.108	0.113	0.127	-
4	0.031	0.010	0.001	0.093	0.175	0.016	0.057	0.089	0.105	0.092	0.123	-
5	0.027	0.006	0.000	0.104	0.024	0.087	0.092	0.025	0.072	0.002	0.094	-
6	0.027	0.006	0.001	0.065	0.051	0.020	0.122	0.013	0.066	0.065	0.001	-
7	0.026	0.005	0.002	0.069	0.069	0.171	0.122	0.080	0.052	0.113	0.037	-
8	0.027	0.003	0.001	0.072	0.055	0.078	0.065	0.132	0.076	0.108	0.120 P	-
9	0.029	0.003	0.000	0.079	0.049	0.110	0.104	0.068	0.107	0.108	-	-
10	0.031	0.002	0.000	0.076	0.060	0.075	0.087	0.099	0.097	0.109	-	-
11	0.032	0.002	0.000	0.057	0.004	0.072	0.111	0.115	0.003	0.148	-	-
12	0.032	0.001	0.000	0.033	0.039	0.120	0.118	0.114	0.004	0.220	-	-
13	0.032	0.001	0.000	0.053	0.091	0.087	0.085	0.112	0.102	0.148	-	-
14	0.035	0.001	0.000	0.022	0.069	0.149	0.112	0.113	0.093	0.114	-	-
15	0.052	0.002	0.000	0.044	0.046	0.141	0.113	0.107	0.070	0.082	-	-
16	0.038	0.002	0.000	0.055	0.041	0.105	0.116	0.119	0.081	0.052	-	-
17	0.036	0.002	0.000	0.058	0.014	0.059	0.151	0.117	0.102	0.085	-	-
18	0.038	0.004	0.000	0.087	0.032	0.019	0.114	0.066	0.086	0.046	-	-
19	0.039	0.004	0.000	0.110	0.120	0.110	0.119	0.062	0.135	0.097	-	0.000
20	0.034	0.004	0.000	0.119	0.070	0.063	0.109	0.097	0.157	0.172	-	0.000
21	0.028	0.004	0.000	0.149	0.009	0.133	0.117	0.091	0.119	0.125	-	0.000
22	0.027	0.003	0.027	0.156	0.019	0.002	0.162	0.118	0.113	0.127	-	0.000
23	0.026	0.003	0.116	0.187	0.202	0.000	0.110	0.127	0.035	0.129	-	0.000
24	0.026	0.001	0.100	0.221	0.189	0.192	0.108	0.062	0.002	0.127	-	0.000
25	0.027	0.001	0.091	0.038	0.185	0.204	0.090	0.066	0.110	0.096	-	0.000
26	0.029	0.001	0.051	0.123	0.106	0.148	0.053	0.060	0.094	0.123	-	0.000
27	0.027	0.001	0.044	0.043	0.124	0.109	0.049	0.131	0.228	0.126	-	0.000
28	0.027	0.006	0.036	0.044	0.106	0.033	0.077	0.197	0.175	0.124	-	0.000
29	0.028	0.004	0.025	0.026	0.202	0.003	0.109	0.107	0.033	0.126	-	0.000
30	0.028	-	0.024	0.019	0.072	0.160	0.084	0.059	0.051	0.084	-	0.000
31	0.028	-	0.020	-	0.119	-	0.076	0.107	-	0.075	-	0.000
<b>min</b>	<b>0.026</b>	<b>0.001</b>	<b>0.000</b>	<b>0.019</b>	<b>0.004</b>	<b>0.000</b>	<b>0.049</b>	<b>0.013</b>	<b>0.002</b>	<b>0.002</b>	<b>0.001</b>	<b>0.000</b>
<b>mean</b>	<b>0.035</b>	<b>0.005</b>	<b>0.018</b>	<b>0.081</b>	<b>0.080</b>	<b>0.087</b>	<b>0.103</b>	<b>0.094</b>	<b>0.090</b>	<b>0.109</b>	<b>0.095</b>	<b>0.000</b>
<b>max</b>	<b>0.093</b>	<b>0.029</b>	<b>0.116</b>	<b>0.221</b>	<b>0.202</b>	<b>0.204</b>	<b>0.213</b>	<b>0.197</b>	<b>0.228</b>	<b>0.220</b>	<b>0.131</b>	<b>0.000</b>

Notes: P - partial daily average.

**Table VI-2 S1 Alsands Drain Mean Daily Water Levels (m) Based on Permanent Benchmark el. 280.015 m (geodetic), 2000**

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	279.530	279.467	279.344	279.504	279.414	279.474	279.635	279.552	279.530	279.546	279.592	-
2	279.555	279.463	279.345	279.565	279.427	279.463	279.464	279.523	279.504	279.578	279.591	-
3	279.505	279.438	279.334	279.470	279.476	279.382	279.486	279.517	279.508	279.577	279.589	-
4	279.470	279.410	279.333	279.534	279.617	279.398	279.453	279.541	279.511	279.541	279.585	-
5	279.464	279.393	279.328	279.565	279.383	279.498	279.486	279.429	279.503	279.355	279.548	-
6	279.462	279.392	279.336	279.472	279.433	279.413	279.507	279.406	279.490	279.479	279.352	-
7	279.461	279.387	279.359	279.496	279.452	279.573	279.510	279.516	279.471	279.576	279.421	-
8	279.463	279.369	279.340	279.513	279.451	279.460	279.461	279.589	279.493	279.572	279.583 P	-
9	279.467	279.367	279.332	279.524	279.439	279.486	279.500	279.499	279.512	279.572	-	-
10	279.471	279.359	279.314	279.505	279.458	279.472	279.493	279.536	279.495	279.573	-	-
11	279.473	279.351	279.199	279.489	279.360	279.471	279.508	279.522	279.367	279.602	-	-
12	279.474	279.344	279.187	279.433	279.412	279.509	279.515	279.513	279.376	279.653	-	-
13	279.474	279.342	279.161	279.472	279.495	279.466	279.510	279.512	279.516	279.601	-	-
14	279.479	279.342	279.158	279.411	279.466	279.561	279.576	279.518	279.510	279.577	-	-
15	279.508	279.353	279.150	279.462	279.430	279.578	279.577	279.512	279.501	279.520	-	-
16	279.484	279.362	279.134	279.474	279.415	279.529	279.579	279.539	279.514	279.461	-	-
17	279.482	279.361	279.114	279.516	279.375	279.468	279.602	279.535	279.553	279.518	-	-
18	279.485	279.377	279.145	279.545	279.398	279.409	279.577	279.500	279.524	279.451	-	-
19	279.485	279.376	279.190	279.558	279.540	279.502	279.580	279.483	279.594	279.501	-	279.161 P
20	279.476	279.381	279.219	279.581	279.472	279.448	279.572	279.505	279.609	279.619	-	279.141
21	279.466	279.378	279.239	279.602	279.371	279.521	279.577	279.503	279.582	279.587	-	279.111
22	279.463	279.368	279.358	279.580	279.392	279.190	279.610	279.548	279.574	279.589	-	279.083
23	279.460	279.367	279.569	279.599	279.593	278.871	279.572	279.559	279.437	279.590	-	279.051
24	279.461	279.350	279.564	279.654	279.602	279.402	279.567	279.481	279.362	279.587	-	279.021
25	279.463	279.342	279.556	279.408	279.591	279.591	279.542	279.492	279.511	279.539	-	278.995
26	279.467	279.333	279.483	279.517	279.495	279.530	279.472	279.474	279.488	279.586	-	278.972
27	279.463	279.341	279.475	279.055	279.500	279.513	279.467	279.557	279.658	279.588	-	278.955
28	279.463	279.389	279.439	279.344	279.484	279.398	279.517	279.639	279.610	279.586	-	278.939
29	279.464	279.376	279.378	279.388	279.594	279.340	279.570	279.544	279.430	279.588	-	278.924
30	279.466	-	279.386	279.368	279.484	279.554	279.536	279.471	279.461	279.517	-	278.909
31	279.466	-	279.348	-	279.538	-	279.527	279.538	-	279.493	-	278.900
<b>min</b>	<b>279.460</b>	<b>279.333</b>	<b>279.114</b>	<b>279.055</b>	<b>279.360</b>	<b>278.871</b>	<b>279.453</b>	<b>279.406</b>	<b>279.362</b>	<b>279.355</b>	<b>279.352</b>	<b>278.900</b>
<b>mean</b>	<b>279.476</b>	<b>279.375</b>	<b>279.317</b>	<b>279.487</b>	<b>279.470</b>	<b>279.449</b>	<b>279.534</b>	<b>279.518</b>	<b>279.506</b>	<b>279.552</b>	<b>279.533</b>	<b>279.012</b>
<b>max</b>	<b>279.555</b>	<b>279.467</b>	<b>279.569</b>	<b>279.654</b>	<b>279.617</b>	<b>279.591</b>	<b>279.635</b>	<b>279.639</b>	<b>279.658</b>	<b>279.653</b>	<b>279.592</b>	<b>279.161</b>

Notes: P - partial daily average.

**Table VI-3 S2 Jackpine Creek Mean Daily Discharges (m<sup>3</sup>/s), 2000**

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	0.243	0.719	5.038	1.314	3.902	2.935	1.067	-
2	-	-	-	-	0.251	0.688	3.979	1.141	4.193	2.907	1.149	-
3	-	-	-	-	0.249	0.659	3.078	1.094	4.341	2.778	1.606	-
4	-	-	-	-	0.255	0.663	2.712	1.067	3.911	2.552	1.383	-
5	-	-	-	-	0.279	0.640	2.404	0.996	3.443	2.370	1.174 P	-
6	-	-	-	-	0.278	0.610	2.512	0.896	3.434	2.383	-	-
7	-	-	-	-	0.265	0.677	2.472	0.864	3.538	1.998	-	-
8	-	-	-	-	0.259	0.879	2.213	0.777	3.394	1.928	-	-
9	-	-	-	-	0.248	0.898	1.925	0.693	3.150	1.849	-	-
10	-	-	-	-	0.252	0.920	1.590	0.659	2.982	1.791	-	-
11	-	-	-	-	0.267	1.069	1.365	0.649	2.817	1.733	-	-
12	-	-	-	-	0.268	1.124	1.195	0.687	2.611	1.641	-	-
13	-	-	-	-	0.265	1.064	1.024	0.703	2.382	1.578	-	-
14	-	-	-	-	0.250	0.967	0.987	1.166	2.156	1.541	-	-
15	-	-	-	-	0.254	0.902	1.052	1.682	1.958	1.473	-	-
16	-	-	-	-	0.225	0.891	1.339	1.570	1.724	1.427	-	-
17	-	-	-	-	0.237	0.850	1.453	1.379	1.583	1.354	-	-
18	-	-	-	-	0.237	0.823	1.470	1.178	1.650	1.310	-	-
19	-	-	-	-	0.240	0.814	1.352	1.053	2.499	1.304	-	-
20	-	-	-	0.116 P	0.229	1.713	1.210	0.938	3.170	1.323	-	-
21	-	-	-	0.149	0.216	3.072	1.073	0.832	3.350	1.315	-	-
22	-	-	-	0.150	0.231	5.521	0.916	0.754	3.123	1.300	-	-
23	-	-	-	0.192	0.392	7.526	0.790	0.692	2.893	1.272	-	-
24	-	-	-	0.299	0.745	10.813	0.692	0.617	2.761	1.242	-	-
25	-	-	-	0.229	1.029	12.725	0.598	0.573	2.831	1.219	-	-
26	-	-	-	0.236	1.074	11.942	0.559	0.765	2.898	1.193	-	-
27	-	-	-	0.240	1.090	10.483	1.187	1.585	2.914	1.121	-	-
28	-	-	-	0.240	1.007	8.889	2.418	2.698	2.797	1.109	-	-
29	-	-	-	0.234	0.908	7.205	2.488	3.339	2.628	1.095	-	-
30	-	-	-	0.233	0.811	6.033	1.990	3.666	2.624	1.090	-	-
31	-	-	-	-	0.761	-	1.587	3.870	-	1.082	-	-
<b>min</b>	-	-	-	<b>0.116</b>	<b>0.216</b>	<b>0.610</b>	<b>0.559</b>	<b>0.573</b>	<b>1.583</b>	<b>1.082</b>	<b>1.067</b>	-
<b>mean</b>	-	-	-	<b>0.211</b>	<b>0.430</b>	<b>3.393</b>	<b>1.764</b>	<b>1.287</b>	<b>2.922</b>	<b>1.652</b>	<b>1.276</b>	-
<b>max</b>	-	-	-	<b>0.299</b>	<b>1.090</b>	<b>12.725</b>	<b>5.038</b>	<b>3.870</b>	<b>4.341</b>	<b>2.935</b>	<b>1.606</b>	-

Notes: P – partial daily average.

**Table VI-4 S2 Jackpine Creek Mean Daily Water Levels (m) Based on Permanent Benchmark el. 297.990 m (geodetic), 2000**

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	296.812	296.927	297.201	297.002	297.160	297.115	296.974	-
2	-	-	-	-	296.816	296.922	297.162	296.984	297.171	297.114	296.980	-
3	-	-	-	-	296.815	296.917	297.122	296.978	297.177	297.107	297.024	-
4	-	-	-	-	296.817	296.918	297.103	296.975	297.160	297.094	297.007	-
5	-	-	-	-	296.826	296.914	297.085	296.967	297.140	297.083	296.987 P	-
6	-	-	-	-	296.826	296.908	297.092	296.954	297.139	297.084	-	-
7	-	-	-	-	296.821	296.920	297.090	296.949	297.144	297.059	-	-
8	-	-	-	-	296.819	296.951	297.073	296.936	297.138	297.054	-	-
9	-	-	-	-	296.814	296.954	297.052	296.923	297.126	297.048	-	-
10	-	-	-	-	296.816	296.957	297.027	296.917	297.118	297.044	-	-
11	-	-	-	-	296.822	296.975	297.007	296.915	297.109	297.039	-	-
12	-	-	-	-	296.822	296.982	296.989	296.922	297.098	297.032	-	-
13	-	-	-	-	296.821	296.975	296.970	296.925	297.084	297.026	-	-
14	-	-	-	-	296.815	296.963	296.965	296.983	297.070	297.023	-	-
15	-	-	-	-	296.817	296.954	296.973	297.035	297.056	297.017	-	-
16	-	-	-	-	296.805	296.953	297.004	297.026	297.038	297.013	-	-
17	-	-	-	-	296.810	296.947	297.015	297.008	297.027	297.006	-	-
18	-	-	-	-	296.810	296.943	297.017	296.988	297.032	297.002	-	-
19	-	-	-	-	296.811	296.942	297.005	296.973	297.090	297.001	-	-
20	-	-	-	296.746 P	296.807	297.031	296.991	296.959	297.127	297.003	-	-
21	-	-	-	296.765	296.801	297.121	296.976	296.945	297.136	297.002	-	-
22	-	-	-	296.768	296.808	297.216	296.956	296.933	297.125	297.000	-	-
23	-	-	-	296.790	296.857	297.271	296.938	296.923	297.113	296.998	-	-
24	-	-	-	296.828	296.931	297.339	296.923	296.910	297.106	296.995	-	-
25	-	-	-	296.807	296.971	297.371	296.906	296.901	297.110	296.992	-	-
26	-	-	-	296.810	296.976	297.359	296.898	296.933	297.113	296.989	-	-
27	-	-	-	296.811	296.978	297.333	296.986	297.025	297.114	296.981	-	-
28	-	-	-	296.811	296.968	297.302	297.086	297.102	297.108	296.980	-	-
29	-	-	-	296.809	296.955	297.263	297.090	297.135	297.099	296.978	-	-
30	-	-	-	296.809	296.942	297.232	297.058	297.150	297.098	296.978	-	-
31	-	-	-	-	296.934	-	297.027	297.158	-	296.977	-	-
<b>min</b>	-	-	-	<b>296.746</b>	<b>296.801</b>	<b>296.908</b>	<b>296.898</b>	<b>296.901</b>	<b>297.027</b>	<b>296.977</b>	<b>296.974</b>	-
<b>mean</b>	-	-	-	<b>296.796</b>	<b>296.853</b>	<b>297.059</b>	<b>297.025</b>	<b>296.982</b>	<b>297.111</b>	<b>297.027</b>	<b>296.994</b>	-
<b>max</b>	-	-	-	<b>296.828</b>	<b>296.978</b>	<b>297.371</b>	<b>297.201</b>	<b>297.158</b>	<b>297.177</b>	<b>297.115</b>	<b>297.024</b>	-

Notes: P – partial daily average.

**Table VI-5 S5A Muskeg River Aurora Mean Daily Discharges (m<sup>3</sup>/s), 2000**

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	0.110 B	0.034 B	0.026 B	0.506 B	0.370	6.813	11.449	0.866	1.076	2.864	0.671	0.071 B
2	0.108 B	0.029 B	0.030 B	0.742 B	0.346	6.171	10.794	0.739	1.221	2.870	0.678	0.070 B
3	0.106 B	0.028 B	0.033 B	0.605 B	0.335	5.444	10.272	0.697	1.270	2.662	0.845 B	0.067 B
4	0.102 B	0.028 B	0.033 B	0.588 B	0.348	4.566	9.539	0.653	1.174	2.446	0.488 B	0.063 B
5	0.097 B	0.029 B	0.031 B	0.601 B	0.477	3.635	8.648	0.623	1.107	2.277	0.547 B	0.063 B
6	0.091 B	0.027 B	0.031 B	0.477 B	0.465	2.649	7.778	0.571	1.221	2.015	0.365 B	0.062 B
7	0.090 B	0.029 B	0.031 B	0.405 B	0.451	2.275	7.004	0.565	1.352	1.815	0.290 B	0.059 B
8	0.086 B	0.025 B	0.033 B	0.377 B	0.457	2.421	6.237	0.479	1.264	1.777	0.246 B	0.056 B
9	0.083 BP	0.025 B	0.039 B	0.347	0.454	2.385	5.286	0.419	1.296	1.729	0.213 B	0.051 B
10	0.055 BP	0.025 B	0.037 B	0.314	0.440	2.278	4.460	0.405	1.535	1.677	0.180 B	0.048 B
11	0.052 B	0.025 B	0.041 B	0.289	0.424	2.372	3.942	0.375	1.472	1.633	0.167 B	0.047 B
12	0.049 B	0.023 B	0.049 B	0.274	0.406	2.351	3.287	0.396	1.441	1.549	0.156 B	0.046 B
13	0.047 B	0.024 B	0.048 B	0.248	0.405	2.138	2.626	0.422	1.390	1.403	0.148 B	0.046 B
14	0.046 B	0.022 B	0.054 B	0.219	0.405	1.951	2.186	0.408	1.303	1.322	0.141 B	0.046 B
15	0.044 B	0.019 B	0.059 B	0.206	0.398	1.811	2.051	0.378	1.213	1.254	0.131 B	0.044 B
16	0.043 B	0.021 B	0.072 B	0.205	0.405	1.669	2.115	0.365	1.088	1.181	0.121 B	0.047 B
17	0.040 B	0.022 B	0.093 B	0.213	0.393	1.475	1.880	0.387	1.004	1.110	0.115 B	0.052 B
18	0.038 B	0.022 B	0.083 B	0.230	0.390	1.315	1.747	0.374	1.188	1.037	0.115 B	0.050 B
19	0.038 B	0.021 B	0.079 B	0.282	0.396	1.424	1.661	0.361	1.814	1.022	0.110 B	0.053 BP
20	0.040 B	0.021 B	0.069 B	0.374	0.398	3.039	1.416	0.355	1.998	1.008	0.106 B	0.046 B
21	0.040 B	0.021 B	0.079 B	0.438	0.419	6.233	1.244	0.336	1.976	0.977	0.100 B	0.048 B
22	0.037 B	0.020 B	0.079 B	0.508	0.428	8.606	1.056	0.313	1.886	0.950	0.099 B	0.040 B
23	0.038 B	0.022 B	0.099 B	0.584	0.803	10.011	0.876	0.286	1.864	0.925	0.097 B	0.039 B
24	0.036 B	0.024 B	0.105 B	0.503	2.278	11.804	0.725	0.257	1.871	0.925	0.094 B	0.039 B
25	0.036 B	0.026 B	0.114 B	0.478	3.444	14.080	0.602	0.227	2.079	0.949	0.091 B	0.038 B
26	0.035 B	0.026 B	0.128 B	0.480	4.331	15.042	0.537	0.324	2.438	0.835	0.087 B	0.042 B
27	0.034 B	0.023 B	0.146 B	0.484	5.212	14.757	0.826	0.816	2.567	0.779	0.084 B	0.040 B
28	0.035 B	0.025 B	0.185 B	0.449	6.345	14.056	1.179	1.021	2.627	0.784	0.079 B	0.037 B
29	0.034 B	0.024 B	0.262 B	0.427	7.427	13.164	1.575	1.050	2.571	0.833	0.075 B	0.037 B
30	0.033 B	-	0.327 B	0.409	7.667	12.341	1.382	1.045	2.561	0.813	0.073 B	0.035 B
31	0.035 B	-	0.353 B	-	7.317	-	1.075	1.060	-	0.742	0.071 B	0.035 B
<b>min</b>	<b>0.033</b>	<b>0.019</b>	<b>0.026</b>	<b>0.205</b>	<b>0.335</b>	<b>1.315</b>	<b>0.537</b>	<b>0.227</b>	<b>1.004</b>	<b>0.742</b>	<b>0.071</b>	<b>0.035</b>
<b>mean</b>	<b>0.057</b>	<b>0.024</b>	<b>0.092</b>	<b>0.409</b>	<b>1.737</b>	<b>5.942</b>	<b>3.724</b>	<b>0.535</b>	<b>1.629</b>	<b>1.425</b>	<b>0.219</b>	<b>0.049</b>
<b>max</b>	<b>0.110</b>	<b>0.034</b>	<b>0.353</b>	<b>0.742</b>	<b>7.667</b>	<b>15.042</b>	<b>11.449</b>	<b>1.060</b>	<b>2.627</b>	<b>2.870</b>	<b>0.845</b>	<b>0.071</b>

Notes: P – partial daily average.  
B – ice effects.

**Table VI-6 S5A Muskeg River Aurora Mean Daily Water Levels (m) Based on Permanent Benchmark el. 282.380 m (geodetic), 2000**

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	281.184 B	281.149 B	281.102 B	281.429 B	281.300	282.284	282.526	281.533	281.599	281.932	281.459	281.160 B
2	281.183 B	281.129 B	281.111 B	281.523 B	281.283	282.241	282.497	281.486	281.638	281.933	281.461	281.160 B
3	281.181 B	281.127 B	281.117 B	281.461 B	281.275	282.187	282.473	281.470	281.651	281.905	281.535 B	281.155 B
4	281.186 B	281.132 B	281.112 B	281.445 B	281.285	282.114	282.438	281.451	281.626	281.874	281.410 B	281.147 B
5	281.187 B	281.137 B	281.090 B	281.439 B	281.366	282.022	282.392	281.438	281.607	281.848	281.457 B	281.149 B
6	281.187 B	281.131 B	281.081 B	281.365 B	281.359	281.902	282.344	281.414	281.637	281.805	281.372 B	281.151 B
7	281.197 B	281.146 B	281.073 B	281.323 B	281.351	281.848	282.297	281.411	281.671	281.769	281.335 B	281.143 B
8	281.201 B	281.130 B	281.075 B	281.305 B	281.355	281.870	282.245	281.367	281.649	281.761	281.315 B	281.137 B
9	281.203 BP	281.131 B	281.092 B	281.284	281.353	281.865	282.174	281.332	281.657	281.752	281.301 B	281.124 B
10	281.150 BP	281.135 B	281.077 B	281.259	281.345	281.848	282.104	281.323	281.712	281.742	281.280 B	281.120 B
11	281.146 B	281.138 B	281.084 B	281.240	281.335	281.863	282.055	281.304	281.698	281.733	281.268 B	281.118 B
12	281.143 B	281.130 B	281.104 B	281.227	281.324	281.859	281.983	281.317	281.692	281.715	281.257 B	281.118 B
13	281.138 B	281.140 B	281.093 B	281.203	281.323	281.825	281.899	281.334	281.680	281.683	281.248 B	281.121 B
14	281.138 B	281.128 B	281.104 B	281.175	281.323	281.794	281.833	281.325	281.659	281.664	281.242 B	281.123 B
15	281.134 B	281.109 B	281.111 B	281.161	281.319	281.768	281.811	281.306	281.636	281.647	281.230 B	281.117 B
16	281.134 B	281.130 B	281.136 B	281.160	281.323	281.740	281.822	281.297	281.602	281.628	281.216 B	281.132 B
17	281.124 B	281.141 B	281.177 B	281.169	281.316	281.699	281.780	281.311	281.577	281.608	281.209 B	281.154 B
18	281.123 B	281.143 B	281.145 B	281.186	281.314	281.662	281.756	281.303	281.628	281.587	281.212 B	281.150 B
19	281.126 B	281.140 B	281.129 B	281.234	281.318	281.687	281.738	281.294	281.768	281.583	281.206 B	281.163 B
20	281.137 B	281.142 B	281.093 B	281.303	281.319	281.935	281.686	281.290	281.802	281.578	281.201 B	281.138 B
21	281.137 B	281.144 B	281.110 B	281.343	281.332	282.243	281.644	281.276	281.798	281.569	281.194 B	281.146 B
22	281.131 B	281.134 B	281.102 B	281.382	281.338	282.389	281.593	281.259	281.782	281.561	281.194 B	281.116 B
23	281.138 B	281.136 B	281.135 B	281.419	281.490	282.461	281.536	281.237	281.778	281.553	281.193 B	281.112 B
24	281.130 B	281.140 B	281.138 B	281.380	281.843	282.540	281.481	281.212	281.779	281.552	281.191 B	281.111 B
25	281.136 B	281.142 B	281.146 B	281.366	282.001	282.629	281.428	281.182	281.815	281.560	281.188 B	281.108 B
26	281.136 B	281.132 B	281.159 B	281.368	282.092	282.663	281.397	281.264	281.872	281.522	281.183 B	281.126 B
27	281.132 B	281.107 B	281.179 B	281.370	282.169	282.653	281.517	281.503	281.891	281.502	281.177 B	281.116 B
28	281.140 B	281.111 B	281.221 B	281.350	282.253	282.628	281.624	281.582	281.900	281.504	281.169 B	281.104 B
29	281.141 B	281.094 B	281.292 B	281.337	282.323	282.595	281.721	281.591	281.892	281.521	281.164 B	281.104 B
30	281.141 B	-	281.336 B	281.326	282.337	282.563	281.677	281.589	281.891	281.514	281.161 B	281.098 B
31	281.151 B	-	281.346 B	-	282.316	-	281.598	281.594	-	281.488	-	281.098 B
<b>min</b>	<b>281.123</b>	<b>281.094</b>	<b>281.073</b>	<b>281.160</b>	<b>281.275</b>	<b>281.662</b>	<b>281.397</b>	<b>281.182</b>	<b>281.577</b>	<b>281.488</b>	<b>281.161</b>	<b>281.098</b>
<b>mean</b>	<b>281.152</b>	<b>281.132</b>	<b>281.138</b>	<b>281.318</b>	<b>281.548</b>	<b>282.113</b>	<b>281.905</b>	<b>281.374</b>	<b>281.720</b>	<b>281.664</b>	<b>281.268</b>	<b>281.130</b>
<b>max</b>	<b>281.203</b>	<b>281.149</b>	<b>281.346</b>	<b>281.523</b>	<b>282.337</b>	<b>282.663</b>	<b>282.526</b>	<b>281.594</b>	<b>281.900</b>	<b>281.933</b>	<b>281.535</b>	<b>281.163</b>

Notes: P - partial daily average.  
B - ice effects.

**Table VI-7 S6 Mills Creek Mean Daily Discharges (m<sup>3</sup>/s), 2000**

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	0.012	0.018	0.013	0.008	0.012	0.058	0.031	-
2	-	-	-	0.020 P	0.011	0.016	0.012	0.009	0.012	0.048	0.029	-
3	-	-	-	0.016	0.011	0.016	0.011	0.009	0.011	0.043	0.028	-
4	-	-	-	0.015	0.020	0.015	0.012	0.008	0.010	0.045	0.028	-
5	-	-	-	0.014	0.023	0.014	0.016	0.008	0.010	0.048	0.028	-
6	-	-	-	0.012	0.018	0.014	0.016	0.009	0.013	0.046	0.027	-
7	-	-	-	0.011	0.016	0.021	0.014	0.008	0.011	0.047	0.026	-
8	-	-	-	0.010	0.016	0.021	0.012	0.008	0.011	0.049	0.026	-
9	-	-	-	0.010	0.014	0.018	0.011	0.008	0.011	0.050	0.023	-
10	-	-	-	0.009	0.014	0.023	0.021	0.009	0.011	0.054	0.022 P	-
11	-	-	-	0.009	0.013	0.024	0.022	0.009	0.010	0.055	-	-
12	-	-	-	0.009	0.012	0.021	0.017	0.010	0.010	0.054	-	-
13	-	-	-	0.009	0.013	0.019	0.015	0.012	0.010	0.054	-	-
14	-	-	-	0.013	0.013	0.017	0.019	0.013	0.010	0.054	-	-
15	-	-	-	0.015	0.013	0.016	0.020	0.011	0.009	0.051	-	-
16	-	-	-	0.008	0.012	0.015	0.020	0.010	0.009	0.049	-	-
17	-	-	-	0.008	0.012	0.013	0.017	0.010	0.010	0.046	-	-
18	-	-	-	0.008	0.015	0.012	0.021	0.009	0.015	0.045	-	-
19	-	-	-	0.009	0.015	0.013	0.017	0.009	0.018	0.046	-	-
20	-	-	-	0.009	0.015	0.024	0.015	0.009	0.015	0.044	-	-
21	-	-	-	0.010	0.015	0.021	0.013	0.009	0.013	0.042	-	-
22	-	-	-	0.011	0.016	0.022	0.012	0.009	0.013	0.041	-	-
23	-	-	-	0.012	0.035	0.030	0.011	0.009	0.014	0.040	-	-
24	-	-	-	0.019	0.039	0.030	0.010	0.008	0.015	0.039	-	-
25	-	-	-	0.033	0.039	0.026	0.010	0.010	0.023	0.036	-	-
26	-	-	-	0.027	0.036	0.022	0.011	0.013	0.027	0.033	-	-
27	-	-	-	0.012	0.033	0.018	0.011	0.014	0.033	0.033	-	-
28	-	-	-	0.014	0.028	0.016	0.012	0.013	0.041	0.035	-	-
29	-	-	-	0.015	0.024	0.014	0.010	0.012	0.048	0.037	-	-
30	-	-	-	0.012	0.021	0.013	0.009	0.011	0.059	0.037	-	-
31	-	-	-	-	0.019	-	0.009	0.011	-	0.033	-	-
<b>min</b>	-	-	-	<b>0.008</b>	<b>0.011</b>	<b>0.012</b>	<b>0.009</b>	<b>0.008</b>	<b>0.009</b>	<b>0.033</b>	<b>0.022</b>	-
<b>mean</b>	-	-	-	<b>0.013</b>	<b>0.019</b>	<b>0.019</b>	<b>0.014</b>	<b>0.010</b>	<b>0.017</b>	<b>0.045</b>	<b>0.027</b>	-
<b>max</b>	-	-	-	<b>0.033</b>	<b>0.039</b>	<b>0.030</b>	<b>0.022</b>	<b>0.014</b>	<b>0.059</b>	<b>0.058</b>	<b>0.031</b>	-

Notes: P - partial daily average.

**Table VI-8 S6 Mills Creek Mean Daily Water Levels (m) Based on Permanent Benchmark el. 273.600 m (geodetic), 2000**

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	272.397 X	272.151	272.127	272.101	272.120	272.256	272.195	-
2	-	-	-	272.159 P	272.395 X	272.144	272.123	272.102	272.125	272.236	272.191	-
3	-	-	-	272.143	272.395 X	272.141	272.118	272.101	272.116	272.226	272.188	-
4	-	-	-	272.140	272.416 X	272.136	272.123	272.100	272.112	272.229	272.187	-
5	-	-	-	272.132	272.426 X	272.131	272.141	272.099	272.108	272.235	272.185	-
6	-	-	-	272.125	272.414 X	272.133	272.144	272.101	272.129	272.232	272.183	-
7	-	-	-	272.114	272.410 X	272.160	272.131	272.100	272.119	272.234	272.180	-
8	-	-	-	272.113	272.408 X	272.161	272.124	272.096	272.115	272.237	272.179	-
9	-	-	-	272.110	272.405 X	272.153	272.117	272.095	272.117	272.241	272.169	-
10	-	-	-	272.107	272.403 X	272.171	272.152	272.105	272.115	272.248	272.168 P	-
11	-	-	-	272.106	272.399 X	272.173	272.166	272.103	272.112	272.251	-	-
12	-	-	-	272.105	272.397 X	272.164	272.148	272.110	272.113	272.249	-	-
13	-	-	-	272.101	272.401 X	272.156	272.139	272.118	272.110	272.249	-	-
14	-	-	-	272.121	272.399 X	272.147	272.155	272.128	272.109	272.248	-	-
15	-	-	-	272.123	272.400 X	272.143	272.158	272.117	272.107	272.242	-	-
16	-	-	-	272.095	272.399 X	272.139	272.158	272.113	272.107	272.238	-	-
17	-	-	-	272.096	272.316 X	272.129	272.148	272.109	272.109	272.232	-	-
18	-	-	-	272.099	272.137	272.125	272.162	272.107	272.137	272.229	-	-
19	-	-	-	272.102	272.137	272.130	272.147	272.106	272.150	272.231	-	-
20	-	-	-	272.105	272.139	272.173	272.136	272.107	272.137	272.227	-	-
21	-	-	-	272.111	272.139	272.163	272.128	272.107	272.131	272.223	-	-
22	-	-	-	272.118	272.143	272.168	272.120	272.103	272.128	272.221	-	-
23	-	-	-	272.124	272.202	272.189	272.115	272.101	272.133	272.218	-	-
24	-	-	-	272.149	272.215	272.193	272.111	272.099	272.136	272.216	-	-
25	-	-	-	272.200	272.215	272.180	272.109	272.111	272.170	272.209	-	-
26	-	-	-	272.175	272.210	272.168	272.114	272.125	272.184	272.200	-	-
27	-	-	-	272.123	272.199	272.153	272.119	272.131	272.202	272.200	-	-
28	-	-	-	272.267 X	272.186	272.142	272.121	272.126	272.220	272.205	-	-
29	-	-	-	272.406 X	272.174	272.134	272.113	272.121	272.236	272.211	-	-
30	-	-	-	272.396 X	272.163	272.130	272.106	272.120	272.258	272.210	-	-
31	-	-	-	-	272.154	-	272.103	272.117	-	272.200	-	-
<b>min</b>	-	-	-	<b>272.095</b>	<b>272.137</b>	<b>272.125</b>	<b>272.103</b>	<b>272.095</b>	<b>272.107</b>	<b>272.200</b>	<b>272.168</b>	-
<b>mean</b>	-	-	-	<b>272.147</b>	<b>272.297</b>	<b>272.153</b>	<b>272.132</b>	<b>272.109</b>	<b>272.139</b>	<b>272.229</b>	<b>272.183</b>	-
<b>max</b>	-	-	-	<b>272.406</b>	<b>272.426</b>	<b>272.193</b>	<b>272.166</b>	<b>272.131</b>	<b>272.258</b>	<b>272.256</b>	<b>272.195</b>	-

Notes: P - partial daily average.

X - water levels affected by weir blockage; discharges derived to remove effect of blockage.



**Table VI-9 S7 Muskeg River WSC Mean Daily Discharges (m<sup>3</sup>/s), 2000**

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	0.453 B	0.229 B	0.139 B	0.514 B	1.989	15.153	32.066	7.833	7.767	9.187	6.135	0.348 E
2	0.445 B	0.213 B	0.144 B	0.567 B	1.861	14.502	29.523	7.184	7.972	9.458	5.807 P	0.343 E
3	0.442 B	0.210 B	0.143 B	0.643 B	1.846	13.688	26.941	6.713	8.320	9.472	4.101 E	0.328 E
4	0.432 B	0.203 B	0.140 B	0.649 B	1.761	12.809	24.608	6.573	8.295	9.264	2.372 E	0.308 E
5	0.424 B	0.200 B	0.135 B	0.680 B	2.064	11.962	22.924	6.127	7.894	8.800	2.656 E	0.306 E
6	0.424 B	0.197 B	0.126 B	0.687 B	2.279	11.037	21.463	5.863	7.756	8.233	1.775 E	0.304 E
7	0.414 B	0.200 B	0.123 B	0.688 B	2.362	10.357	19.710	5.589	7.888	8.258	1.411 E	0.286 E
8	0.417 B	0.182 B	0.121 B	0.674 B	2.222	10.116	17.616	5.280	7.953	7.862	1.200 E	0.272 E
9	0.411 B	0.178 B	0.116 B	0.845 BE	2.135	10.218	15.780	4.792	7.829	7.744	1.037 E	0.248 E
10	0.380 B	0.173 B	0.114 B	0.763 BE	2.181	10.148	14.359	4.395	7.781	7.629	0.876 E	0.237 E
11	0.353 B	0.168 B	0.105 B	0.704 BE	1.910	10.238	13.575	4.241	7.819	7.518	0.812 E	0.231 E
12	0.343 B	0.161 B	0.105 B	0.666 BE	1.847	10.579	12.278	4.075	7.662	7.521	0.761 E	0.227 E
13	0.337 B	0.156 B	0.124 B	0.603 BE	1.846	10.382	11.183	4.102	7.405	7.228	0.720 E	0.226 E
14	0.332 B	0.145 B	0.142 B	0.533 BE	1.822	9.974	10.431	4.344	7.116	6.921	0.688 E	0.225 E
15	0.323 B	0.138 B	0.164 B	0.503 BE	1.846	9.592	9.855	4.706	6.816	7.309	0.641 E	0.213 E
16	0.319 B	0.136 B	0.187 B	0.669 B	1.692	9.336	9.987	4.579	6.402	7.103	0.591 E	0.230 E
17	0.307 B	0.132 B	0.205 B	0.715 B	1.707	8.884	10.242	4.215	6.105	6.987	0.563 E	0.256 E
18	0.299 B	0.131 B	0.227 B	0.665 B	1.681	8.352	10.026	3.860	6.037	6.946	0.563 E	0.245 E
19	0.289 B	0.129 B	0.213 B	0.963 B	1.628	8.101	9.812	3.680	6.860	6.659	0.537 E	0.272 E
20	0.286 B	0.125 B	0.217 B	1.150 B	1.780	9.104	9.312	3.448	8.250	6.918	0.516 E	0.268 E
21	0.277 B	0.122 B	0.224 B	1.647 B	1.567	12.256	8.711	3.267	8.781	6.671	0.490 E	0.263 E
22	0.272 B	0.115 B	0.243 B	1.991 B	1.594	15.959	8.162	3.070	8.775	6.722	0.483 E	0.259 E
23	0.265 B	0.117 B	0.281 B	2.423	2.399	19.345	7.447	2.858	8.527	6.575	0.473 E	0.255 E
24	0.261 B	0.115 B	0.355 B	3.115	7.793	22.264	6.793	2.518	8.280	6.489	0.461 E	0.251 E
25	0.263 B	0.121 B	0.397 B	2.789	10.926	25.386	6.224	2.313	8.412	6.527	0.447 E	0.246 E
26	0.254 B	0.124 B	0.391 B	2.506	11.701	29.520	5.720	2.411	8.638	6.698	0.426 E	0.242 E
27	0.246 B	0.126 B	0.388 B	2.598	12.456	34.998	5.942	3.389	9.092	6.478	0.408 E	0.238 E
28	0.243 B	0.126 B	0.388 B	2.547	12.953	37.813	7.772	5.559	9.287	6.309	0.384 E	0.234 E
29	0.238 B	0.131 B	0.392 B	2.466	14.030	36.570	9.055	6.841	9.065	6.318	0.367 E	0.230 E
30	0.231 B	-	0.447 B	2.197	15.065	34.414	9.296	7.311	8.855	6.410	0.355 E	0.225 E
31	0.230 B	-	0.488 B	-	15.526	-	8.637	7.561	-	6.353	-	0.221 E
<b>min</b>	<b>0.230</b>	<b>0.115</b>	<b>0.105</b>	<b>0.503</b>	<b>1.567</b>	<b>8.101</b>	<b>9.312</b>	<b>2.313</b>	<b>6.037</b>	<b>6.309</b>	<b>0.355</b>	<b>0.213</b>
<b>mean</b>	<b>0.329</b>	<b>0.155</b>	<b>0.225</b>	<b>1.272</b>	<b>4.660</b>	<b>16.102</b>	<b>16.585</b>	<b>4.797</b>	<b>7.921</b>	<b>7.373</b>	<b>1.269</b>	<b>0.259</b>
<b>max</b>	<b>0.453</b>	<b>0.229</b>	<b>0.488</b>	<b>3.115</b>	<b>15.526</b>	<b>37.813</b>	<b>32.066</b>	<b>7.833</b>	<b>9.287</b>	<b>9.472</b>	<b>6.135</b>	<b>0.348</b>

Notes: P - partial daily average.  
B - ice effects.

E - estimated.

16 Apr - 14 Oct data provisional data from Water Survey of Canada.

**Table VI-10 S7 Muskeg River WSC Mean Daily Water Levels (m) Based on Permanent Benchmark el. 273.720 m (geodetic), 2000**

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	271.826 B	271.686 B	271.725 B	271.901 B	-	-	-	-	-	-	272.085	-
2	271.820 B	271.663 B	271.741 B	271.954 B	-	-	-	-	-	-	272.063 P	-
3	271.820 B	271.667 B	271.743 B	272.039 B	-	-	-	-	-	-	-	-
4	271.810 B	271.662 B	271.739 B	272.020 B	-	-	-	-	-	-	-	-
5	271.802 B	271.667 B	271.731 B	272.036 B	-	-	-	-	-	-	-	-
6	271.808 B	271.669 B	271.714 B	272.018 B	-	-	-	-	-	-	-	-
7	271.797 B	271.685 B	271.709 B	271.991 B	-	-	-	-	-	-	-	-
8	271.808 B	271.657 B	271.709 B	271.942 BP	-	-	-	-	-	-	-	-
9	271.803 B	271.659 B	271.701 B	-	-	-	-	-	-	-	-	-
10	271.757 B	271.657 B	271.700 B	-	-	-	-	-	-	-	-	-
11	271.715 B	271.655 B	271.681 B	-	-	-	-	-	-	-	-	-
12	271.705 B	271.649 B	271.681 B	-	-	-	-	-	-	-	-	-
13	271.702 B	271.650 B	271.706 B	-	-	-	-	-	-	-	-	-
14	271.705 B	271.634 B	271.721 B	-	-	-	-	-	-	-	-	-
15	271.697 B	271.626 B	271.744 B	-	-	-	-	-	-	272.164 BP	-	-
16	271.700 B	271.632 B	271.767 B	-	-	-	-	-	-	272.150	-	-
17	271.688 B	271.632 B	271.777 B	-	-	-	-	-	-	272.142	-	-
18	271.684 B	271.639 B	271.794 B	-	-	-	-	-	-	272.139	-	-
19	271.675 B	271.644 B	271.736 B	-	-	-	-	-	-	272.120	-	-
20	271.679 B	271.645 B	271.717 B	-	-	-	-	-	-	272.137	-	-
21	271.671 B	271.647 B	271.703 B	-	-	-	-	-	-	272.121	-	-
22	271.672 B	271.634 B	271.712 B	-	-	-	-	-	-	272.124	-	-
23	271.669 B	271.643 B	271.757 B	-	-	-	-	-	-	272.115	-	-
24	271.671 B	271.641 B	271.865 B	-	-	-	-	-	-	272.109	-	-
25	271.684 B	271.661 B	271.910 B	-	-	-	-	-	-	272.111	-	-
26	271.677 B	271.673 B	271.870 B	-	-	-	-	-	-	272.123	-	-
27	271.671 B	271.680 B	271.838 B	-	-	-	-	-	-	272.108	-	-
28	271.674 B	271.684 B	271.809 B	-	-	-	-	-	-	272.097	-	-
29	271.675 B	271.702 B	271.788 B	-	-	-	-	-	-	272.097	-	-
30	271.671 B	-	271.850 B	-	-	-	-	-	-	272.103	-	-
31	271.678 B	-	271.888 B	-	-	-	-	-	-	272.100	-	-
<b>min</b>	<b>271.669</b>	<b>271.626</b>	<b>271.681</b>	<b>271.901</b>	-	-	-	-	-	<b>272.097</b>	<b>272.063</b>	-
<b>mean</b>	<b>271.723</b>	<b>271.657</b>	<b>271.759</b>	<b>271.988</b>	-	-	-	-	-	<b>272.121</b>	<b>272.074</b>	-
<b>max</b>	<b>271.826</b>	<b>271.702</b>	<b>271.910</b>	<b>272.039</b>	-	-	-	-	-	<b>272.164</b>	<b>272.085</b>	-

Notes: P - partial daily average.

E - estimated.

B - ice effects.

16 Apr - 14 Oct data not available.

**Table VI-11 S8 Stanley Creek Mean Daily Water Levels (m) Based on Permanent Benchmark el. 292.150 m (geodetic), 2000**

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	289.730	289.752	289.753	289.774	289.788	289.776	289.767	-
2	-	-	-	-	289.725	289.747	289.751	289.773	289.786	289.769	289.771	-
3	-	-	-	289.911 P	289.717	289.741	289.752	289.775	289.783	289.766	289.775	-
4	-	-	-	289.875	289.718	289.734	289.764	289.779	289.780	289.766	289.775	-
5	-	-	-	289.842	289.729	289.726	289.768	289.784	289.778	289.764	289.774	-
6	-	-	-	289.816	289.730	289.731	289.768	289.788	289.786	289.763	289.780	-
7	-	-	-	289.796	289.728	289.745	289.765	289.795	289.786	289.759	289.785	-
8	-	-	-	289.784	289.725	289.753	289.760	289.795	289.784	289.757	289.789	-
9	-	-	-	289.777	289.721	289.755	289.755	289.792	289.789	289.756	289.792 P	-
10	-	-	-	289.775	289.717	289.757	289.752	289.793	289.793	289.756	-	-
11	-	-	-	289.777	289.715	289.759	289.754	289.793	289.784	289.758	-	-
12	-	-	-	289.774	289.711	289.759	289.755	289.801	289.779	289.760	-	-
13	-	-	-	289.774	289.711	289.756	289.754	289.805	289.787	289.757	-	-
14	-	-	-	289.782	289.707	289.752	289.759	289.811	289.795	289.760	-	-
15	-	-	-	289.787	289.707	289.749	289.765	289.808	289.790	289.745	-	-
16	-	-	-	289.789	289.718	289.745	289.776	289.805	289.790	289.738	-	-
17	-	-	-	289.794	289.723	289.740	289.778	289.801	289.788	289.733	-	-
18	-	-	-	289.808	289.712	289.736	289.782	289.796	289.801	289.733	-	-
19	-	-	-	289.833	289.708	289.737	289.781	289.782	289.808	289.737	-	-
20	-	-	-	289.839	289.716	289.779	289.776	289.750	289.800	289.739	-	-
21	-	-	-	289.819	289.722	289.796	289.770	289.748	289.797	289.746	-	-
22	-	-	-	289.798	289.725	289.801	289.764	289.751	289.790	289.748	-	-
23	-	-	-	289.789	289.771	289.793	289.759	289.752	289.783	289.752	-	-
24	-	-	-	289.771	289.801	289.787	289.757	289.745	289.778	289.756	-	-
25	-	-	-	289.752	289.801	289.782	289.752	289.746	289.783	289.757	-	-
26	-	-	-	289.739	289.795	289.775	289.748	289.771	289.778	289.758	-	-
27	-	-	-	289.735	289.787	289.768	289.758	289.798	289.773	289.758	-	-
28	-	-	-	289.730	289.781	289.761	289.776	289.804	289.771	289.759	-	-
29	-	-	-	289.730	289.773	289.754	289.784	289.804	289.769	289.760	-	-
30	-	-	-	289.732	289.765	289.757	289.784	289.799	289.773	289.760	-	-
31	-	-	-	-	289.759	-	289.779	289.793	-	289.763	-	-
<b>min</b>	-	-	-	<b>289.730</b>	<b>289.707</b>	<b>289.726</b>	<b>289.748</b>	<b>289.745</b>	<b>289.769</b>	<b>289.733</b>	-	-
<b>mean</b>	-	-	-	<b>289.790</b>	<b>289.737</b>	<b>289.758</b>	<b>289.765</b>	<b>289.784</b>	<b>289.786</b>	<b>289.755</b>	-	-
<b>max</b>	-	-	-	<b>289.911</b>	<b>289.801</b>	<b>289.801</b>	<b>289.784</b>	<b>289.811</b>	<b>289.808</b>	<b>289.776</b>	-	-

Notes: P - partial daily average.

**Table VI-12 S11 Poplar Creek Mean Daily Discharges (m<sup>3</sup>/s), 2000**

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	0.449	0.698	2.930	0.562	0.304	0.388	0.129	-
2	-	-	-	0.382 P	0.443	0.630	2.604	0.547	0.303	0.413	0.123	-
3	-	-	-	0.410	0.424	0.587	2.368	0.570	0.300	0.395	0.118	-
4	-	-	-	0.152	0.501	0.560	2.333	0.613	0.280	0.400	0.127	-
5	-	-	-	0.107	0.587	0.491	2.386	0.516	0.262	0.350	0.123	-
6	-	-	-	0.099	0.569	0.414	2.349	0.512	0.283	0.300	0.104	-
7	-	-	-	0.075	0.631	0.518	2.144	0.496	0.255	0.302	0.101	-
8	-	-	-	0.053	0.675	0.530	1.914	0.409	0.234	0.326	0.107 P	-
9	-	-	-	0.052	0.701	0.507	1.713	0.328	0.214	0.349	-	-
10	-	-	-	0.143	0.723	0.553	1.606	0.319	0.230	0.478	-	-
11	-	-	-	0.301	0.733	0.584	1.530	0.243	0.190	1.417	-	-
12	-	-	-	0.370	0.741	0.625	1.362	0.241	0.175	1.929	-	-
13	-	-	-	0.354	0.813	0.637	1.218	0.199	0.163	1.857	-	-
14	-	-	-	0.356	0.714	0.672	1.275	0.277	0.147	1.790	-	-
15	-	-	-	0.346	0.713	0.742	1.325	0.198	0.141	1.720	-	-
16	-	-	-	0.244	0.721	0.707	1.376	0.149	0.126	1.668	-	-
17	-	-	-	0.228	0.654	0.654	1.254	0.098	0.120	1.585	-	-
18	-	-	-	0.231	0.641	0.687	1.249	0.079	0.170	1.530	-	-
19	-	-	-	0.220	0.625	0.818	1.197	0.074	0.371	1.452	-	-
20	-	-	-	0.237	0.625	1.384	1.124	0.060	0.319	1.314	-	-
21	-	-	-	0.264	0.577	1.440	1.030	0.063	0.280	1.206	-	-
22	-	-	-	0.322	0.627	1.791	0.925	0.051	0.226	1.034	-	-
23	-	-	-	0.317	0.765	2.574	0.859	0.042	0.228	0.931	-	-
24	-	-	-	0.289	0.867	3.219	0.814	0.037	0.227	0.819	-	-
25	-	-	-	0.290	0.814	3.707	0.767	0.039	0.260	0.713	-	-
26	-	-	-	0.335	0.851	4.033	0.725	0.131	0.268	0.611	-	-
27	-	-	-	0.350	0.986	3.666	0.705	0.387	0.263	0.389	-	-
28	-	-	-	0.350	0.893	3.451	0.737	0.511	0.268	0.135	-	-
29	-	-	-	0.453	0.869	3.210	0.746	0.431	0.255	0.140	-	-
30	-	-	-	0.447	0.772	3.228	0.735	0.359	0.289	0.142	-	-
31	-	-	-	-	0.719	-	0.623	0.304	-	0.134	-	-
<b>min</b>	-	-	-	<b>0.052</b>	<b>0.424</b>	<b>0.414</b>	<b>0.623</b>	<b>0.037</b>	<b>0.120</b>	<b>0.134</b>	<b>0.101</b>	-
<b>mean</b>	-	-	-	<b>0.268</b>	<b>0.691</b>	<b>1.444</b>	<b>1.417</b>	<b>0.285</b>	<b>0.238</b>	<b>0.846</b>	<b>0.117</b>	-
<b>max</b>	-	-	-	<b>0.453</b>	<b>0.986</b>	<b>4.033</b>	<b>2.930</b>	<b>0.613</b>	<b>0.371</b>	<b>1.929</b>	<b>0.129</b>	-

Notes: P – partial daily average.

**Table VI-13 S11 Poplar Creek Mean Daily Water Levels (m) Based on Permanent Benchmark el. 245.550 m (geodetic), 2000**

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	241.061	241.098	241.240	241.080	241.031	241.049	240.971	-
2	-	-	-	241.047 P	241.060	241.089	241.227	241.077	241.031	241.054	240.967	-
3	-	-	-	241.054	241.057	241.083	241.217	241.081	241.030	241.051	240.965	-
4	-	-	-	240.980	241.070	241.079	241.215	241.085	241.025	241.052	240.970	-
5	-	-	-	240.956	241.083	241.068	241.218	241.073	241.020	241.042	240.968	-
6	-	-	-	240.952	241.081	241.055	241.216	241.072	241.026	241.030	240.957	-
7	-	-	-	240.937	241.089	241.073	241.206	241.069	241.018	241.030	240.956	-
8	-	-	-	240.918	241.095	241.075	241.194	241.054	241.012	241.036	240.959 P	-
9	-	-	-	240.916	241.099	241.071	241.183	241.036	241.005	241.041	-	-
10	-	-	-	240.976	241.101	241.078	241.176	241.034	241.010	241.066	-	-
11	-	-	-	241.026	241.103	241.083	241.171	241.014	240.997	241.147	-	-
12	-	-	-	241.043	241.104	241.089	241.160	241.013	240.991	241.195	-	-
13	-	-	-	241.041	241.112	241.090	241.149	240.999	240.986	241.191	-	-
14	-	-	-	241.042	241.100	241.095	241.154	241.024	240.980	241.187	-	-
15	-	-	-	241.038	241.100	241.104	241.157	240.999	240.977	241.183	-	-
16	-	-	-	241.014	241.101	241.099	241.161	240.980	240.969	241.180	-	-
17	-	-	-	241.010	241.093	241.093	241.152	240.953	240.966	241.175	-	-
18	-	-	-	241.010	241.091	241.097	241.152	240.940	240.987	241.172	-	-
19	-	-	-	241.007	241.089	241.111	241.148	240.936	241.046	241.166	-	-
20	-	-	-	241.012	241.089	241.161	241.141	240.924	241.034	241.156	-	-
21	-	-	-	241.020	241.082	241.166	241.133	240.927	241.024	241.148	-	-
22	-	-	-	241.034	241.089	241.187	241.123	240.915	241.009	241.134	-	-
23	-	-	-	241.034	241.106	241.224	241.117	240.905	241.010	241.124	-	-
24	-	-	-	241.027	241.117	241.251	241.112	240.898	241.009	241.112	-	-
25	-	-	-	241.027	241.112	241.267	241.107	240.901	241.019	241.100	-	-
26	-	-	-	241.038	241.116	241.277	241.102	240.960	241.021	241.087	-	-
27	-	-	-	241.041	241.129	241.266	241.099	241.048	241.020	241.040	-	-
28	-	-	-	241.041	241.120	241.259	241.103	241.072	241.021	240.974	-	-
29	-	-	-	241.062	241.118	241.251	241.104	241.058	241.018	240.976	-	-
30	-	-	-	241.061	241.107	241.251	241.100	241.043	241.026	240.977	-	-
31	-	-	-	-	241.101	-	241.088	241.031	-	240.973	-	-
<b>min</b>	-	-	-	<b>240.916</b>	<b>241.057</b>	<b>241.055</b>	<b>241.088</b>	<b>240.898</b>	<b>240.966</b>	<b>240.973</b>	<b>240.956</b>	-
<b>mean</b>	-	-	-	<b>241.013</b>	<b>241.096</b>	<b>241.140</b>	<b>241.156</b>	<b>241.007</b>	<b>241.011</b>	<b>241.092</b>	<b>240.964</b>	-
<b>max</b>	-	-	-	<b>241.062</b>	<b>241.129</b>	<b>241.277</b>	<b>241.240</b>	<b>241.085</b>	<b>241.046</b>	<b>241.195</b>	<b>240.971</b>	-

Notes: P - partial daily average.

**Table VI-14 S12 Fort Creek Mean Daily Discharges (m<sup>3</sup>/s), 2000**

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	0.227	0.184	0.070	0.079	0.118	0.066	-
2	-	-	-	0.091 P	-	0.197	0.160	0.087	0.087	0.105	0.065	-
3	-	-	-	0.123	-	0.178	0.133	0.109	0.082	0.097	0.063	-
4	-	-	-	0.062	-	0.168	0.130	0.065	0.075	0.094	0.063	-
5	-	-	-	0.334	-	0.162	0.144	0.070	0.074	0.089	-	-
6	-	-	-	0.273	-	0.177	0.170	0.071	0.090	0.084	-	-
7	-	-	-	0.111	-	0.152	0.158	0.077	0.088	0.085	-	-
8	-	-	-	0.039	-	0.166	0.139	0.071	0.079	0.086	-	-
9	-	-	-	0.023	-	0.160	0.123	0.066	0.098	0.087	-	-
10	-	-	-	0.027	-	0.178	0.115	0.068	0.104	0.090	-	-
11	-	-	-	0.019	-	0.219	0.121	0.066	0.092	0.093	-	-
12	-	-	-	0.012	-	0.206	0.112	0.078	0.092	0.092	-	-
13	-	-	-	0.025	-	0.192	0.105	0.081	0.085	0.091	-	-
14	-	-	-	0.033	-	0.178	0.110	0.097	0.078	0.087	-	-
15	-	-	-	0.027	-	0.212	0.141	0.093	0.078	0.084	-	-
16	-	-	-	0.034	-	0.144	0.172	0.090	0.073	0.083	-	-
17	-	-	-	0.045	0.135 P	0.106	0.187	0.083	0.074	0.078	-	-
18	-	-	-	0.081	0.134	0.124	0.178	0.076	0.101	0.079	-	-
19	-	-	-	0.131	0.132	0.136	0.147	0.080	0.123	0.080	-	-
20	-	-	-	0.105	0.131	0.251	0.122	0.080	0.111	0.076	-	-
21	-	-	-	-	0.131	0.275	0.116	0.074	0.107	0.075	-	-
22	-	-	-	-	0.140	0.325	0.103	0.069	0.104	0.075	-	-
23	-	-	-	-	0.362	0.306	0.094	0.066	0.103	0.075	-	-
24	-	-	-	-	0.412	0.272	0.086	0.065	0.105	0.077	-	-
25	-	-	-	-	0.521	0.242	0.083	0.069	0.116	0.074	-	-
26	-	-	-	-	0.484	0.219	0.085	0.083	0.113	0.067	-	-
27	-	-	-	-	0.437	0.194	0.086	0.098	0.115	0.069	-	-
28	-	-	-	-	0.360	0.179	0.087	0.093	0.115	0.070	-	-
29	-	-	-	-	0.294	0.186	0.087	0.087	0.107	0.075	-	-
30	-	-	-	-	0.266	0.186	0.080	0.086	0.112	0.074	-	-
31	-	-	-	-	0.245	-	0.076	0.082	-	0.068	-	-
<b>min</b>	-	-	-	<b>0.012</b>	<b>0.131</b>	<b>0.106</b>	<b>0.076</b>	<b>0.065</b>	<b>0.073</b>	<b>0.067</b>	<b>0.063</b>	-
<b>mean</b>	-	-	-	<b>0.084</b>	<b>0.279</b>	<b>0.197</b>	<b>0.124</b>	<b>0.079</b>	<b>0.095</b>	<b>0.083</b>	<b>0.064</b>	-
<b>max</b>	-	-	-	<b>0.334</b>	<b>0.521</b>	<b>0.325</b>	<b>0.187</b>	<b>0.109</b>	<b>0.123</b>	<b>0.118</b>	<b>0.066</b>	-

Notes: P – partial daily average.

**Table VI-15 S12 Fort Creek Mean Daily Water Levels (m) Based on Permanent Benchmark el. 253.440 m (geodetic), 2000**

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	251.114	251.097	251.024	251.032	251.062	251.020	-
2	-	-	-	251.489 P	-	251.102	251.085	251.037	251.039	251.053	251.019	-
3	-	-	-	251.507	-	251.094	251.071	251.054	251.035	251.047	251.017	-
4	-	-	-	251.462	-	251.090	251.069	251.019	251.029	251.045	251.016	-
5	-	-	-	251.586	-	251.087	251.077	251.024	251.028	251.041	251.064 B	-
6	-	-	-	251.568	-	251.093	251.091	251.025	251.042	251.037	251.195 B	-
7	-	-	-	251.497	-	251.081	251.085	251.031	251.040	251.038	251.206 B	-
8	-	-	-	251.429	-	251.089	251.075	251.025	251.033	251.039	251.118 B	-
9	-	-	-	251.397	-	251.086	251.065	251.020	251.047	251.039	251.221 B	-
10	-	-	-	251.404	-	251.094	251.060	251.021	251.053	251.042	251.250 BP	-
11	-	-	-	251.385	-	251.111	251.064	251.019	251.044	251.044	-	-
12	-	-	-	251.361	-	251.106	251.058	251.031	251.044	251.043	-	-
13	-	-	-	251.399	-	251.100	251.053	251.034	251.038	251.043	-	-
14	-	-	-	251.417	-	251.094	251.057	251.047	251.031	251.039	-	-
15	-	-	-	251.404	-	251.106	251.074	251.045	251.032	251.037	-	-
16	-	-	-	251.415	-	251.074	251.091	251.042	251.027	251.036	-	-
17	-	-	-	251.434	251.072 P	251.053	251.097	251.036	251.028	251.032	-	-
18	-	-	-	251.463	251.072	251.066	251.094	251.030	251.050	251.032	-	-
19	-	-	-	251.516	251.071	251.073	251.079	251.034	251.065	251.033	-	-
20	-	-	-	251.496	251.071	251.121	251.065	251.034	251.057	251.029	-	-
21	-	-	-	-	251.070	251.130	251.061	251.028	251.055	251.029	-	-
22	-	-	-	-	251.075	251.145	251.052	251.023	251.053	251.028	-	-
23	-	-	-	-	251.150	251.140	251.045	251.020	251.052	251.029	-	-
24	-	-	-	-	251.166	251.129	251.039	251.018	251.053	251.031	-	-
25	-	-	-	-	251.187	251.120	251.036	251.022	251.061	251.028	-	-
26	-	-	-	-	251.181	251.111	251.038	251.036	251.059	251.021	-	-
27	-	-	-	-	251.171	251.101	251.039	251.048	251.060	251.023	-	-
28	-	-	-	-	251.154	251.095	251.040	251.045	251.060	251.024	-	-
29	-	-	-	-	251.136	251.096	251.039	251.039	251.055	251.029	-	-
30	-	-	-	-	251.128	251.097	251.033	251.039	251.058	251.027	-	-
31	-	-	-	-	251.121	-	251.030	251.035	-	251.022	-	-
<b>min</b>	-	-	-	<b>251.361</b>	<b>251.070</b>	<b>251.053</b>	<b>251.030</b>	<b>251.018</b>	<b>251.027</b>	<b>251.021</b>	<b>251.016</b>	-
<b>mean</b>	-	-	-	<b>251.454</b>	<b>251.122</b>	<b>251.100</b>	<b>251.063</b>	<b>251.032</b>	<b>251.045</b>	<b>251.036</b>	<b>251.113</b>	-
<b>max</b>	-	-	-	<b>251.586</b>	<b>251.187</b>	<b>251.145</b>	<b>251.097</b>	<b>251.054</b>	<b>251.065</b>	<b>251.062</b>	<b>251.250</b>	-

Notes: P - partial daily average.

B - ice effects.

**Table VI-16 Albian Sands Polishing Pond #3 Mean Daily Discharges (m<sup>3</sup>/s), 2000**

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	0.000	0.000	0.000	0.232	0.062	0.013	0.000	0.000	0.000
2	-	-	0.000 P	0.000	0.000	0.106	0.088	0.071	0.018	0.000	0.000	0.000
3	-	-	0.000	0.000	0.000	0.060	0.094	0.060	0.016	0.000	0.000	0.000
4	-	-	0.000	0.000	0.000	0.113	0.140	0.052	0.013	0.000	0.000	0.000
5	-	-	0.000	0.000	0.000	0.144	0.148	0.052	0.012	0.000	0.000	0.000
6	-	-	0.000	0.000	0.000	0.150	0.195	0.041	0.016	0.000	0.005	0.000
7	-	-	0.000	0.000	0.000	0.134	0.163	0.037	0.021	0.000	0.015	0.000
8	-	-	0.000	0.000	0.000	0.111	0.108	0.035	0.019	0.000	0.020	0.000
9	-	-	0.000	0.000	0.000	0.078	0.095	0.034	0.027	0.000	0.025	0.000
10	-	-	0.000	0.000	0.000	0.082	0.162	0.040	0.028	0.000	0.045	0.000
11	-	-	0.000	0.000	0.000	0.011	0.194	0.042	0.021	0.000	0.041	0.000
12	-	-	0.000	0.000	0.000	0.096	0.170	0.034	0.017	0.000	0.038	0.000
13	-	-	0.000	0.000	0.000	0.091	0.143	0.029	0.006	0.000	0.018	0.000
14	-	-	0.000	0.000	0.000	0.080	0.127	0.042	0.000	0.000	0.015	0.000
15	-	-	0.000	0.000	0.008	0.069	0.144	0.060	0.000	0.000	0.009	0.000
16	-	-	0.000	0.000	0.000	0.057	0.145	0.045	0.000	0.000	0.006	0.000
17	-	-	0.000	0.000	0.043	0.057	0.143	0.035	0.000	0.000	0.005	0.000
18	-	-	0.000	0.000	0.031	0.001	0.116	0.053	0.000	0.000	0.005	0.000
19	-	-	0.000	0.000	0.033	0.043	0.106	0.058	0.000	0.000	0.004	0.000
20	-	-	0.000	0.000	0.000	0.045	0.091	0.031	0.000	0.000	0.004	0.000
21	-	-	0.000	0.000	0.000	0.048	0.086	0.019	0.000	0.000	0.003	0.000
22	-	-	0.000	0.000	0.000	0.078	0.087	0.018	0.000	0.000	0.002	0.004
23	-	-	0.000	0.000	0.019	0.068	0.094	0.029	0.000	0.000	0.002	0.000
24	-	-	0.000	0.000	0.082	0.093	0.079	0.025	0.000	0.000	0.003	0.000
25	-	-	0.000	0.000	0.041	0.082	0.078	0.020	0.000	0.000	0.003	0.000
26	-	-	0.000	0.000	0.081	0.066	0.069	0.023	0.000	0.000	0.005	0.000
27	-	-	0.000	0.000	0.060	0.129	0.071	0.040	0.000	0.000	0.001	0.000
28	-	-	0.000	0.000	0.026	0.091	0.073	0.037	0.000	0.000	0.000	0.000
29	-	-	0.000	0.000	0.022	0.019	0.088	0.029	0.000	0.000	0.000	0.000
30	-	-	0.000	0.000	0.000	0.050	0.069	0.020	0.000	0.000	0.000	0.000
31	-	-	0.000	-	0.005	-	0.063	0.014	-	0.000	-	0.000
<b>min</b>	-	-	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>	<b>0.063</b>	<b>0.014</b>	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>
<b>mean</b>	-	-	<b>0.000</b>	<b>0.000</b>	<b>0.015</b>	<b>0.075</b>	<b>0.118</b>	<b>0.038</b>	<b>0.008</b>	<b>0.000</b>	<b>0.009</b>	<b>0.000</b>
<b>max</b>	-	-	<b>0.000</b>	<b>0.000</b>	<b>0.082</b>	<b>0.150</b>	<b>0.232</b>	<b>0.071</b>	<b>0.028</b>	<b>0.000</b>	<b>0.045</b>	<b>0.004</b>

Notes: P -partial daily average.



**Table VI-17 Albion Sands Polishing Pond #3 Mean Daily Water Levels (m) Based on benchmark el. 279.590 m (geodetic), 2000**

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	277.674	277.523	278.711	279.229	279.093	278.999	278.513	278.147	278.914
2	-	-	277.524 P	277.678	277.523	278.986	279.123	279.103	279.012	278.503	278.136	278.910
3	-	-	277.524	277.696	277.549	279.068	279.124	279.090	279.008	278.480	278.178	278.897
4	-	-	277.524	277.589	277.566	279.112	279.171	279.079	278.999	278.468	278.394	278.891
5	-	-	277.524	277.689	277.651	279.158	279.176	279.078	278.993	278.449	278.254	278.885
6	-	-	277.524	277.753	278.054	279.165	279.211	279.061	279.005	278.437	278.945	278.877
7	-	-	277.522	277.733	278.154	279.145	279.188	279.055	279.021	278.428	279.006	278.861
8	-	-	277.520	277.779	278.203	279.124	279.143	279.051	279.017	278.425	279.019	278.853
9	-	-	277.522	277.780	278.238	279.084	279.130	279.050	279.035	278.420	279.029	278.842
10	-	-	277.520	277.786	278.276	279.098	279.183	279.060	279.036	278.414	279.068	278.881
11	-	-	277.520	277.788	278.327	278.986	279.210	279.063	279.020	278.406	279.062	278.883
12	-	-	277.518	277.668	278.355	279.099	279.194	279.049	279.011	278.395	279.056	278.861
13	-	-	277.517	277.826	278.358	279.107	279.174	279.039	278.920	278.387	279.012	278.837
14	-	-	277.516	277.874	278.342	279.088	279.160	279.062	278.814	278.383	279.003	278.774
15	-	-	277.517	277.863	278.671	279.078	279.175	279.090	278.794	278.382	278.985	278.701
16	-	-	277.518	277.810	278.748	279.052	279.175	279.067	278.851	278.376	278.971	278.670
17	-	-	277.522	277.755	278.907	279.067	279.173	279.051	278.833	278.226	278.966	278.649
18	-	-	277.522	277.664	278.988	278.905	279.151	279.079	278.794	278.137	278.965	278.626
19	-	-	277.523	277.634	278.975	279.012	279.141	279.087	278.709	278.136	278.959	278.597
20	-	-	277.523	277.620	278.836	279.051	279.126	279.042	278.530	278.130	278.958	278.570
21	-	-	277.523	277.789	278.720	279.048	279.121	279.016	278.411	278.131	278.949	278.636
22	-	-	277.523	277.522	278.701	279.111	279.122	279.013	278.406	278.122	278.943	278.907
23	-	-	277.523	277.522	278.890	279.097	279.130	279.039	278.444	278.121	278.943	278.733
24	-	-	277.523	277.523	279.062	279.129	279.114	279.031	278.560	278.130	278.950	278.672
25	-	-	277.523	277.523	279.019	279.114	279.112	279.019	278.569	278.130	278.947	278.635
26	-	-	277.523	277.513	279.068	279.087	279.101	279.026	278.555	278.134	278.960	278.614
27	-	-	277.560	277.523	279.056	279.162	279.104	279.060	278.549	278.133	278.923	278.597
28	-	-	277.644	277.523	278.969	279.119	279.107	279.055	278.541	278.134	278.919	278.578
29	-	-	277.629	277.523	278.958	279.015	279.123	279.040	278.539	278.136	278.910	278.562
30	-	-	277.630	277.523	278.780	279.061	279.101	279.019	278.524	278.154	278.909	278.552
31	-	-	277.659	-	278.833	-	279.093	279.002	-	278.170	-	278.546
min	-	-	277.516	277.513	277.523	278.711	279.093	279.002	278.406	278.121	278.136	278.546
mean	-	-	277.539	277.671	278.494	279.068	279.148	279.054	278.783	278.290	278.849	278.742
max	-	-	277.659	277.874	279.068	279.165	279.229	279.103	279.036	278.513	279.068	278.914

Notes: P - partial daily average.

**Table VI-18 L1 McClelland Lake Mean Daily Discharges (m<sup>3</sup>/s), 2000**

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	0.002	0.007	0.007	0.006	0.008	-	-
2	-	-	-	-	-	0.002	0.007	0.007	0.006	0.009	-	-
3	-	-	-	-	-	0.002	0.007	0.007	0.006	0.009	-	-
4	-	-	-	-	-	0.002	0.007	0.008	0.006	0.010	-	-
5	-	-	-	-	-	0.001	0.007	0.008	0.006	0.010	-	-
6	-	-	-	-	-	0.001	0.007	0.008	0.006	0.009	-	-
7	-	-	-	-	-	0.002	0.008	0.007	0.006	0.008	-	-
8	-	-	-	-	-	0.002	0.007	0.006	0.007	0.009	-	-
9	-	-	-	-	-	0.001	0.007	0.006	0.007	0.010	-	-
10	-	-	-	-	-	0.002	0.007	0.006	0.007	0.010	-	-
11	-	-	-	-	-	0.002	0.007	0.006	0.007	0.010	-	-
12	-	-	-	-	-	0.002	0.007	0.006	0.007	0.010	-	-
13	-	-	-	-	-	0.002	0.007	0.006	0.007	0.010	-	-
14	-	-	-	-	-	0.002	0.007	0.006	0.007	0.010	-	-
15	-	-	-	-	-	0.002	0.007	0.006	0.007	0.009	-	-
16	-	-	-	-	0.000 P	0.002	0.007	0.005	0.007	0.009	-	-
17	-	-	-	-	0.000	0.002	0.007	0.005	0.007	0.009	-	-
18	-	-	-	-	0.000	0.002	0.007	0.005	0.009	0.009	-	-
19	-	-	-	-	0.000	0.002	0.007	0.005	0.009	0.008	-	-
20	-	-	-	-	0.000	0.004	0.006	0.005	0.009	0.009	-	-
21	-	-	-	-	0.000	0.005	0.006	0.005	0.008	0.009	-	-
22	-	-	-	-	0.000	0.005	0.006	0.005	0.007	0.008	-	-
23	-	-	-	-	0.001	0.006	0.006	0.005	0.008	0.009	-	-
24	-	-	-	-	0.001	0.006	0.006	0.005	0.008	0.009	-	-
25	-	-	-	-	0.002	0.006	0.006	0.005	0.009	0.009	-	-
26	-	-	-	-	0.002	0.006	0.007	0.006	0.009	0.009	-	-
27	-	-	-	-	0.002	0.006	0.008	0.006	0.009	0.008	-	-
28	-	-	-	-	0.002	0.006	0.009	0.006	0.009	-	-	-
29	-	-	-	-	0.002	0.006	0.007	0.007	0.009	-	-	-
30	-	-	-	-	0.002	0.006	0.007	0.007	0.009	-	-	-
31	-	-	-	-	0.002	-	0.007	0.007	-	-	-	-
<b>min</b>	-	-	-	-	<b>0.000</b>	<b>0.001</b>	<b>0.006</b>	<b>0.005</b>	<b>0.006</b>	<b>0.008</b>	-	-
<b>mean</b>	-	-	-	-	<b>0.001</b>	<b>0.003</b>	<b>0.007</b>	<b>0.006</b>	<b>0.008</b>	<b>0.009</b>	-	-
<b>max</b>	-	-	-	-	<b>0.002</b>	<b>0.006</b>	<b>0.009</b>	<b>0.008</b>	<b>0.009</b>	<b>0.010</b>	-	-

Notes: P - partial daily average.

**Table VI-19 L1 McClelland Lake Mean Daily Water Levels (m) Based on Permanent Benchmark el. 295.840 m (geodetic), 2000**

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	294.397	294.486	294.487	294.479	294.495	294.505	-
2	-	-	-	-	-	294.399	294.480	294.486	294.479	294.498	294.505	-
3	-	-	-	-	-	294.396	294.480	294.488	294.477	294.500	294.506	-
4	-	-	-	-	-	294.396	294.483	294.494	294.475	294.505	294.509	-
5	-	-	-	-	-	294.391	294.485	294.493	294.472	294.508	294.510	-
6	-	-	-	-	-	294.390	294.488	294.489	294.476	294.502	294.514	-
7	-	-	-	-	-	294.395	294.489	294.487	294.477	294.496	294.514	-
8	-	-	-	-	-	294.396	294.486	294.478	294.481	294.502	294.514	-
9	-	-	-	-	-	294.391	294.483	294.475	294.485	294.506	294.514 P	-
10	-	-	-	-	-	294.394	294.482	294.475	294.480	294.506	-	-
11	-	-	-	-	-	294.401	294.486	294.471	294.483	294.507	-	-
12	-	-	-	-	-	294.403	294.488	294.474	294.482	294.509	-	-
13	-	-	-	-	-	294.404	294.488	294.475	294.488	294.508	-	-
14	-	-	-	-	-	294.404	294.487	294.473	294.483	294.507	-	-
15	-	-	-	-	-	294.400	294.485	294.470	294.479	294.504	-	-
16	-	-	-	-	294.328 P	294.400	294.486	294.463	294.484	294.497	-	-
17	-	-	-	-	294.328	294.398	294.482	294.463	294.486	294.503	-	-
18	-	-	-	-	294.326	294.398	294.482	294.463	294.501	294.504	-	-
19	-	-	-	-	294.328	294.401	294.481	294.463	294.503	294.496	-	-
20	-	-	-	-	294.325	294.440	294.479	294.457	294.499	294.499	-	-
21	-	-	-	-	294.333	294.457	294.475	294.461	294.493	294.499	-	-
22	-	-	-	-	294.330	294.464	294.476	294.456	294.486	294.492	-	-
23	-	-	-	-	294.363	294.472	294.478	294.457	294.488	294.498	-	-
24	-	-	-	-	294.387	294.471	294.478	294.459	294.495	294.504	-	-
25	-	-	-	-	294.395	294.470	294.476	294.458	294.497	294.501	-	-
26	-	-	-	-	294.404	294.474	294.481	294.468	294.499	294.501	-	-
27	-	-	-	-	294.410	294.476	294.494	294.468	294.502	294.496	-	-
28	-	-	-	-	294.404	294.478	294.503	294.474	294.502	294.499	-	-
29	-	-	-	-	294.396	294.476	294.488	294.483	294.504	294.504	-	-
30	-	-	-	-	294.396	294.479	294.485	294.482	294.502	294.504	-	-
31	-	-	-	-	294.395	-	294.485	294.482	-	294.505	-	-
<b>min</b>	-	-	-	-	<b>294.325</b>	<b>294.390</b>	<b>294.475</b>	<b>294.456</b>	<b>294.472</b>	<b>294.492</b>	<b>294.505</b>	-
<b>mean</b>	-	-	-	-	<b>294.365</b>	<b>294.424</b>	<b>294.484</b>	<b>294.473</b>	<b>294.488</b>	<b>294.502</b>	<b>294.510</b>	-
<b>max</b>	-	-	-	-	<b>294.410</b>	<b>294.479</b>	<b>294.503</b>	<b>294.494</b>	<b>294.504</b>	<b>294.509</b>	<b>294.514</b>	-

Notes: P - partial daily average.

**Table VI-20 L2 Kearl Lake Mean Daily Water Levels (m) Based on Permanent Benchmark el. 333.410 m (geodetic), 2000**

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	331.889	331.874	331.891	331.986	332.254	332.193	332.115	-	332.131	-
2	-	-	331.889	331.883	331.891	331.992	332.258	332.191	332.120	-	332.130 P	-
3	-	-	331.886	331.886	331.891	331.995	332.257	332.187	332.119	-	-	-
4	-	-	331.883	331.890	331.894	331.995	332.253	332.186	332.114	-	-	-
5	-	-	331.879	331.898	331.894	331.992	332.250	332.188	332.112	-	-	-
6	-	-	331.878	331.900	331.898	331.997	332.250	332.184	332.120	-	-	-
7	-	-	331.872	331.903	331.897	332.003	332.248	332.183	332.123	-	-	-
8	-	-	331.873	331.905	331.900	332.013	332.246	332.177	332.122	-	-	-
9	-	-	331.872	331.904	331.902	332.017	332.246	332.172	332.125	-	-	-
10	-	-	331.868	331.906	331.899	332.021	332.244	332.171	332.125	-	-	-
11	-	-	331.868	331.907	331.895	332.025	332.240	332.167	332.125	-	-	-
12	-	-	331.866	331.905	331.895	332.021	332.238	332.168	332.126 P	-	-	-
13	-	-	331.864	331.906	331.895	332.024	332.234	332.166	-	-	-	-
14	-	-	331.862	331.903	331.898	331.991	332.236	332.166	-	-	-	-
15	-	-	331.862	331.902	331.890	331.970	332.231	332.160	-	-	-	-
16	-	-	331.861	331.902	331.889	331.982	332.233	332.154	-	-	-	-
17	-	-	331.859	331.905	331.896	331.986	332.234	332.154	-	332.145 P	-	-
18	-	-	331.863	331.907	331.891	331.984	332.231	332.149	-	332.150	-	-
19	-	-	331.859	331.905	331.891	331.988	332.226	332.142	-	332.131	-	-
20	-	-	331.863	331.899	331.888	332.045	332.223	332.138	-	332.157	-	-
21	-	-	331.861	331.887	331.893	332.073	332.213	332.135	-	332.133	-	-
22	-	331.902 P	331.865	331.887	331.890	332.105	332.210	332.132	-	332.145	-	-
23	-	331.898	331.863	331.887	331.921	332.136	332.204	332.127	-	332.137	-	-
24	-	331.891	331.862	331.887	331.949	332.168	332.199	332.117	-	332.139	-	-
25	-	331.897	331.861	331.887	331.958	332.191	332.195	332.095	-	332.136	-	-
26	-	331.895	331.864	331.892	331.966	332.214	332.195	332.105	-	332.147	-	-
27	-	331.895	331.862	331.895	331.973	332.228	332.206	332.113	-	332.146	-	-
28	-	331.889	331.866	331.895	331.975	332.238	332.211	332.116	-	332.131	-	-
29	-	331.889	331.868	331.890	331.976	332.242	332.211	332.121	-	332.130	-	-
30	-	-	331.871	331.893	331.978	332.250	332.201	332.119	-	332.133	-	-
31	-	-	331.872	-	331.986	-	332.198	332.117	-	332.134	-	-
<b>min</b>	-	<b>331.889</b>	<b>331.859</b>	<b>331.874</b>	<b>331.888</b>	<b>331.970</b>	<b>332.195</b>	<b>332.095</b>	<b>332.112</b>	<b>332.130</b>	<b>332.130</b>	-
<b>mean</b>	-	<b>331.895</b>	<b>331.869</b>	<b>331.896</b>	<b>331.914</b>	<b>332.062</b>	<b>332.228</b>	<b>332.151</b>	<b>332.121</b>	<b>332.140</b>	<b>332.130</b>	-
<b>max</b>	-	<b>331.902</b>	<b>331.889</b>	<b>331.907</b>	<b>331.986</b>	<b>332.250</b>	<b>332.258</b>	<b>332.193</b>	<b>332.126</b>	<b>332.157</b>	<b>332.131</b>	-

Notes: P - partial daily average.

**Table VI-21 L3 Isadore's Lake Mean Daily Water Levels (m) Based on Permanent Benchmark el. 235.910 m, 2000**

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	233.656	233.708	233.666	233.714	233.697	233.673	233.642	233.794	233.860	-
2	-	-	233.668	233.716	233.666	233.713	233.692	233.657	233.644	233.797	233.850 P	-
3	-	-	233.679	233.751	233.648	233.717	233.690	233.666	233.649	233.803	-	-
4	-	-	233.677	233.788	233.660	233.683	233.698	233.677	233.672	233.797	-	-
5	-	-	233.661	233.805	233.672	233.695	233.707	233.665	233.696	233.791	-	-
6	-	-	233.680	233.799	233.682	233.691	233.709	233.666	233.691	233.798	-	-
7	-	-	233.666	233.780	233.653	233.704	233.707	233.662	233.694	233.803	-	-
8	-	-	233.667	233.784	233.659	233.706	233.685	233.664	233.694	233.810	-	-
9	-	-	233.677	233.783	233.667	233.716	233.686	233.641	233.698	233.830	-	-
10	-	-	233.647	233.757	233.660	233.700	233.684	233.648	233.747	233.817	-	-
11	-	-	233.659	233.757	233.652	233.711	233.725	233.648	233.737	233.820	-	-
12	-	-	233.675	233.767	233.635	233.715	233.705	233.677	233.744	233.814	-	-
13	-	-	233.666	233.758	233.635	233.714	233.676	233.671	233.731	233.825	-	-
14	-	-	233.672	233.760	233.656	233.725	233.703	233.672	233.744	233.824	-	-
15	-	-	233.657	233.770	233.656	233.688	233.698	233.642	233.732	233.829	-	-
16	-	-	233.672	233.759	233.650	233.680	233.700	233.627	233.738	233.822	-	-
17	-	-	233.660	233.755	233.657	233.709	233.719	233.636	233.736	233.834	-	-
18	-	-	233.676	233.760	233.755	233.699	233.736	233.681	233.740	233.826	-	-
19	-	-	233.658	233.749	233.719	233.709	233.739	233.667	233.755	233.833	-	-
20	-	-	233.670	233.744	233.727	233.704	233.721	233.667	233.758	233.846	-	-
21	-	-	233.673	233.723	233.729	233.713	233.711	233.652	233.744	233.840	-	-
22	-	233.673 P	233.666	233.715	233.708	233.733	233.708	233.663	233.748	233.844	-	-
23	-	233.648	233.687	233.722	233.758	233.721	233.702	233.656	233.754	233.832	-	-
24	-	233.639	233.674	233.695	233.756	233.711	233.697	233.642	233.772	233.845	-	-
25	-	233.674	233.688	233.694	233.751	233.712	233.702	233.653	233.772	233.843	-	-
26	-	233.677	233.673	233.696	233.764	233.723	233.701	233.663	233.777	233.840	-	-
27	-	233.669	233.690	233.678	233.744	233.729	233.705	233.659	233.778	233.852	-	-
28	-	233.660	233.700	233.675	233.739	233.711	233.701	233.659	233.766	233.862	-	-
29	-	233.661	233.700	233.671	233.727	233.720	233.696	233.644	233.779	233.859	-	-
30	-	-	233.711	233.661	233.728	233.712	233.674	233.656	233.773	233.846	-	-
31	-	-	233.711	-	233.715	-	233.660	233.650	-	233.859	-	-
<b>min</b>	-	<b>233.639</b>	<b>233.647</b>	<b>233.661</b>	<b>233.635</b>	<b>233.680</b>	<b>233.660</b>	<b>233.627</b>	<b>233.642</b>	<b>233.791</b>	<b>233.850</b>	-
<b>mean</b>	-	<b>233.663</b>	<b>233.675</b>	<b>233.739</b>	<b>233.693</b>	<b>233.709</b>	<b>233.701</b>	<b>233.658</b>	<b>233.730</b>	<b>233.827</b>	<b>233.855</b>	-
<b>max</b>	-	<b>233.677</b>	<b>233.711</b>	<b>233.805</b>	<b>233.764</b>	<b>233.733</b>	<b>233.739</b>	<b>233.681</b>	<b>233.779</b>	<b>233.862</b>	<b>233.860</b>	-

Notes: P - partial daily average.

**APPENDIX VII**

**PERMITS FOR STATION INSTALLATIONS**

This appendix contains the following documentation:

- Alberta Environment Licence of Occupation LOC 001050 for Kearl Lake Station (L2); and
- Alberta Environment Licence of Occupation LOC 001053 for Isadore's Lake Station (L3).



Land and Forest Service  
Land Administration Division

Petroleum Plaza - South Tower  
9915 - 108 Street  
Edmonton, Alberta  
Canada T5K 2G8

File No. LOC 001053

Telephone (780) 427-3570  
FAX (780) 427-1185

June 16, 2000

Synchrude Canada Ltd.  
PO Bag 4023, MD 2000  
Fort McMurray, Alberta  
T9H 3H5

Attention: Mr. Barry Wolsey, Law Dept

Dear Sir:

**RE: Licence of Occupation Application No. LOC 001053**  
**Pt. LSD 09-07-095-10-W4**  
**Water Level Monitoring Station (~~Kearl Lake~~) *Creeburn Lake***  
**LETTER OF AUTHORITY**

---

Further to your application dated May 8, 2000, this is to advise that the department has completed its review of your request.

Pursuant to Section 19 of the Public Lands Act, authority is hereby granted to enter upon those portions of vacant or other public lands for which you have obtained the occupant's consent, the approximate location of which is shown on the attached plan, for the purpose of a **water level monitoring station**, subject to the conditions in Schedule A, attached.

Based on the information supplied with your application, first year's charges for this authority are indicated below. Please remit this amount within 30 days. This account will be subject to a 12% interest charge if payment is not received within specified.

.../2



(CONDITIONS) SCHEDULE A

1. 001 IN THIS DOCUMENT, unless the context indicates otherwise:

"**approval (of a departmental officer)**" whenever required, must be in writing.

"**authority**" means: this document or the right to occupy public land granted by this document.

"**department**" means:

Department of Alberta Environment  
Land and Forest Service  
Land Administration Division  
Petroleum Plaza, South Tower  
3<sup>rd</sup> Floor, 9915 – 108<sup>th</sup> Street  
Edmonton, Alberta  
T5K 2G8  
Telephone: (780) 427-3570

"**departmental officer**" means: an employee of the Alberta Environment, Land and Forest Service; or Alberta Agriculture, Food and Rural Development, Public Lands responsible for the management of surface activity on the land.

"**holder**" means: the recipient of the right to occupy public land granted by this document.

"**land(s)**" means: the specific land which the holder is authorized to occupy by this document.

"**minister**" means: the Minister of Alberta Environment.

payments required by this document are to be made payable to "**The Provincial Treasurer**" and may be delivered to the nearest Public Lands or Land and Forest Service office, or mailed to:

Alberta Environment  
Land and Forest Service  
Main Floor, Petroleum Plaza, South Tower  
9915 – 108<sup>th</sup> Street  
Edmonton, Alberta  
T5K 2G8

- a) The holder shall comply with all relevant laws in the Province of Alberta.
- b) A copy of this authority shall be retained on the job site during all phases of your activity, including, if applicable, preparation, construction, development, maintenance and abandonment.

- c) Schedule "B", attached lists any prior and subsisting authorizations and dispositions (prior rights) issued on the quarter sections included in this authority. The holder shall not conduct any activity on the land where prior rights have been issued without the consent of the holder of these prior rights.

Surface rights plot sheets showing dispositions listed on Schedule "B" may be viewed at, or further information obtained from, the Technical Services Branch, Land Administration Division, 2<sup>nd</sup> Floor, Petroleum Plaza, South Tower, 9915 – 108<sup>th</sup> Street, Edmonton, Alberta, T5K 2G8, Telephone (780) 427-3509, Fax (780) 422-4252.

Copies of these plots or any plan showing the location of a disposition may be purchased from IHS Energy Group, Main Floor, Petroleum Plaza, South Tower, 9915 – 108<sup>th</sup> Street, Edmonton, Alberta, T5K 2G8, Telephone (780) 413-3380, Fax (780) 413-3383.

- d) If a trapping area (TPA) is listed in Schedule "B", the holder shall contact the registered trapper at least FIVE DAYS PRIOR TO COMMENCING ANY ACTIVITY. This must be done by registered mail and we recommend personal communication follow-up. The trapper's name and address may be obtained from the Department of Energy, Calgary Information Centre, Telephone: (403) 297-6324. For other information concerning registered traplines, contact the Licencing Section, Natural Resources Service, Department of Alberta Environment, Edmonton, Alberta, Telephone: (780) 427-6729, upon receipt of this approval. The holder may be responsible for any damage to traps, snares or other improvements.
- e) This authorization should not be construed as assuring that any other relevant approvals from this Department or any other department or agency of the Alberta Government will be granted.
- f) This authorization is granted subject to further amendment by the Minister of Alberta Environment, or his designate, based upon evidence obtained from an Alberta Energy and Utilities Board hearing that relates to the subject matter of this authorization.

2. 123

The holder shall contact and advise the departmental officer of its intentions:

- prior to entry upon the lands.
- prior to any additional construction during the term of this authority.
- at the completion of operations, and
- upon abandonment of this activity or cancellation of this authority.

**Northeast Boreal  
Waterways Forest Area  
Fort McMurray Office  
Telephone: (780) 743-7120**

3. 100 Prior to the commencement of any activity, the holder shall arrange and hold a meeting with a departmental officer to discuss site specific operating conditions, which may include access, creek crossings, timber salvage and wildlife concerns.
4. 117 Prior to commencement of construction, the holder shall obtain authority under The Water Act from Natural Resources Service of Alberta Environment at Edmonton, Alberta, Telephone: (780) 427-6451.
5. 060 The holder shall within 30 days provide to the department a written consent from the following occupant(s) who hold prior legal rights:  
  

**Disposition No. FMA 9100029**  
**Joint Venture Parties**  
**Alberta-Pacific Forest Industries Inc.**  
**c/o Evergreen Land Use Consulting**  
**Floor 2, 410 – 6<sup>th</sup> Street SW**  
**Calgary, Alberta T2P 1X2**
6. Access to the site is by foot traffic only, unless otherwise approved by a departmental officer.
7. 165 Unless otherwise approved by a departmental officer, the holder shall use only existing clearings/trails and not clear any new areas.
8. 169 The holder may not conduct any activity incidental to this authority on land not included in this authority without prior approval from a departmental officer. (A departmental officer may approve land use for incidental activities such as campsites, borrow pits, temporary access, flare pits, remote sumps, trails and other temporary uses).
9. 183 The holder shall ensure that surface disturbance is kept to a minimum.
10. 241 The holder shall dispose of all debris/waste in a manner directed by a departmental officer. ...
11. 261 Timber salvage is waived.
12. 265 The holder shall not deposit or push debris, soil or other materials into or through any watercourse or water body or on the ice of any watercourse/water body.
13. 304 The holder shall take all precautions and safeguards necessary to prevent soil/surface erosion.
14. 204 The holder shall reclaim all disturbed areas immediately after operations.

15. 065 The lease, when issued, will be for a term as indicated effective from the date of this authority. Rental will also be assessed effective from this date.

**Term: 1 year**

All licences, authorizations and approvals issued under the Alberta Environment and Enhancement Act, Water Act or Public Lands Act should not be taken to mean the proponent (applicant) has complied with federal legislation. Proponents should contact Habitat Management, Central and Arctic Region, Fisheries and Oceans, 501 University Crescent, Winnipeg, Manitoba, R3T 2N6 (phone: 204 -- 984-2505) in relation to the application of federal laws relating to the Fisheries Act (Canada) and the Navigation Protection Program, Canadian Coast Guard, 201 North Front Street, Suite 703, Sarnia, Ontario, N7T 8B1 (phone: 519 -- 383-1862) relating to the Navigable Waters Protection Act.

MGW/jm

LAND STATUS AUTOMATED SYSTEM

ENR-LSAS  
 REPORT DATE: 2000-05-19 TIME: 13:31:42

LAND STANDING REPORT

LSRC1130  
 REQUESTED BY: LSLEI07 PAGE 1

SCHEDULE "B"

SELECTION CRITERIA

REQUESTED LAND LIST: INCLUDE  
 TITLE INFORMATION : INCLUDE  
 REQUEST LAND STATUS: INCLUDE

SELECT GEO-ADMINISTRATIVE AREA: ALL

SELECT ACTIVITIES:

INCL/EXCL	ACTIVITIES	MAX STATUS	ALL/NONE/SOME	IF SOME, SPECIFY TYPE
I	SURFACE DISP	6	ALL	
I	RESERVATIONS	6	ALL	
I	ENCUMBRANCES	6	ALL	
I	LAND POSTINGS	6	ALL	
I	INTERIM RECORDS	6	ALL	
I	SUBDIVISIONS	5	ALL	

REQUESTED ACTIVITY

REQUESTED ACTIVITY: LOC- 001053

REQUESTED LAND

REQUESTED LAND	OWNERSHIP STATUS	TITLE STATUS	ADMINISTERED BY	SURVEY STATUS	-- AREA IN HECTARES --		--- AREA IN ACRES ---	
					LAND	TITLE	LAND	TITLE
4-10-095-07-09	CROWN	UNTITLED	FLW	UNSURVEYED				
TOTAL	CROWN	UNTITLED		UNSURVEYED				

LAND STATUS INFORMATION (TO QUARTER SECTION ONLY)

LAND IDENTIFIER	OWNERSHIP STATUS	TITLE STATUS	ADMINISTERED BY	SURVEY STATUS	-- AREA IN HECTARES --		--- AREA IN ACRES ---	
					LAND	TITLE	LAND	TITLE

GEO-ADMINISTRATIVE AREAS

COAL DEVELOPMENT REGION 4-10-095	NORTHERN FORESTED		CODE: CDR-2
ENVIRONMENT CONS. & RECL. DISTRICT 4-10-095	NO. 4		CODE: ERD-004
FOREST MANAGEMENT UNIT 4-10-095	ATHABASCA FOREST	A7	CODE: FMU-A -07J
FISH & WILDLIFE ADMIN REGION 4-10-095	NORTHEAST REGION	LAC LA BICHE	CODE: FWA-4 -04
FISH AND WILDLIFE DISTRICT 4-10-095	NORTHEAST REGION	FORT MCMURRAY	CODE: FWD-5 -07

LAND STATUS AUTOMATED SYSTEM

ENR-LSAS  
 REPORT DATE: 2000-05-19 TIME: 13:31:42

LAND STANDING REPORT

LSRC1130  
 REQUESTED BY: LSLEI07 PAGE 2

----- GEO-ADMINISTRATIVE AREAS -----

GENERAL LANDS CLASSIFICATION	GREEN	CODE: GLC-G
4-10-095		
GRAZING ZONE	C	CODE: GRZ-C
4-10-095		
INTEGRATED RESOURCE PLAN	FT. MCMURRAY ATHABASCA OIL SANDS	CODE: IRP-F1
4-10-095		
PUBLIC LAND DISTRICT	NORTHWEST REGION	SHERWOOD PARK
4-10-095		CODE: PLD-6 -6
RANGER DISTRICT	NORTHEAST BOREAL	FORT MCMURRAY - WATERWAYS DISTRICT
4-10-095		CODE: RAD-NEB -1C
SPECIALIZED MUNICIPALITY	REGIONAL MUNICIPALITY OF WOOD BUFFA	CODE: SM -001
4-10-095		

----- ACTIVITIES -----

ACTIVITY	STATUS/TYPE LAND ID	DATE HECTARES	EXPIRY ACRES	CLIENT/INTERIM REMARKS METES AND BOUNDS REMARKS	----- TOTAL AREA -----	
					ACRES	HECTARES
CNC-720002	APPROVED 0530 INDUSTRIAL/COMMERCIAL SITE 4-10-095-07-NE	ON 1972-FEB-11 16.187	2001-FEB-28 40.00	SHELL CANADA LIMITED 1 NO RESTRICTION E/ ATHABASCA RIVER 710 SPECIFIED IN COMMENTS FIELD	94,101.48	38,081.515
CNT-870307 ✓	APPROVED 0530 INDUSTRIAL/COMMERCIAL SITE 4-10-095-07	ON 1988-FEB-11	1998-FEB-28	ALBERTA ENERGY AND UTILITIES BOAR 1 NO RESTRICTION 710 SPECIFIED IN COMMENTS FIELD	0.00	0.000
CNT-960110 ↘	APPROVED 0600 SPECIAL PLACES 4-10-095-07	ON 1996-JAN-19 258.999	2001-JAN-31 640.00	ENVIRONMENT, DEPARTMENT OF 1 NO RESTRICTION 710 SPECIFIED IN COMMENTS FIELD	1,515,214.94	613,185.685
CNT-980068 ↘	APPROVED 0600 SPECIAL PLACES 4-10-095-07-NE	ON 1998-JUL-15 64.750	2003-JUL-31 160.00	ENVIRONMENT, DEPARTMENT OF 1 NO RESTRICTION 710 SPECIFIED IN COMMENTS FIELD	29,307.81	11,860.449
CNT-990076	APPROVED 0580 OTHER MISCELLANEOUS SITE PROTEC. AREAS 4-10-095-07-NE	ON 1999-JUL-22 64.750	2004-JUL-31 160.00	INTERNATIONAL AND INTERGOVERNMENT 1 NO RESTRICTION 710 SPECIFIED IN COMMENTS FIELD 730 WRITTEN AGENCY CONSENTS REQUIR	2,938.01	1,188.970
FMA-9100029	ACTIVE/DISPOSED 4-10-095-07	ON 1991-SEP-01	2011-AUG-31	JOINT VENTURE PARTIES	* 13,923,833.46	5,634,775.064
LOC- 5772	ACTIVE/DISPOSED 4-10-095-07-NE	ON 1975-JUN-12	9999-999-99	SHELL CANADA LIMITED	2.07	0.838
LOC- 001053	APPLICATION	ON 2000-MAY-19		SYNCRUDE CANADA LTD.	0.05	0.020

LAND STATUS AUTOMATED SYSTEM

ENR-LSAS  
 REPORT DATE: 2000-05-19 TIME: 13:31:42

LAND STANDING REPORT

REQUESTED BY: LSLEI07  
 LSRC1130  
 PAGE 3

----- ACTIVITIES -----

ACTIVITY	STATUS/TYPE LAND ID	DATE HECTARES	EXPIRY ACRES	CLIENT/INTERIM REMARKS METES AND BOUNDS REMARKS	----- TOTAL AREA -----	
					ACRES	HECTARES
LOC- 001053	(CONTINUED) 4-10-095-07-09	0.020	0.05	THE BED AND SHORE OF CREE BURN LAKE.		
TPA- 1650	ACTIVE/DISPOSED ON 4-10-095-07-09	1986-AUG-29	2000-JUN-30	DOUCHER, RODDY E/ATHABASCA R	0.00	0.000

\*\*\* NOTE: THE FOLLOWING DISCLAIMER \*\*\*

LAND STATUS AUTOMATED SYSTEM

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LAND STANDING REPORT

REPORT DATE: 2000-05-19

TIME: 13:31:42

REQUESTED BY: LSLEI07

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PAGE 4

----- D I S C L A I M E R -----

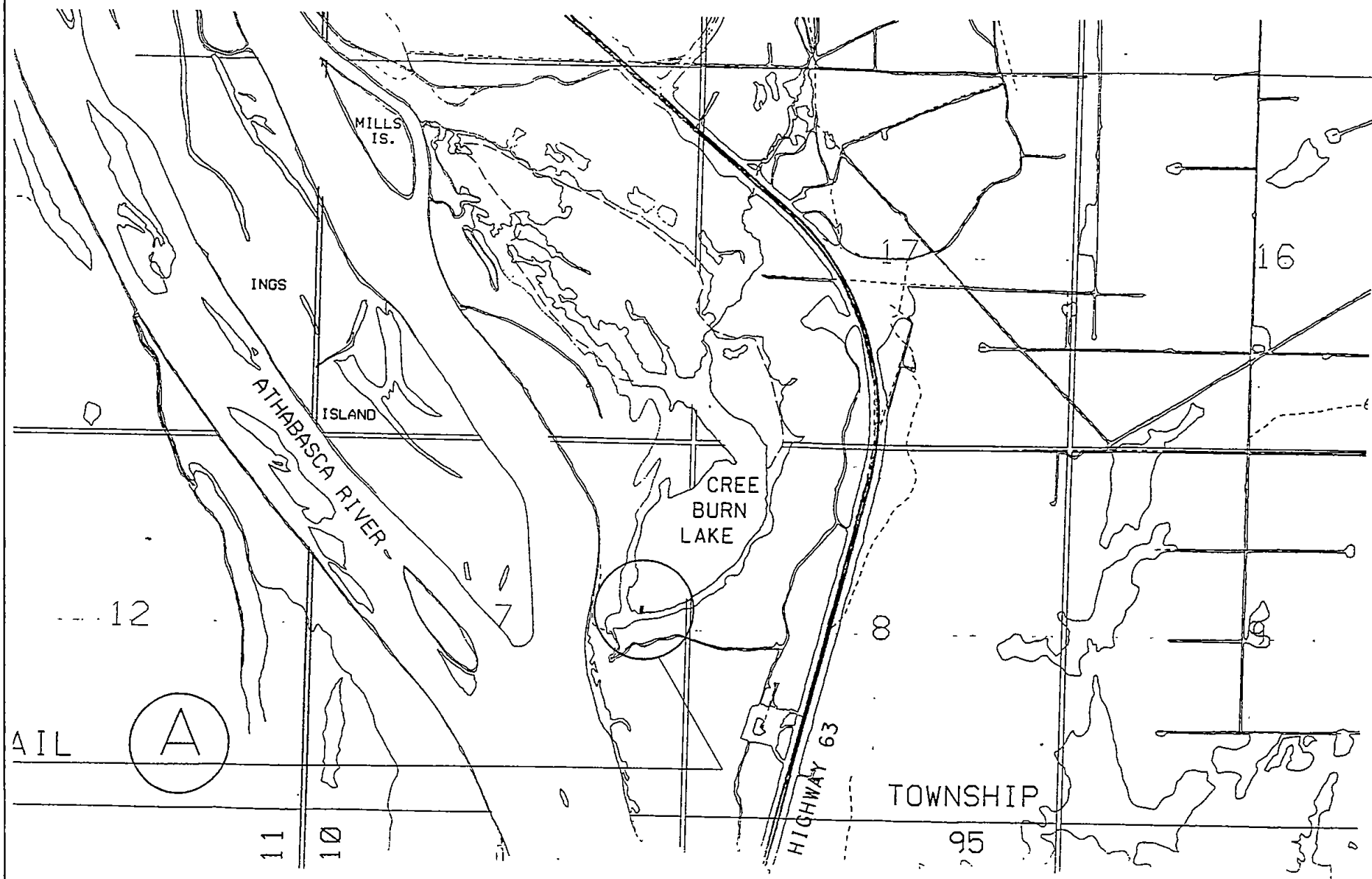
THIS STANDING REPORT IS PROVIDED SUBJECT TO THE CONDITION THAT HER MAJESTY THE QUEEN IN RIGHT OF THE PROVINCE OF ALBERTA AND HER EMPLOYEES:

- (1) HEREBY DISCLAIM AND ARE RELEASED FROM ANY AND ALL RESPONSIBILITY FOR THE INFORMATION IN, AND ANY OMISSION OF THE INFORMATION FROM, THIS REPORT;
- (2) SHALL NOT BEAR ANY RESPONSIBILITY FOR ANY LOSS OR DAMAGE OF ANY KIND ARISING FROM OR IN RESPECT OF ANY ABSENCE OF INFORMATION OR ANY ERRORS OR OMISSIONS (WHETHER THE AFORESAID OCCASIONED BY NEGLIGENCE OR OTHERWISE) IN OR AFFECTING THIS REPORT OR THE INFORMATION THEREIN.

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\*\*\* END OF REPORT \*\*\*





MILLS IS.

INGS

ISLAND

ATHABASCA RIVER

CREE BURN LAKE

HIGHWAY 63

TOWNSHIP

A

B

AIL

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11

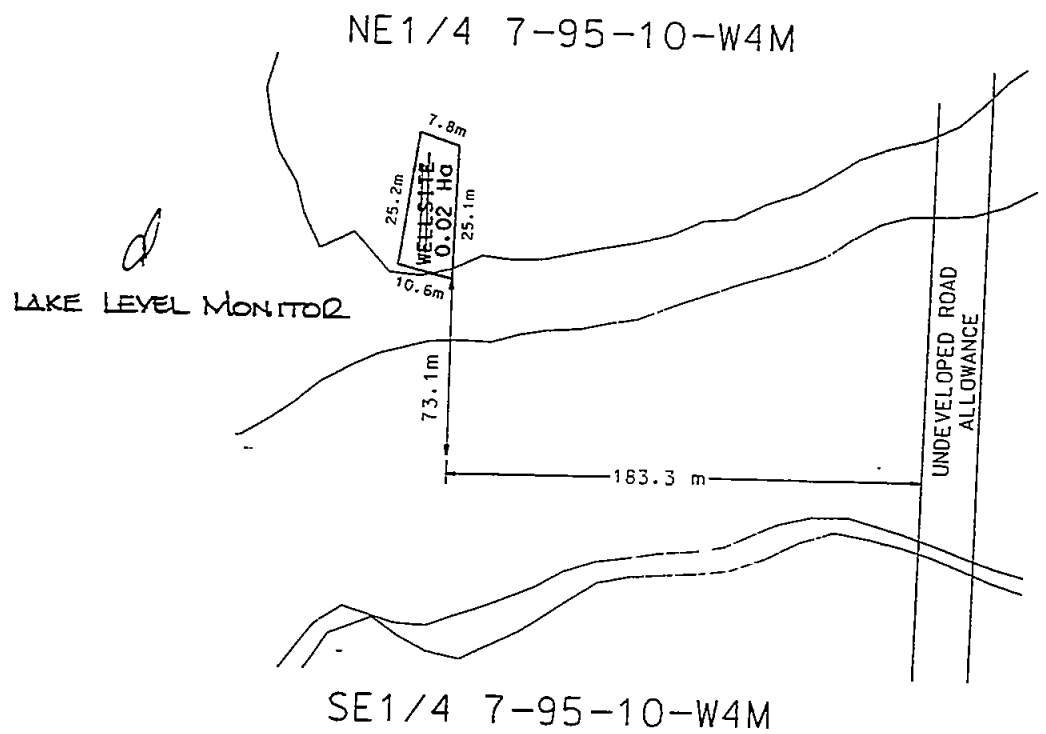
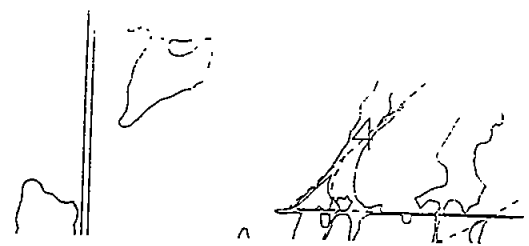
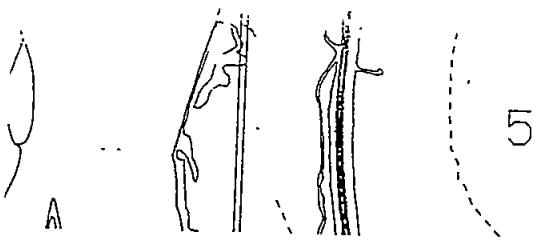
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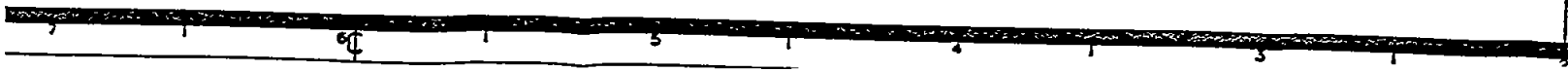
ENLARGED PLAN - DETAIL "A"  
SCALE: NTS

NO.	20290 TL
DATE	2000-05-19
LOC	LOC 001053
TEMPERATURE	TEMP.
SEALED	<i>d</i>

NO.	DATE	REVISION	BY	CHKD	APPD

**Syncrude**

CONTRACT NO.	CONTRACTOR					
SOL CONTRACT NO.						
DRAWING TITLE						
AURORA LOC APPLICATION FOR WATER WELL CREE BURN LAKE						
DATE	PLANT	TRAIN	SUBJECT	SEQUENCE	SHEET	REV.





Land and Forest Service  
Land Administration Division

Petroleum Plaza - South Tower  
9915 - 108 Street  
Edmonton, Alberta  
Canada T5K 2G8

File No. **LOC 001050**

Telephone (780) 427-3570  
FAX (780) 427-1185

June 16, 2000

Syncrude Canada Ltd.  
PO Bag 4023, MD 2000  
Fort McMurray, Alberta  
T9H 3H5

Attention: Mr. Barry Wolsey, Law Dept

Dear Sir:

**RE: Licence of Occupation Application No. LOC 001050  
Pt. LSD 12-04-096-08-W4  
Water Level Monitoring Station (Kearl Lake)  
LETTER OF AUTHORITY**

Further to your application dated May 8, 2000, this is to advise that the department has completed its review of your request.

Pursuant to Section 19 of the Public Lands Act, authority is hereby granted to enter upon those portions of vacant or other public lands for which you have obtained the occupant's consent, the approximate location of which is shown on the attached plan, for the purpose of a **water level monitoring station**, subject to the conditions in Schedule A, attached.

Based on the information supplied with your application, first year's charges for this authority are indicated below. Please remit this amount within 30 days. This account will be subject to a 12% interest charge if payment is not received within specified.

.../2

(CONDITIONS) SCHEDULE A

1. 001 IN THIS DOCUMENT, unless the context indicates otherwise:

"approval (of a departmental officer)" whenever required, must be in writing.

"authority" means: this document or the right to occupy public land granted by this document.

"department" means:

Department of Alberta Environment  
Land and Forest Service  
Land Administration Division  
Petroleum Plaza, South Tower  
3<sup>rd</sup> Floor, 9915 – 108<sup>th</sup> Street  
Edmonton, Alberta  
T5K 2G8  
Telephone: (780) 427-3570

"departmental officer" means: an employee of the Alberta Environment, Land and Forest Service; or Alberta Agriculture, Food and Rural Development, Public Lands responsible for the management of surface activity on the land.

"holder" means: the recipient of the right to occupy public land granted by this document.

"land(s)" means: the specific land which the holder is authorized to occupy by this document.

"minister" means: the Minister of Alberta Environment.

payments required by this document are to be made payable to "**The Provincial Treasurer**" and may be delivered to the nearest Public Lands or Land and Forest Service office, or mailed to:

Alberta Environment  
Land and Forest Service  
Main Floor, Petroleum Plaza, South Tower  
9915 – 108<sup>th</sup> Street  
Edmonton, Alberta  
T5K 2G8

- a) The holder shall comply with all relevant laws in the Province of Alberta.
- b) A copy of this authority shall be retained on the job site during all phases of your activity, including, if applicable, preparation, construction, development, maintenance and abandonment.

- c) Schedule "B", attached lists any prior and subsisting authorizations and dispositions (prior rights) issued on the quarter sections included in this authority. The holder shall not conduct any activity on the land where prior rights have been issued without the consent of the holder of these prior rights.

Surface rights plot sheets showing dispositions listed on Schedule "B" may be viewed at, or further information obtained from, the Technical Services Branch, Land Administration Division, 2<sup>nd</sup> Floor, Petroleum Plaza, South Tower, 9915 – 108<sup>th</sup> Street, Edmonton, Alberta, T5K 2G8, Telephone (780) 427-3509, Fax (780) 422-4252.

Copies of these plots or any plan showing the location of a disposition may be purchased from IHS Energy Group, Main Floor, Petroleum Plaza, South Tower, 9915 – 108<sup>th</sup> Street, Edmonton, Alberta, T5K 2G8, Telephone (780) 413-3380, Fax (780) 413-3383.

- d) If a trapping area (TPA) is listed in Schedule "B", the holder shall contact the registered trapper at least FIVE DAYS PRIOR TO COMMENCING ANY ACTIVITY. This must be done by registered mail and we recommend personal communication follow-up. The trapper's name and address may be obtained from the Department of Energy, Calgary Information Centre, Telephone: (403) 297-6324. For other information concerning registered traplines, contact the Licencing Section, Natural Resources Service, Department of Alberta Environment, Edmonton, Alberta, Telephone: (780) 427-6729, upon receipt of this approval. The holder may be responsible for any damage to traps, snares or other improvements.
- e) This authorization should not be construed as assuring that any other relevant approvals from this Department or any other department or agency of the Alberta Government will be granted.
- f) This authorization is granted subject to further amendment by the Minister of Alberta Environment, or his designate, based upon evidence obtained from an Alberta Energy and Utilities Board hearing that relates to the subject matter of this authorization.

2. 123

The holder shall contact and advise the departmental officer of its intentions:

- prior to entry upon the lands.
- prior to any additional construction during the term of this authority.
- at the completion of operations, and
- upon abandonment of this activity or cancellation of this authority.

**Northeast Boreal  
Waterways Forest Area  
Fort McMurray Office  
Telephone: (780) 743-7120**

3. 100 Prior to the commencement of any activity, the holder shall arrange and hold a meeting with a departmental officer to discuss site specific operating conditions, which may include access, creek crossings, timber salvage and wildlife concerns.
4. 117 Prior to commencement of construction, the holder shall obtain authority under The Water Act from Natural Resources Service of Alberta Environment at Edmonton, Alberta, Telephone: (780) 427-6451.
5. 060 The holder shall within 30 days provide to the department a written consent from the following occupant(s) who hold prior legal rights:
 

**Disposition No. FMA 9100029**  
**Joint Venture Parties**  
**Alberta-Pacific Forest Industries Inc.**  
**c/o Evergreen Land Use Consulting**  
**Floor 2, 410 – 6<sup>th</sup> Street SW**  
**Calgary, Alberta T2P 1X2**
6. Access to the site is by foot traffic only, unless otherwise approved by a departmental officer.
7. 165 Unless otherwise approved by a departmental officer, the holder shall use only existing clearings/trails and not clear any new areas.
8. 169 The holder may not conduct any activity incidental to this authority on land not included in this authority without prior approval from a departmental officer. (A departmental officer may approve land use for incidental activities such as campsites, borrow pits, temporary access, flare pits, remote sumps, trails and other temporary uses).
9. 183 The holder shall ensure that surface disturbance is kept to a minimum.
10. 241 The holder shall dispose of all debris/waste in a manner directed by a departmental officer.
11. 261 Timber salvage is waived.
12. 265 The holder shall not deposit or push debris, soil or other materials into or through any watercourse or water body or on the ice of any watercourse/water body.
13. 304 The holder shall take all precautions and safeguards necessary to prevent soil/surface erosion.
14. 204 The holder shall reclaim all disturbed areas immediately after operations.

15. 065 The lease, when issued, will be for a term as indicated effective from the date of this authority. Rental will also be assessed effective from this date.

**Term: 10 years**

All licences, authorizations and approvals issued under the Alberta Environment and Enhancement Act, Water Act or Public Lands Act should not be taken to mean the proponent (applicant) has complied with federal legislation. Proponents should contact Habitat Management, Central and Arctic Region, Fisheries and Oceans, 501 University Crescent, Winnipeg, Manitoba, R3T 2N6 (phone: 204 – 984-2505) in relation to the application of federal laws relating to the Fisheries Act (Canada) and the Navigation Protection Program, Canadian Coast Guard, 201 North Front Street, Suite 703, Sarnia, Ontario, N7T 8B1 (phone: 519 – 383-1862) relating to the Navigable Waters Protection Act.

MGW/jm

LAND STATUS AUTOMATED SYSTEM

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 REPORT DATE: 2000-05-19 TIME: 11:38:11

LAND STANDING REPORT

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 REQUESTED BY: LSLEI07 PAGE 1

**SCHEDULE "B"**  
 SELECTION CRITERIA

REQUESTED LAND LIST: INCLUDE  
 TITLE INFORMATION : INCLUDE  
 REQUEST LAND STATUS: INCLUDE

SELECT GEO-ADMINISTRATIVE AREA: ALL  
 SELECT ACTIVITIES:

INCL/EXCL	ACTIVITIES	MAX STATUS	ALL/NONE/SOME	IF SOME, SPECIFY TYPE
I	SURFACE DISP	6	ALL	
I	RESERVATIONS	6	ALL	
I	ENCUMBRANCES	6	ALL	
I	LAND POSTINGS	6	ALL	
I	INTERIM RECORDS	6	ALL	
I	SUBDIVISIONS	5	ALL	

REQUESTED ACTIVITY

REQUESTED ACTIVITY: LOC- 001050

REQUESTED LAND

REQUESTED LAND	OWNERSHIP STATUS	TITLE STATUS	ADMINISTERED BY	SURVEY STATUS	-- AREA IN HECTARES --		--- AREA IN ACRES ---	
					LAND	TITLE	LAND	TITLE
4-08-096-04-12	CROWN	UNTITLED FLW		UNSURVEYED				
TOTAL	CROWN	UNTITLED		UNSURVEYED				

LAND STATUS INFORMATION (TO QUARTER SECTION ONLY)

LAND IDENTIFIER	OWNERSHIP STATUS	TITLE STATUS	ADMINISTERED BY	SURVEY STATUS	-- AREA IN HECTARES --		--- AREA IN ACRES ---	
					LAND	TITLE	LAND	TITLE

GEO-ADMINISTRATIVE AREAS

COAL DEVELOPMENT REGION 4-08-096	NORTHERN FORESTED	CODE: CDR-2
ENVIRONMENT CONS. & RECL. DISTRICT 4-08-096	NO. 4	CODE: ERD-004
FOREST MANAGEMENT UNIT 4-08-096	ATHABASCA FOREST	A7 CODE: FMU-A -07J
FISH & WILDLIFE ADMIN REGION 4-08-096	NORTHEAST REGION	LAC LA BICHE CODE: FWA-4 -04
FISH AND WILDLIFE DISTRICT 4-08-096	NORTHEAST REGION	FORT MCMURRAY CODE: FWD-5 -07



LAND STATUS AUTOMATED SYSTEM

ENR-LSAS  
 REPORT DATE: 2000-05-19 TIME: 11:38:11

LAND STANDING REPORT

LSRC1130  
 REQUESTED BY: LSLEI07 PAGE 2

----- GEO-ADMINISTRATIVE AREAS -----

GENERAL LANDS CLASSIFICATION	GREEN	CODE: GLC-G
4-08-096		
GRAZING ZONE	C	CODE: GRZ-C
4-08-096		
INTEGRATED RESOURCE PLAN	FT. MCMURRAY ATHABASCA OIL SANDS	CODE: IRP-F1
4-08-096		
PUBLIC LAND DISTRICT	NORTHWEST REGION	SHERWOOD PARK
4-08-096		CODE: PLD-6 -6
RANGER DISTRICT	NORTHEAST BOREAL	FORT MCMURRAY - WATERWAYS DISTRICT
4-08-096		CODE: RAD-NEB -1C
SPECIALIZED MUNICIPALITY	REGIONAL MUNICIPALITY OF WOOD BUFFA	CODE: SM -001
4-08-096		

----- ACTIVITIES -----

ACTIVITY	STATUS/TYPE LAND ID	DATE HECTARES	EXPIRY ACRES	CLIENT/INTERIM REMARKS METES AND BOUNDS REMARKS	----- TOTAL AREA -----	
					ACRES	HECTARES
CNC-810154 <i>OR</i>	APPROVED 0530 INDUSTRIAL/COMMERCIAL SITE 4-08-096-04	ON 1981-NOV-04	2001-OCT-31	MOBIL OIL CANADA, LTD 1 NO RESTRICTION 710 SPECIFIED IN COMMENTS FIELD	12,000.00	4,856.227
CNT-870307 ✓	APPROVED 0530 INDUSTRIAL/COMMERCIAL SITE 4-08-096-04	ON 1988-FEB-11	1998-FEB-28	ALBERTA ENERGY AND UTILITIES BOAR 1 NO RESTRICTION 710 SPECIFIED IN COMMENTS FIELD	0.00	0.000
FMA-9100029	ACTIVE/DISPOSED 4-08-096	ON 1991-SEP-01	2011-AUG-31	JOINT VENTURE PARTIES	* 13,923,833.46	5,634,775.064
LOC- 5726	LOA AMENDMENT 4-08-096-04-NW	ON 1999-MAR-23	9999-999-99	IMPERIAL OIL RESOURCES LIMITED	64.49	26.100
LOC- 001050	APPLICATION 4-08-096-04-12	ON 2000-MAY-19	0.030 0.07	SYNCRUDE CANADA LTD. THE BED AND SHORE OF KEARL LAKE.	0.07	0.030
TPA- 1714	ACTIVE/DISPOSED 4-08-096-04-12	ON 1986-AUG-29	2000-JUN-30	L'HOMMECOURT, MARVIN W/KEARL L	0.00	0.000

\*\*\* NOTE: THE FOLLOWING DISCLAIMER \*\*\*

*THIS IS US*

LAND STATUS AUTOMATED SYSTEM

ENR-LSAS  
REPORT DATE: 2000-05-19

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TIME: 11:38:11

REQUESTED BY: LSLEI07

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PAGE 3

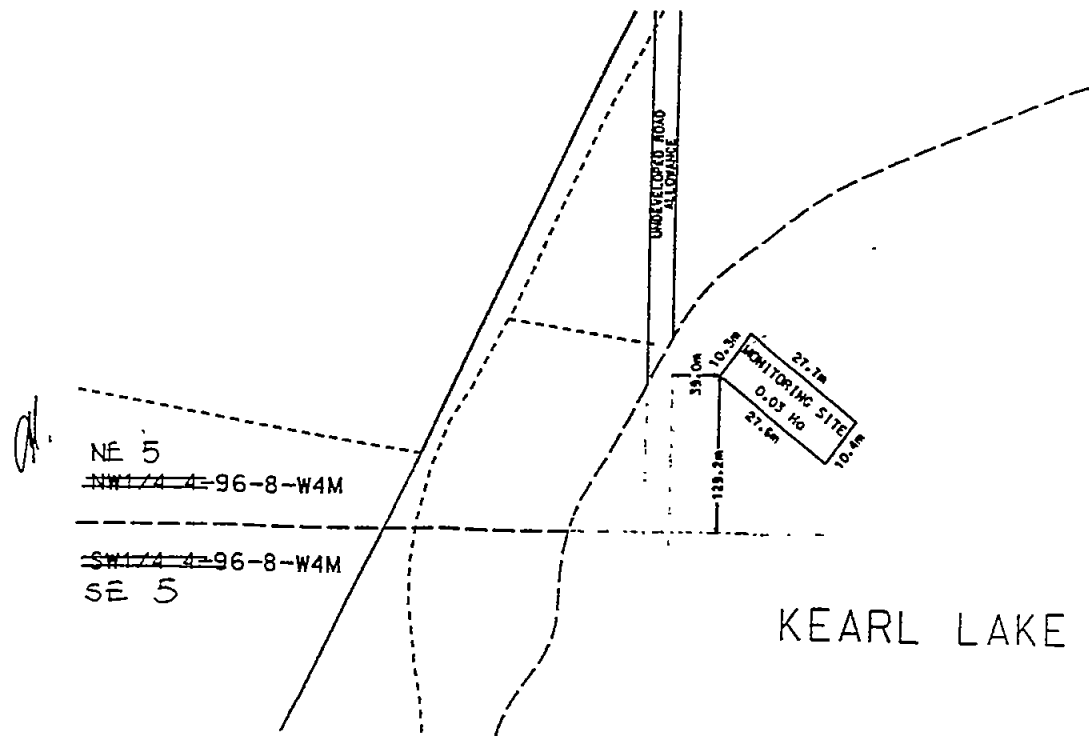
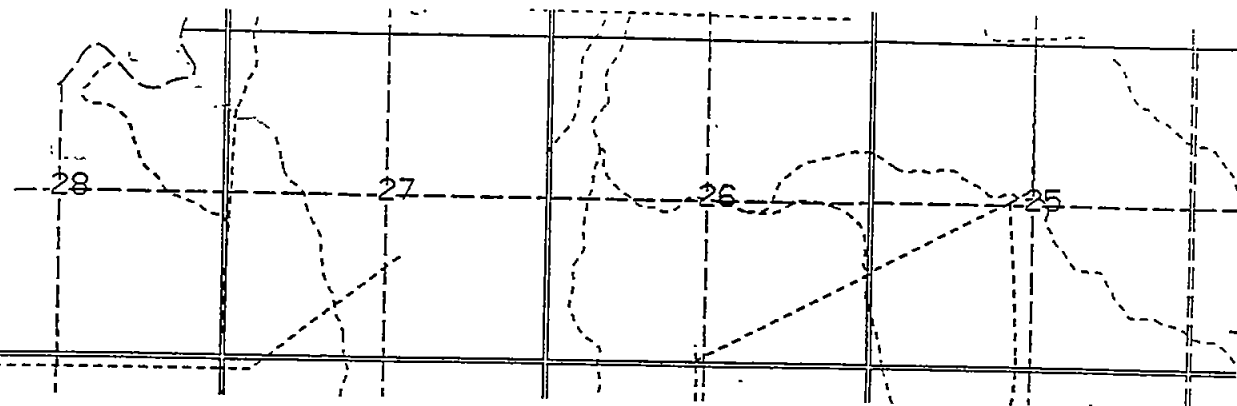
----- D I S C L A I M E R -----

THIS STANDING REPORT IS PROVIDED SUBJECT TO THE CONDITION THAT HER  
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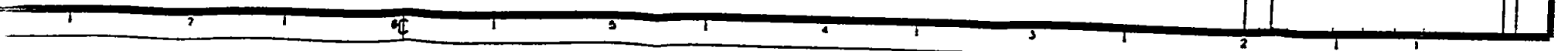
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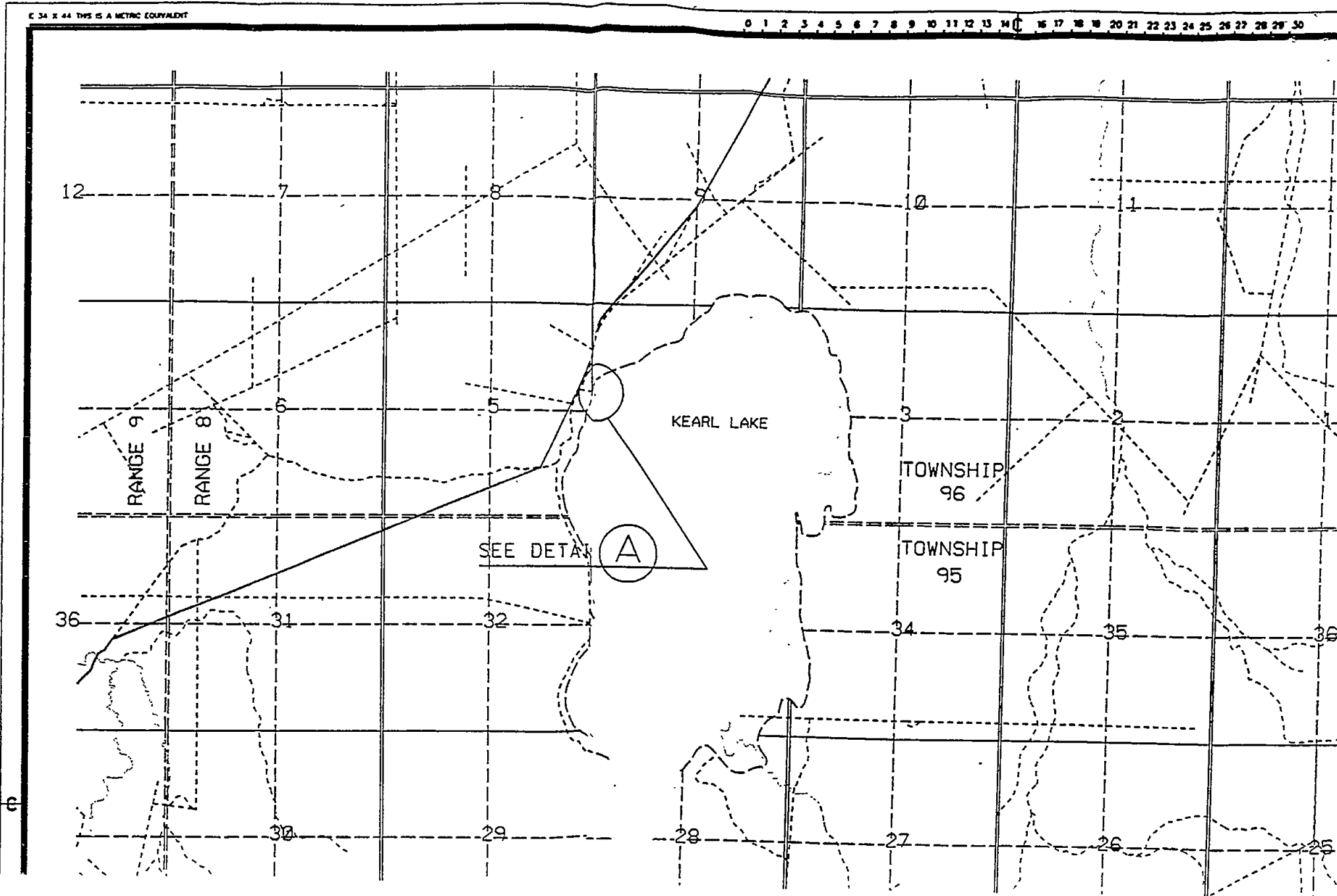


ENLARGED PLAN - DETAIL "A"  
SCALE: NTS

Plan #:	20287 TL
Version:	2000.05.19
File:	LOC 001050
TECHNICAL SERVICES	TEMP. <i>U</i>

Syncrude	
AURORA LOC APPLICATION FOR WATER MONITORING SITE - KEARL LAKE	
DATE	BY





**APPENDIX VIII**

**BRIEF DESCRIPTION OF 2000  
CLIMATIC AND HYDROLOGIC CONDITIONS  
INCLUDED IN RAMP REPORT**

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## **Brief Description of 2000 Climatic and Hydrologic Conditions Included in RAMP Report**

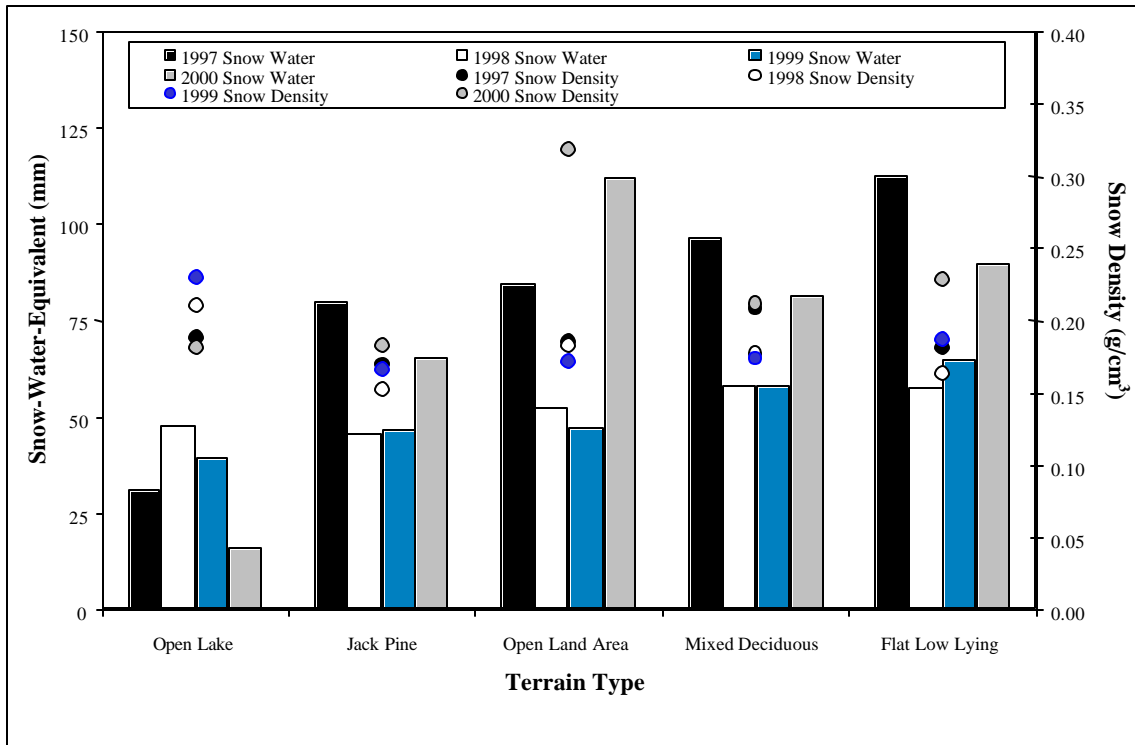
The core components of the 2000 monitoring program (water and sediment quality, benthic invertebrate communities and fish populations) are all influenced by climatic conditions. In particular, changes that alter the quantity of water in the Athabasca River, the tributaries of the Athabasca River, wetlands and lakes will influence these core components.

Monitoring of climatic and hydrologic conditions in the Oil Sands Region is accomplished via the RAMP Climatic and Hydrologic Monitoring Program. This program, which is currently supported by Syncrude, Albian, Mobil, True North, Petro Canada, and Suncor, has been in place since 1995. An annual report on the program is issued as Volume II of the 2000 RAMP report. Summaries of historical information, as well as data collected during 2000, are included in Volume II. Since changes in flows and water levels may affect both the success and the results of RAMP sampling throughout the study area, a summary of the 2000 conditions is provided as background information in this section.

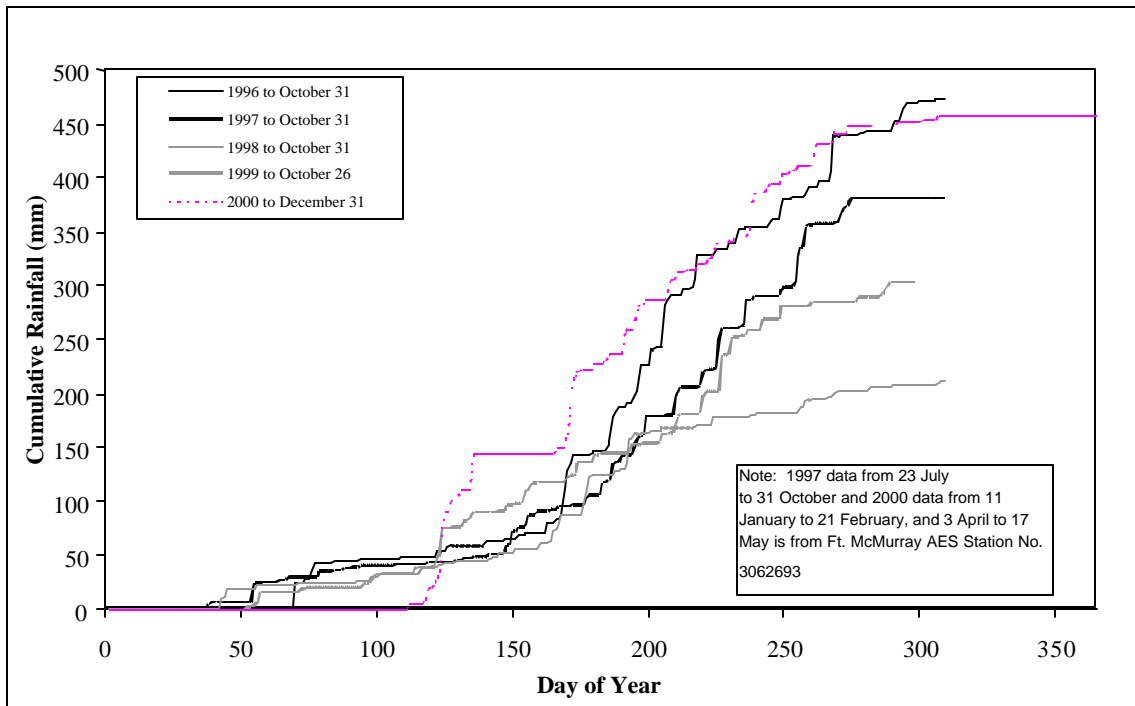
Field observations indicate that 2000 was a wetter than normal year in the Muskeg River and adjacent basins, in contrast to the dry conditions observed in 1998 and 1999. Heavy snowfall during November and December, 1999 was followed by light snowfall in early 2000. The resulting moderate snowpack (Figure VIII-1), combined with dry muskeg, produced relatively low stream discharges during snowmelt in 2000. However, significant rainfall occurred in late May and late June, as shown in Figure VIII-2. During the late June rainfall event, 63 mm of rain was measured at the Aurora Climate Station, and five-year flood events were measured on Jackpine Creek and the Muskeg and Firebag rivers. The total rainfall measured at the Aurora Climate Station in 2000 was 457 mm. This is similar to that measured in 1996 (472 mm) and significantly more than that measured in 1997, 1998 and 1999 (382 mm, 212 mm and 303 mm, respectively), as shown in Figure VIII-2.

The analysis of available data indicates that maximum daily stream discharges in 2000 were slightly higher than the long-term mean of annual maximum daily values (Table VIII-1). Minimum daily discharges were lower than the mean for most stations. Lower than normal minimum daily discharges occurred at the start of 2000 due to dry conditions occurring in 1999. The low of record on the Athabasca River, equal to the 50 year low flow, was recorded in January 2000, and a discharge equal to the 20 year low flow was recorded in the Muskeg River in January 2000. Minimum daily discharges during the latter half of 2000 were not representative of drought conditions.

**Figure VIII-1 Snow Accumulation in Muskeg River Basin, 1997 - 2000**



**Figure VIII-2 Cumulative Annual Rainfall at Aurora Climate Station, 1996 - 2000**



The cumulative flow volume for the period from March to September 2000 (i.e., spring melt to late summer) was similar to average (Table VIII-2) for local streams. However, the cumulative flow volume for the Athabasca River was the lowest recorded in 41 years of record. 1999 and 1998 were both dry years and the 2000 cumulative flow volumes were close to average. This indicates that dry muskeg areas observed in 1998 and 1999 may have recharged.

**Table VIII-1 Maximum and Minimum Mean Daily Discharges, RAMP Study Area**

Stream Station ID Period of Record	Athabasca R. 07DA001 41 Years	Steepbank R. 07DA006 27 Years	Muskeg R. 07DA008 27 Years	Jackpine Cr. S2 24 Years	MacKay R. 07DB001 28 Years	Firebag R. 07DC001 25 Years
<b>Maximum Mean Daily Discharge</b>						
2000 value (m <sup>3</sup> /s)	1790	43.9	37.8	12.7	73.5	137
average recorded (m <sup>3</sup> /s)	2460	35.6	26.5	7.54	126	104
maximum recorded (m <sup>3</sup> /s)	4700	81.0	66.1	17.2	339	236
flood return period (yr)	< 2 years	3 years	5 years	5 years	< 2 years	5 years
<b>Minimum Mean Daily Discharge</b>						
2000 value (m <sup>3</sup> /s)	89	0.617	0.105	0.116	0.160	7.19
average recorded (m <sup>3</sup> /s)	136	0.294	0.277	0.007	0.352	8.00
minimum recorded (m <sup>3</sup> /s)	89	0.022	0.095	0.000	0.023	4.24
drought return period (yr)	50 years	< 2 years	20 years	n/a	7 years	4 years

Source: Environment Canada, Water Survey Branch; Golder (2000).

**Table VIII-2 Cumulative Streamflow Volumes, RAMP Study Area, March to September**

Stream Station ID Period of Record	Athabasca R. 07DA001 41 Years	Steepbank R. 07DA006 27 Years	Muskeg R. 07DA008 27 Years	Jackpine Cr. S2 24 Years	MacKay R. 07DB001 28 Years	Firebag R. 07DC001 25 Years
2000 value (dam <sup>3</sup> )	11,782,282	135,438	127,440	25,920	340,377	660,874
maximum recorded (dam <sup>3</sup> )	25,279,862	273,634	187,146	59,051	904,734	903,836
average recorded (dam <sup>3</sup> )	16,696,140	134,073	105,526	27,340	427,279	605,260
minimum recorded (dam <sup>3</sup> )	11,782,282	36,587	18,151	1,000	28,526	344,469
drought return period (yr)	20 years	< 2 years	< 2 years	< 2 Years	3 years	< 2 Years

Source: Environment Canada, Water Survey Branch; Golder (2000).



**APPENDIX IX**  
**UPDATED CLIMATIC AND HYDROLOGIC DATABASE**

The database CD included in this appendix contains data from local monitoring programs and regional data collected by the Meteorologic Service Canada (MSC) and Water Survey of Canada (WSC). A digital copy of this report is also provided on the CD. The data included in the database CD were discussed in Section 6 of this report. The following table shows the directory structure of the database CD.

**Directory of Database CD in Appendix IX**

DATABASE_CD			
Local		Regional	
Hydrology	Climate	Hydrology	Climate
Stream Gauging Data	Aurora Climate Station	Daily Mean WSC Data	Daily MSC Data
S1-Alsands Drain-95to00.xls	Aurora-Climate-95to00.xls	Regional-Daily Discharges-00 Update.xls	Regional-Daily Climate-00 Update.xls
S2-Jackpine Creek-95to00.xls	Aurora-Raw Data-95to00.xls		Hourly MSC Data
S3-Iyininin Creek-95to99.xls	Aurora-Wind Roses-95to00.xls		Ft McMurray A-Hourly Temperature-53to00.xls
S4-Blackfly Creek-95to98.xls	Aurora-Wind Roses-95to00.xls		Ft McMurray A-Hourly Wind-53to00.xls
S5A-Muskeg River Aurora-95to00.xls	Other Climatic Data		Ft McMurray A-Hourly Pressure-53to00.xls
S6-Mills Creek-96to00.xls	Iyininin-TBRG-99to99.xls		Mildred Lake-Hourly Climate-85to00.xls
S7-Muskeg River WSC-98to00.xls	Kearl-Barometer-99to00.xls		
S8-Stanley Creek-99to00.xls	Snow Survey Data		
S9-Kearl Lake Outlet-98to99.xls	Muskeg-Snow Survey-97.xls		
S10-Wapasu Creek-98to99.xls	Muskeg-Snow Survey-98.xls		
S11-Poplar Creek-95to00.xls	Muskeg-Snow Survey-99.xls		
S12-Fort Creek-00to00.xls	Muskeg-Snow Survey-00.xls		
S13-Albian Pond #3-00to00.xls			
L1-McClelland Lake-97to99.xls			
L2-Kearl Lake-99to99.xls			
L3-Isadore's Lake-00to00.xls			
Other Data			
Muskeg-Ice Observations-97to00.xls			
Muskeg-TSS Observations-97to00.xls			