OIL SANDS REGIONAL AQUATICS MONITORING PROGRAM (RAMP) 2001

VOLUME II:

CLIMATIC AND HYDROLOGIC MONITORING

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FINAL REPORT ON

OIL SANDS REGIONAL AQUATICS MONITORING PROGRAM (RAMP) 2001

VOLUME II: CLIMATIC AND HYDROLOGIC MONITORING

Submitted to:
RAMP Steering Committee

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EXECUTIVE SUMMARY

This report documents the climatic and hydrologic data collection in 2001 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 Albian Sands, Canadian Natural Resources, ExxonMobil, Petro-Canada, Suncor, Syncrude and TrueNorth.

The 2001 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, atmospheric pressure and wind speeds and directions. Operation and maintenance of the station 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 2001 program included the following:

- manual flow measurements, development or update of stage-discharge rating curves, and derivation of hourly and daily discharges at the streamflow monitoring stations including McClelland Lake Outlet (L1), Alsands Drain (S1), Jackpine Creek (S2), Iyinimin Creek (S3), Muskeg River Aurora (S5A), Mills Creek (S6), Muskeg River 7DA8 (S7), Kearl Lake Outlet (S9), Wapasu Creek (S10), Poplar Creek (S11), Fort Creek (S12), Albian Sands Pond #3 (S13), Ells River (S14), Tar River (S15), Calumet River (S16), Tar River Upland (S17), Calumet River Upland (S18), Tar River Lowland (S19), Muskeg River Upland (S20), Shelley Creek (S21), Muskeg Creek (S22), Aurora Boundary Weir (S23) and Athabasca River (S24);
- measurements of high water marks at seven staff gauges on the Muskeg River and Jackpine Creek;
- 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 selected streamflow and lake monitoring stations.

This report documents the work associated with installation of new water level monitoring stations on the Ells River (S14), Tar River (S15), Calumet River (S16), Tar River Upland (S17), Calumet River Upland (S18), Tar River Lowland (S19), Muskeg River Upland (S20), Shelley Creek (S21), Muskeg Creek (S22), Aurora Boundary Weir (S23), Athabasca River (S24) and Khahago Creek (S28). Blackfly Creek (S4) was not monitored in 2001.

The snow course survey conducted on March 18-19, 2001 provided a basis for determining the average accumulated snow depth in the Muskeg River watershed and snow re-distribution in five representative terrain types. The 2001 survey was a continuation of a five-year program in the Muskeg River basin 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 2001 program has resulted in development of a regional climatic and hydrologic database. This database (which is updated to the end of 2001) is stored on a compact disc to facilitate user access.

It is recommended that the collection of climatic and hydrologic data at the existing monitoring stations be continued. Furthermore, monitoring should cover the entire year including winter low flows, snowmelt and summer flows. Specific recommendations for the 2002 monitoring program include ongoing operation and maintenance of the climatic and hydrologic monitoring stations, and a snow course survey on the Canadian Natural Resources Ltd. lease for the 2001/2002 winter.

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1 INTRODUCTION

This report presents the methodology and data collected in the 2001 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. Joint funding for the 2001 monitoring program, which was conducted by Golder Associates Ltd. (Golder), way provided by: Albian Sands Energy Inc. (Albian Sands), Canadian Natural Resources Ltd. (CNRL), ExxonMobil (ExxonMobil), Petro-Canada Oil and Gas Ltd. (Petro-Canada), Shell Canada Ltd. (Shell), Suncor Energy Inc. (Suncor), Syncrude Canada Ltd. (Syncrude) and TrueNorth Energy Inc. (TrueNorth). The objectives of this program were as follows:

- to undertake climatic and hydrologic monitoring as required by Alberta Environment in the regulatory approvals for the Syncrude Aurora and Albian Sands Muskeg River Mine projects;
- to undertake climatic and hydrologic monitoring as recommended in the environmental impact assessments (EIA's) for the Syncrude Aurora and Albian Sands Muskeg River Mine projects;
- to undertake baseline hydrologic monitoring for the TrueNorth Fort Hills Oil Sands Project EIA, the Shell Jackpine Mine – Phase 1 EIA and the CNRL Horizon 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 (Albian Sands, CNRL, ExxonMobil, Petro-Canada, Shell, Suncor, Syncrude and TrueNorth).

The 2001 program focused on climatic and hydrologic monitoring in the Muskeg River basin and the east slopes of the Birch Mountains. However the program also included hydrologic monitoring of the Athabasca River downstream of the proposed oil sands developments, and monitoring of Mills Creek, Fort Creek, Poplar Creek, McClelland Lake and Isadore's Lake, all of which drain to the Athabasca River. The 2001 program design was based on the current regulatory monitoring requirements, the long-term need for expanding the regional climatic and hydrologic database. The program design was based on a thorough understanding of the historic database developed to date.

Environment Canada operates 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 Environment Canada. Other climatic and hydrologic monitoring efforts initiated by oil sands developers in the region 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, Iyinimin 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 Sands) 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, ExxonMobil and Suncor (1998 and 1999)**

  Syncrude, Shell (Albian Sands), ExxonMobil 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 and 2001)**

  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 Sands, ExxonMobil, Suncor, Shell, TrueNorth and Petro-Canada, while CNRL joined the program as a funder. The program expanded in scope to include hydrologic monitoring on the Ells River, Tar River, Calumet River, Upland Tar River, Upland Calumet River, Lowland Tar River, Upland Muskeg River, Shelley Creek, Muskeg Creek, Aurora Boundary Weir, Athabasca River and Khahago Creek Stations. The hydrologic monitoring on Iyinimin Creek, Kearl Lake Outlet and Wapasu Creek, that was suspended in 2000, was re-started in 2001. The snow course survey program initiated in 1997 was continued.

In accordance with the draft rationale document prepared by Golder in February 2001, the scope of work for the 2001 monitoring program was designed to include the following:

- collection and compilation of climatic data recorded at the Aurora Climate Station;
- collection and compilation of snow course data in the Muskeg River basin;
- installation of streamflow monitoring stations on the Ells River, Tar River, Calumet River, Upland Tar River, Upland Calumet River, Lowland Tar River, Upland Muskeg River, Shelley Creek, Muskeg Creek, Athabasca River and Khahago Creek;
- reinstallation of streamflow monitoring stations on Iyinimin Creek, Kearl Lake Outlet and Wapasu Creek;
- collection, processing and compilation of streamflow data at 14 streamflow monitoring stations in the Muskeg River basin, including new stations on the Upland Muskeg River, Shelley Creek, Muskeg Creek and Khahago Creek, at six streamflow monitoring stations on the east slopes of the Birch Mountains, including new stations on the Ells River, Tar River, Calumet River, Upland Tar River, Upland Calumet River and Lowland Tar River, at four streamflow monitoring stations on Athabasca River tributaries, and at one new station on the Athabasca River; and
- collection, processing and compilation of water level data at three lake level monitoring stations at McClelland, Kearl and Isadore's lakes.

The climatic and hydrologic data documented in this report were collected from January to December 2001. Figure 1.1 shows the locations of the climatic and

hydrologic monitoring stations covered in the 2001 program, which included the Aurora Climate Station and the following hydrologic stations:

- Alsands Drain (S1);
- Jackpine Creek (S2);
- Iyinimin Creek (S3);
- Blackfly Creek (S4) (inactive in 2001);
- Muskeg River Aurora (S5A);
- Mills Creek (S6);
- Muskeg River 7DA8 (S7);
- Stanley Creek (S8);
- Kearl Lake Outlet Creek (S9);
- Wapasu Creek (S10);
- Poplar Creek (S11);
- Fort Creek (S12);
- Albian Sands Pond #3 (S13);
- Ells River (S14);
- Tar River (S15);
- Calumet River (S16);
- Upland Tar River (S17);
- Upland Calumet River (S18);
- Lowland Tar River (S19);
- Upland Muskeg River (S20);
- Shelley Creek (S21);
- Muskeg Creek (S22);
- Aurora Boundary Weir (S23);
- Athabasca River (S24);
- Susan Lake Outlet Creek (S25) (proposed for 2002);
- MacKay River 7DB1 (S26) (proposed for 2002);
- Firebag River 7DC1 (S27) (proposed for 2002);
- Khahago Creek (S28);
- McClelland Lake (L1);
- Kearl Lake (L2); and
- Isadore's Lake (L3).

A brief description of the climatic and hydrologic conditions in 2001 is provided in Appendix I.

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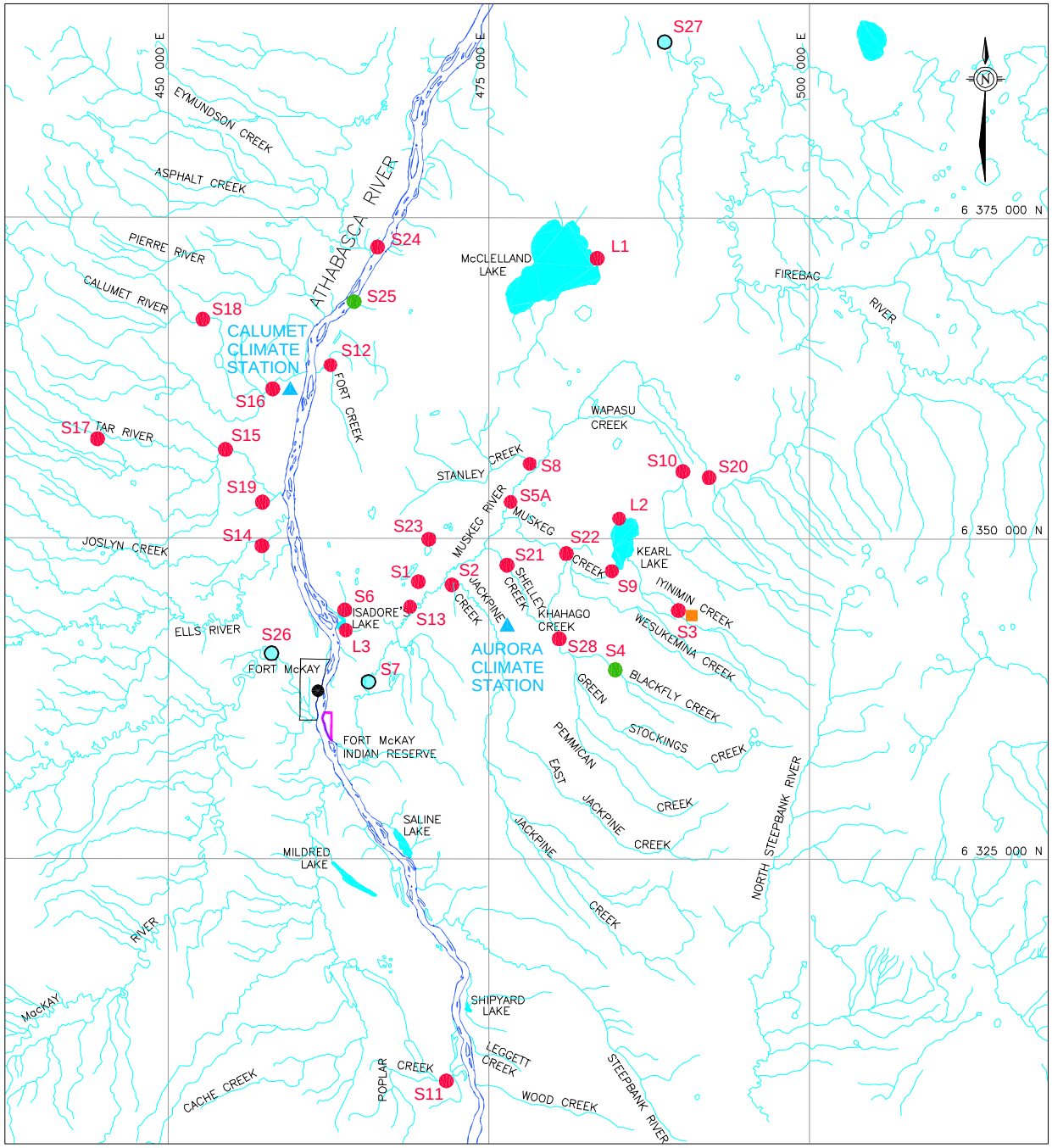


LEGEND

- ACTIVE HYDROLOGIC STATION (SUMMER OR YEAR–ROUND MONITORING BY RAMP)
- ACTIVE HYDROLOGIC STATION (WINTER MONIOTORING BY RAMP; SUMMER MONITORING BY WSC)
- INACTIVE HYDROLOGIC STATION
- RAMP CLIMATIC STATION
- RAMP RAIN GAUGE

10 0 10
SCALE KILOMETRES

NOTE

STATION S4 WAS NOT OPERATIONAL IN 2001

REFERENCE

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

PROJECT

RAMP

TITLE

LOCATIONS OF CLIMATIC AND HYDROLOGIC MONITORING STATIONS

Golder Associates
Calgary, Alberta

PROJECT No. 022–2301.7000			FILE No. climatic and hydro	
DESIGN			SCALE AS SHOWN	REV. 0
CADD	DLM	05/03/02	FIGURE: 1.1	
CHECK				
REVIEW				

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; it was operated for only one year (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
Vaisala PTB 101B Barometric Sensor, currently installed in Lakewood RX-2 data logger	atmospheric pressure

2.2 STATION OPERATION AND MAINTENANCE

The station operation and maintenance in 2001 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 to avoid missing periods of data. The station was visited on January 16, February 15, March 18, April 20, May 8, June 10, July 8, August 6, September 19, October 27 and December 6, 2001.

The tipping-bucket snow gauge and snowfall adapter that was installed in 2001 operated successfully through 2001. Other sensors replaced in 2000 remained in service throughout 2001. These should be replaced with recalibrated sensors, as part of the regular 2002 maintenance program.

The Aurora Climate Station operated continuously in 2001 with no data gaps. However, as discussed in the 2000 report, this station should be considered a candidate for retrofitting with a remote data retrieval system.

2.3 DATA PROCESSING AND COMPILATION

The hourly climatic data recorded in the data-logger storage modules were downloaded eleven times in 2001. Continuous measurements were available from January 1 to December 31, 2001. These hourly data were processed to derive the daily and monthly data. The daily data are presented in Appendix II. Table 2.2 presents the monthly climatic data statistics based on the recorded data, including air temperatures, rainfall, snowfall, solar radiation, atmospheric pressure and wind speeds and directions. Recorded and processed hourly climatic data collected in 2001 are stored on a compact disc in Appendix III.

Table 2.2 Summary of 2001 Climatic Data Statistics Recorded at the Aurora Climate Station

Month	Temperature			Total Rainfall (mm)	Total Snowfall[a] (mm)	Mean Relative Humidity (%)	Mean Daily Global Solar Radiation (kW·h/m^2)	Wind Speed and Direction				
								Mean Daily Wind		Maximum Sustained Gusts		
	Minimum (°C)	Mean (°C)	Maximum (°C)					Speed (km/h)	Direction (degrees)	5 Second (km/h)	2 Minute (km/h)	10 Minute (km/h)
Jan	-31.9	-9.8	4.0	0.0	5.7	87.8	19.8	4.0	165.7	28.9	19.1	15.5
Feb	-39.9	-17.1	11.6	0.0	13.2	75.8	41.3	4.0	154.5	29.2	16.7	12.6
Mar	-33.5	-6.6	11.9	0.0	22.9	68.2	94.1	5.5	176.5	39.2	24.6	19.5
Apr	-14.5	3.1	26.8	9.8	3.6	58.4	142.5	6.1	154.6	57.9	34.3	27.8
May	-6.1	10.3	27.3	63.2	0.0	61.3	160.7	5.7	187.7	43.6	25.7	21.6
Jun	-0.5	14.6	30.3	72.0	0.0	67.0	180.2	4.3	152.9	44.0	26.1	19.4
Jul	1.5	17.6	31.7	58.4	0.0	72.0	185.9	4.1	189.0	41.8	23.4	18.0
Aug	2.4	16.2	31.7	80.6	0.0	75.7	150.2	3.7	196.0	42.8	19.8	16.3
Sep	-1.6	11.1	30.5	28.2	0.0	77.4	94.7	3.7	187.7	37.4	20.5	18.0
Oct	-15.5	0.2	17.9	10.4	3.0	78.6	49.6	4.2	191.9	40.6	27.1	20.1
Nov	-22.3	-5.2	9.1	0.0	19.6	86.3	19.1	4.3	162.0	31.9	16.6	13.6
Dec	-38.4	-17.0	-0.7	0.0	21.1	86.3	5.2	2.9	191.6	33.7	19.7	16.2

(a) Snowfall is expressed as snow water equivalent, based on snowmelt measured with a tipping bucket snow gauge.

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 a watershed during winter as well as snow re-distribution 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, 1999 and 2000. The 2001 program was a continuation of this systematic snow course survey program. Although the survey was conducted in the Muskeg River basin from 1997 to 2001, 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 2001 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.

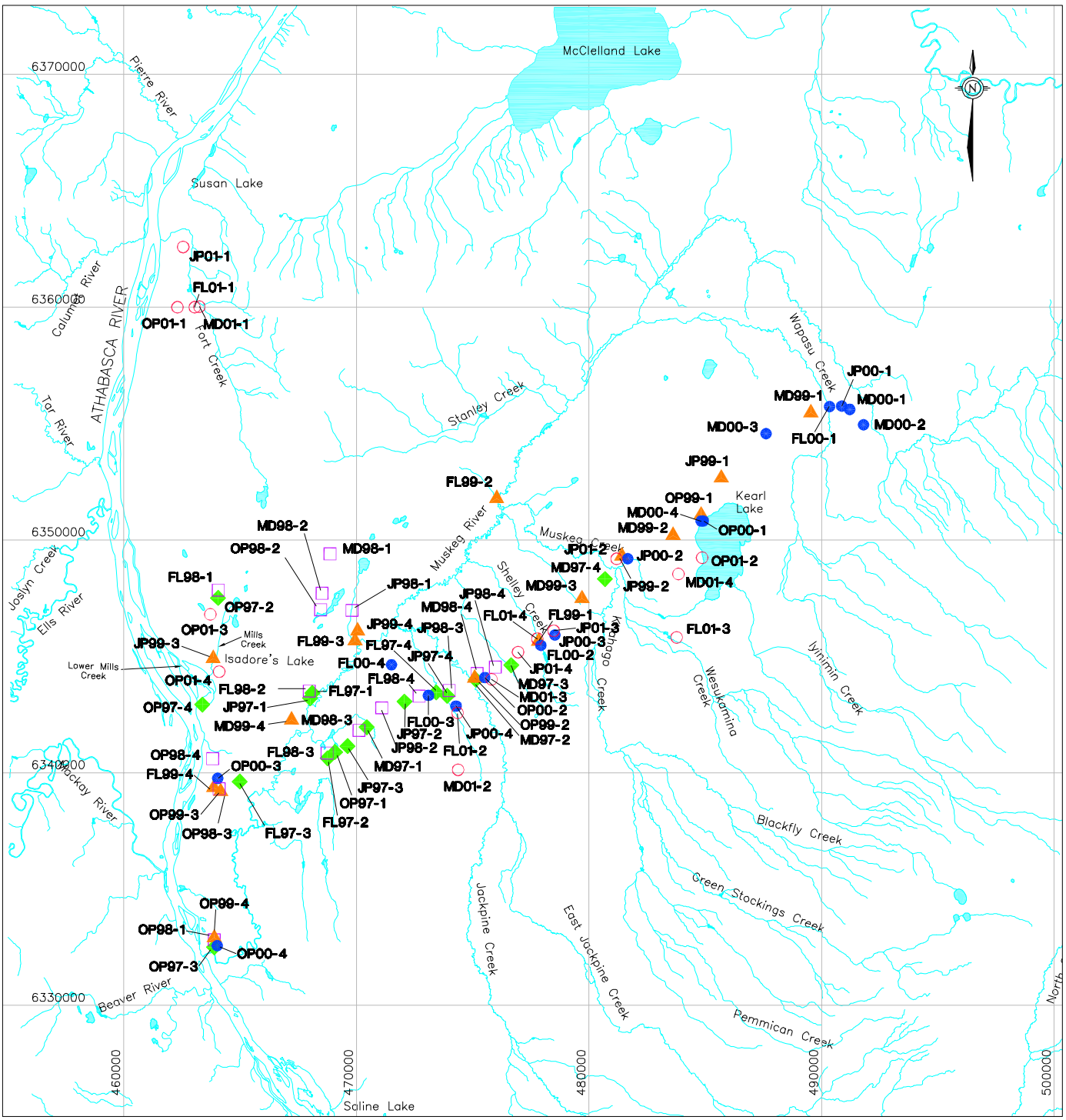
- **Snow Density Measurement**

  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 IV presents the terrain type, snow cover information and snowpack measurement data collected on March 18 and 19, 2001. 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), March 15 to 17, 1999 (Golder 2000) and March 12, 2000 (Golder 2001). Photographs of sampling locations were not presented in 2000 or 2001, but photos representative of the various terrain types were provided in previous reports.

3.4 SUMMARY OF SNOW COURSE DATA 1997-2001

The snow course survey sampling locations for the 1997 to 2001 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	JACK PINE
◆ 97	1997 SNOW COURSE SURVEY
□ 98	1998 SNOW COURSE SURVEY
▲ 99	1999 SNOW COURSE SURVEY
● 00	2000 SNOW COURSE SURVEY
○ 01	2001 SNOW COURSE SURVEY

REFERENCE

DRAWING FROM AGRA EARTH AND ENVIRONMENTAL LIMITED FIG.1435-A3 CATCHMENT BOUNDARIES OF LOCAL STUDY AREA JAN, 1996. NAD 83, UTM ZONE 12

5 0 5
SCALE KILOMETRES

PROJECT
RAMP

TITLE
LOCATIONS OF SNOW COURSE SURVEY SITES

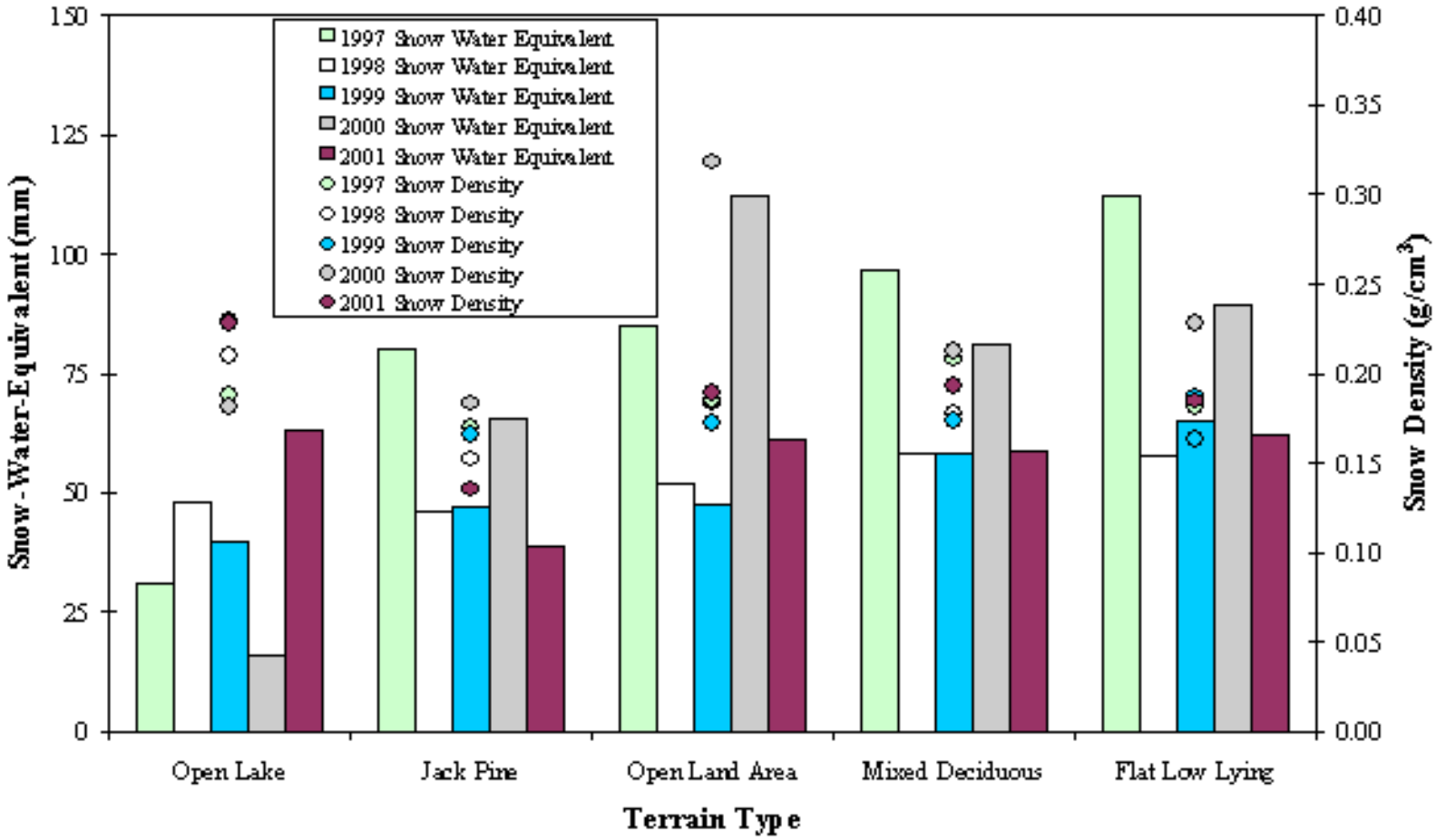
Golder Associates
Calgary, Alberta

PROJECT No. 022-2301.7000			FILE No. snow course survey	
DESIGN			SCALE AS SHOWN	REV. 0
CADD	JMA	11/03/02	FIGURE: 3.1	
CHECK				
REVIEW				

R:\Active\2300\022-2301\2001_Report\Report Volume II\2001 Final Report\RAMP Vol II 2001 - CD\REPORT\CAD Figures\ Drawing file: Snow course survey sites.dwg Apr 17, 2002 - 2:26pm

Table 3.1 Summary of 1997-2001 Muskeg River Basin Snow Course Survey Data

	1997 Snow Course Survey				1998 Snow Course Survey				1999 Snow Course Survey				2000 Snow Course Survey				2001 Snow Course Survey			
Terrain Type	Survey Plot No.	Snow Density (g/cm^3)	Snow Depth (cm)	Snow Water Equivalent (mm)	Survey Plot No.	Snow Density (g/cm^3)	Snow Depth (cm)	Snow Water Equivalent (mm)	Survey Plot No.	Snow Density (g/cm^3)	Snow Depth (cm)	Snow Water Equivalent (mm)	Survey Plot No.	Snow Density (g/cm^3)	Snow Depth (cm)	Snow Water Equivalent (mm)	Survey Plot No.	Snow Density (g/cm^3)	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	OP01-1	0.228	28.7	63.0
	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	OP01-3	N/A	N/A	N/A
	97 Mean	**0.188**	**16.4**	**31.2**	**98 Mean**	**0.210**	**24.7**	**48.0**	**99 Mean**	**0.229**	**17.3**	**39.6**	**00 Mean**	**0.181**	**9.0**	**16.2**	**01 Mean**	**0.228**	**28.7**	**63.0**
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	JP01-1	0.149	25.3	37.8
	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	JP01-2	0.138	33.3	45.8
	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	JP01-3	0.119	26.7	31.9
	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	JP01-4	0.136	29.3	39.7
	97 Mean	**0.170**	**46.9**	**79.9**	**98 Mean**	**0.152**	**30.3**	**45.9**	**99 Mean**	**0.166**	**28.4**	**46.9**	**00 Mean**	**0.183**	**35.5**	**65.4**	**00 Mean**	**0.136**	**28.7**	**38.8**
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	OP01-2	0.161	30.5	49.1
													OP00-3	0.280	30.2	84.7	OP01-3	0.218	33.7	73.3
	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	OP01-4	0.195	32.0	62.4
	97 Mean	**0.185**	**46.0**	**84.9**	**98 Mean**	**0.183**	**28.9**	**52.1**	**99 Mean**	**0.172**	**29.1**	**47.6**	**00 Mean**	**0.318**	**34.7**	**112.0**	**01 Mean**	**0.190**	**32.1**	**61.2**
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	MD01-1	0.252	28.2	70.9
	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	MD01-2	0.196	36.3	71.2
	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	MD01-3	0.155	29.3	45.4
	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	MD01-4	0.167	28.5	47.6
	97 Mean	**0.208**	**46.2**	**96.5**	**98 Mean**	**0.177**	**33.0**	**58.2**	**99 Mean**	**0.174**	**33.7**	**58.1**	**00 Mean**	**0.212**	**38.3**	**81.1**	**01 Mean**	**0.193**	**30.6**	**58.8**
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	FL01-1	0.132	35.6	47.1
	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	FL01-2	0.225	32.2	72.4
	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	FL01-3	0.155	40.7	63.2
	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	FL01-4	0.226	29.2	66.2
	97 Mean	**0.181**	**61.7**	**112.3**	**98 Mean**	**0.163**	**35.6**	**57.6**	**99 Mean**	**0.187**	**34.7**	**64.9**	**00 Mean**	**0.228**	**39.5**	**89.4**	**01 Mean**	**0.185**	**34.4**	**62.2**



PROJECT

RAMP

TITLE

SNOW WATER EQUIVALENT AND SNOW DENSITY OF VARIOUS TERRAIN TYPES

Golder Associates
Calgary, Alberta

PROJECT No. 022-2301.7000			FILE No. snow water equiv
DESIGN			SCALE AS SHOWN REV. 0
CADD	AS	05/02/02	
CHECK			**FIGURE: 3.2**
REVIEW			

The data in Table 3.1 and Figure 3.2 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. Differences in snow accumulation appear to be less pronounced in 2001 than in previous years.

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; and 39 and 59 mm in 2001). 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; and 62 mm in 2001).

Open lake areas generally have the smallest snow-water-equivalent depth (31 mm in 1997; 48 mm in 1998; 40 mm in 1999; 16 mm in 2000; and 63 mm in 2001), 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; and 61 mm in 2001). 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 S24 and S28 and the lake level monitoring stations are named L1 to L3. The stations at Ells River (S14), Tar River (S15), Calumet River (S16), Upland Tar River (S17), Upland Calumet River (S18), Lowland Tar River (S19), Upland Muskeg River (S20); Shelley Creek (S21, Muskeg Creek (S22), Aurora Boundary Weir (S23), Athabasca River (S24) and Khahago Creek (S28) were installed and commenced operation in 2000. The monitoring stations at Iyinimin Creek (S3), Kearl Lake Outlet (S9) and Wapasu Creek (S10) were reactivated in 2001, and the monitoring station at Blackfly Creek (S4) was inactive in 2001. Station labels S25, S26 and S27 are reserved for the stations that will be included in the 2002 RAMP work. Table 4.1 summarizes the pertinent details of the hydrologic monitoring stations included in the 2001 program. Additional information, including photographs and descriptions of equipment, is provided on each station's Factsheet in Appendix V.

Table 4.1 Details of Hydrologic Monitoring Stations

Station No.	Stream Name	Station Location		Basin Area (km^2)	Period of Record
		Latitude (N)	Longitude (W)		
S1	Alsands Drain	57° 15' 12"	111° 29' 52"	15.8	1995 – 2001
S2[(a)]	Jackpine Creek	57° 14' 21"	111° 24' 53"	358	1995 – 2001
S3	Iyinimin Creek	57° 15' 00"	111° 10' 27"	24.5	1995 – 1999; 2001
S4	Blackfly Creek	57° 12' 20"	111° 15' 22"	38.2	1995 – 1998
S5A[(b)]	Muskeg River Aurora	57° 18' 30"	111° 23' 43"	552	1995 – 2001
S6	Mills Creek	57° 14' 44"	111° 35' 57"	23.8	1997 – 2001
S7	Muskeg River 7DA8	57° 11' 29"	111° 34' 10"	1,460	1975 – 2001
S8	Stanley Creek	57° 21' 06"	111° 22' 26"	71.8	1999 – 2001
S9	Kearl Lake Outlet	57° 15' 57"	111° 15' 57"	73.6	1998 – 1999; 2001
S10	Wapasu Creek	57° 20' 35"	111° 09' 40"	90.7	1997 – 1999; 2001
S11	Poplar Creek	56° 54' 46"	111° 27' 44"	422	1995 – 2001
S12	Fort Creek	57° 24' 48"	111° 37' 18"	35.5	2000 – 2001
S13	Albian Sands Pond #3	57° 14' 47"	111° 30' 58"	disturbed	2000 – 2001
S14	Ells River	57° 17' 10"	111° 42' 30"	2,450	2001
S15	Tar River	57° 21' 12"	111° 45' 25"	301	2001
S16	Calumet River	57° 23' 46"	111° 41' 47"	182	2001
S17	Upland Tar River	57° 21' 35"	111° 55' 22"	13.8	2001
S18	Upland Calumet River	57° 26' 40"	111° 47' 17"	48	2001
S19	Lowland Tar River	57° 19' 00"	111° 42' 30"	11.5	2001
S20	Upland Muskeg	57° 20' 09"	111° 07' 48"	157	2001
S21	Shelley Creek	57° 16' 26"	111° 23' 28"	16	2001
S22	Muskeg Creek	57° 16' 56"	111° 18' 52"	345	2001
S23	Aurora Boundary Weir	57° 17' 30"	111° 29' 33"	disturbed	2001
S24	Athabasca River	57° 29' 46"	111° 33' 43"	146,000	2001
S25	Susan Lake Outlet	57° 27' 28"	111° 35' 31"	13.6	2001
S26	MacKay River 7DB1	57° 12' 39"	111° 41' 41"	5,570	2001
S27	Firebag River 7DC1	57° 38' 26"	111° 11' 22"	5,990	2001
S28	Khahago Creek	57° 13' 21"	111° 19' 23"	212	2001
L1	McClelland Lake	57° 29' 30"	111° 16' 37"	191	1997 – 2001
L2	Kearl Lake	57° 18' 15"	111° 14' 40"	72.6	1999 – 2001
L3	Isadore's Lake	57° 13' 15"	111° 36' 24"	28.0	2000 – 2001

(a) Relocated in 2000.

(b) Relocated in 1998.

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 2001. In general, discharge measurements were undertaken on a monthly interval during the continuous monitoring period. For helicopter access sites of stations with well-developed rating curves, measurements were undertaken on a bi-monthly interval. This schedule was altered where measurments were precluded by equipment malfunction or unsafe conditions, such as thin ice. Extra measurments were undertaken on an opportunistic basis, where required. The water levels at these streamflow stations were continuously monitored by pressure transducers and recorded by data loggers over the summer months in 2001. Continuous monitoring extended into the winter period at several stations where freezing to the streambed was considered unlikely. Appendix VI presents a summary table of manual discharge measurements and the detailed calculation sheets for measurements performed in 2001.

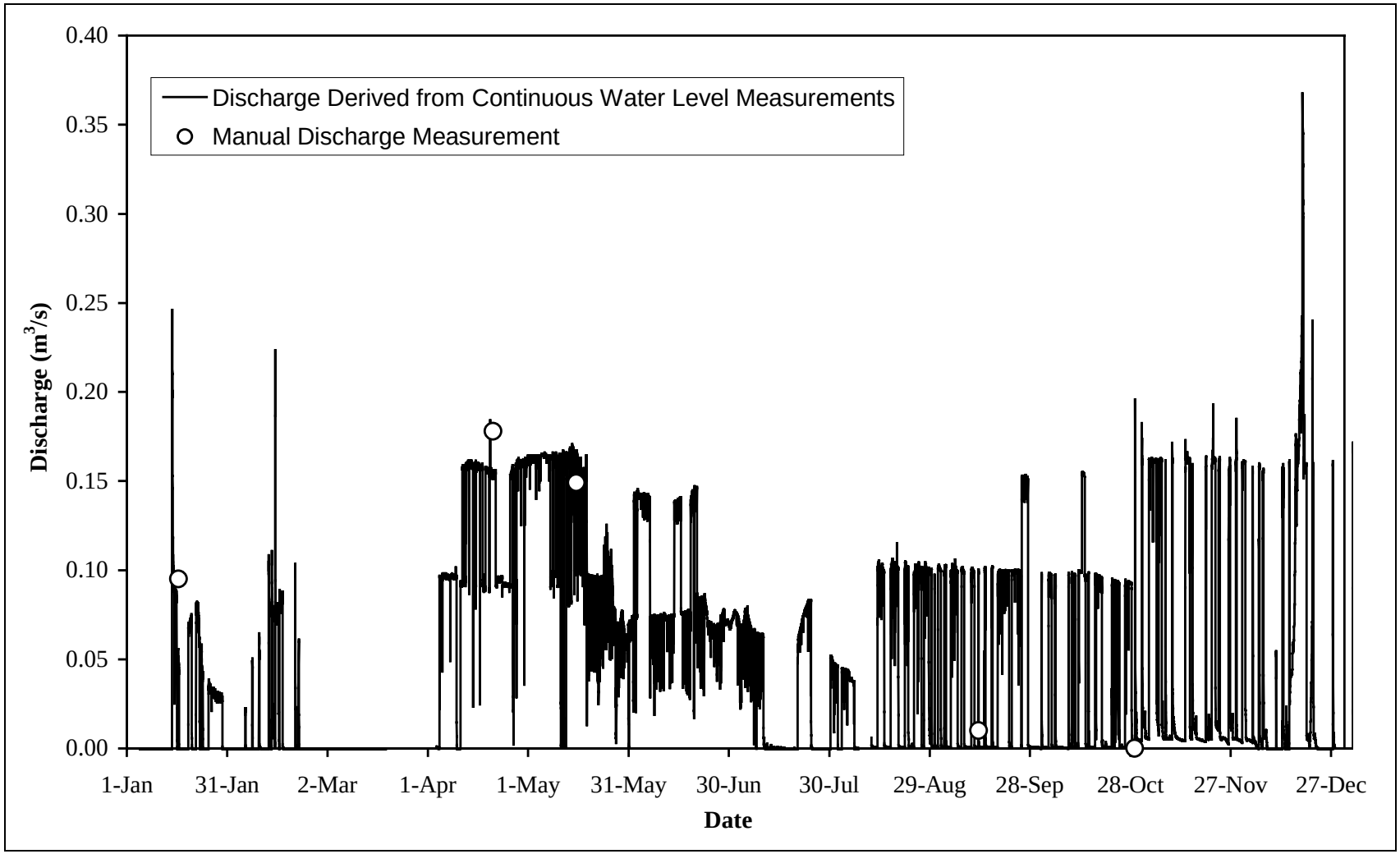
Manual discharge measurements from 2001 and, where applicable, 1997 through 2000, were used to develop stage-discharge rating curves for the streamflow monitoring stations. These rating curves were used to derive discharges from the continuous record of water level measurements. The resulting stage-discharge rating curves are presented in Appendix VII. Appendix VIII 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 III.

4.2.2 Alsands Drain Streamflow Monitoring Station (S1)

The Alsands Drain weir was in service throughout 2001 except for the period from February 23 to April 2, when the pressure transducer was damaged by frost, and from August 8 to 10, when a new pressure transducer failed for unknown reasons. The station was visited on January 16, February 15, April 3, April 20, May 15, August 6, 7 and 11, September 12 and 18, October 29 and December 6, 2001. The recorded hydrograph for this station is presented on Figure 4.1. It shows continuous records from January 1 to February 22, April 3 to August 7 and August 10 to December 31, 2001. The measured discharges are documented in Appendix VI and the current rating curve is provided in Appendix VII. Mean daily water levels and discharges are provided in Appendix VIII.

Water from a polishing pond on the Muskeg River Mine site was pumped into the channel upstream of this station, so rapid and significant fluctuations in discharge occurred at this station over the course of a typical day. Therefore, mean daily discharges are illustrated (Figure 4.1) instead of 15-minute discharges. Most measured discharges appear high, since the mean daily data typically incorporate periods of zero discharge.

Figure 4.1 2001 Discharge Hydrograph at Alsands Drain Station (S1)



4.2.3 Jackpine Creek Streamflow Monitoring Station (S2)

The hydrograph for this station is based on a continuous record from April 22 to October 25, 2001 (Figure 4.2). The pressure transducer and data logger were removed from this site in late October to prevent ice damage, because it was expected that the channel would freeze solid over the winter. Six manual discharge measurements were performed at this station (January 16, May 11, June 12, July 8, August 6 and October 27, 2001). The site was also visited on April 21 and September 10, water level measurements were taken on those dates but discharge measurements were not performed. The measured discharges are documented in Appendix VI and the current rating curve is provided in Appendix VII. Mean daily water levels and discharges are provided in Appendix VIII.

4.2.4 Iyinimin Creek Streamflow Monitoring Station (S3)

This hydrometric monitoring station was reactivated in 2001 after being out of service in 2000. It shows a continuous record from May 8 to May 13, June 12 to July 10 and August 4 to October 24, 2001(Figure 4.3). The first data gap, from mid-May to mid-June, was attributed to water levels falling below the level of the temporary transducer installation. In early May, ice prevented the installation of the transducer in the conduit under the streambed; installation was accomplished on June 12. The second data gap occurred because the site was not accessed as scheduled on September 20 (ie., broken bear's paw on the helicopter skid prevented the pilot from landing). The site was not accessed again until the next helicopter visit in October at which time, data from late July and early August had been overwritten.

The recorded hydrograph for this station (Figure 4.3) is based on three manual discharge measurements performed at this station on June 12, July 10 and October 25. The measured discharges are documented in Appendix VI and the current rating curve is provided in Appendix VII. Mean daily water levels and discharges are provided in Appendix VIII.

A tipping-bucket rain gauge was operational at this station in 2001; and data are available from May 8 to July 10 and August 4 to October 24, 2001 (Figure 4.4).

Figure 4.2 2001 Discharge Hydrograph at Jackpine Creek Station (S2)

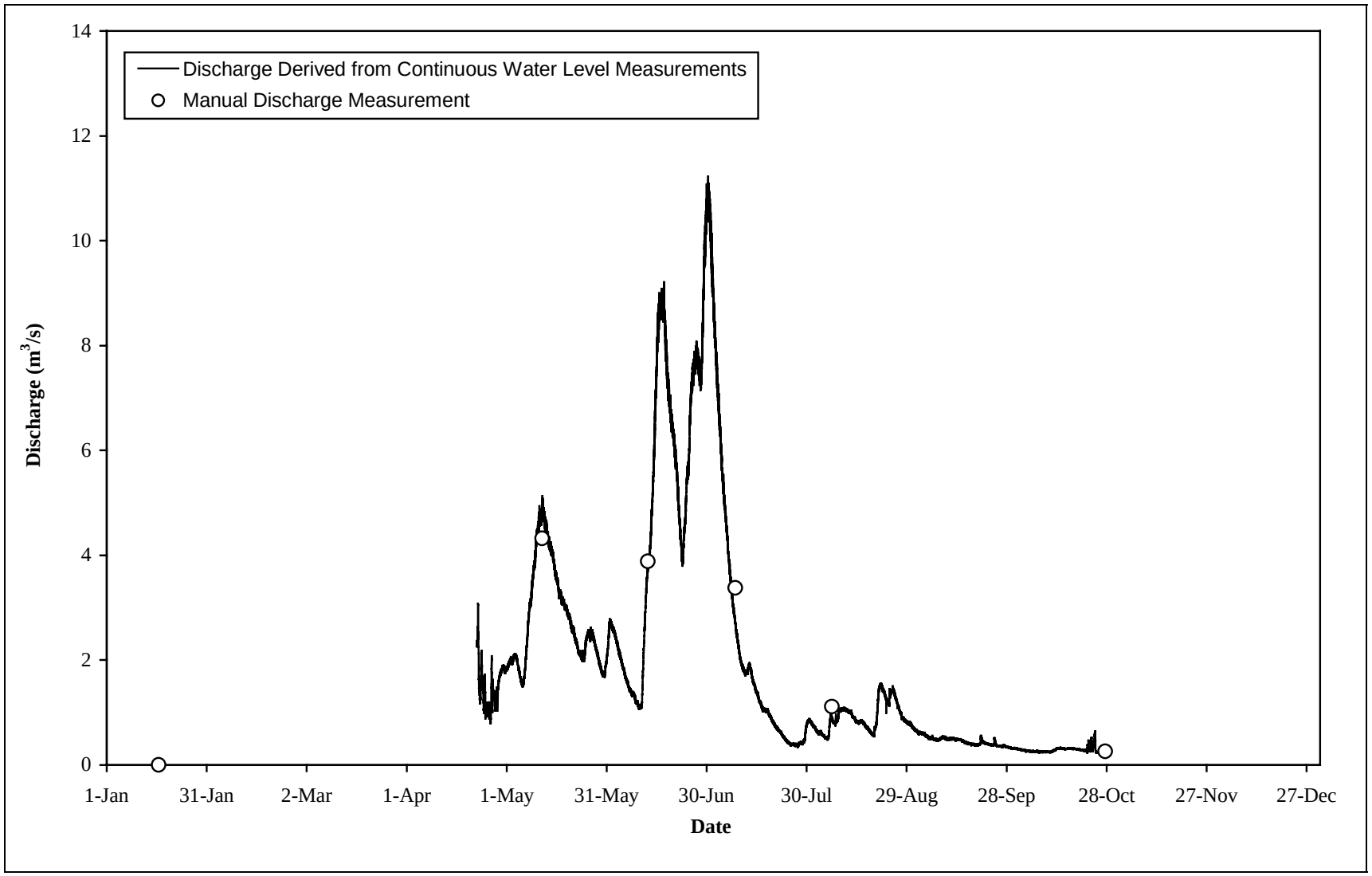


Figure 4.3 2001 Discharge Hydrograph at Iyinimin Creek Station (S3)

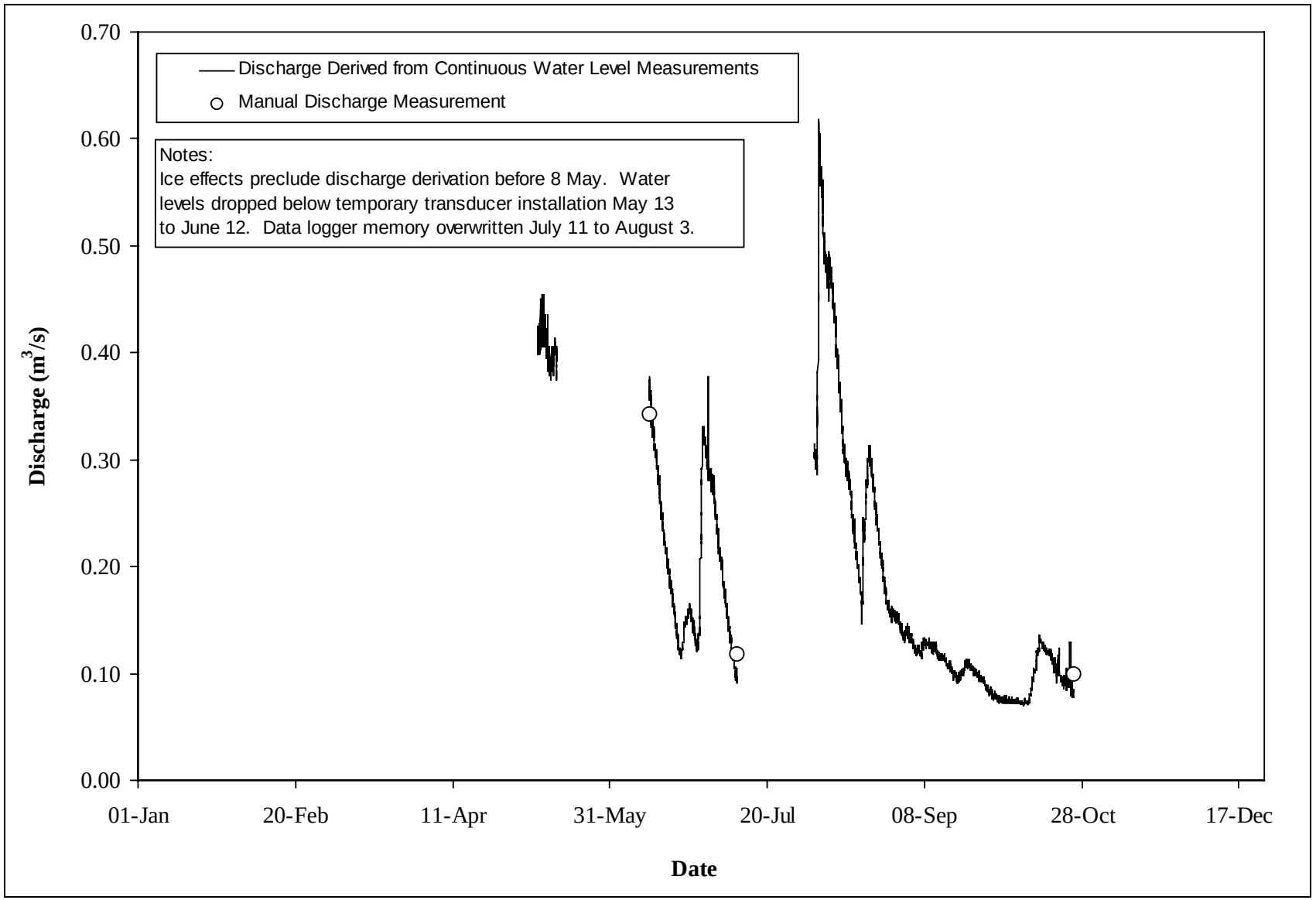
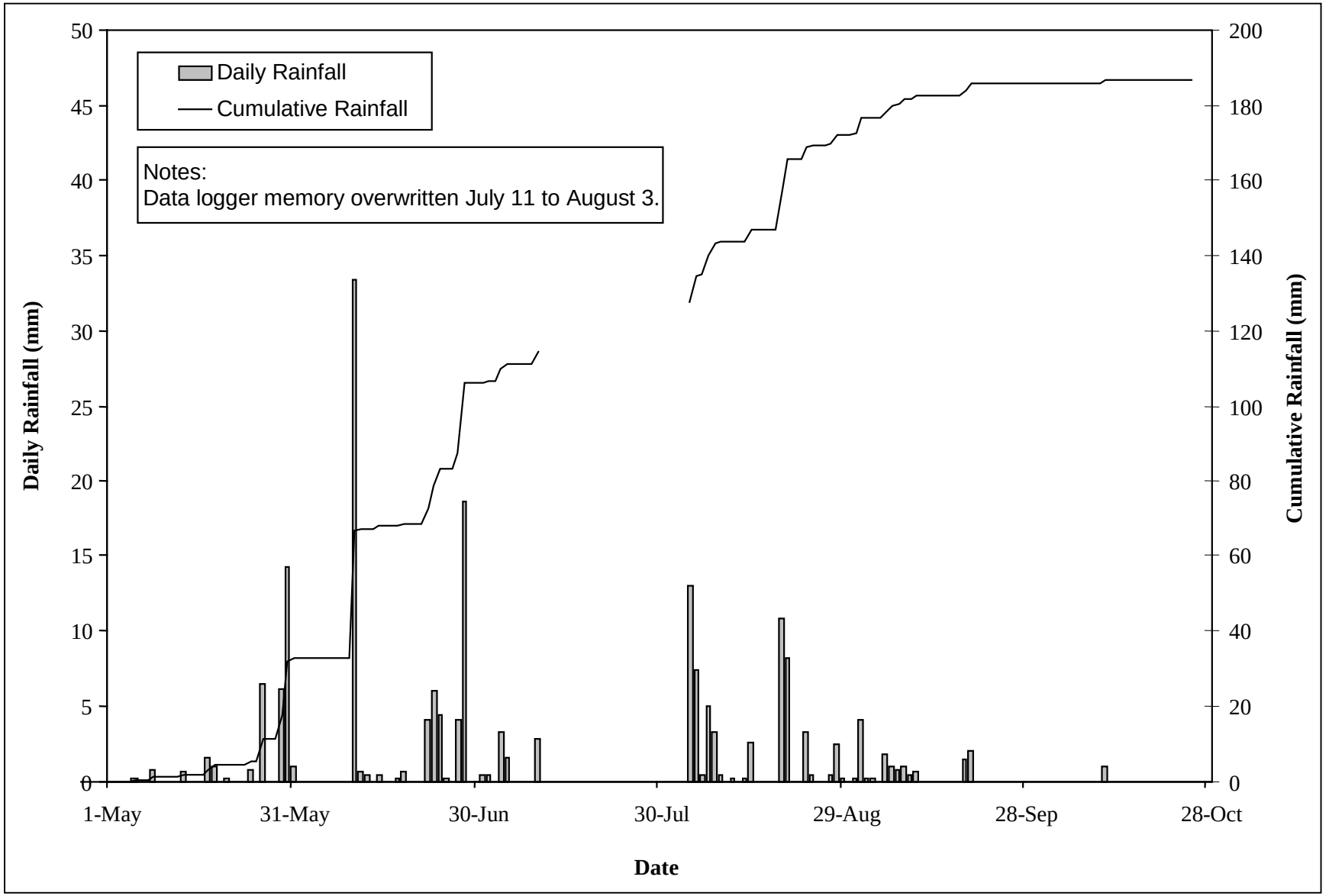


Figure 4.4 2001 Precipitation at Iyinimin Creek Station (S3)



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4.2.5 Blackfly Creek Streamflow Monitoring Station (S4)

This hydrometric monitoring station was not operated in 2000 or 2001. The decision to discontinue operation was based on its location in the Aurora South Lease area (Lease 31). In early 2000, it was anticipated that this lease would not be developed for at least ten years. 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 VII.

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 2001. The hydrograph for this station is based on a continuous record from January 1 to December 31, 2001 (Figure 4.5). Five manual discharge measurements were performed at this station on January 17, February 16, June 13, August 7 and December 5, 2001. The station was also visited to download data on April 2, April 20, May 15, July 9 and November 10, 2001. The measured discharges are documented in Appendix VI and the updated rating curve is provided in Appendix VII. Mean daily water levels and discharges are provided in Appendix VIII.

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

4.2.7 Mills Creek Streamflow Monitoring Station (S6)

The hydrograph for this station is based on a continuous record from April 20 to June 13, July 9 to September 8, and September 23 to October 29, 2001 (Figure 4.6). Two date gaps occurred; the first due to a data logger malfunction and the second was the result of backwater effects that drowned out the weir during the reconstruction of the highway just downstream of the station. Eight manual discharge measurements were performed at this station on January 17, February 16, April 20, May 11, June 13, July 8, October 29, and December 5, 2001. The station was also visited on July 9, August 7 and September 10, 2001. The measured discharges are documented in Appendix VI and the current rating curve is provided in Appendix VII. Mean daily water levels and discharges are provided in Appendix VIII.

Figure 4.5 2001 Discharge Hydrograph at Muskeg River Aurora Station (S5A)

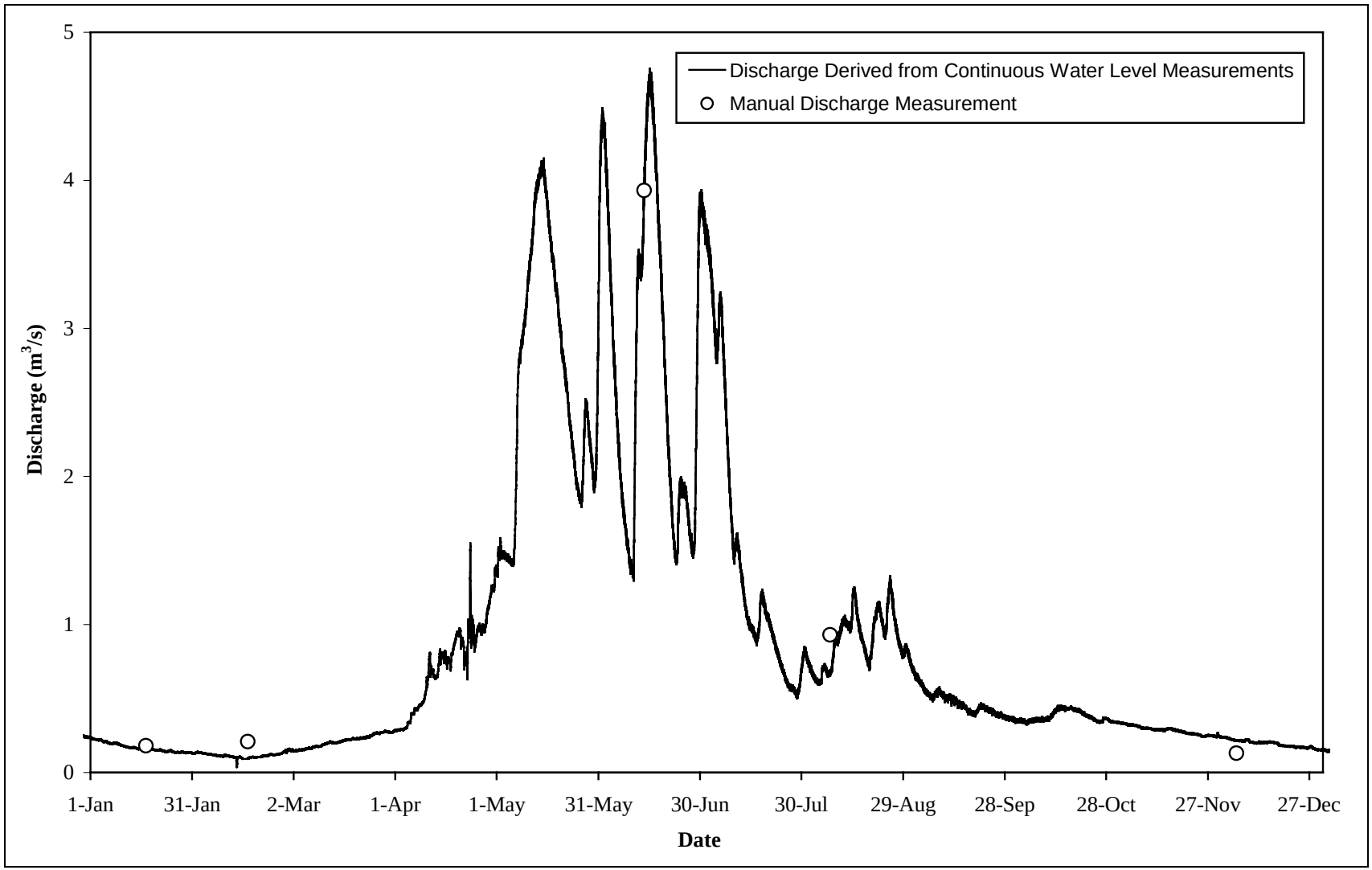
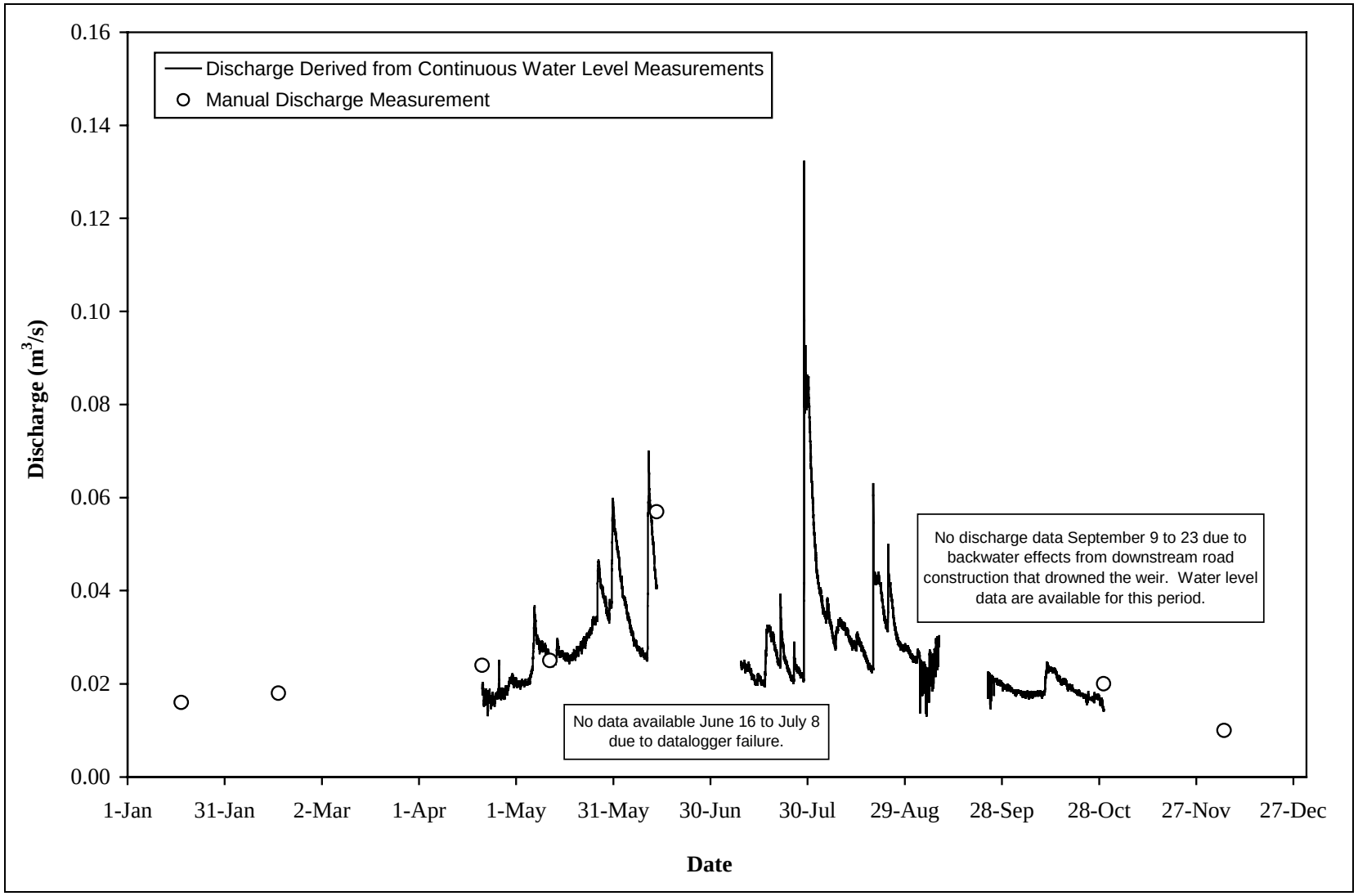


Figure 4.6 2001 Discharge Hydrograph at Mills Creek Station (S6)



4.2.8 Muskeg River 7DA8 Environment Canada Hydometric Station (S7)

This station is operated by the Environment Canada during the open water season of each year. In 2001, 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 Environment Canada data were unavailable. The site was visited on January 16, February 16, November 2 and December 6, 2001 to conduct manual discharge measurements. The station was also visited on April 24, May 11, June 13, July 8, September 12 and October 29 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 was retrieved after ice breakup. Unfortunately it stopped recording on full memory in late November. Thus, no continuous record of water levels is available for January and February. Manual discharge measurements from January and February are indicated on the hydrograph.

The mean daily discharge hydrograph for this station is presented on Figure 4.5. It shows a continuous record from January 1 to October 31 and November 5 to December 31, 2001. Discharges from January 1 to February 28, 2001 were estimated based a linear recession curve based on field measurements. The data gap in early November occurred during installation of new monitoring equipment at the station. The manual discharge measurements undertaken in 2000 are documented in Appendix VI and the current rating curve is provided in Appendix VII. Mean daily discharges are provided in Appendix VIII.

4.2.9 Stanley Creek Streamflow Monitoring Station (S8)

As was the case in 1999 and 2000, only water levels were monitored at this station. The site is located where the muskeg narrows to less than 100 m, but the channel is ill-defined. It is not possible to traverse the wet ground on foot and the ill-defined channel does not permit accurate discharge measurements.

The recorded water levels for this station are presented on Figure 4.8. The database includes a continuous record from September 17 to October 26, 2001. In addition six manual water level measurements were performed at this station on April 25, June 12, July 10, August 9, September 17 and October 26, 2001. During the August visit, it was discovered that the datalogger had been disturbed by animals and was submerged in water, resulting in the loss of data collected to that point. New monitoring equipment was installed during the next site visit (September 17). Mean daily water levels are provided in Appendix VIII.

Figure 4.7 2001 Discharge Hydrograph at Muskeg River 7DA8 Environment Canada Hydometric Station (S7)

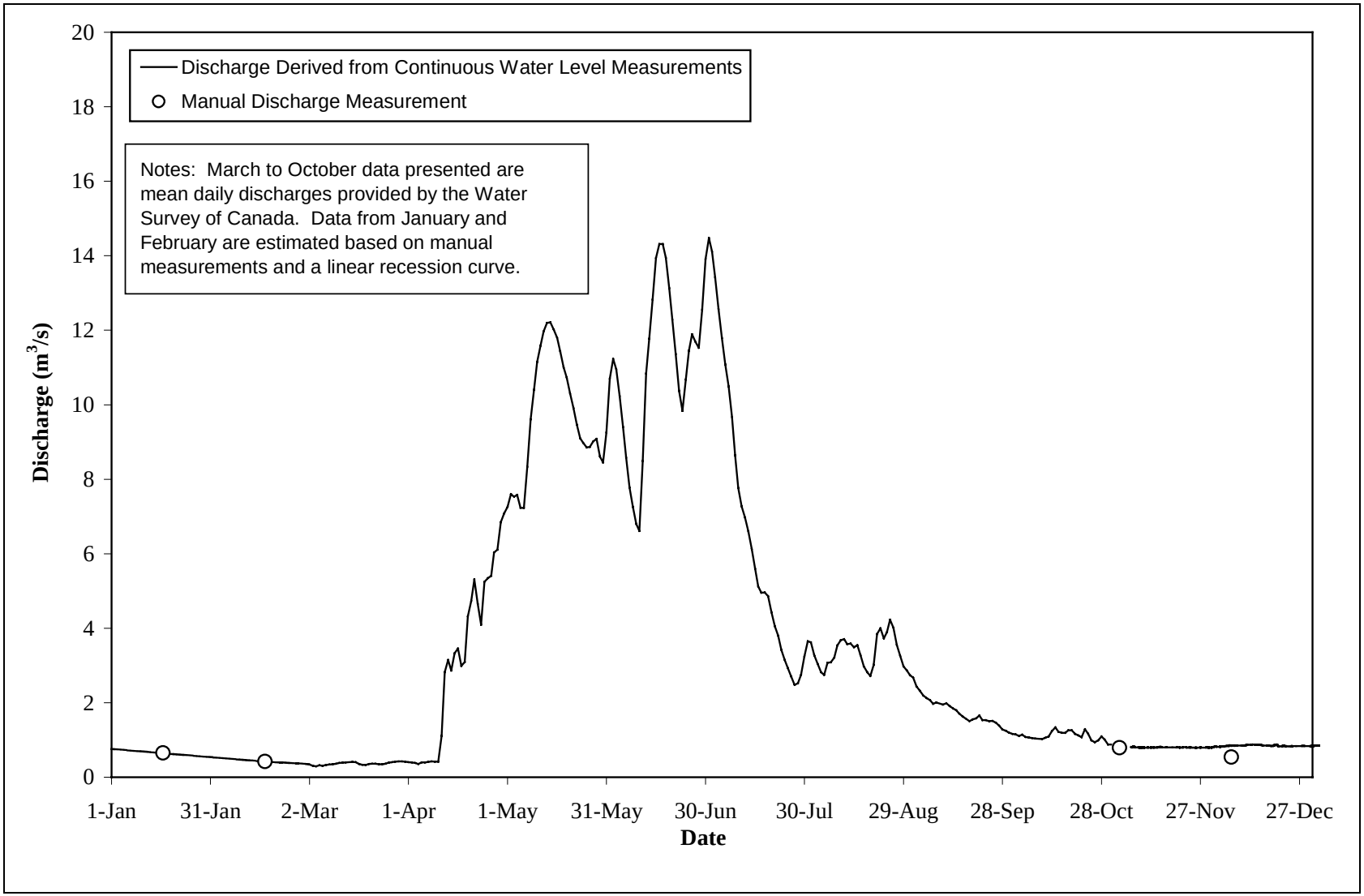
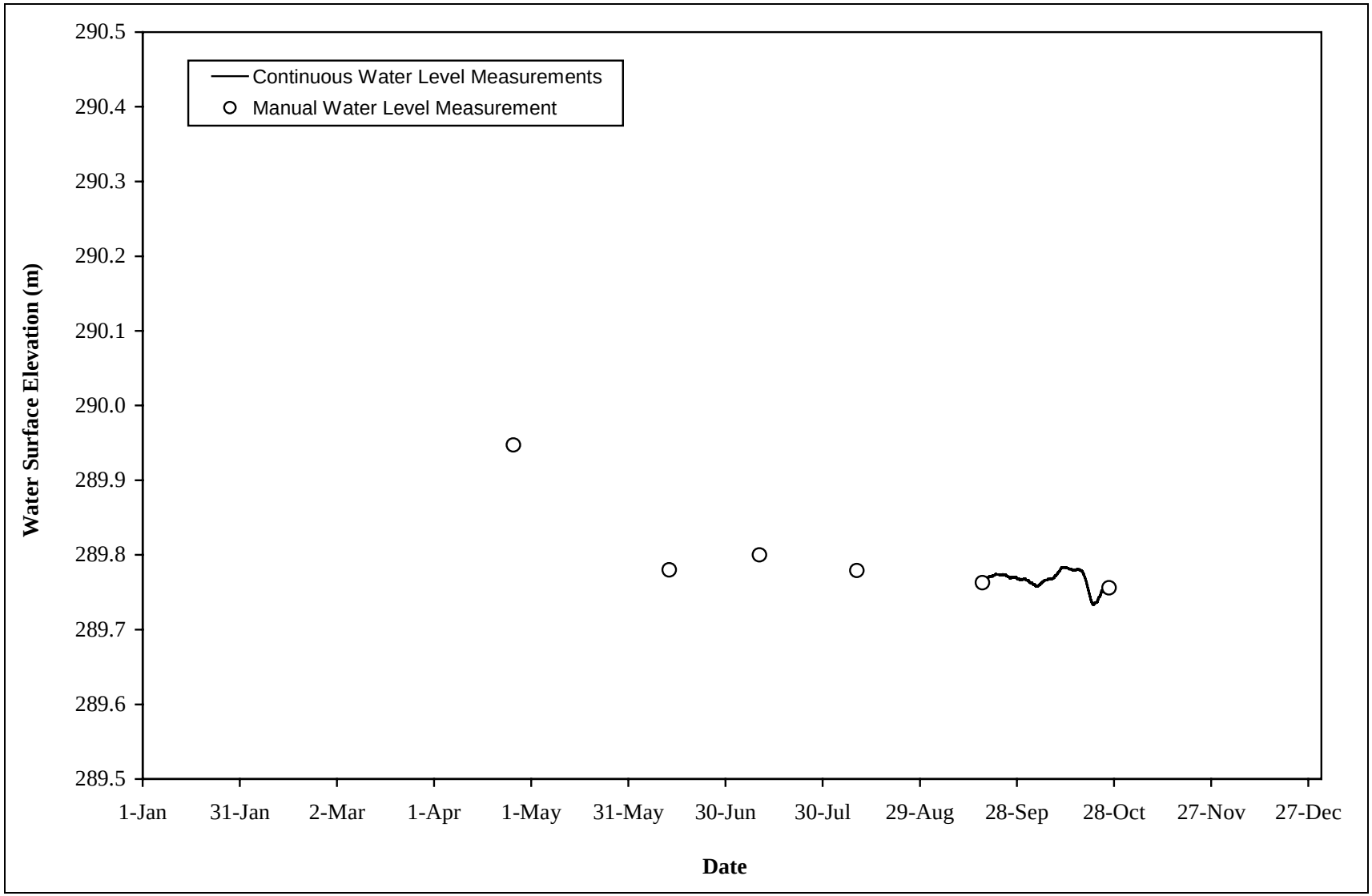


Figure 4.8 2001 Water Level Hydrograph at Stanley Creek Station (S8)



4.2.10 Kearl Lake Outlet Streamflow Monitoring Station (S9)

The recorded hydrograph for this station is presented on Figure 4.9. The database includes a continuous record from April 21 to June 10 and July 8 to October 27, 2001. The data gap from June 10 to July 8 was due to a pressure transducer failure. Seven manual discharge measurements were performed at this station on April 21, May 11, June 10, July 8, August 6, September 19 and October 27, 2001. The measured discharges are documented in Appendix VI and the updated rating curve is provided in Appendix VII. Mean daily water levels and discharges are provided in Appendix VIII.

4.2.11 Wapasu Creek Streamflow Monitoring Station (S10)

The recorded hydrograph for this station is presented on Figure 4.10. The database includes a continuous record from April 20 to October 27, 2001. Seven manual discharge measurements were performed at this station on April 20, May 11, June 10, July 8, September 19 and October 27, 2001. The measured discharges are documented in Appendix VI and the updated rating curve is provided in Appendix VII. Mean daily water levels and discharges are provided in Appendix VIII.

4.2.12 Poplar Creek Streamflow Monitoring Station (S11)

The recorded hydrograph for this station is presented on Figure 4.11. The database includes a continuous record from April 24 to October 27, 2001. Six manual discharge measurements were performed at this station on April 24, May 11, June 13, July 9, September 12 and October 27, 2001. The station was also visited on April 3 2001. The measured discharges are documented in Appendix VI and the updated rating curve is provided in Appendix VII. Mean daily water levels and discharges are provided in Appendix VIII.

4.2.13 Fort Creek Streamflow Monitoring Station (S12)

The rating curve for this station was updated based on discharge and water level data collected in 2001. The recorded hydrograph for this station is presented on Figure 4.12. The database includes a continuous record from May 11 to October 22, 2001. Water levels were recorded until October 28, but were subject to ice effects after October 22. Ten manual discharge measurements were performed at this station on January 17, February 15, April 21, May 11, June 13, July 9, August 7, September 10, October 28 and December 3, 2001. The measured discharges are documented in Appendix VI and the rating curve is provided in Appendix VII. Mean daily water levels and discharges are provided in Appendix VII.

Figure 4.9 2001 Discharge Hydrograph at Kearl Lake Outlet Station (S9)

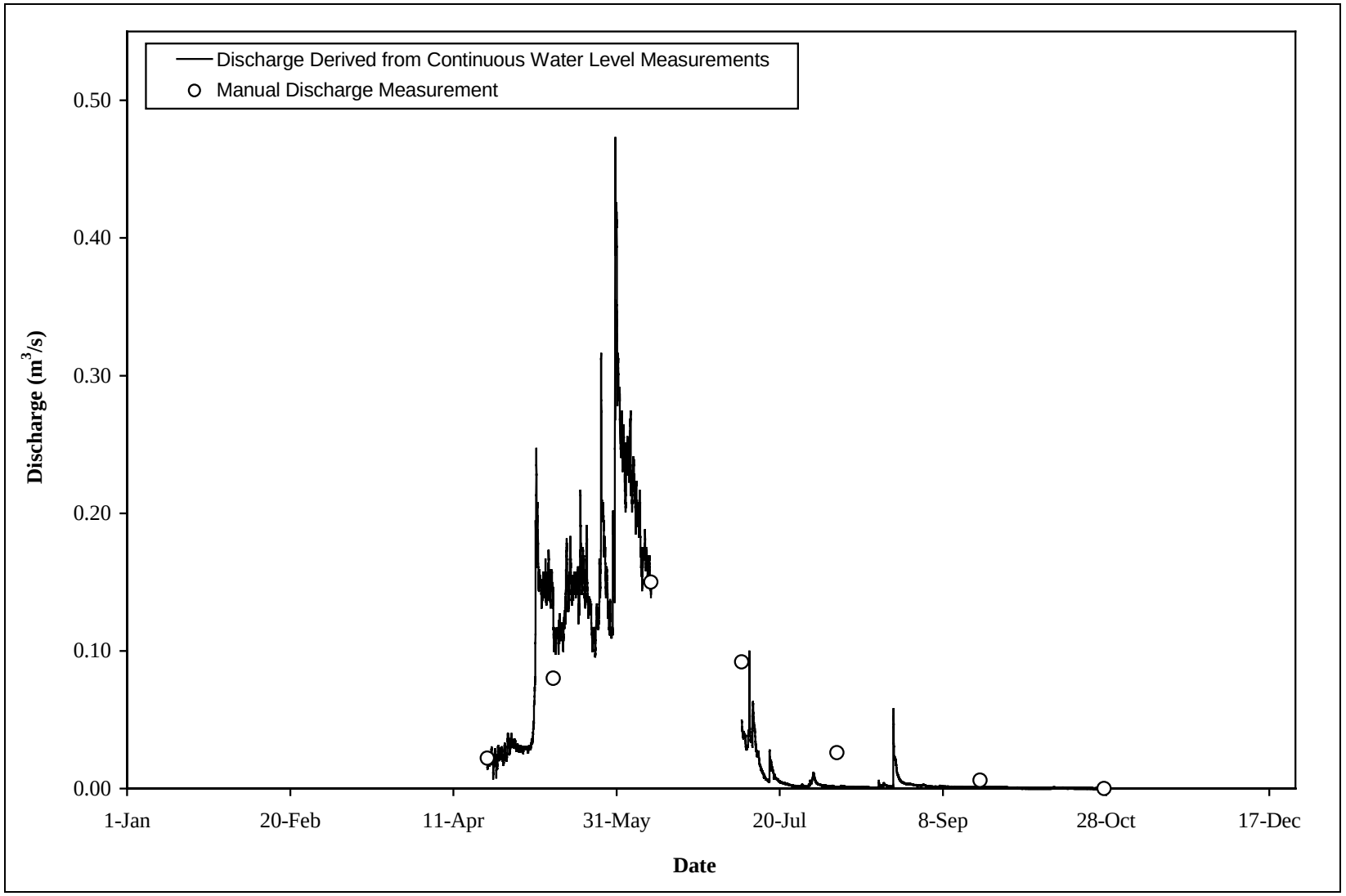


Figure 4.10 2001 Discharge Hydrograph at Wapasu Creek Station (S10)

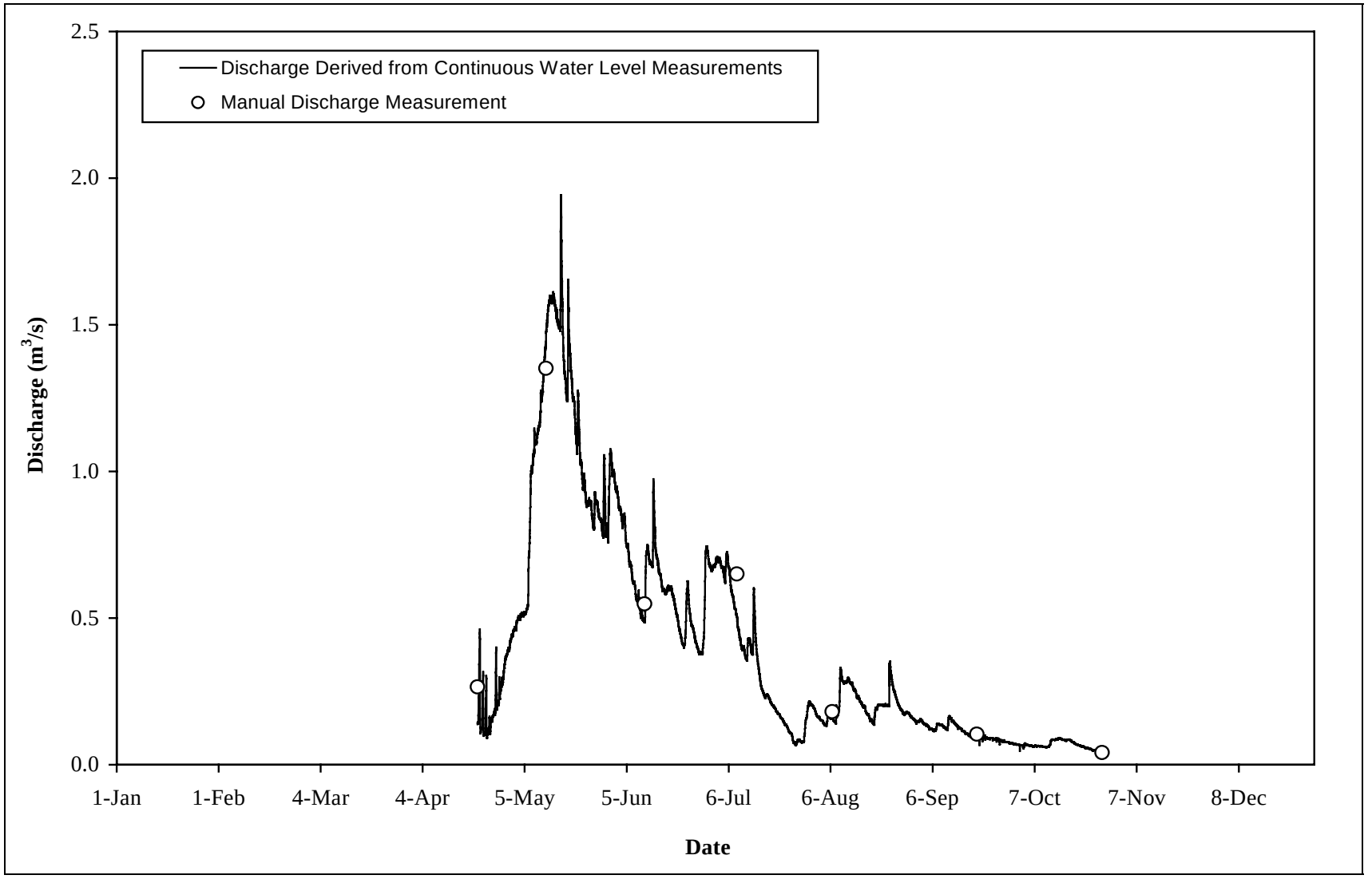


Figure 4.11 2001 Discharge Hydrograph at Poplar Creek Station (S11)

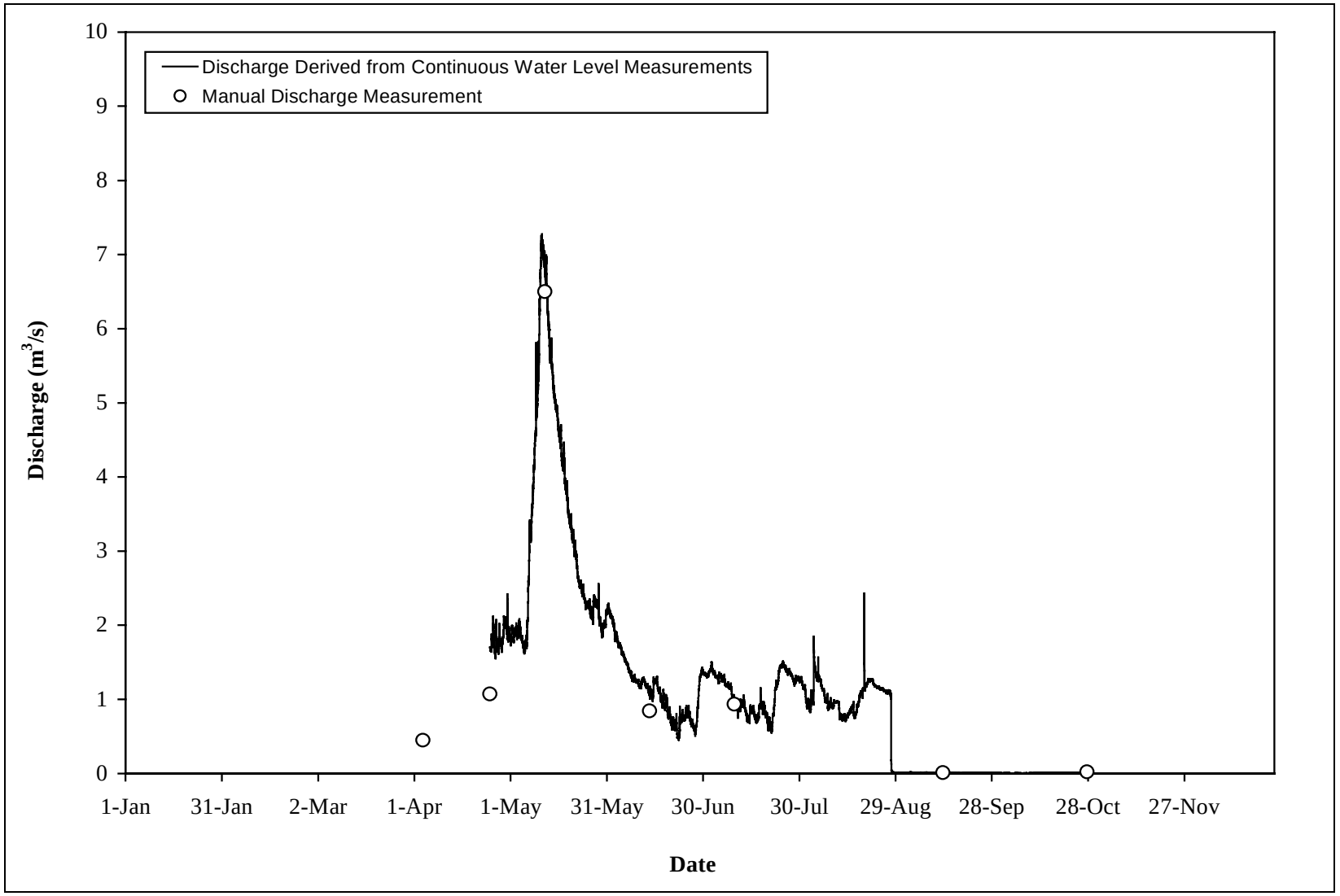
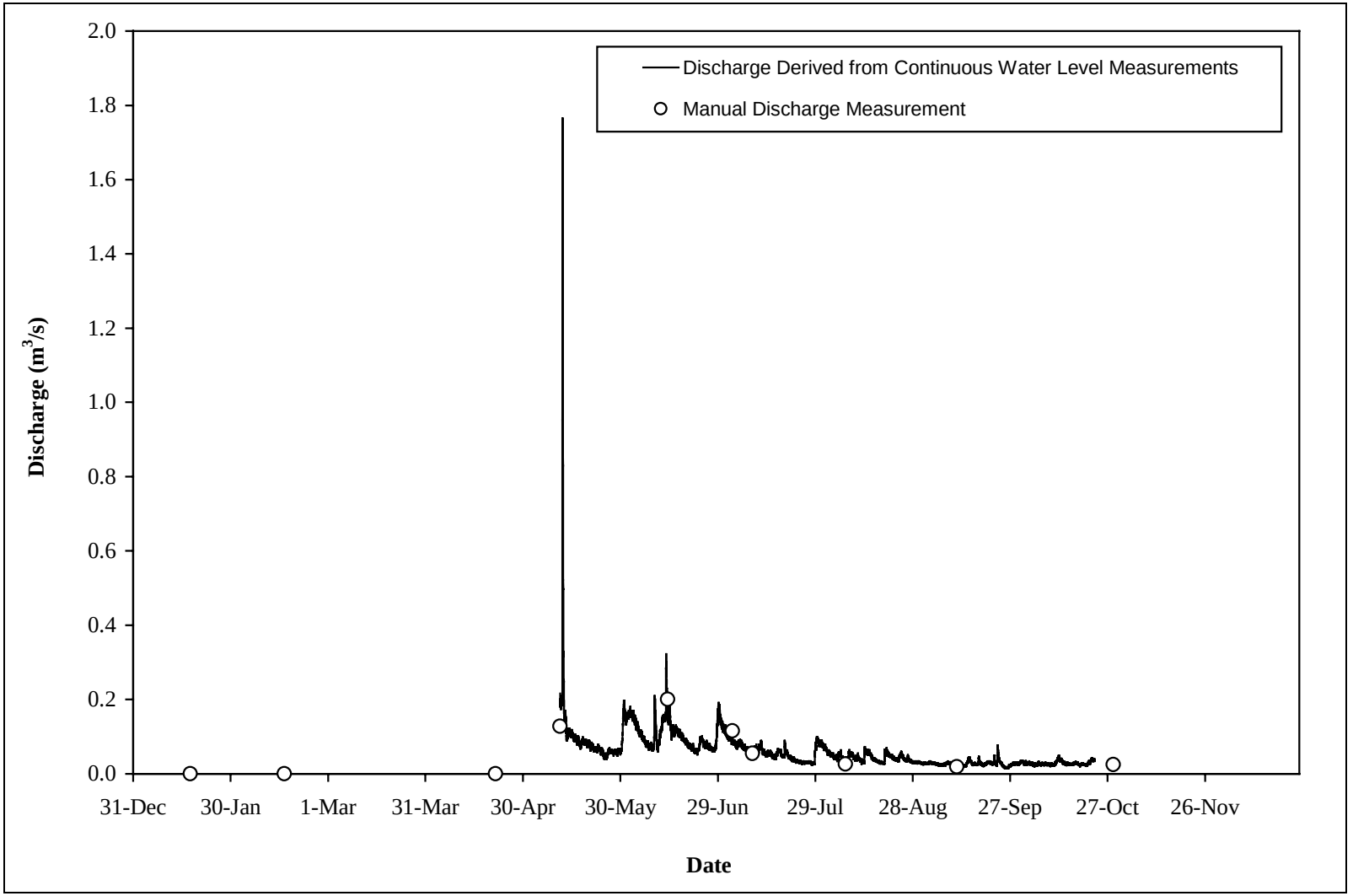


Figure 4.12 2001 Discharge Hydrograph at Fort Creek Station (S12)



4.2.14 Albian Sands Pond #3 Streamflow Monitoring Station (S13)

The recorded hydrograph for this station is presented on Figure 4.13. It shows a continuous record from January 1 to January 16 and from May 23 to November 4, 2001. The pressure transducer was removed from the site on January 16 as the pond outlet was frozen and not expected to discharge until the spring. The transducer was replaced on May 23 and operated continuously until it was removed for the winter on December 11. Eight site visits were undertaken, on January 16, April 3 and 20, May 11, July 8, September 12, October 27 and December 6, 2001. During the site visits, discharges were either zero or too small to measure with a flow meter. In the latter case, discharges were estimated based on the depth of flow over the weir. The measured discharges are documented in Appendix VI and the rating curve is provided in Appendix VII. Mean daily water levels and discharges are provided in Appendix VIII.

4.2.15 Ells River Streamflow Monitoring Station (S14)

The recorded hydrograph for this station is presented on Figure 4.14. It shows a continuous record from May 13 to October 23, 2001. A continuous record of water levels is available to October 31, but ice effects were present after October 23. Five manual discharge measurements were performed at this station on March 15, May 13, June 21, August 9 and September 15, 2001. The station was also visited on June 11, September 17 and October 31, 2001. The measured discharges are documented in Appendix VI and the updated rating curve is provided in Appendix VII. Mean daily water levels and discharges are provided in Appendix VIII.

4.2.16 Tar River Streamflow Monitoring Station (S15)

The recorded hydrograph for this station is presented on Figure 4.15. It shows a continuous record from May 9 to October 30, 2001. Eight manual discharge measurements were performed at this station on March 14, May 9, June 11, July 8, August 6, September 11, October 30 and December 7, 2001. The measured discharges are documented in Appendix VI and the updated rating curve is provided in Appendix VII. Mean daily water levels and discharges are provided in Appendix VIII.

4.2.17 Calumet River Streamflow Monitoring Station (S16)

The recorded hydrograph for this station is presented on Figure 4.16. It shows a continuous record from June 11 to October 31, 2001. Six manual discharge measurements were performed at this station on March 14, May 12, June 11, July 10, August 9, September 15 and October 31, 2001.

Figure 4.13 2001 Discharge Hydrograph at Albian Sands Pond #3 Station (S13)

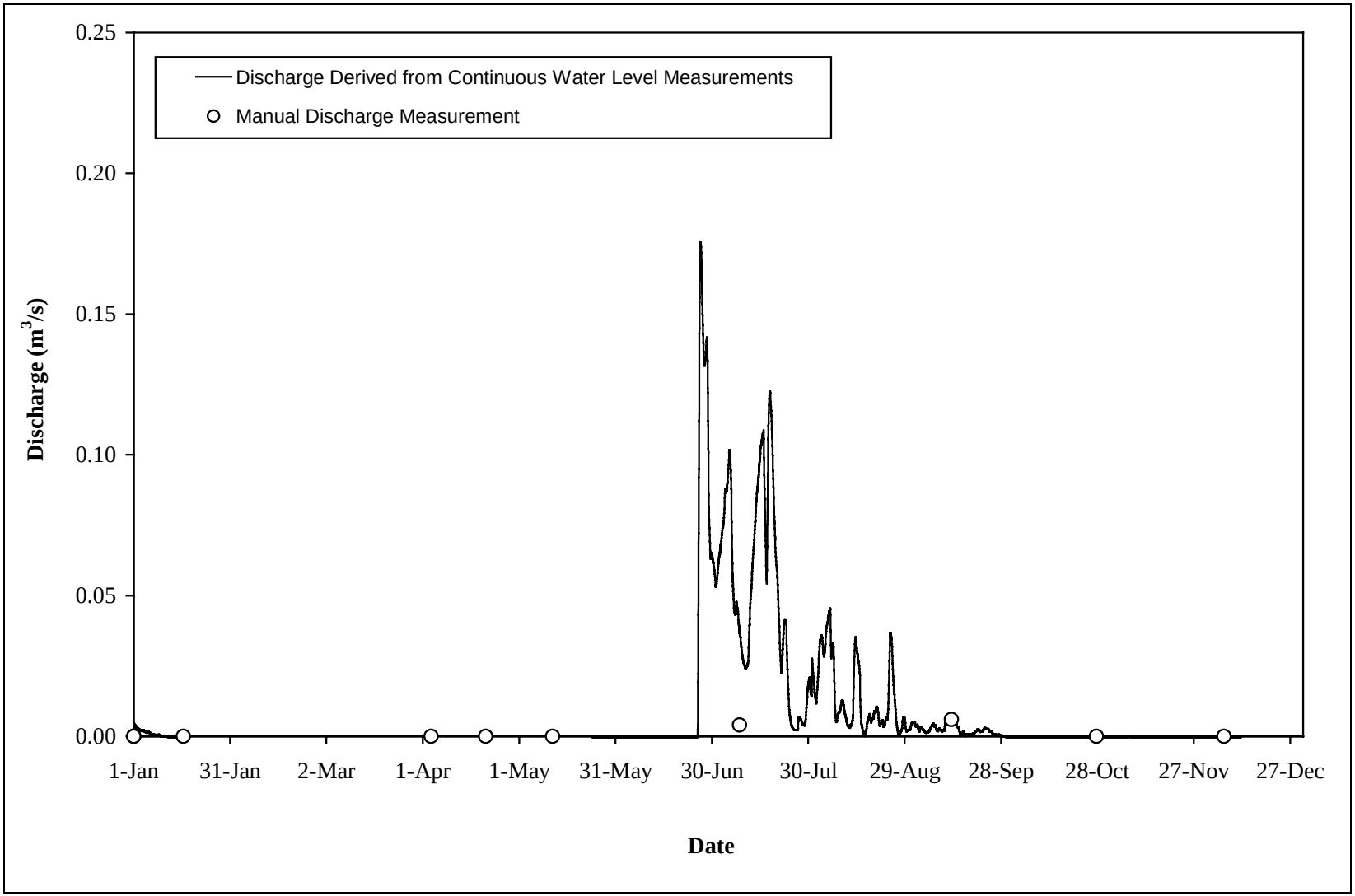


Figure 4.14 2001 Discharge Hydrograph at Ells River Station (S14)

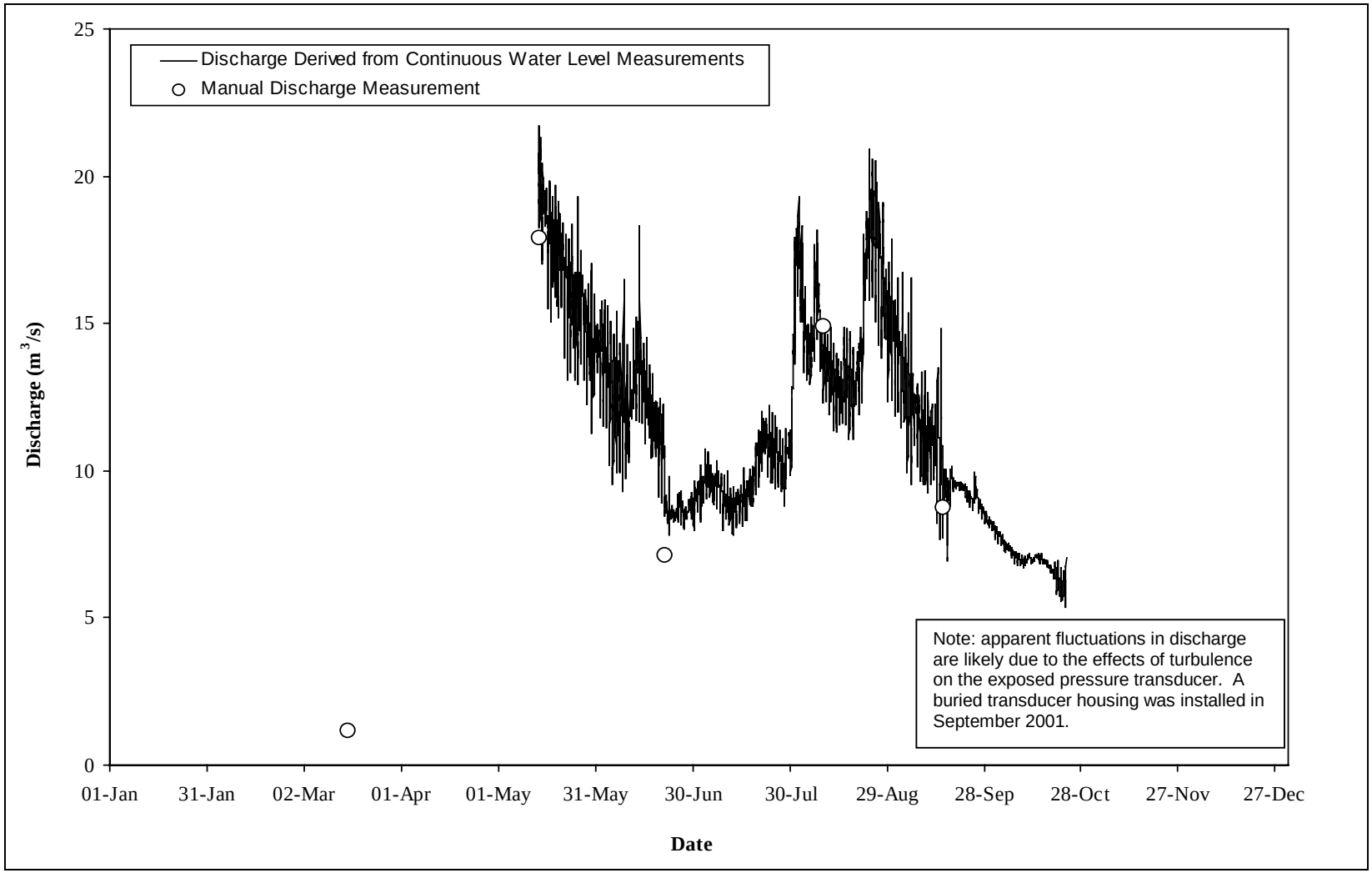


Figure 4.15 2001 Discharge Hydrograph at Tar River Station (S15)

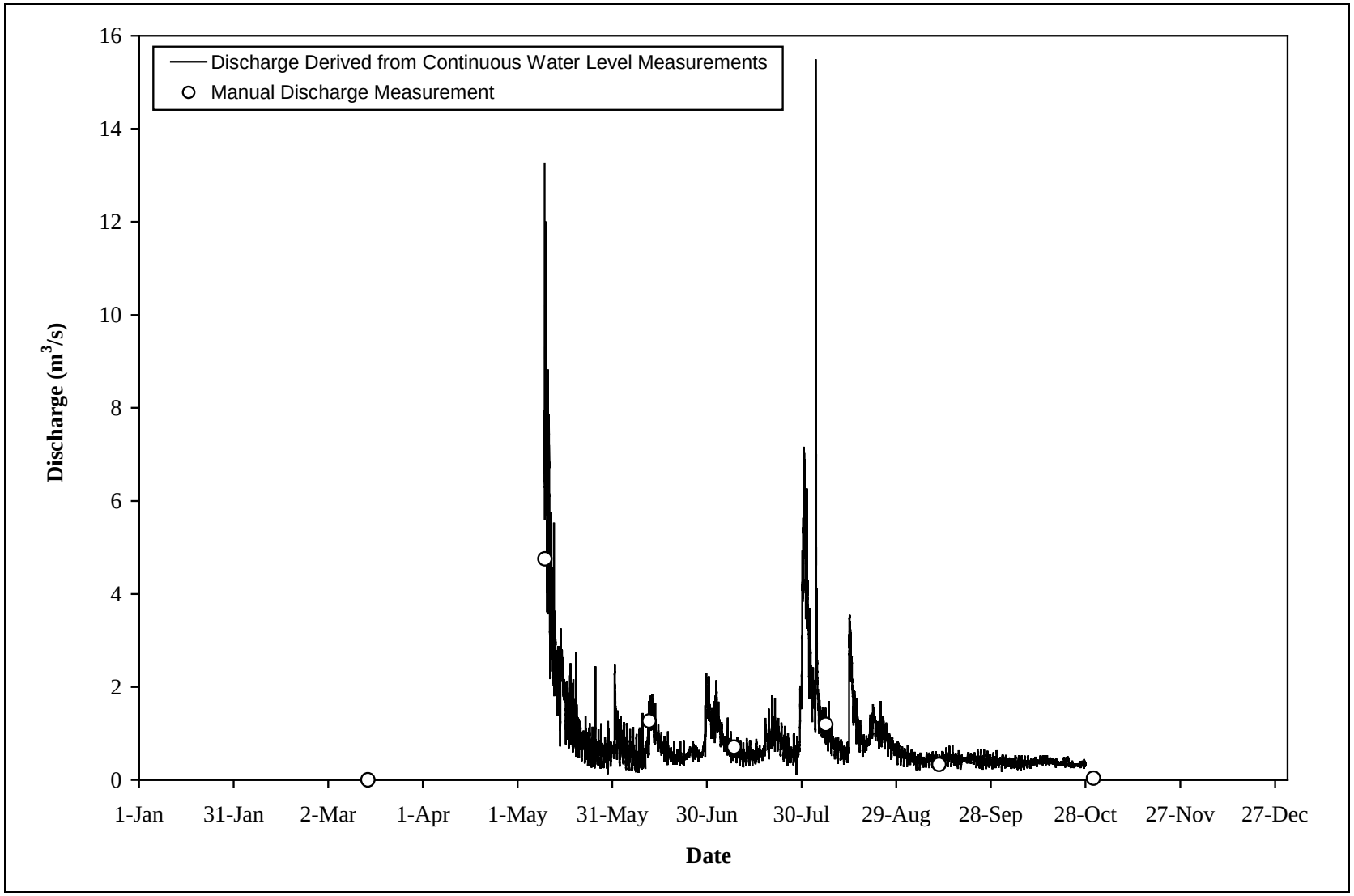
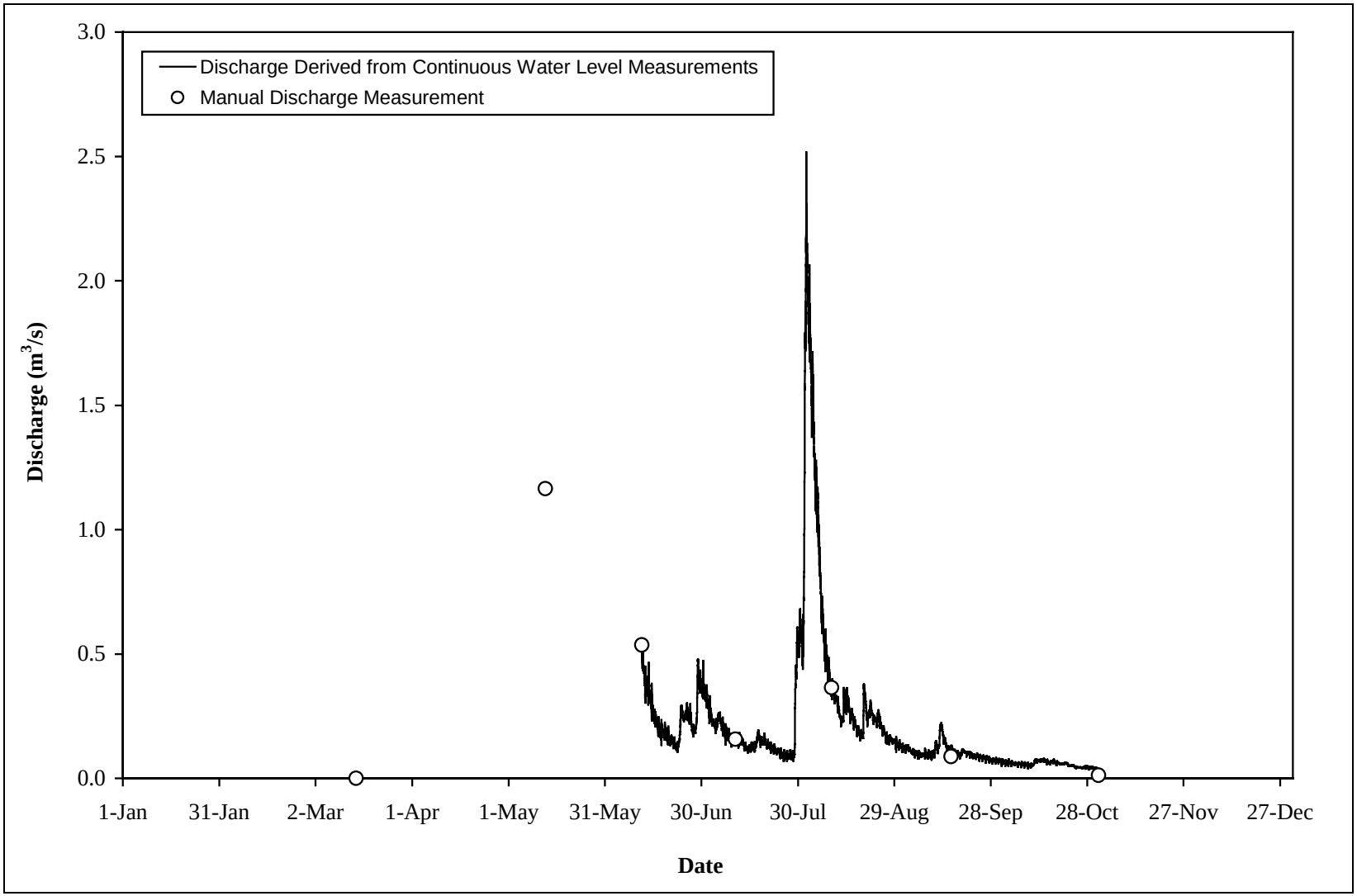


Figure 4.16 2001 Discharge Hydrograph at Calumet River Station (S16)



The measured discharges are documented in Appendix VI and the updated rating curve is provided in Appendix VII. Mean daily water levels and discharges are provided in Appendix VIII.

4.2.18 Upland Tar River Streamflow Monitoring Station (S17)

The recorded hydrograph for this station is presented on Figure 4.17. It shows a continuous record from May 12 to October 31, 2001. Five manual discharge measurements were performed at this station on May 12, June 11, August 9, September 15 and October 31, 2001. The measured discharges are documented in Appendix VI and the updated rating curve is provided in Appendix VII. Mean daily water levels and discharges are provided in Appendix VIII.

4.2.19 Upland Calumet River Streamflow Monitoring Station (S18)

The recorded hydrograph for this station is presented on Figure 4.18. It shows a continuous record from May 12 to June 28, 2001. After June 28, water levels were affected by beaver dam construction and it was not possible to derive discharge values from the recorded water levels. Two manual discharge measurements were performed at this station on May 12 and June 11, 2001. The station was also visited on July 10, August 9, September 17 and October 31, 2001. The measured discharges are documented in Appendix VI and the updated rating curve is provided in Appendix VII. Mean daily water levels and discharges are provided in Appendix VIII.

4.2.20 Lowland Tar River Streamflow Monitoring Station (S19)

The recorded hydrograph for this station is presented on Figure 4.19. No continuous record is available for 2001. Eight manual discharge measurements were performed at this station on May 9, June 13 and 21, July 4 and 8, August 6, September 11 and October 30, 2001. The pressure transducer at this station appeared to be functioning well and providing output that compared favorably with manual measurements. However, as more data were collected, it became apparent that the recorded diurnal flow pattern was not due to water level fluctuations but was in fact related to a faulty pressure transducer. The transducer response varied with temperature as well as water level. Frequent blockages of the channel by debris and beaver activity made diagnosing this more difficult, and the fault was not established until late in the monitoring season. In 2002, the transducer will be replaced and the station will be moved upstream to a location less prone to blockages.

Figure 4.17 2001 Discharge Hydrograph at Upland Tar River Station (S17)

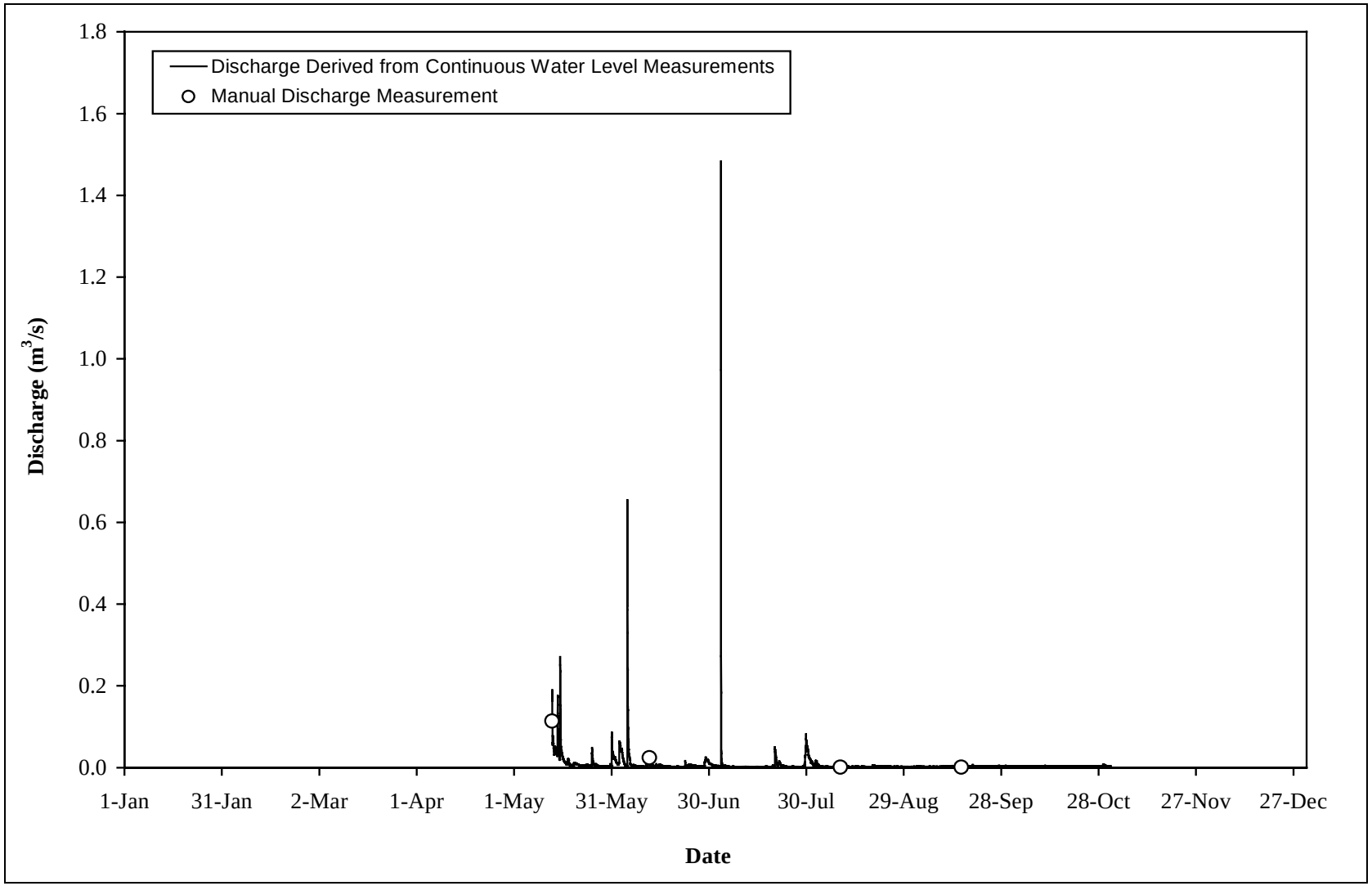


Figure 4.18 2001 Discharge Hydrograph at Upland Calumet River Station (S18)

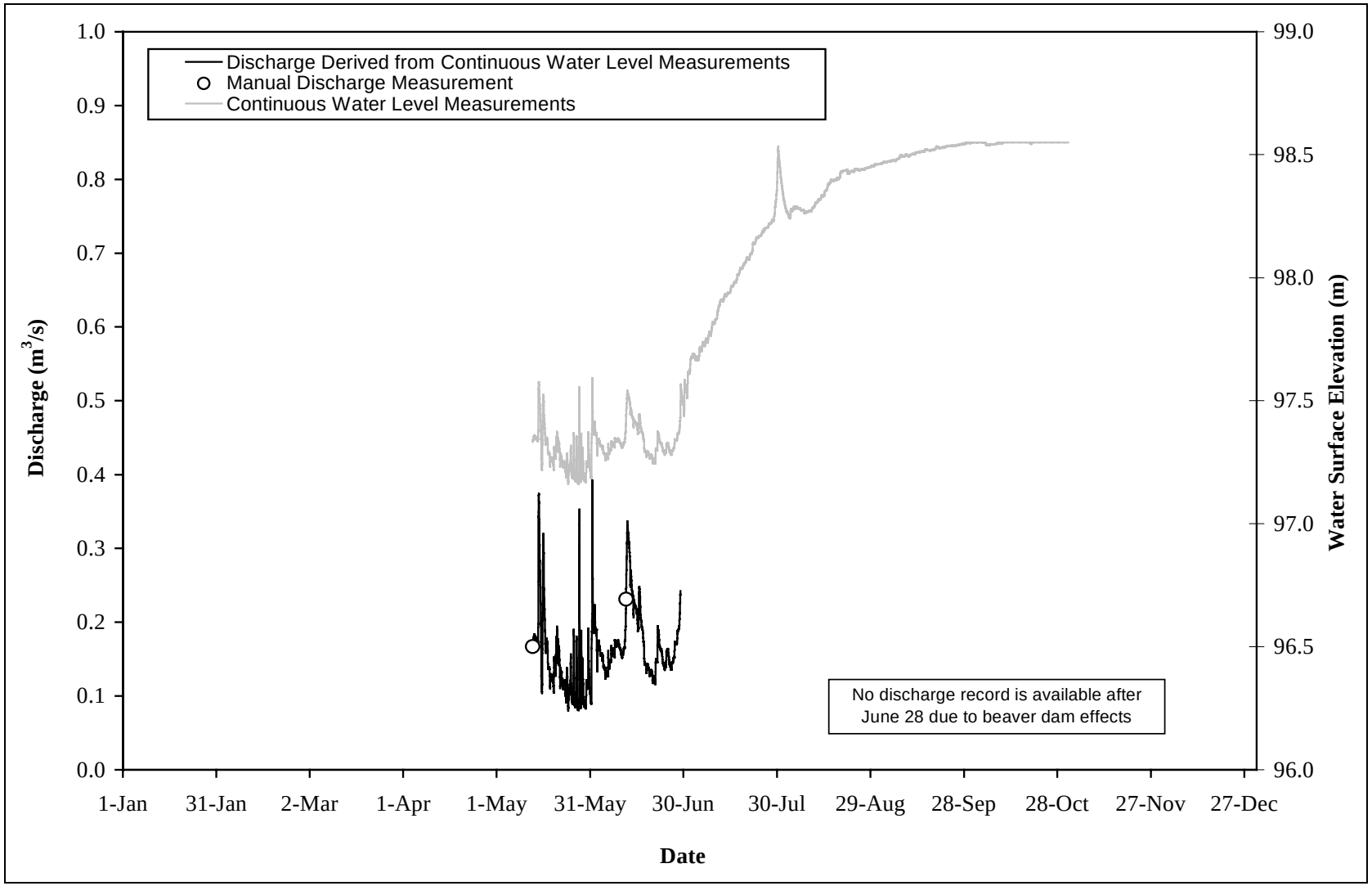
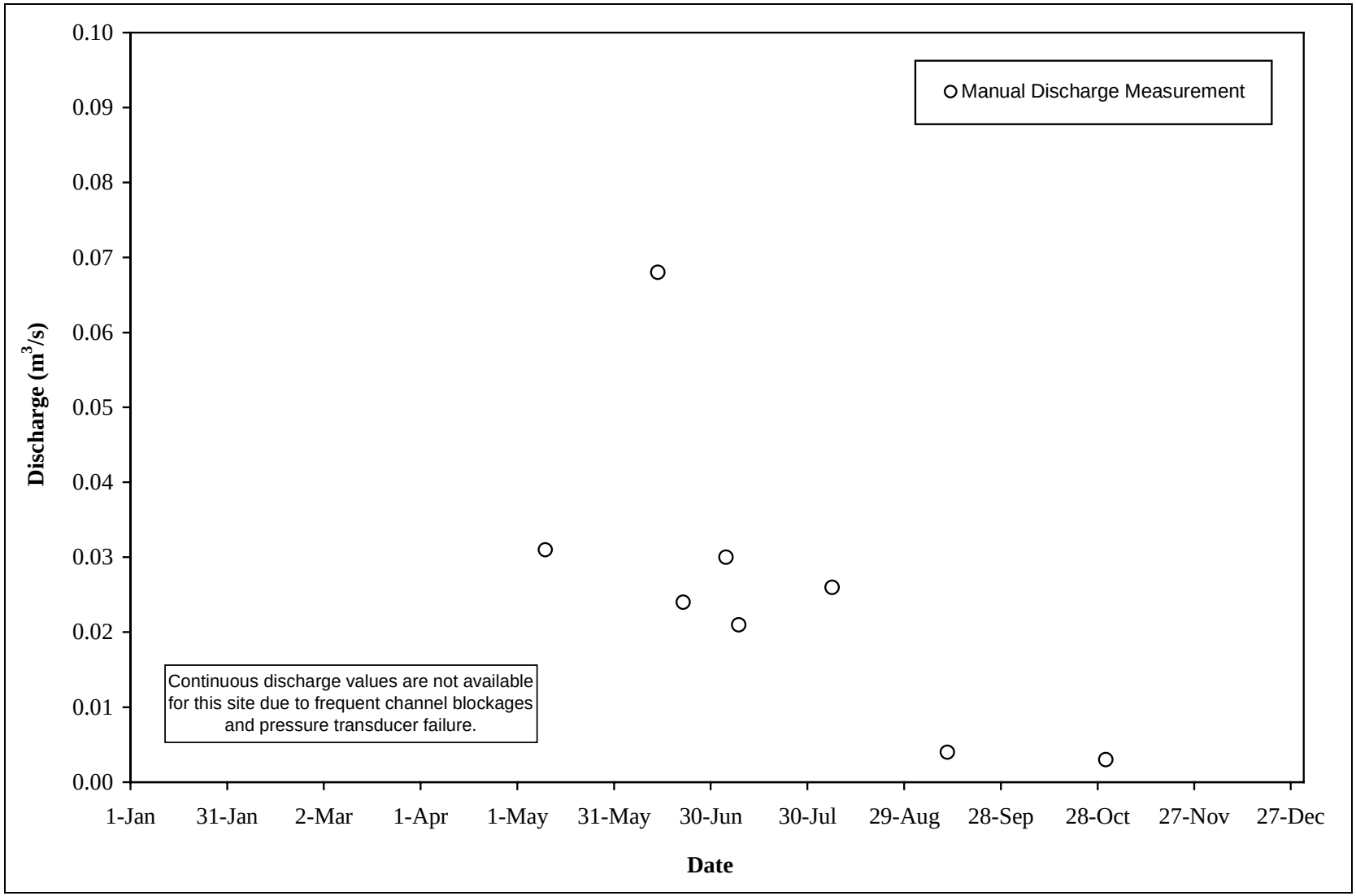


Figure 4.19 2001 Discharge Hydrograph at Lowland Tar River Station (S19)



The measured discharges are documented in Appendix VI and the updated rating curve is provided in Appendix VII. Mean daily water levels and discharges are provided in Appendix VIII.

4.2.21 Upland Muskeg River Streamflow Monitoring Station (S20)

The recorded hydrograph for this station is presented on Figure 4.20. It shows a continuous record from May 9 to August 29, 2001. After August 29, water levels were affected by beaver dam construction and it was not possible to derive discharge values from the recorded water levels. Five manual discharge measurements were performed at this station on April 21, May 8, June 10, July 8 and August 6, 2001. The station was also visited on September 19 and October 27, 2001. The measured discharges are documented in Appendix VI and the updated rating curve is provided in Appendix VII. Mean daily water levels and discharges are provided in Appendix VIII.

4.2.22 Shelley Creek Streamflow Monitoring Station (S21)

This station is in an area affected by beaver dams and it was not possible to derive a reliable stage-discharge rating curve from the data collected in 2001. The record of water levels for this station is presented on Figure 4.21. It shows a continuous record from May 14 to October 26, 2001. Figure 4.21 also shows six manual discharge measurements that were performed at this station on May 14, June 12, July 10, August 9, September 19 and October 26, 2001. The measured discharges are documented in Appendix VI. No rating curve is provided for this station. Mean daily water levels and discharges are provided in Appendix VIII.

4.2.23 Muskeg Creek Streamflow Monitoring Station (S22)

The recorded hydrograph for this station is presented on Figure 4.22. It shows a continuous record from May 16 to July 24 and from July 29 to October 27, 2001. The data gap in late July occurred when water levels dropped below the elevation of the temporary pressure transducer installation. Seven manual discharge measurements were performed at this station on April 21, May 8, June 12, July 8, August 6, September 10 and October 27, 2001. Additional discharge measurements from June 6 and 7 were supplied by a Golder field crew that undertook benthic invertebrate sampling on those dates. The measured discharges are documented in Appendix VI and the updated rating curve is provided in Appendix VII. Mean daily water levels and discharges are provided in Appendix VIII.

Figure 4.20 2001 Discharge Hydrograph at Upland Muskeg River Station (S20)

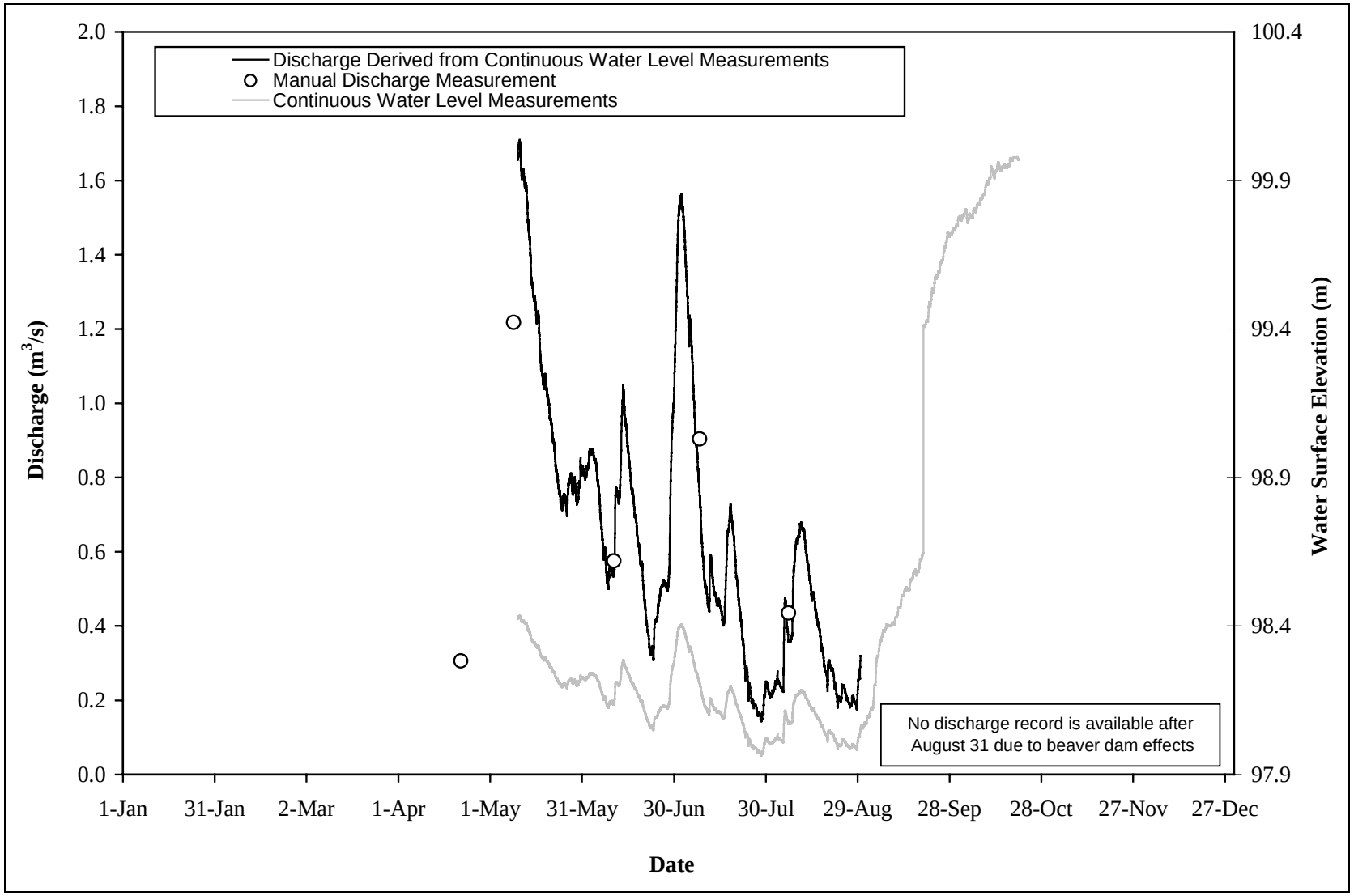


Figure 4.21 2001 Discharge Hydrograph at Shelley Creek Station (S21)

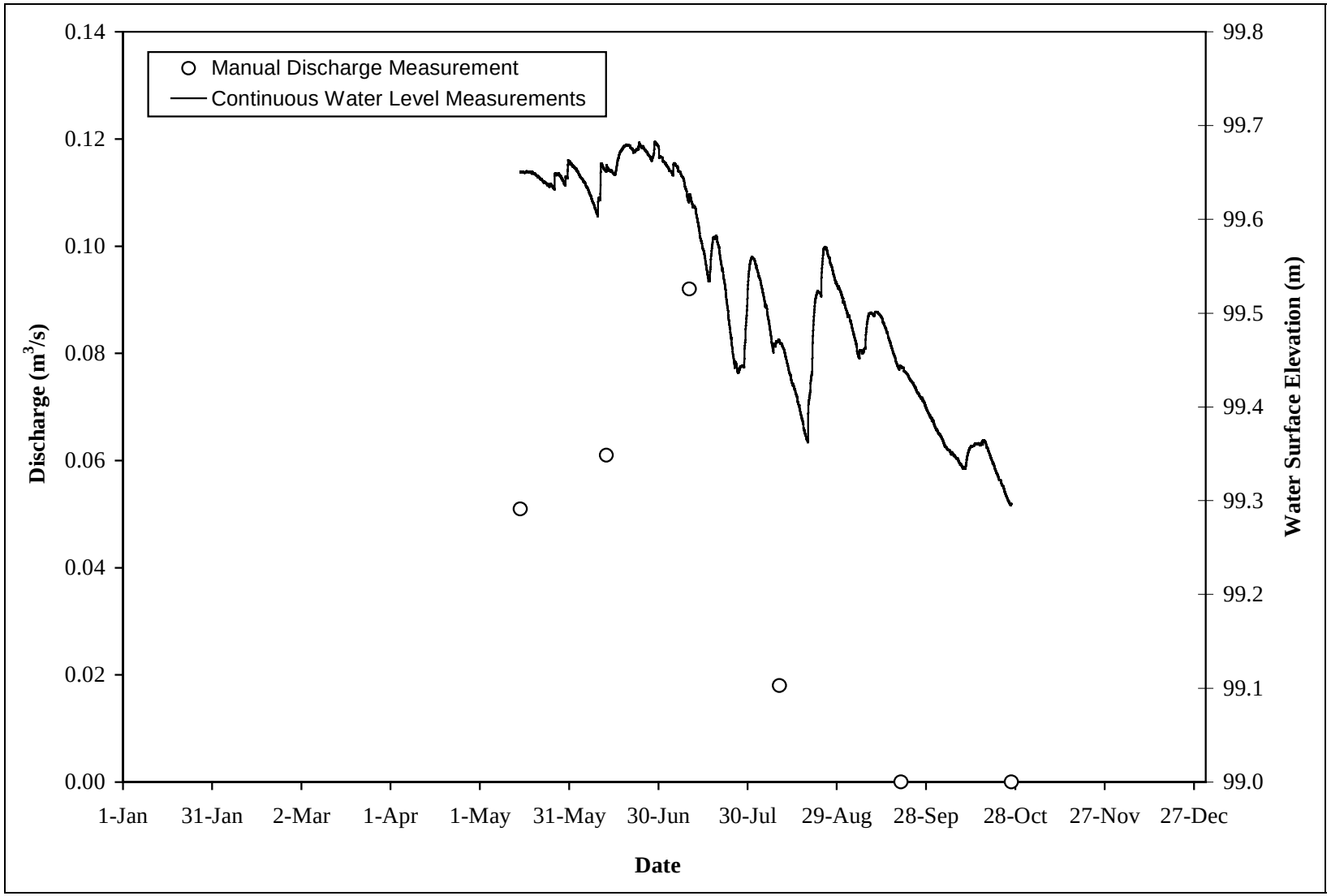
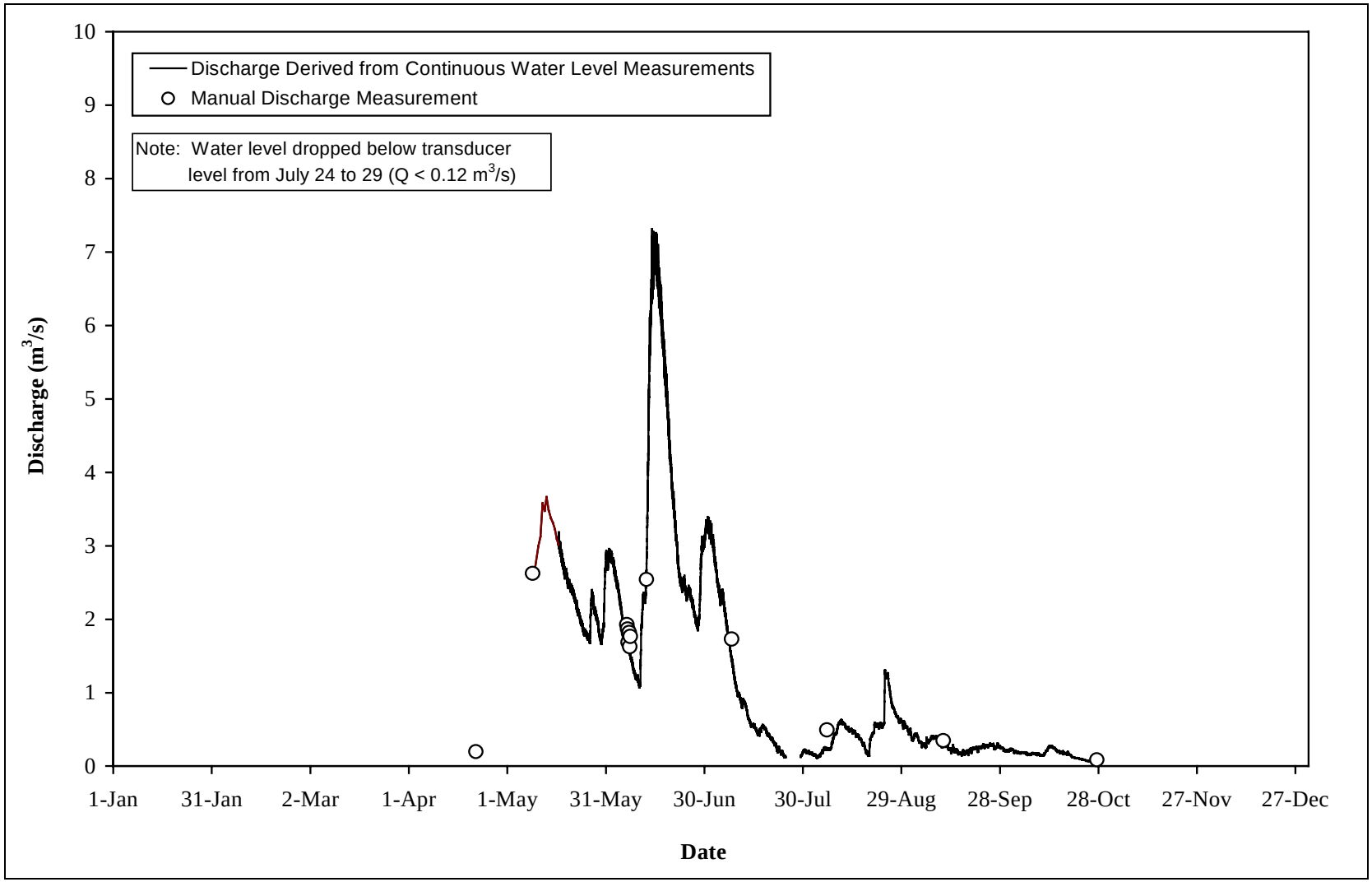


Figure 4.22 2001 Discharge Hydrograph at Muskeg Creek Station (S22)



4.2.24 Aurora Boundary Weir Streamflow Monitoring Station (S23)

The recorded hydrograph for this station is presented on Figure 4.23. It shows a continuous record from January 1 to December 31, 2001. Seven manual discharge measurements were performed at this station on February 16, March 18, May 15, June 13, 2001. The station was also visited on April 20, July 9 and August 7, September 12, October 2, October 30 and December 4 and December 5, 2001. The measured discharges are documented in Appendix VI and the rating curve is provided in Appendix VII. Mean daily water levels and discharges are provided in Appendix VIII.

4.2.25 Athabasca River Streamflow Monitoring Station (S24)

The recorded hydrograph for this station is presented on Figure 4.24. It shows a continuous record from June 21 to December 31, 2001. Four manual discharge measurements were performed at this station on June 20, July 4, August 11 and October 3, 2001. The station was also visited on May 14 and September 14, 2001. To supplement the limited first-year rating curve data for this station, three additional discharges were derived based on discharges reported by the Environment Canada at upstream stations. These are shown as black circles on Figure 4.24.

The measured discharges are documented in Appendix VI and the updated rating curve is provided in Appendix VII. Mean daily water levels and discharges are provided in Appendix VIII.

4.2.26 Khahago Creek Streamflow Monitoring Station (S28)

The recorded hydrograph for this station is presented on Figure 4.25. It shows a continuous record from June 17 to October 25, 2001. Two manual discharge measurements were performed at this station on September 19 and November 1, 2001. The station was also visited on May 14, June 12, July 10 and October 25, 2001. During several visits, it was not possible to undertake discharge measurements, but water levels were measured. The black circles on Figure 4.25 show discharges derived from those water level measurements using the stage-discharge rating curve for the station. The measured discharges are documented in Appendix VI and the updated rating curve is provided in Appendix VII. Mean daily water levels and discharges are provided in Appendix VIII.

Figure 4.23 2001 Discharge Hydrograph at Aurora Boundary Weir Station (S23)

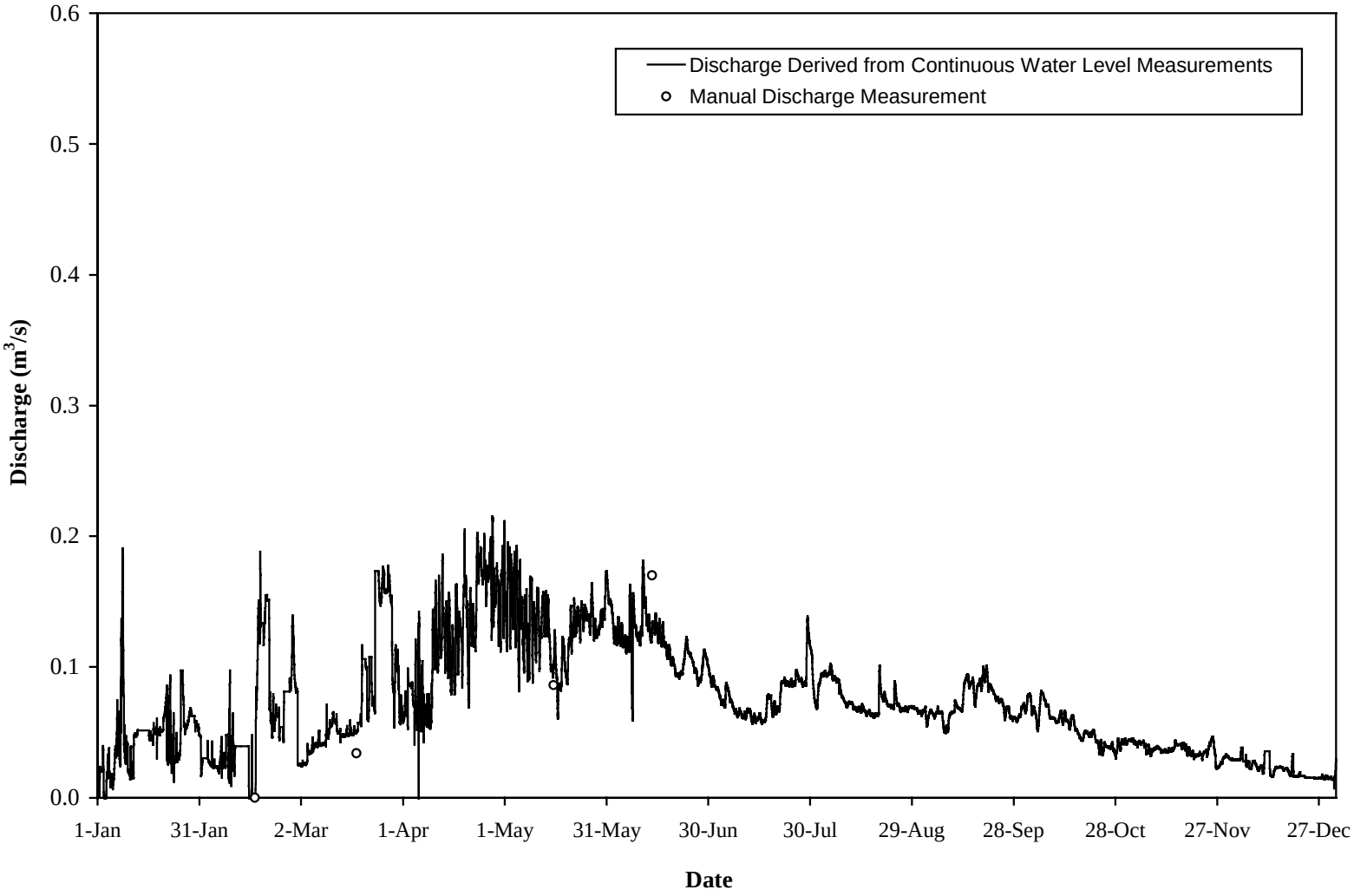


Figure 4.24 2001 Discharge Hydrograph at Athabasca River Station (S24)

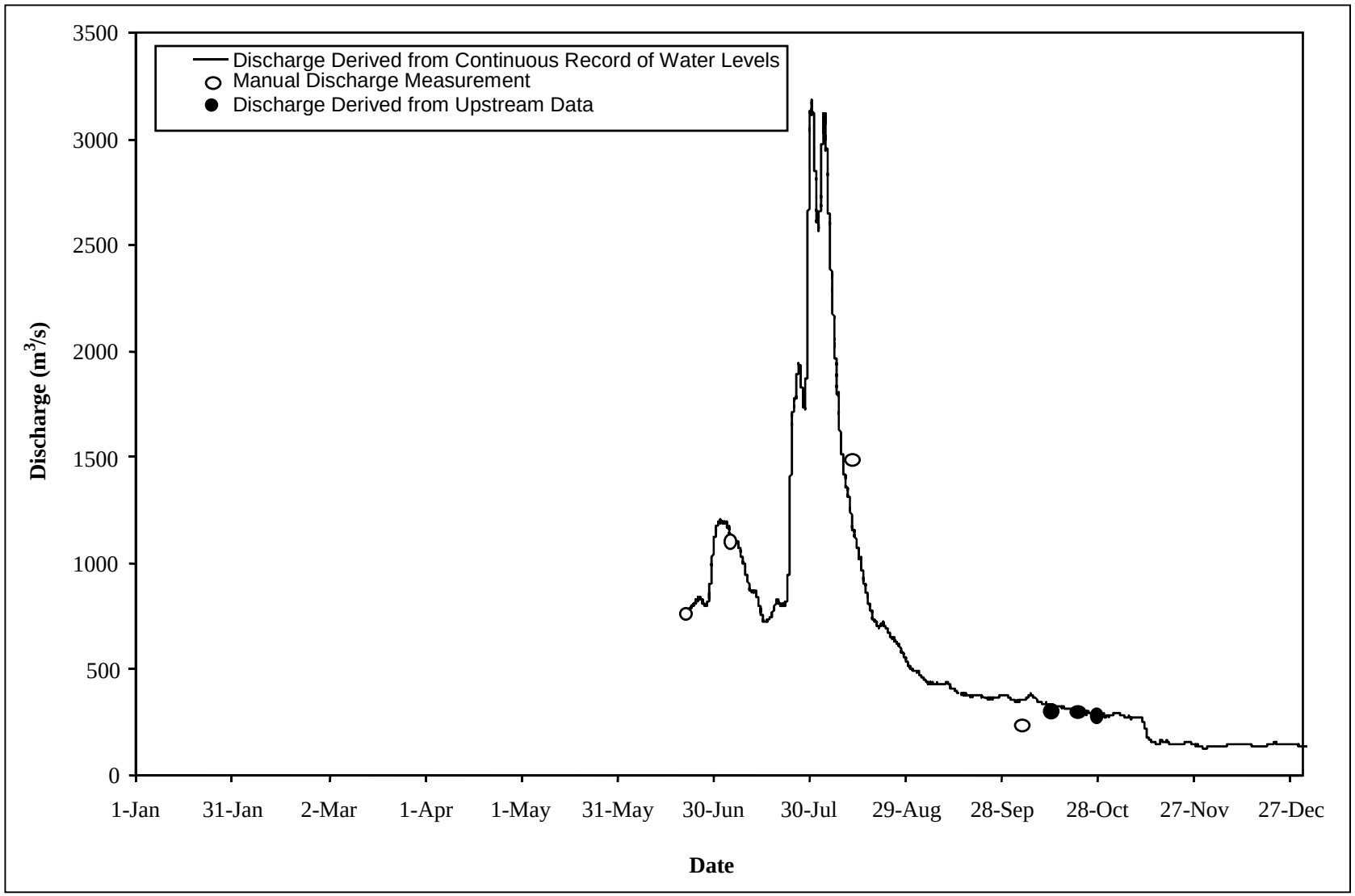
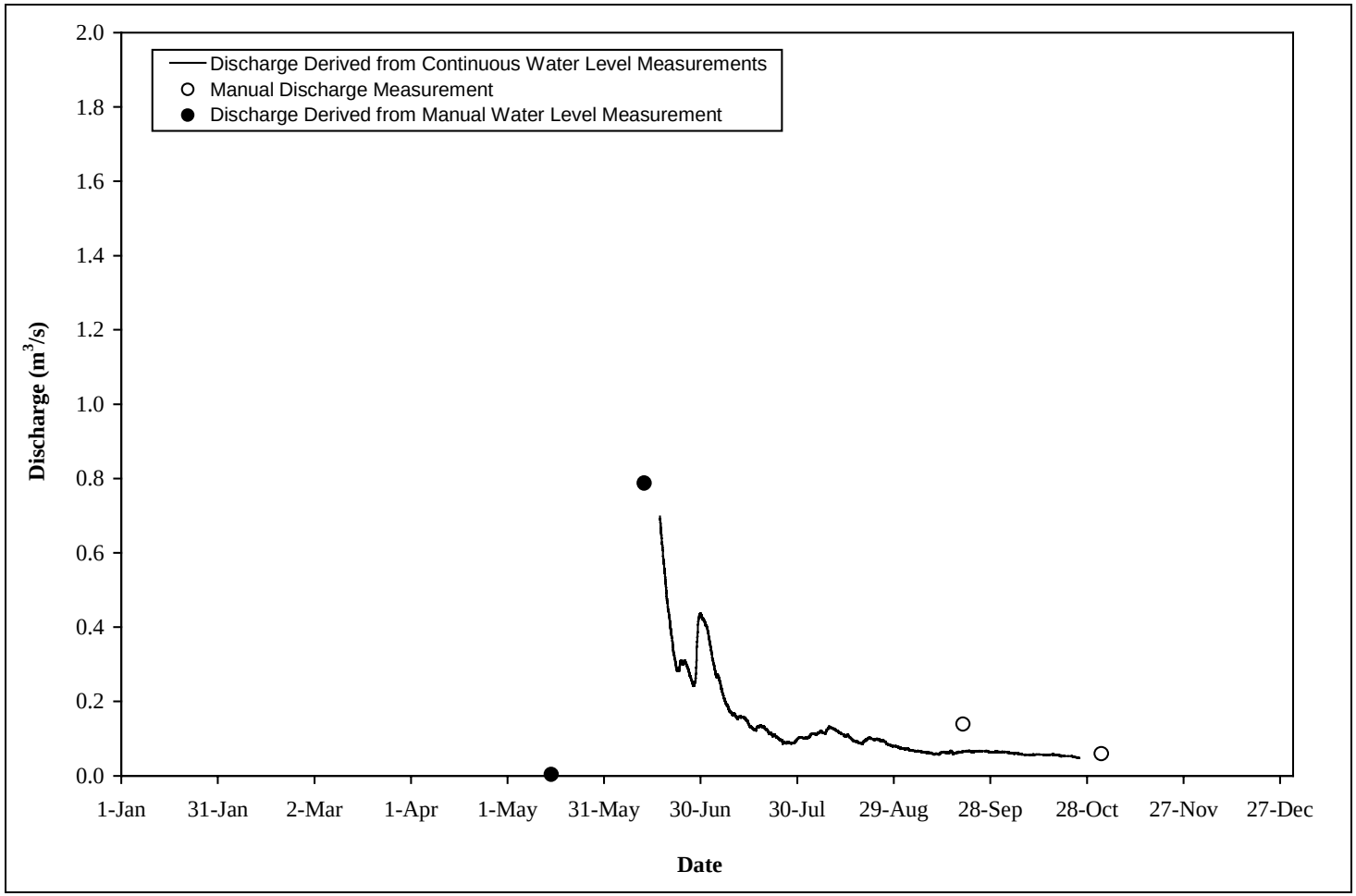


Figure 4.25 2001 Discharge Hydrograph at Khahago Creek Station (S28)



4.2.27 McClelland Lake Water Level and Outflow Monitoring Station (L1)

The recorded hydrograph for this station is presented on Figure 4.26. 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 VI and the outlet rating curve is provided in Appendix VII. Mean daily water levels and discharges are provided in Appendix VIII.

4.2.28 Kearl Lake Water Level Monitoring Station (L2)

The recorded hydrograph for this station is presented on Figure 4.27. It shows a continuous record from August 6 to August 17, August 23 to September 19 and December 6 to December 31, 2001. No data were recorded before August 6 because the submersible pressure transducer and datalogger were removed from the site by a third party, at some time between May 11 and June 10. Earlier data downloads were not possible because of ice conditions on the lake. A spare transducer and data logger was to have been installed in early July, but the replacement unit was installed at Kearl Lake Outlet (Station S9) instead. A replacement was eventually installed on August 6. During the field visit of October 27, this unit was found removed from the lake, resulting in the data gap from September 19 to December 6. A third small data gap, from August 17 to August 23, resulted from a pressure transducer malfunction.

This station was located at a popular fishing spot and has been temporarily relocated, with the permission of a local trapper, to a more secluded location on the lake. A permanent installation at the new location will be undertaken as part of the 2002 program. Nine manual water level measurements were recorded at this station on January 16, February 25, May 11, June 10, July 8, August 6, September 19, October 27 and December 6, 2001. Mean daily water levels are provided in Appendix VIII.

4.2.29 Isadore's Lake Water Level Monitoring Station (L3)

The water level record for this station is presented on Figure 4.28. It shows a continuous record from January 1 to October 2, 2001. The pressure transducer was left in place over the winter and data from October 2 onwards will be downloaded as soon as possible after the ice is out of the lake. Five manual water level measurements were recorded at this station on January 17, June 13, July 9, September 10 and October 29, 2001. The station was also visited on October 2, 2001. Raw data from the pressure transducer was corrected using atmospheric pressure data recorded at Fort McMurray Airport. Mean daily water levels are provided in Appendix VIII.

Figure 4.26 2001 Water Level and Discharge Hydrographs at McClelland Lake Station (L1)

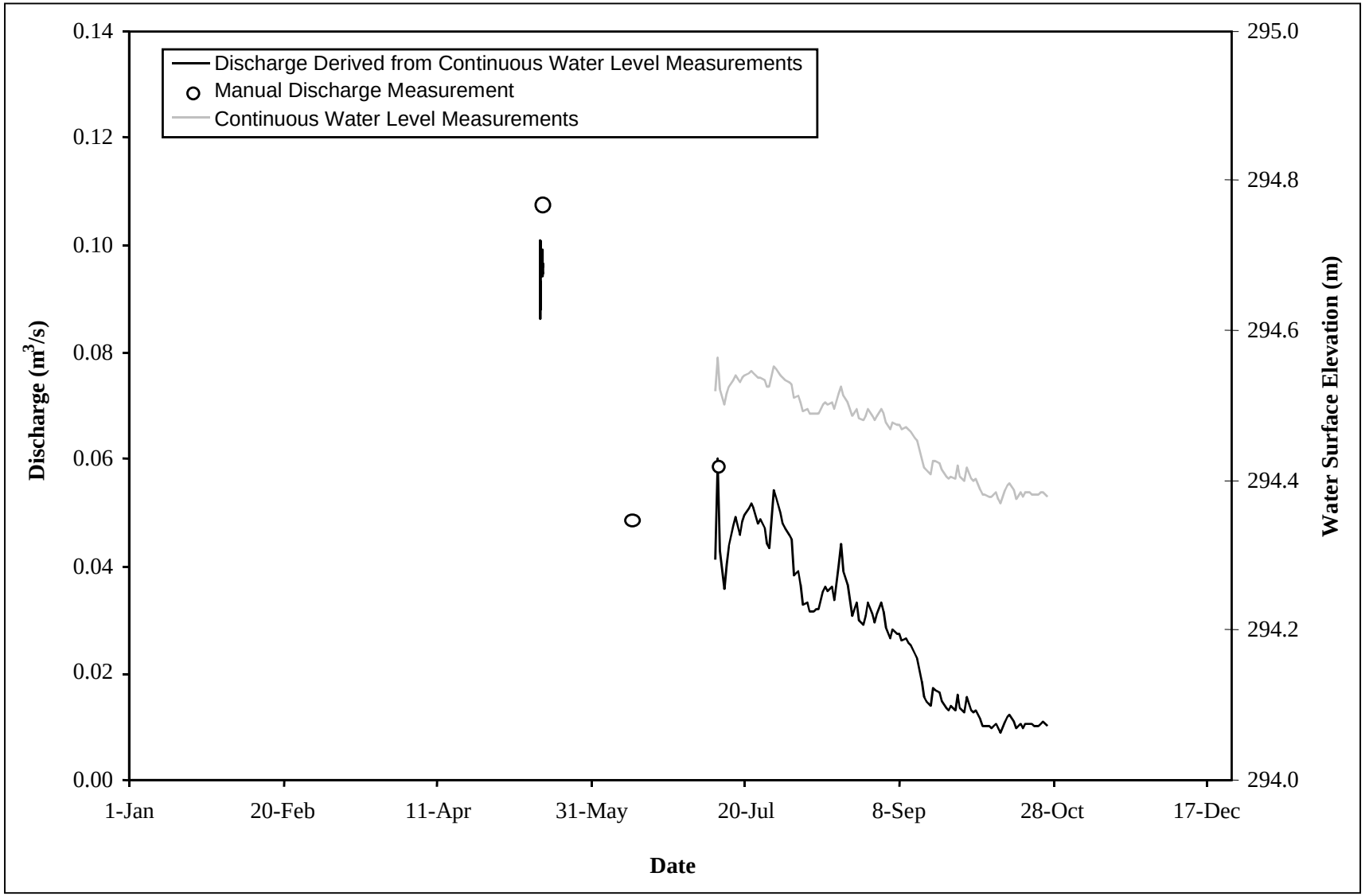


Figure 4.27 2001 Water Level Hydrograph at Kearl Lake Station (L2)

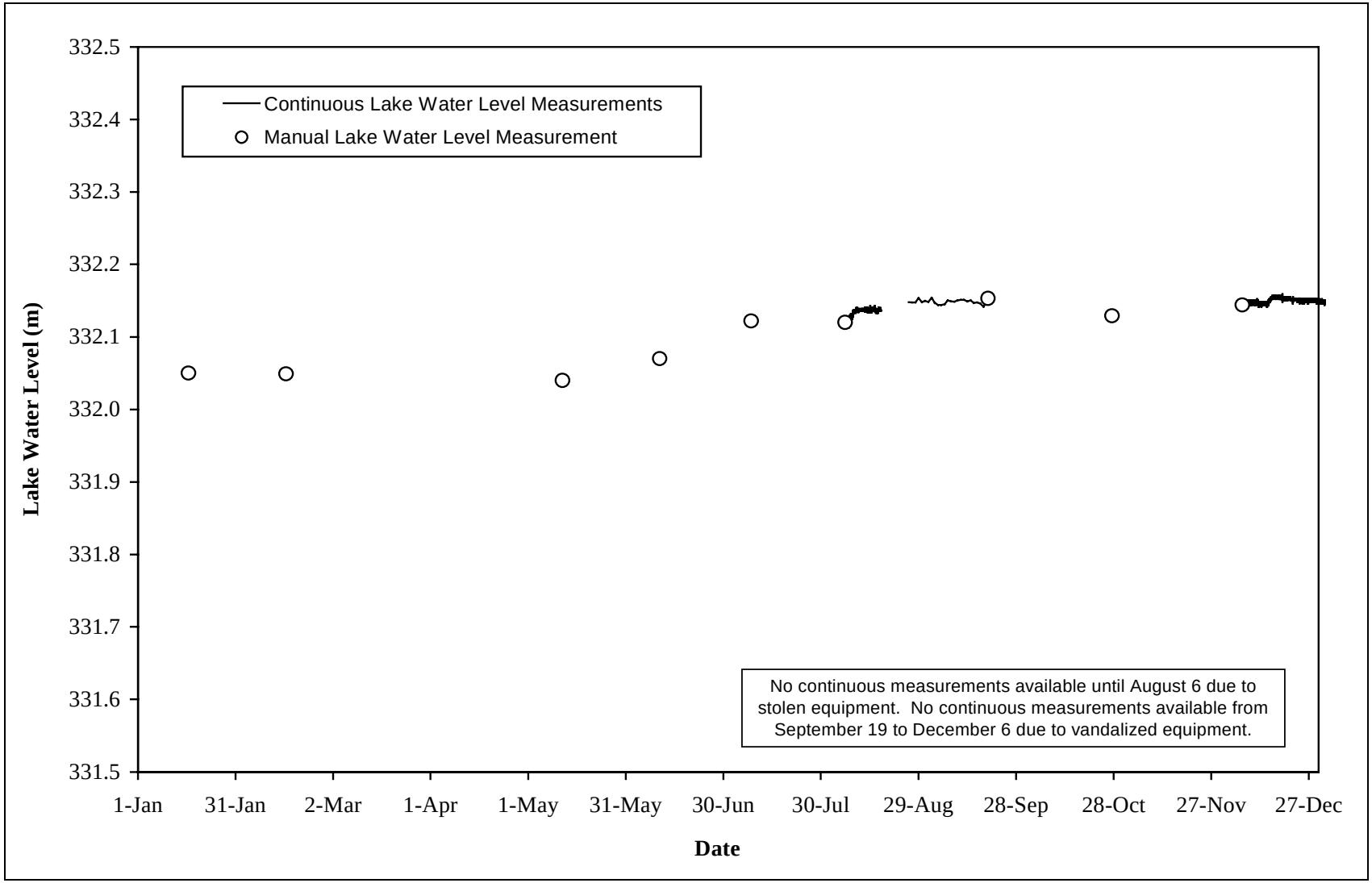
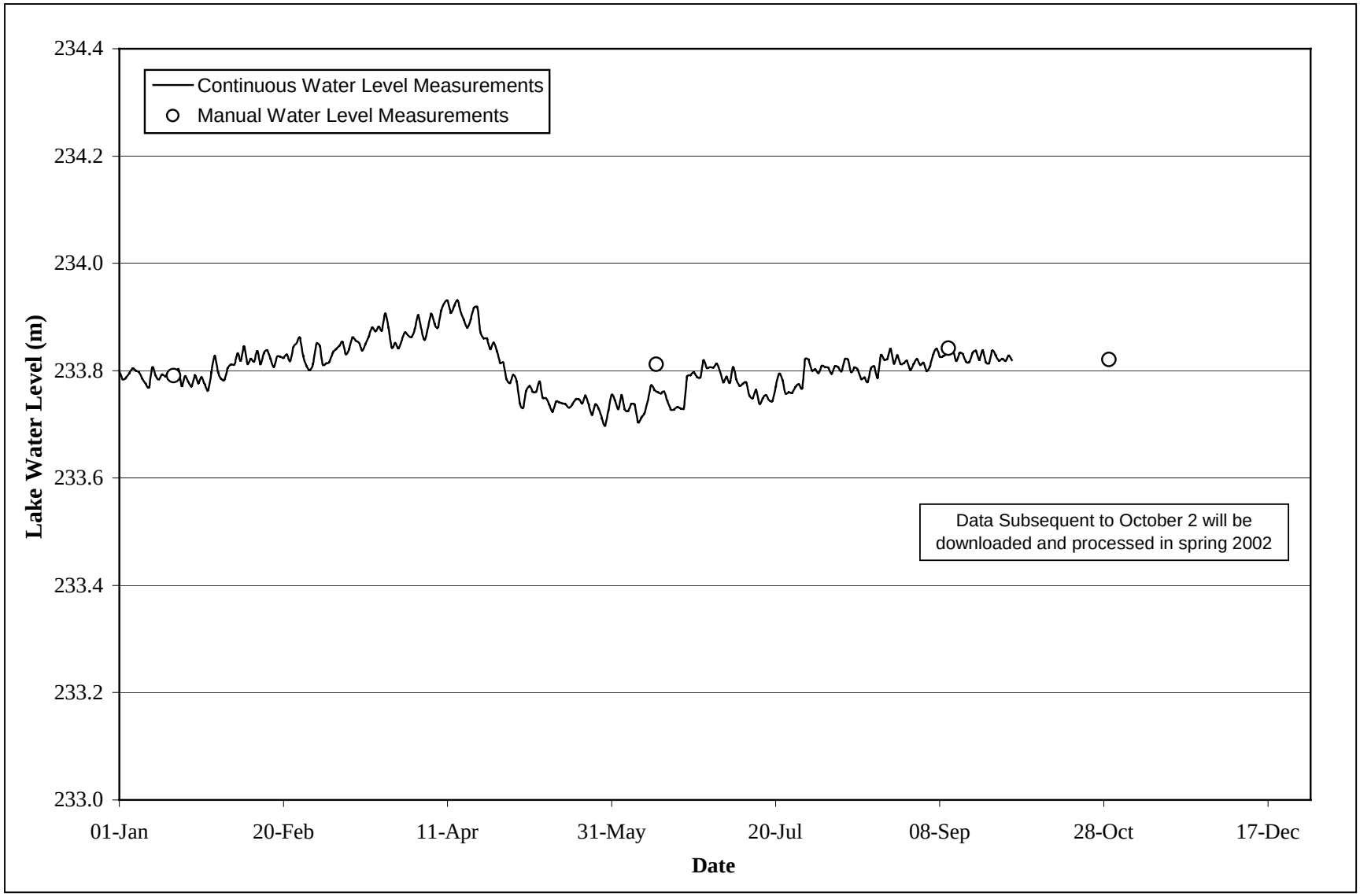


Figure 4.28 2001 Water Level Hydrograph at Isadore's Lake Station (L3)



4.3 HIGH WATER MARK SURVEY

In 2001, seven staff gauges were installed along the study reaches of the Muskeg River and Jackpine Creek to record high water marks. Locations of the high water mark gauges are provided in Table 4.2 and shown on Figure 4.29.

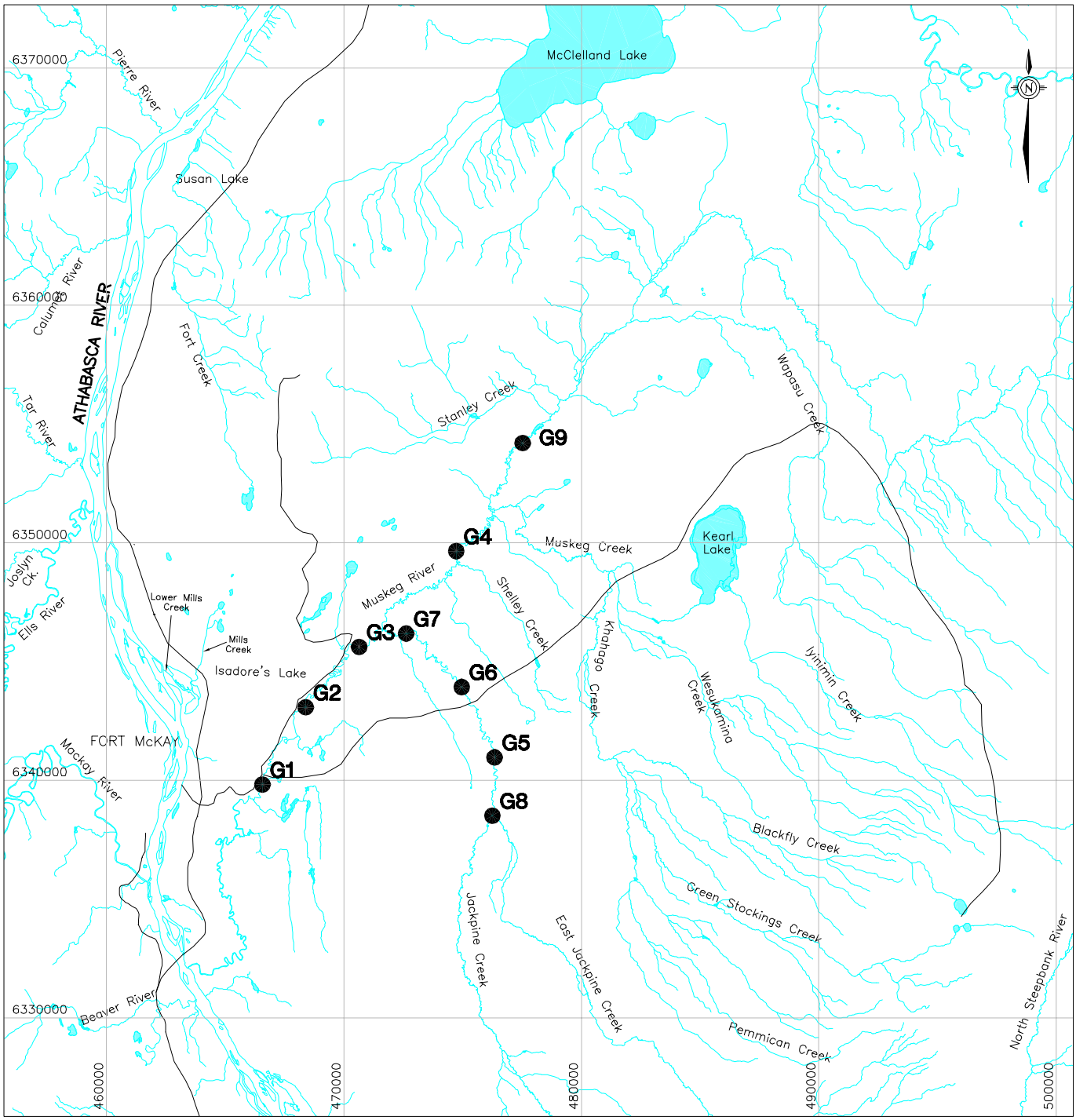
Table 4.2 Locations of High Water Mark Gauges

Muskeg River			Jackpine Creek		
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[(a)]	57° 14' 12"	111° 31' 20"	G6 [(a)]	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"			

[(a)] Not installed in 2001.

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. Water-based paint on the gauges failed to wash off when immersed in water. 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. No extreme flood events were recorded in 2001. High water mark data from 1997 to 2001 are provided in Table 4.3.



LEGEND

● WATER LEVEL STAFF GAUGES

0 2.5 5 7.5 10 12.5km

SCALE 1:250,000

NOTE

ONLY MUSKEG RIVER STAFF GAUGES (G1, G2, G3, G4 AND G9) WERE INSTALLED IN 1999 AND 2000. STAFF GAUGES G2 AND G6 WERE NOT INSTALLED IN 2001

REFERENCE

DRAWING FROM AGRA EARTH AND ENVIRONMENTAL LIMITED
FIG.1435-A3 CATCHMENT BOUNDARIES OF LOCAL STUDY AREA
JAN, 1996.

PROJECT: RAMP

TITLE: **LOCATION PLAN FOR HIGH WATER MARK GAUGES**

Golder Associates
Calgary, Alberta

PROJECT No. 022-2301.7000			FILE No.	High Water Mark
DESIGN			SCALE AS SHOWN	REV. 0
CADD	JMA	11/03/02		
CHECK			**FIGURE: 4.29**	
REVIEW				

R:\Active\2300\022-2301\2001_Report\Report Volume II\2001 Final Report\RAMP Vol II 2001 - CD\REPORT\CAD Figures\ Drawing file: High Water Mark.dwg Apr 17, 2002 - 2:17pm

Table 4.3 High Water Mark Data 1997 - 2001

	19-20 August 1997	1999	26-28 June 2000	21-25 August 2001
Peak Discharges at Local Streamflow Gauges (m^3/s)				
S2 Jackpine Creek	3.2	*	12.8	1.6
S5A Muskeg River	6.1	1.33	15.1	1.5
S7 Muskeg River	13	3.84	37.8	4.2
Peak Water Surface Elevations at Staff Gauges (m)				
G1	273.88	272.98	274.99	273.042
G2	276.57	276.06	277.20	*
G3	277.90	276.51	278.15	276.822
G4	281.72	281.25	281.85	280.595
G5	299.51	*	*	98.257 L
G6	298.05	*	*	*
G7	278.82	*	*	98.292 L
G8	302.30	*	*	99.005 L
G9	*	*	285.18	283.952

* No data collected.
L – Referenced to local datum.

4.4 MEASUREMENTS OF TOTAL SUSPENDED SOLIDS

Measurements of total suspended solids (TSS) are required to characterize the watershed, assess channel sediment yields and erosion, and to monitor streamflow water quality. In previous years, water samples were collected on a regular basis during site visits to each hydrologic monitoring station. These samples were analysed in a commercial laboratory to determine TSS concentration. A summary of 1997 to 2000 results for the various stations (Alsands Drain (S1), Jackpine Creek (S2), Iyinimin Creek (S3), Blackfly Creek (S4), Muskeg River Aurora (S5A), Mills Creek (S6), Kearl Lake Outlet (S9), Wapasu Creek (S10), Poplar Creek (S11) and Albian Sands Pond #3 (S13)) was provided in the 2000 RAMP report (Golder 2001). Because sufficient data was available for these stations, TSS samples will only be taken during high discharge periods or when unusual conditions are observed.

Ass part or the 2002 program, TSS measurments will be taken on a regular basis at stations established in 2000 and 2001, including Fort Creek (S12), Ells River (S14), Tar River (S15), Calumet River (S16), Tar River Upland (S17), Calumet River Upland (S18), Tar River Lowland (S19), Muskeg River Upland (S20), Shelley Creek (S21), Muskeg Creek (S22), Athabasca River (S24), Khahago Creek (S28) and at stations to be established in 2002, including Susan Lake Outlet (S25), MacKay River 7DB1 (S26), Firebag River 7DC1 (S27) and Christina River Environment Canada (S28). Table 4.4 summarizes the 2001 TSS results. Figures presenting the variation of TSS with discharge at these streams will be prepared when more data are available.

All TSS data collected under RAMP are presented in the Climate and Hydrology Database that is discussed in Section 6.

Table 4.4 Total Suspended Solids Data Collected in 2001

Station No.	Stream Name	TSS (mg/L)	Date
S1	Alsands Drain	-	-
S2	Jackpine Creek	-	-
S3	Iyinimin Creek	-	-
S4	Blackfly Creek	-	-
S5A	Muskeg River Aurora	-	-
S6	Mills Creek	-	-
S7	Muskeg River 7DA1	-	-
S8	Stanley Creek	-	-
S9	Kearl Lake Outlet	-	-
S10	Wapasu Creek	< 3	19 Sep
S11	Poplar Creek	-	-
S12	Fort Creek	-	-
S13	Albian Sands Pond #3	-	-
S14	Ells River	28 6 5 5	28 May[(a)] 15 Sep 13 Oct[(a)] 15 Oct[(a)]
S15	Tar River	11 9 50[(b)] 50[(b)]	28 May[(a)] 11 Sep 13 Oct[(a)] 15 Oct[(a)]
S16	Calumet River	4 < 3 < 3 < 3	28 May[(a)] 15 Sep 12 Oct[(a)] 15 Oct[(a)]
S17	Tar River Upland	10	15 Sep
S18	Calumet River Upland	-	-
S19	Tar River Lowland	< 3	11 Sep
S20	Muskeg River Upland	< 3	19 Sep
S21	Shelley Creek	10	20 Sep
S22	Muskeg Creek	< 3	10 Sep
S23	Aurora Boundary Weir	-	-
S24	Athabasca River	-	-
S28	Khahago Creek	3	20 Sep
L1	McClelland Lake	-	-
L2	Kearl Lake	-	-
L3	Isadore's Lake	-	-

(a) Measured at the river mouth

(b) These values appear high but are within historically measured limits. 10 mm of rainfall was measured at station S16 over the period from October 11 to 15, 2001.

5 INSTALLATION AND MAINTENANCE

5.1 WORK PERFORMED IN 2001

5.1.1 Aurora Climate Station (C1)

Only routine maintenance of the tipping bucket snow gauge was undertaken in 2001. All other sensors will be recalibrated as part of routine maintenance in 2002.

5.1.2 Alsands Drain Monitoring Station (S1)

The datalogger at this site was replaced with a new Optimum Instruments Data Dolphin unit with remote data retrieval capability in May 2001. Replacement of a frost-damaged pressure transducer was undertaken at the same time. In August 2001, the replacement transducer failed for unknown reasons and was replaced with a functioning unit.

5.1.3 Jackpine Creek Monitoring Station (S2)

Jackpine Creek Station was relocated to a new site in 2000 (immediately downstream of the Canterra Road bridge). However, a temporary installation was used until permits for instream work were received. The permanent station, including conduit installed under the streambed, was installed in September 2001. A copy of the installation permit is provided in Appendix VII.

5.1.4 Iyinimin Creek Monitoring Station (S3)

This station was reactivated in May 2001 after being taken out of service at the end of 1999. The station was reinstalled with the old datalogger and transducer, which had been stored as spare equipment in 2000.

5.1.5 Muskeg River 7DA8 Environment Canada Hydometric Station (S7)

This site previously used a non-vented pressure transducer and datalogger to collect data. This system allowed for data downloads and status checks only at the end of the ice-covered season. A permanent station, including conduit installed under the streambed, was installed in October 2001. The datalogger was replaced with a new Optimum Instruments Data Dolphin unit with remote data retrieval capability. A copy of the installation permit is provided in Appendix IX.

5.1.6 Kearl Lake Outlet Monitoring Station (S9)

This station was reactivated in May 2001 after being taken out of service at the end of 1999. The station was reinstalled with the old datalogger and transducer that had been stored as spare equipment in 2000.

5.1.7 Wapasu Creek Monitoring Station (S10)

This station was reactivated in May 2001 after being taken out of service at the end of 1999. The station was reinstalled with the old datalogger and transducer that had been stored as spare equipment in 2000.

5.1.8 Fort Creek Streamflow Monitoring Station (S12)

Fort Creek Station was installed in 2000, immediately downstream of the Highway 63 culvert. However, a temporary installation was used until permits for instream work were received. The permanent station, including conduit installed under the streambed, was installed in September 2001. A copy of the installation permit is provided in Appendix IX.

5.1.9 Albian Sands Pond #3 Streamflow Monitoring Station (S13)

The datalogger at this site was replaced with a new Optimum Instruments Data Dolphin unit with remote data retrieval capability in May 2001.

5.1.10 Ells River Streamflow Monitoring Station (S14)

This station was installed in May 2001 to support baseline work for the CNRL Horizon project. A temporary installation was used until permits for instream work were received. The permanent station, including conduit installed under the streambed, was installed in September 2001. The datalogger at this site has remote data retrieval capability. Sensors at this site include a pressure transducer, thermistor and conductivity probe. A copy of the installation permit is provided in Appendix IX.

5.1.11 Tar River Streamflow Monitoring Station (S15)

This station was installed in May 2001 to support baseline work for the CNRL Horizon project. A temporary installation was used until permits for instream work were received. The permanent station, including conduit installed under the streambed, was installed in September 2001. The datalogger at this site has

remote data retrieval capability. Sensors at this site include a pressure transducer, thermistor and conductivity probe. A copy of the installation permit is provided in Appendix IX.

5.1.12 Calumet River Streamflow Monitoring Station (S16)

This station was installed in May 2001 to support baseline work for the CNRL Horizon project. A temporary installation was used until permits for instream work were received. The permanent station, including conduit installed under the streambed, was installed in September 2001. The datalogger at this site has remote data retrieval capability. Sensors at this site include a pressure transducer, thermistor, air temperature sensor tipping bucket snow gauge and tipping bucket rain gauge. A copy of the installation permit is provided in Appendix IX.

5.1.13 Tar River Upland Streamflow Monitoring Station (S17)

This station was installed in May 2001 to support baseline work for the CNRL Horizon project. A temporary installation was used until permits for instream work were received. The permanent station, including conduit installed under the streambed, was installed in October 2001. The datalogger at this site has remote data retrieval capability. Sensors at this site include a pressure transducer, thermistor and conductivity probe. A copy of the installation permit is provided in Appendix IX.

5.1.14 Calumet River Upland Streamflow Monitoring Station (S18)

This station was installed in May 2001 to support baseline work for the CNRL Horizon project. A temporary installation was used until permits for instream work were received. The permanent station was not installed due to inundation by a new beaver pond. The datalogger at this site has remote data retrieval capability. The only sensor at this site is a pressure transducer. A copy of the installation permit is provided in Appendix IX.

5.1.15 Tar River Lowland Streamflow Monitoring Station (S19)

This station was installed in May 2001 to support baseline work for the CNRL Horizon project. A temporary installation was used until permits for instream work were received. The permanent station, including conduit installed under the streambed, was installed in October 2001. The datalogger at this site has remote data retrieval capability. Sensors at this site include a pressure transducer and thermistor. A copy of the installation permit is provided in Appendix IX.

5.1.16 Muskeg River Upland Streamflow Monitoring Station (S20)

This station was installed in May 2001 to support baseline work for the Shell Jackpine project. A temporary installation was used until permits for instream work were received. The permanent station was not installed due to inundation by a newly-constructed beaver pond. The datalogger at this site has remote data retrieval capability. Sensors at this site include a pressure transducer and thermistor. A copy of the installation permit is provided in Appendix IX.

5.1.17 Shelley Creek Streamflow Monitoring Station (S21)

This station was installed in May 2001 to support baseline work for the Shell Jackpine project. A temporary installation was used until permits for instream work were received. The permanent station, including conduit installed under the streambed, was installed in October 2001. The datalogger at this site has remote data retrieval capability. Sensors at this site include a pressure transducer and thermistor. A copy of the installation permit is provided in Appendix IX.

5.1.18 Muskeg Creek Streamflow Monitoring Station (S22)

This station was installed in May 2001 to support baseline work for the Shell Jackpine project. A temporary installation was used until permits for instream work were received. The permanent station, including conduit installed under the streambed, was installed in September 2001. The datalogger at this site has remote data retrieval capability. Sensors at this site include a pressure transducer, thermistor and conductivity probe. A copy of the installation permit is provided in Appendix IX.

5.1.19 Aurora Boundary Weir Streamflow Monitoring Station (S23)

The weir and equipment shed for this station, located on the boundary between the Aurora North Mine site and the Albian Sands Muskeg River Mine site, were previously installed by Syncrude. Operation was taken over by RAMP in January 2001. The datalogger at this site was replaced with a new Optimum Instruments Data Dolphin unit with remote data retrieval capability in November 2001.

5.1.20 Athabasca River Streamflow Monitoring Station (S24)

This station was installed in May 2001 to provide data to upstream operators participating in RAMP. A temporary installation was used until permits for instream work were received. The permanent station, including conduit installed under the streambed, was installed in September 2001. The datalogger at this site has remote data retrieval capability. The only sensor at this site is a pressure transducer. A copy of the installation permit is provided in Appendix IX.

5.1.21 Kearl Lake Station (L2)

This site was vandalized twice in 2001. The non-vented pressure transducer and datalogger was stolen in May or June 2001. This equipment was replaced with a vented transducer and non-submersible datalogger in August 2001. The replacement equipment was removed from the lake and thrown onto the ice cover in October 2001. New equipment was installed at a more protected location in November 2001. Relocation of the station is recommended.

5.2 WORK RECOMMENDED FOR 2002

5.2.1 Mills Creek Streamflow Monitoring Station (S6)

The existing weir at Mills Creek Station has deteriorated since it was installed in 1998, primarily due to frost jacking and exposure to freeze-thaw cycles. It is recommended that the weir be replaced with a new structure, similar to that installed at the Alsands Drain (S1) and Albian Sands Pond #3 (S13), with a service life of at least 20 years. Mine development in this area means that monitoring of this station is likely to be required for several decades.

5.2.2 Susan Lake Outlet Creek Streamflow Monitoring Station (S25)

Open-water streamflow monitoring of the Susan Lake Outlet Creek is included in RAMP in 2002. A reconnaissance was undertaken in September 2001 to identify a suitable site for equipment installation. A temporary installation will be undertaken in the spring of 2002 and a permanent installation will be undertaken when permits are received. The datalogger should be equipped with remote data retrieval capability and a pressure transducer and thermistor should be installed.

5.2.3 Mackay River Streamflow Monitoring Station (S26)

Winter streamflow monitoring of the Firebag River is included in RAMP in 2002. Equipment was temporarily installed at the station in October 2001. A permanent installation should be undertaken during the open water season in 2002. The datalogger should be equipped with remote data retrieval capability and a pressure transducer and thermistor should be installed.

5.2.4 Firebag River Streamflow Monitoring Station (S27)

Winter streamflow monitoring of the Mackay River is included in RAMP in 2002. Equipment was temporarily installed at the station in October 2001. A permanent installation should be undertaken during the open water season in 2002. The datalogger should be equipped with remote data retrieval capability and a pressure transducer and thermistor should be installed.

5.2.5 Christina River Streamflow Monitoring Station (S29)

Winter monitoring of the Christina River near Chard has been requested for 2002. A temporary installation was installed in January 2002. A permanent installation should be undertaken during the open water season in 2002. The datalogger should be equipped with remote data retrieval capability and a pressure transducer and thermistor should be installed.

5.2.6 Telemetry Retrofitting

Sixteen of the 27 RAMP hydrometric stations active in 2001 were equipped with remote data download and programming capability. This has allowed the following:

- assessment of field conditions before visiting sites;
- identification of sensor problems before visiting sites;
- diagnosis of instrumentation problems from the office while field staff are on site; and
- download and reporting of site data without field visits.

These capabilities have greatly enhanced QA/QC, allowed early detection of equipment malfunctions, and in the long term should reduce the cost of fieldwork by reducing the number of station visits required each year.

It is recommended that instrumentation at non-equipped sites be replaced with telemetry-capable equipment when equipment fails or is retired on an opportunistic basis under the existing maintenance budget. Recommendations for data logger replacement in 2002 are shown in Table 5.1.

Table 5.1 Recommendations for Datalogger Replacement in 2002

Rank	Station	Rationale
1	McClelland Lake (L1)	Helicopter access site. Convert station to 12 month operation.
2	Jackpine Creek (S2)	Old equipment installed at newly-relocated site. Long term site. Reporting likely required due to mine development.
3	Mills Creek (S6)	Undertake in conjunction with weir reconstruction.
4	Kearl Lake (L2)	Undertake in conjunction with relocation of site.
5	Isadore's Lake (L3)	Replace non-vented transducer, enable downloads during ice-covered conditions.
6	Iyinimin Creek (S3)	Old equipment at helicopter access site. Tipping bucket rain gauge at this site.
7	Kearl Lake Outlet (S9)	Old equipment, long drive from mine sites.
8	Wapasu Creek (S10)	Old equipment, long drive from mine sites.
9	Fort Creek (S12)	Old equipment, long drive from mine sites.
10	Poplar Creek (S11)	Old equipment, easy road access.
11	Stanley Creek (S8)	Old equipment at helicopter access site, water levels only.
12	Aurora Climate Station (C1)	Campbell Scientific datalogger would be adapted with download device only (no new logger).

5.2.7 Geodetic Surveys

Benchmarks associated with the RAMP climatic and hydrologic component were last surveyed in October, 2000. This allowed all water surface elevations at stream discharge, lake level and high water gauges to be referenced to geodetic elevations. Stations installed since October, 2000 are referenced to local data only, and surveys to tie benchmarks into a geodetic datum are recommended. Benchmark elevations for hydrometric stations are summarized in Appendix VII.

6 UPDATE OF THE REGIONAL CLIMATIC AND HYDROLOGIC DATABASE

The 2001 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 III of this report contains data from local monitoring programs and regional data collected by Environment Canada. 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

RAMP Data		Environment Canada Data	
Hydrology	**Climate**	**Hydrology**	**Climate**
North of Fort McMurray	North of Fort McMurray	North of Fort McMurray	North of Fort McMurray
Alsands Drain (S1)	Aurora Climate Station	Athabasca River (07DA001)	Birch Mountain. Lookout (3060700)
Jackpine Creek (S2)	Iyinimin Creek Station	Beaver River (07DA005)	Bitumont Lookout (3060705)
Iyinimin Creek (S3)	Calumet River Station	Steepbank River (07DA006)	Buckton Lookout (3060922)
Blackfly Creek (S4)	Snow Course Survey in the Muskeg River Basin	Poplar Creek (07DA007)	Ells Lookout (3062300)
Muskeg River Aurora (S5/S5A)	Snow Course Survey in the Fort Creek Basin	Muskeg River (07DA008)	Fort McMurray Airport (3062693)
Mills Creek (S6)	Snow Course Survey in the CNRL Lease Area	Jackpine Creek (07DA009)	Johnson Lake Lookout (3063563)
Muskeg River 7DA8 (S7)		Ells River (07DA010)	Legend Lookout (3073792)
Stanley Creek (S8)		Unnamed Creek (07DA011)	Mildred Lake (3064531 and 3064528)
Kearl Lake Outlet (S9)		Asphalt Creek (07DA012)	Muskeg Lookout (3064740)
Wapasu Creek (S10)		Pierre River (07DA013)	Richardson Lookout (3065492)
Poplar Creek (S11)		Calumet River (07DA014)	Tar Island (3066364)
Fort Creek (S12)		Tar River (07DA015)	Thickwood Lookout (3066380)
Alsands Pond #3 (S13)		Joslyn Creek (07DA016)	South of Fort McMurray
Ells River (S14)		Ells River (07DA017)	Algar Lookout (3060110)
Tar River (S15)		Beaver River (07DA018)	Christina Lookout (3061580)
Calumet River (S16)		Tar River (07DA019)	Conklin Lookout (3061800)
Upland Tar River (S17)		MacKay River (07DB001)	Cowpar Lookout (3061930)
Upland Calumet River (S18)		Dover River (07DB002)	Gordon Lake Lookout (3062889)
Lowland Tar River (S19)		Dunkirk River (07DB003)	Heart Lake Lookout (3063120)
Upland Muskeg River (S20)		Thickwood Creek (07DB004)	Round Hill Lookout (3065560)
Shelley Creek (S21)		MacKay River (07DB005)	Stoney Mountain Lookout (3066160)
Muskeg Creek (S22)		Firebag River (07DC001)	Winefred Lookout (3067590)
Aurora Boundary Weir (S23)		Lost Creek (07DC002)	
Athabasca River (S24)		South of Fort McMurray	
Khahago Creek (S28)		Horse River (07CC001)	
McClelland Lake (L1)		Clearwater River at Draper (07D001)	
Kearl Lake (L2)		Hangingstone River (07CD004)	
Isadore's Lake (L3)		Clearwater River above Christina River (07CD005)	
		Gregoire Lake (07CE001)	
		Christina River (07CE002)	
		Pony Creek (07CE003)	
		Robert Creek (07CE004)	
		Jackfish River (07CE005)	
		Birch Creek (07CE006)	

Table 6.2 RAMP 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^2	280 – 300 m	1995 – 2001
Jackpine Creek (S2)	57° 15' 31"	111° 27' 55"	358 km^2	270 – 490 m	1995 – 2001
Iyinimin Creek (S3)	57° 15' 00"	111° 10' 27"	32.3 km^2	340 – 560 m	1995 – 1999; 2001
Blackfly Creek (S4)	57° 12' 20"	111° 15' 22"	31.1 km^2	345 – 540 m	1995 – 1998
Muskeg River Aurora (S5/S5A)	57° 18' 30"	111° 23' 43"	552 km^2	280 – 560 m	1995 – 2001
Mills Creek (S6)	57° 14' 44"	111° 35' 57"	23.8 km^2	280 – 300 m	1997 – 2001
Muskeg River 7DA8 (S7)	57° 11' 29"	111° 34' 10"	1,460 km^2	260 – 560 m	1998 – 2001
Stanley Creek (S8)	57° 21' 06"	111° 22' 26"	71.8 km^2	290 – 360 m	1999 – 2000
Kearl Lake Outlet (S9)	57° 15' 57"	111° 15' 57"	73.6 km^2	330 – 560 m	1998 – 1999; 2001
Wapasu Creek (S10)	57° 20' 35"	111° 09' 40"	90.7 km^2	320 – 560 m	1998 – 1999; 2001
Poplar Creek (S11)	56° 54' 46"	111° 27' 44"	422 km^2	240 – 510 m	1995 – 2001
Fort Creek (S12)	57° 24' 48"	111° 37' 18"	35.5 km^2	250 – 360 m	2000 - 2001
Alsands Pond #3 (S13)	57° 14' 47"	111° 30' 58"	disturbed area	gauge at 279 m	2000 - 2001
Ells River (S14)	57° 17' 10"	111° 42' 30"	2450 km^2	235 – 730 m	2001
Tar River (S15)	57° 21' 12"	111° 45' 25"	301 km^2	285 – 810 m	2001
Calumet River (S16)	57° 23' 46"	111° 41' 47"	182 km^2	265 – 750 m	2001
Upland Tar River (S17)	57° 21' 35"	111° 55' 22"	13.8 km^2	365 – 650 m	2001
Upland Calumet River (S18)	57° 26' 40"	111° 47' 17"	48 km^2	308 – 750 m	2001
Lowland Tar River (S19)	57° 19' 00"	111° 42' 30"	11.5 km^2	270 – 300 m	2001
Upland Muskeg (S20)	57° 20' 09"	111° 07' 48"	157 km^2	335 – 560 m	2001
Shelley Creek (S21)	57° 16' 26"	111° 23' 28"	16 km^2	295 – 327 m	2001
Muskeg Creek (S22)	57° 16' 56"	111° 18' 52"	345 km^2	308 – 540 m	2001
Aurora Boundary Weir (S23)	57° 17' 30"	111° 29' 33"	Disturbed	gauge at 295 m	2001
Athabasca River (S24)	57° 29' 46"	111° 33' 43"	146,000 km^2	230 – 1490 m	2001
Khahago Creek (S28)	57° 13' 21"	111° 19' 23"	13.6 km^2	325 – 540 m	2001
McClelland Lake (L1)	57° 29' 30"	111° 16' 37"	191 km^2	295 – 350 m	1997-2001
Kearl Lake (L2)	57° 18' 15"	111° 14' 40"	72.6 km^2	330 – 560 m	1999-2001
Isadore's Lake (L3)	57° 13' 15"	111° 36' 24"	28.0 km^2	240 – 300 m	2000-2001
TSS Data	all local hydrologic monitoring stations				1997 – 2001
Ice thickness data	all local hydrologic monitoring stations				1997 – 2001

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

Table 6.3 RAMP 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
Iyinimin Creek Station	57° 15' 00" North 111° 10' 27" West 340 m elevation	TBRG rainfall instantaneous TBRG rainfall hourly accumulation 1999, 2001	
Kearl Lake Outlet Station	57° 15' 57" North 111° 15' 57" West 330 m elevation	atmospheric pressure 1999 monitored in 2000-2001 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, March 2001	

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

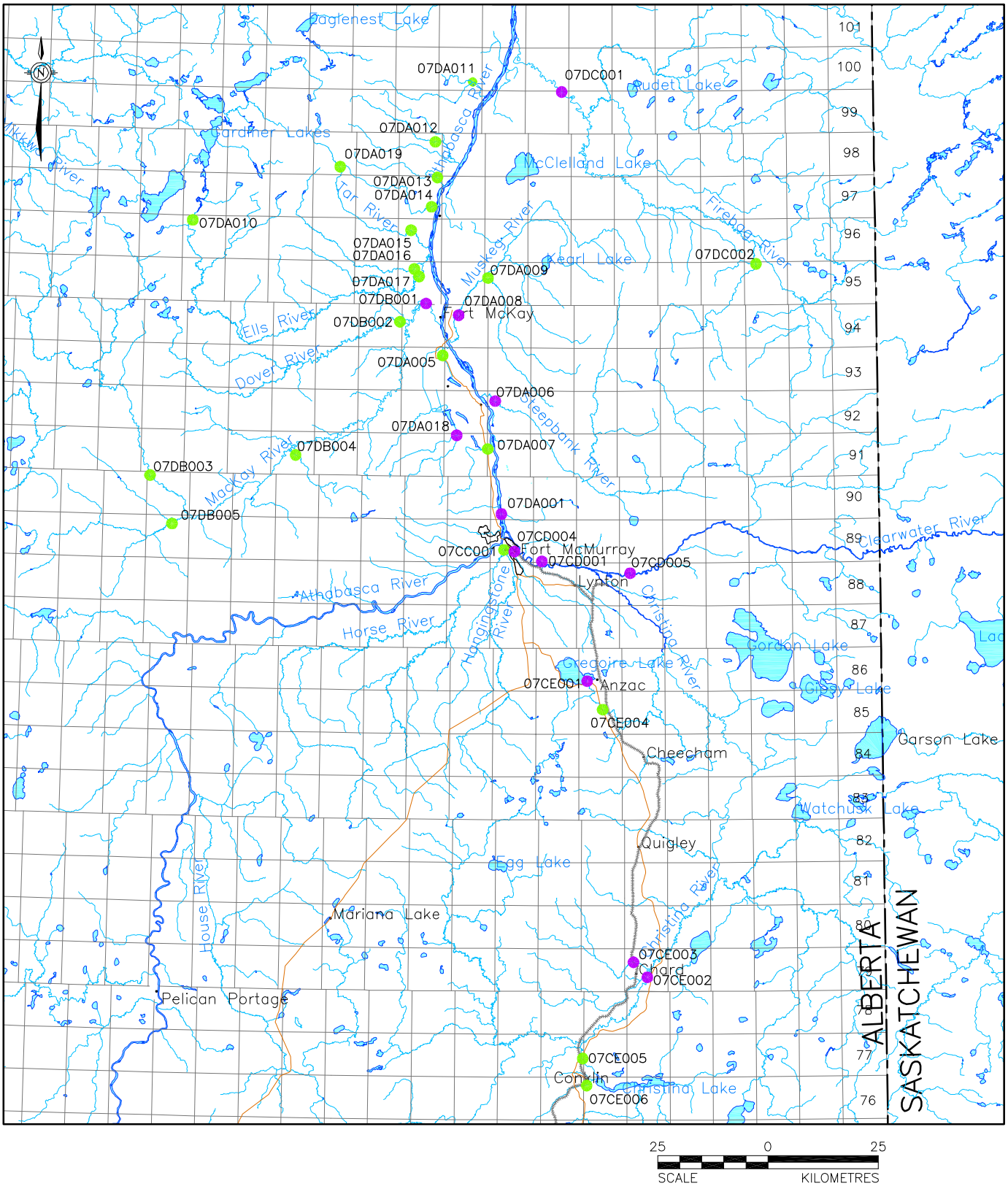
Table 6.4 Envrionment Canada Hydrologic Data

Station	Location		Basin Characteristics		Period of Record
	North	West	Drainage Area	Elevation	
Horse River (Station 07CC001)	56° 42' 29"	111° 23' 40"	2,130 km^2	250 – 738 m	1976 – 1979
Clearwater River at Draper (Station 07CD001)	56° 41' 07"	111° 15' 15"	30,800 km^2	245 – 550 m	1957 – 2001
Hangingstone River (Station 07CD004)	56° 42' 18"	111° 21' 20"	959 km^2	250 – 720 m	1965 – 2001
Clearwater River above Christina River (Station 07CD005)	56° 39' 40"	110° 55' 40"	17,000 km^2	250 – 550 m	1966 – 2001
Gregoire Lake (Station 07CE001)	56° 26' 30"	111° 05' 10"	263 km^2	472 – 750 m	1969 – 2001
Christina River (Station 07CE002)	55° 50' 20"	110° 52' 00"	4,860 km^2	476 – 732 m	1982 – 2001
Pony Creek (Station 07CE003)	55° 52' 11"	110° 55' 00"	278 km^2	518 – 701 m	1982 – 2001
Robert Creek (Station 07CE004)	56° 23' 01"	111° 01' 42"	54.1 km^2	470 – 740 m	1982 – 1995
Jackfish River (Station 07CE005)	55° 40' 25"	111° 06' 00"	1,290 km^2	549 – 637 m	1982 – 1995
Birch Creek (Station 07CE006)	55° 37' 07"	111° 05' 09"	232 km^2	560 – 655 m	1984 – 1995
Athabasca River (Station 07DA001)	56° 46' 50"	111° 24' 00"	133,000 km^2	240 – 1,490 m	1957 – 2000
Beaver River (Station 07DA005)	57° 06' 00"	111° 38' 00"	454 km^2	270 – 530 m	1961 – 1966 1972 – 1975
Steepbank River (Station 07DA006)	57° 00' 14"	111° 24' 53"	1,320 km^2	300 – 580 m	1972 – 2000
Poplar Creek (Station 07DA007)	56° 54' 50"	111° 27' 35"	151 km^2	270 – 460 m	1972 – 1986
Muskeg River[(a)] (Station 07DA008)	57° 11' 30"	111° 34' 05"	1,460 km^2	260 – 560 m	1974 – 2000
Jackpine Creek[(b)] (Station 07DA009)	57° 15' 34"	111° 27' 53"	358 km^2	270 – 490 m	1975 – 1993
Ells River (Station 07DA010)	57° 22' 30"	112° 33' 40"	1,380 km^2	640 – 730 m	1975 – 1979
Unnamed Creek (Station 07DA011)	57° 39' 41"	111° 31' 11"	274 km^2	270 – 760 m	1975 – 1993
Asphalt Creek (Station 07DA012)	57° 32' 20"	111° 40' 36"	148 km^2	290 – 850 m	1975 – 1977
Pierre River (Station 07DA013)	57° 27' 55"	111° 39' 14"	123 km^2	270 – 820 m	1975 – 1977
Calumet River (Station 07DA014)	57° 24' 12"	111° 40' 57"	183 km^2	250 – 610 m	1975 – 1977
Tar River (Station 07DA015)	57° 21' 14"	111° 45' 29"	301 km^2	270 – 810 m	1975 – 1977
Joslyn Creek (Station 07DA016)	57° 16' 27"	111° 44' 30"	257 km^2	270 – 760 m	1975 – 1993
Ells River (Station 07DA017)	57° 16' 04"	111° 42' 51"	2,450 km^2	270 – 730 m	1975 - 1986
Beaver River (Station 07DA018)	56° 56' 29"	111° 33' 54"	165 km^2	320 – 530 m	1975 – 2000
Tar River (Station 07DA019)	57° 29' 05"	112° 01' 10"	103 km^2	620 – 810 m	1976 – 1977
MacKay River (Station 07DB001)	57° 12' 38"	111° 41' 36"	5,570 km^2	240 – 520 m	1972 – 2000
Dover River (Station 07DB002)	57° 10' 12"	111° 47' 38"	963 km^2	290 – 580 m	1975 – 1977
Dunkirk River (Station 07DB003)	56° 51' 20"	112° 42' 40"	1,570 km^2	490 – 820 m	1975 – 1979
Thickwood Creek (Station 07DB004)	56° 53' 55"	112° 10' 15"	176 km^2	460 – 520 m	1976 – 1977
MacKay River (Station 07DB005)	56° 45' 35"	112 ° 36' 50"	1,010 km^2	470 – 520 m	1983 – 1991
Firebag River (Station 07DC001)	57° 38' 30"	111° 10' 30"	5,990 km^2	270 – 580 m	1971 – 2000
Lost Creek (Station 07DC002)	57° 17' 20"	110° 27' 50"	418 km^2	470 – 640 m	1976 – 1977

(a) This site is now monitored in winter months as part of the current program.

(b) 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

ALBERTA NTDB DATA SUPPLIED BY GEOMATICS CANADA, AUG. 2001. NAD 83 ZONE 12. SHEETS 74D, E AND L IN NAD 27, ZONE 12. SASKATCHEWAN NTDB DATA SUPPLIED BY ISC, AUG, 2001. NAD 83 ZONE 13. ALL DATA CONVERTED TO NAD 83, UTM ZONE 12.

PROJECT

RAMP

TITLE

REGIONAL WSC HYDROMETRIC MONITORING STATIONS

Golder Associates
Calgary, Alberta

PROJECT No. 022-2301.7000			FILE No. Region-WSC-Station	
DESIGN			SCALE AS SHOWN	REV. 0
CADD	JMA	08/03/02		
CHECK				
REVIEW				

FIGURE: 6.1

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Table 6.5 Environment Canada Climatic Data

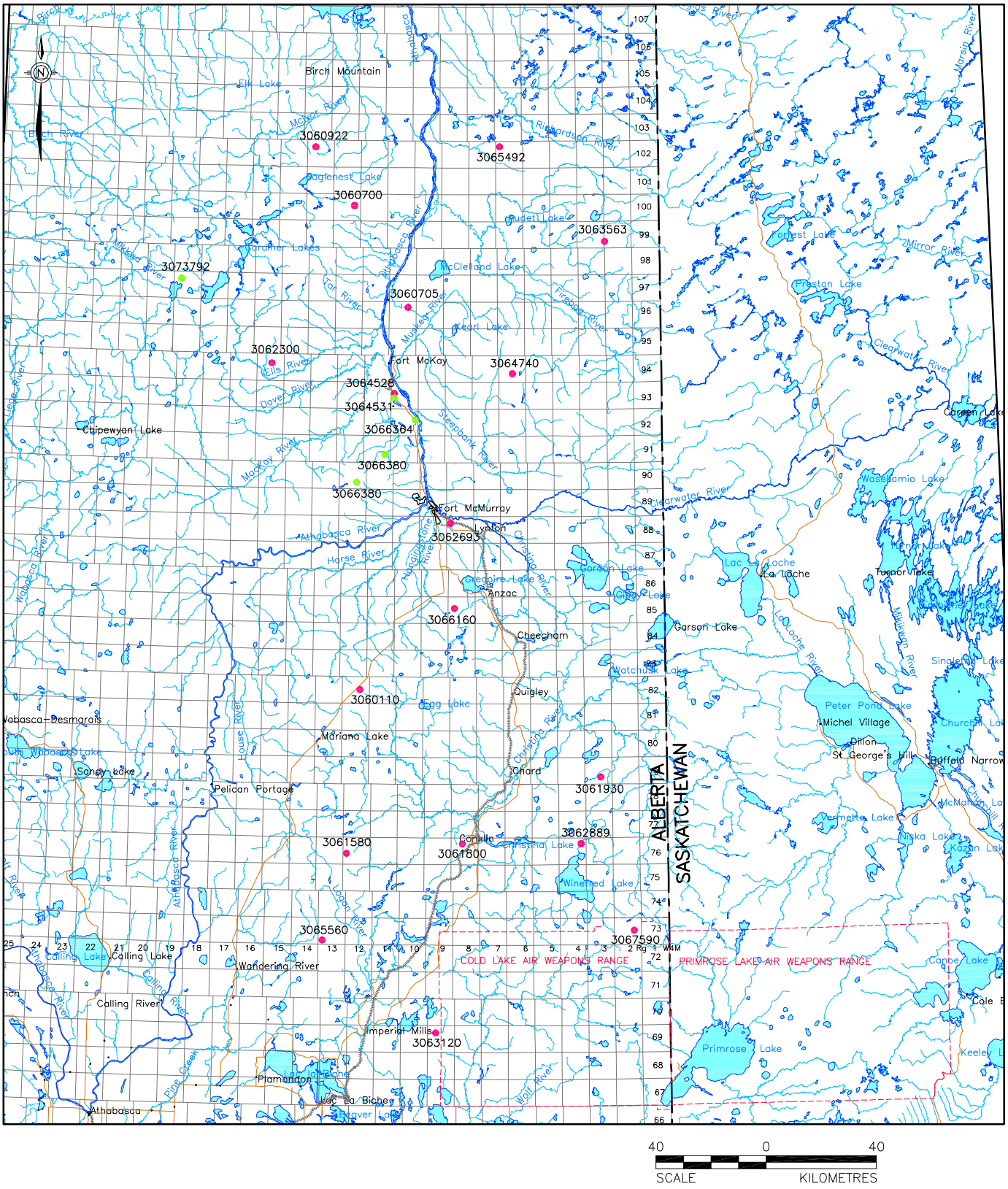
Station	Location		Elevation	Daily Mean Data		Hourly Data	
	North	West					
Algar Lookout (Station 3060110)	56° 07'	111° 47'	780 m	rainfall temperature	1957 – 2001[(a)] 1965 – 2001[(a)]		
Birch Mountain Lookout (Station 3060700)	57° 43'	111° 51'	853 m	rainfall temperature	1960 – 2001[(a)] 1966 – 2001[(a)]		
Bitumont Lookout (Station 3060705)	57° 22'	111° 32'	349 m	rainfall temperature	1962 – 2001[(a)] 1962 – 2001[(a)]		
Buckton Lookout (Station 3060922)	57° 52'	112° 06'	793 m	rainfall temperature	1965 – 2001[(a)] 1965 – 2001[(a)]		
Christina Lookout (Station 3061580)	55° 35'	111° 51'	823 m	rainfall temperature	1967 – 2001[(a)] 1967 – 2001[(a)]		
Conklin Lookout (Station 3061800)	55° 37'	111° 11'	671 m	rainfall temperature	1954 – 2001[(a)] 1965 – 2001[(a)]		
Cowpar Lookout (Station 3061930)	55° 50'	110° 23'	563 m	rainfall temperature	1957 – 2001[(a)] 1965 – 2001[(a)]		
Ells Lookout (Station 3062300)	57° 11'	112° 20'	610 m	rainfall temperature	1961 – 2001[(a)] 1964 – 2001[(a)]		
Fort McMurray Airport (Station 3062693)	56° 39'	111° 13'	369 m	rainfall snowfall precipitation temperature	1944 – 2001 1944 – 2001 1944 – 2001 1944 – 2001	atmospheric pressure dew point temperature dry bulb temperature wind speed wind direction	1953 – 2001 1953 – 2001 1953 – 2001 1953 – 2001 1959 – 2001
Gordon Lake Lookout (Station 3062889)	55° 37'	110° 30'	488 m	rainfall temperature	1964 – 2001[(a)] 1964 – 2001[(a)]		
Heart Lake Lookout (Station 3063120)	55° 00'	111° 20'	887 m	rainfall temperature	1947– 2001[(a)] 1965 – 2001[(a)]		
Johnson Lake Lookout (Station 3063563)	57° 35'	110° 20'	549 m	rainfall temperature	1965 – 2001[(a)] 1965 – 2001[(a)]		
Legend Lookout (Station 3073792)	57° 27'	112° 53'	911 m	rainfall temperature	1962 – 1995[(a)] 1962 – 1995[(a)]		

Table 6.5 Environment Canada Climatic Data (continued)

Mildred Lake (Station 3064531 and Station 3064528)	57° 05’	111° 36’	310 m	rainfall snowfall precipitation temperature	1973 – 1982, 1993 – 2001 1973 – 1982, 1993 – 2001 1973 – 1982, 1993 – 2001 1973 – 1982, 1993 – 2001	temperature dew point temperature wind speed rainfall snow by weight snow on ground	1994 – 2001 1994 – 2001 1994 – 2001 1995 – 1996 1995 – 1996 1995 – 1996
Muskeg Lookout (Station 3064740)	57° 08’	110° 54’	652 m	rainfall temperature	1965 – 2001[(a)] 1965 – 2001[(a)]		
Richardson Lookout (Station 3065492)	57° 55’	110° 58’	305 m	rainfall temperature	1960 – 2001[(a)] 1964 – 2001[(a)]		
Round Hill Lookout (Station 3065560)	55° 18’	111° 59’	750 m	rainfall temperature	1952 – 2001[(a)] 1951 – 2001[(a)]		
Stoney Mountain Lookout (Station 3066160)	56° 23’	111° 14’	762 m	rainfall temperature	1954 – 2001[(a)] 1964 – 2001[(a)]		
Tar Island (Station 3066364)	56° 59’	111° 28’	240 m	rainfall	1970 – 1984[(a)]		
Thickwood Lookout (Station 3066380)	56° 53’	111° 39’	604 m	rainfall snowfall precipitation temperature	1957 – 1994[(a)] 1957 – 1991[(a)] 1957 – 1991[(a)] 1957 – 1992[(a)]		
Winefred Lookout (Station 3067590)	55° 20’	110° 12’	744 m	rainfall temperature	1957 – 2001[(a)] 1965 – 2001[(a)]		

[(a)] 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

ALBERTA NTDB DATA SUPPLIED BY GEOMATICS CANADA, AUG. 2001. NAD 83 ZONE 12. SHEETS 74D, E AND L IN NAD 27, ZONE 12. SASKATCHEWAN NTDB DATA SUPPLIED BY ISC, AUG, 2001. NAD 83 ZONE 13. ALL DATA CONVERTED TO NAD 83, UTM ZONE 12.

PROJECT

RAMP

TITLE

REGIONAL MSC CLIMATE MONITORING STATIONS

Golder Associates
Calgary, Alberta

PROJECT No. 022-2301.7000			FILE No. Region-MSC-Station	
DESIGN			SCALE AS SHOWN	REV. 0
CADD	AS	05/02/02	FIGURE: 6.2	
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REVIEW				

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7 CONCLUSIONS AND RECOMMENDATIONS

The 2001 monitoring program, jointly funded and commissioned by Albian Sands, Canadian Natural Resources, ExxonMobil, Petro-Canada, Suncor, Syncrude and TrueNorth 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 and Birch Mountains east slope basins. The specific contributions of the 2001 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. Installation of precipitation and temperature sensors at the Calumet River site initiated collection of climatic data to extend the regional coverage to the north and west.
- A fifth year of snow course survey for various terrain types in the Muskeg River basin 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 snow course survey is now complete in the Muskeg River basin and will be undertaken in the Birch Mountains east slopes in 2002.
- The 2001 program resulted in installation of new water level monitoring stations on the Ells River (S14), Tar River (S15), Calumet River (S16), Tar River Upland (S17), Calumet River Upland (S18), Tar River Lowland (S19), Muskeg River Upland (S20), Shelley Creek (S21), Muskeg Creek (S22), Athabasca River (S24) and Khahago Creek (S28). Operation of the station at the Aurora Boundary Weir (S23) was taken over by RAMP in 2001, and streamflow monitoring stations were reinstalled at Iyinimin Creek (S3), Kearl Lake Outlet (S9) and Wapasu Creek (S10).
- The 2001 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 2001 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 effects of the regional oil sands developments on the lake.
- The 2001 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 2002 monitoring program.
- The 2001 program has resulted in development of a regional climatic and hydrologic database updated to the end of 2001. 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 snowmelt flows, summer flows and winter low flows, where possible. 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 effects of the oil sands projects as required by regulatory agencies. The specific recommendations for the 2002 monitoring program, which were identified during the 2001 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 Birch Mountains east slope basins should be conducted in early March 2002 to collect a second year of snowpack data to supplement data acquired during the CNRL Horizon Project baseline studies.
- Selected streamflow stations in the Birch Mountains east slope basins and the region south of Fort McMurray should be equipped with rain gauges to complement the existing Environment Canada monitoring network.
- Consideration should be given to retrofitting streamflow and lake level monitoring stations, where budgets allow, to permit remote data retrieval.
- New stations should be installed and operated at the Susan Lake Outlet Creek (S25), MacKay River 7DA8 (S26), Firebag River 7DC1 (S27) and Christina River Environment Canada (S29). The Environment Canada Hydrometric stations would provide data for the winter period from November to February to supplement available open-water data.

8 CLOSURE

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APPENDIX I

BRIEF DESCRIPTION OF 2001 CLIMATIC AND HYDROLOGIC CONDITIONS INCLUDED IN RAMP REPORT VOLUME I (CHEMICAL AND BIOLOGICAL MONITORING)

Brief Description of 2001 Climatic and Hydrologic Conditions Included in RAMP Report Volume I (Chemical and Biological Monitoring)

The core components of the 2001 chemical and biological monitoring program (water and sediment quality, benthic invertebrate communities and fish populations) are all influenced by climatic and hydrologic 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 Sands, ExxonMobil, True North, Petro-Canada, Canadian Natural Resources and Suncor, has been in place since 1995. An annual report on the program is issued as Volume II of the 2001 RAMP report. Summaries of historical information, as well as data collected during 2001, 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 2001 conditions is provided as background information in this section.

Field observations indicate that 2001 was a relatively average year in the Muskeg River and adjacent basins, with lower snowpack and precipitation depth than recorded in 2000. Light snowfall during November and December, 2000 was followed by moderate precipitation in early 2001. The resulting light snowpack (Figure I-1) produced relatively low stream discharges during snowmelt in 2001. A moderately dry spring was followed by typical summer rainfall, as shown in Figure I-2. A summary of precipitation measured at the Aurora Climate Station for the hydrologic year November 2000 to October 2001 is provided in Table I-1. The snow water equivalent snowfall of 45.4 mm measured at the Aurora Climate Station was 12% of the total measured precipitation. However, snow water equivalent depths or the order of 60 mm were recorded for most terrain types during the Muskeg River Basin snow survey. This indicates that the Aurora data is subject to undercatch due to wind effects and trace events, as is typical for these types of stations.

Table I-1 Precipitation at Aurora Climate Station, Hydrologic Year November 2000 to October 2001

Month	Rainfall (mm water)	Snowfall[(a)] (mm snow water equivalent)	Precipitation (mm water)
November 2000	2.6	0.0	2.6
December 2000	0.0	0.0	0.0
January 2001	0.0	5.7	5.7
February 2001	0.0	13.2	13.2
March 2001	0.0	22.9	22.9
April 2001	9.8	3.6	13.4
May 2001	63.2	0.0	63.2
June 2001	72.0	0.0	72.0
July 2001	58.4	0.0	58.4
August 2001	80.6	0.0	80.6
September 2001	25.2	0.0	28.2
October 2001	10.4	0.0	13.4
total	325.2	45.4	370.6

(a) No undercatch adjustment has been applied.

During the late June rainfall event, a four-year flood event was measured on Jackpine Creek. Peak flows for other regional streams with long-term flow records had return periods of less than two years. The total rainfall measured at the Aurora Climate Station in 2001 was 323 mm. This is similar to that measured in 1997 and 1999 (382 mm and 303 mm, respectively) and noticeably less than that measured in 1996 and 2000 (472 mm and 457 mm, respectively) as shown in Figure I-2.

The analysis of available data indicates that maximum daily stream discharges in 2001 were slightly higher than the long-term mean of annual maximum daily values for the Athabasca River and Jackpine Creek and slightly lower than the mean for the Steepbank, Muskeg, MacKay, and Firebag Rivers (Table I-2). Minimum daily discharges were close to the mean for most stations. No extreme flood or drought events were observed in the region in 2001.

The cumulative flow volumes for the period from March to September 2001 (i.e., spring melt to late summer) were in general slightly less than the long term average (Table I-3), with drought return periods in the range of 3 to 4 years. The exception is Jackpine Creek, which had higher than average streamflow volumes in 2001. Annual mean daily flow hydrographs for the Athabasca River, Steepbank River, Muskeg River, Jackpine Creek, Mackay River and Firebag River are shown in Figures I-3 – I-8, respectively.

Figure I-1 Snow Accumulation in the Muskeg River Basin, 1997 – 2001

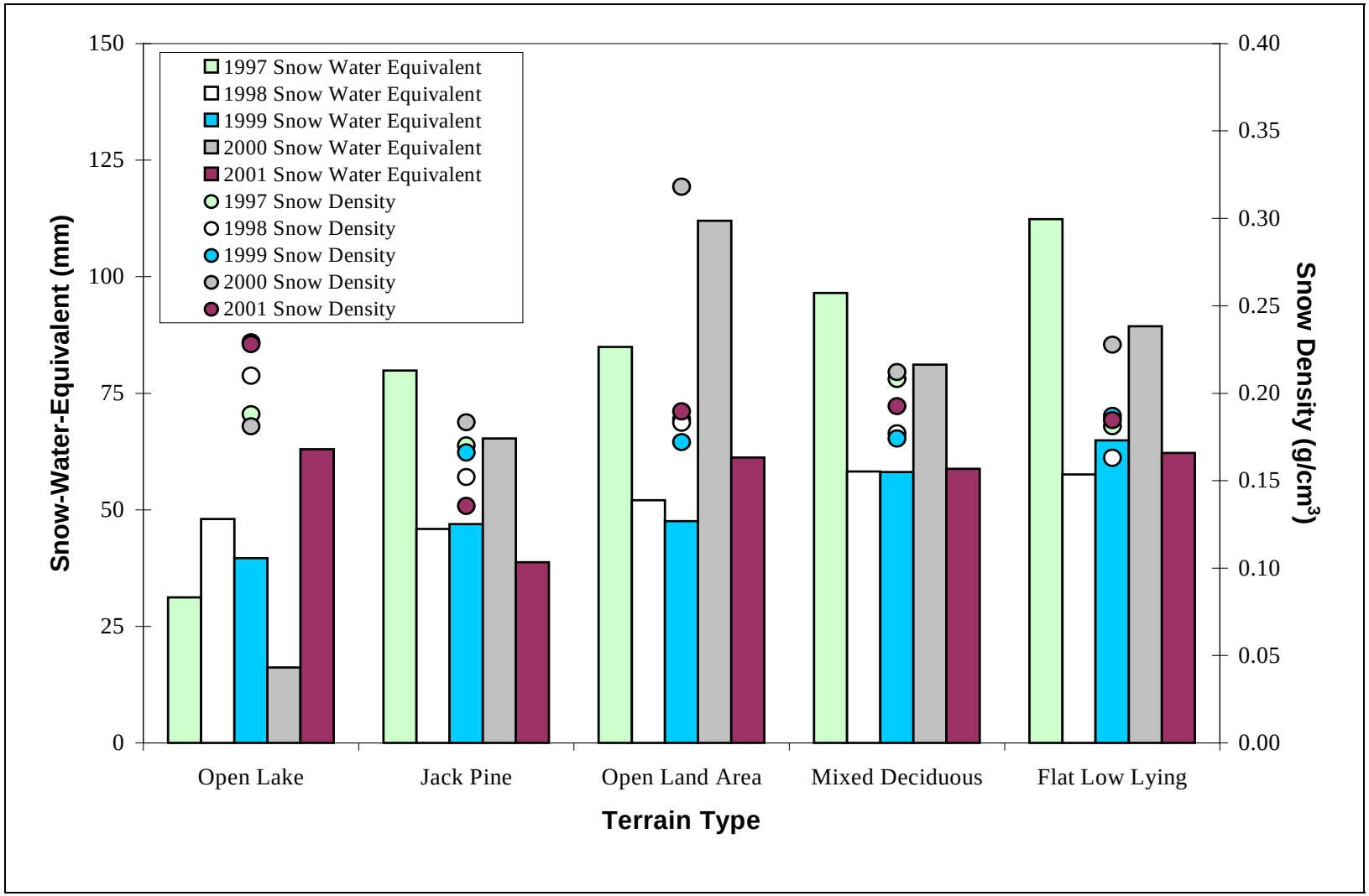


Figure I-2 Cumulative Annual Rainfall at Aurora Climate Station, 1996 - 2001

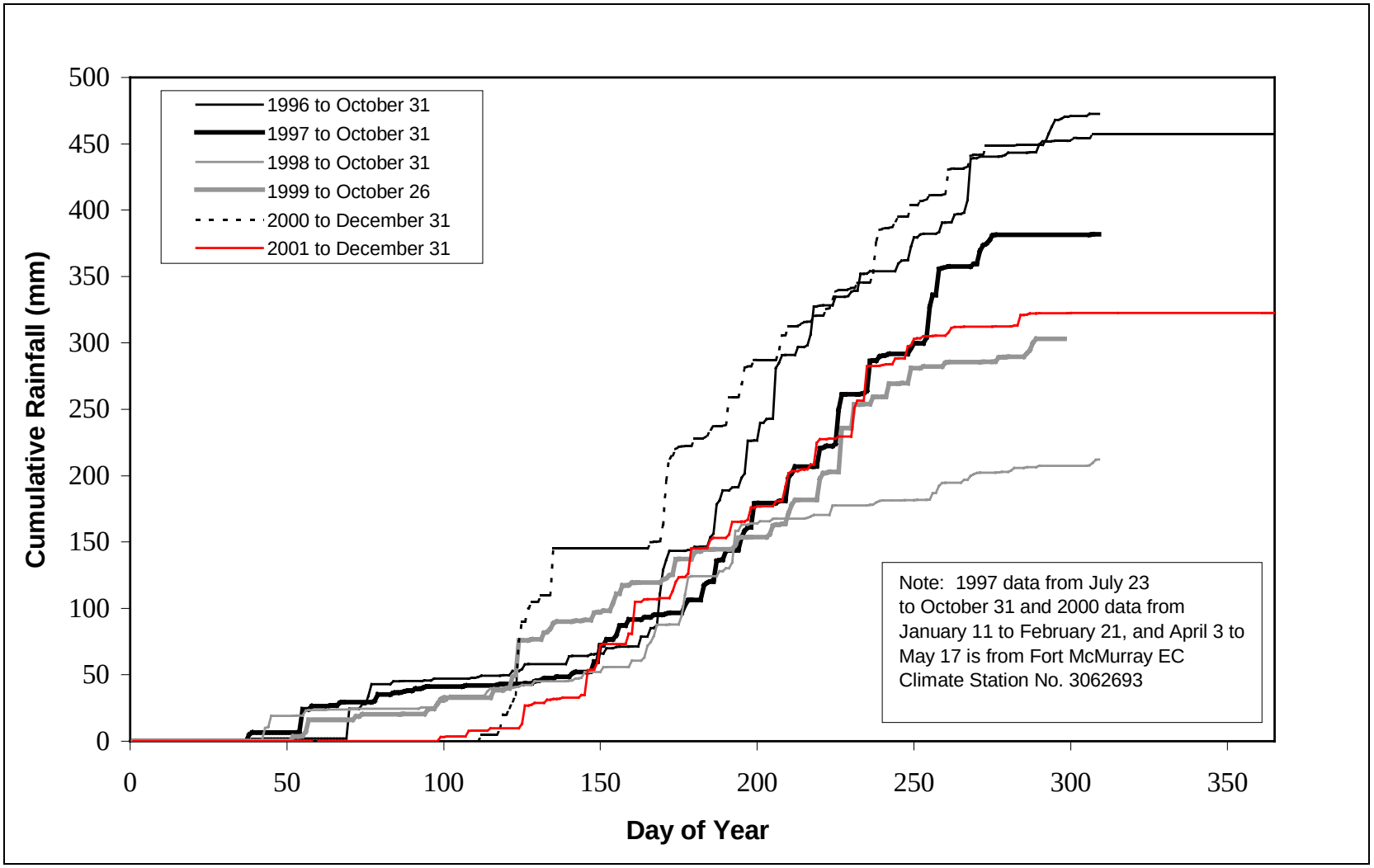


Table I-2 Maximum and Minimum Mean Daily Discharges, RAMP Study Area

Stream	Athabasca R.	Steepbank R.	Muskeg R.	Jackpine Cr.	MacKay R.	Firebag R.
Station ID	**07DA001**	**07DA006**	**07DA008**	**S2**	**07DB001**	**07DC001**
Period of Record	**44 Years**	**28 Years**	**28 Years**	**25 Years**	**28 Years**	**26 Years**
Maximum Mean Daily Discharge						
2001 value (m^3/s)	2930	20.7	14.5	10.3	52.3	84.5
average recorded (m^3/s)	2585	35.6	26.5	8.4	121	104
maximum recorded (m^3/s)	4700	81.0	66.1	17.2	339	236
flood return period (yr)	3 Year	< 2 Year	< 2 Year	4 Year	< 2 Year	< 2 Year
Minimum Mean Daily Discharge						
2001 value (m^3/s)	102	0.290[(a)]	0.292	0.000	0.269[(a)]	7.8[(a)]
average recorded (m^3/s)	134	0.294	0.275	0.007	0.351	7.97
minimum recorded (m^3/s)	89	0.022	0.095	0.000	0.023	4.24
drought return period (yr)	< 2 Year	2 Year	< 2 Year	> 2 Year	3 Year	2 Year

(a) Assumes low flow occurred at end of recession in March. No data available for Jan-Feb or Nov-Dec.
Source: Environment Canada, Water Survey Branch; Golder (2002).

Table I-3 Cumulative Streamflow Volumes, RAMP Study Area, March to September

Stream	Athabasca R.	Steepbank R.	Muskeg R.	Jackpine Cr.	MacKay R.	Firebag R.
Station ID	**07DA001**	**07DA006**	**07DA008**	**S2**	**07DB001**	**07DC001**
Period of Record	**41 Years**	**28 Years**	**28 Years**	**25 Years**	**29 Years**	**26 Years**
2001 value (dam^3)	[(a)]	110,304	94,682	34,643	225,200	517,700
maximum recorded (dam^3)	25,279,862	273,634	187,146	59,051	904,734	903,836
average recorded (dam^3)	16,696,207	133,296	105,148	27,640	420,299	602,329
minimum recorded (dam^3)	11,785,000	36,670	17,995	1,000	26,372	344,469
drought return period (yr)	n/a	3 Year	3 Year	< 2 Year	3 Year	4 Year

(a) 9,349,171 dam^3 for period excluding March 9 to June 7, 2001 (no data available from Environment Canada).
Source: Environment Canada, Water Survey Branch; Golder (2002).

Figure I-3 Annual Mean Daily Flow Hydrograph for the Athabasca River, 2001

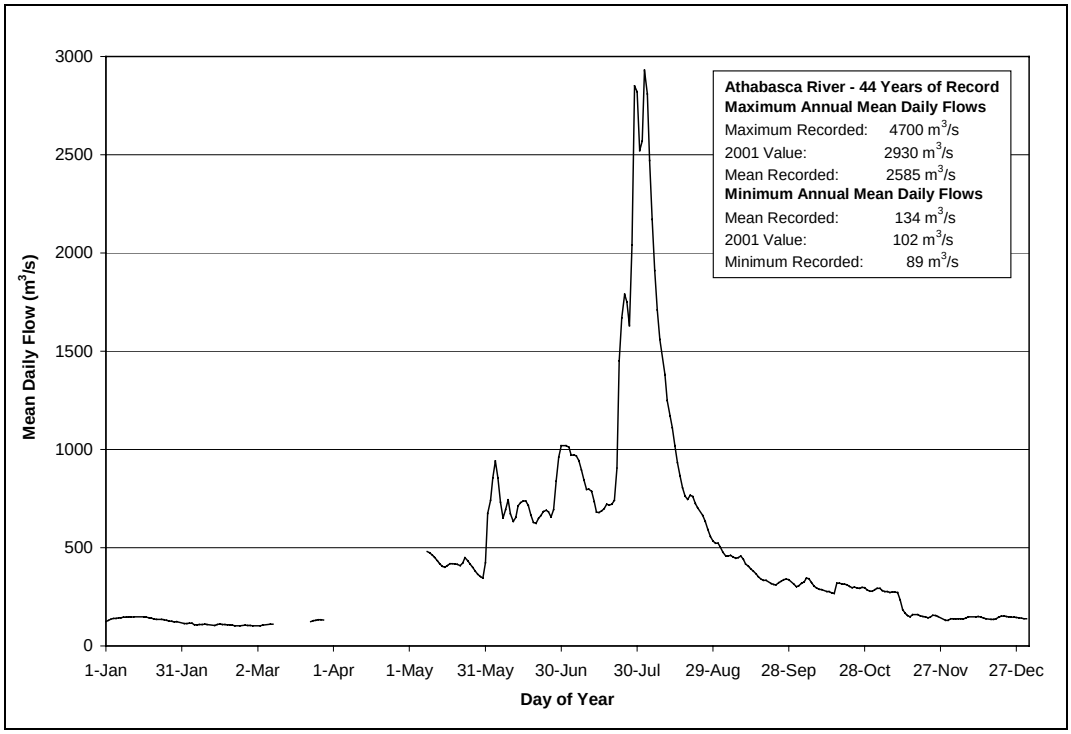


Figure I-4 Annual Mean Daily Flow Hydrograph for the Steepbank River, 2001

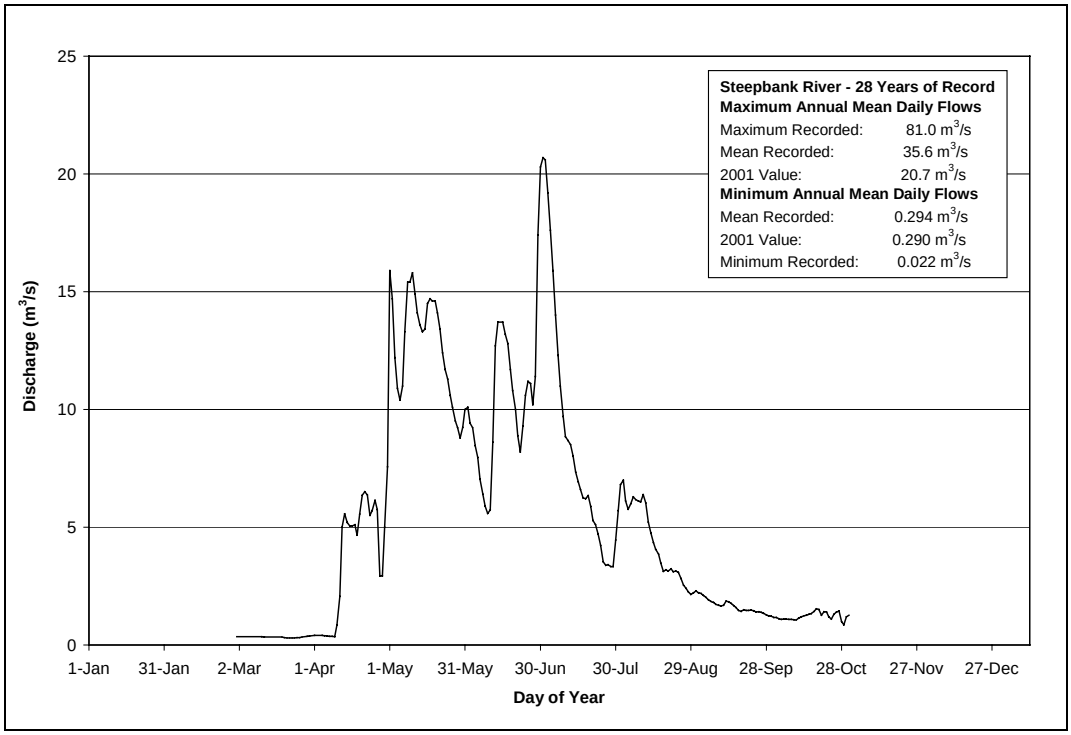


Figure I-5 Annual Mean Daily Flow Hydrograph for the Muskeg River, 2001

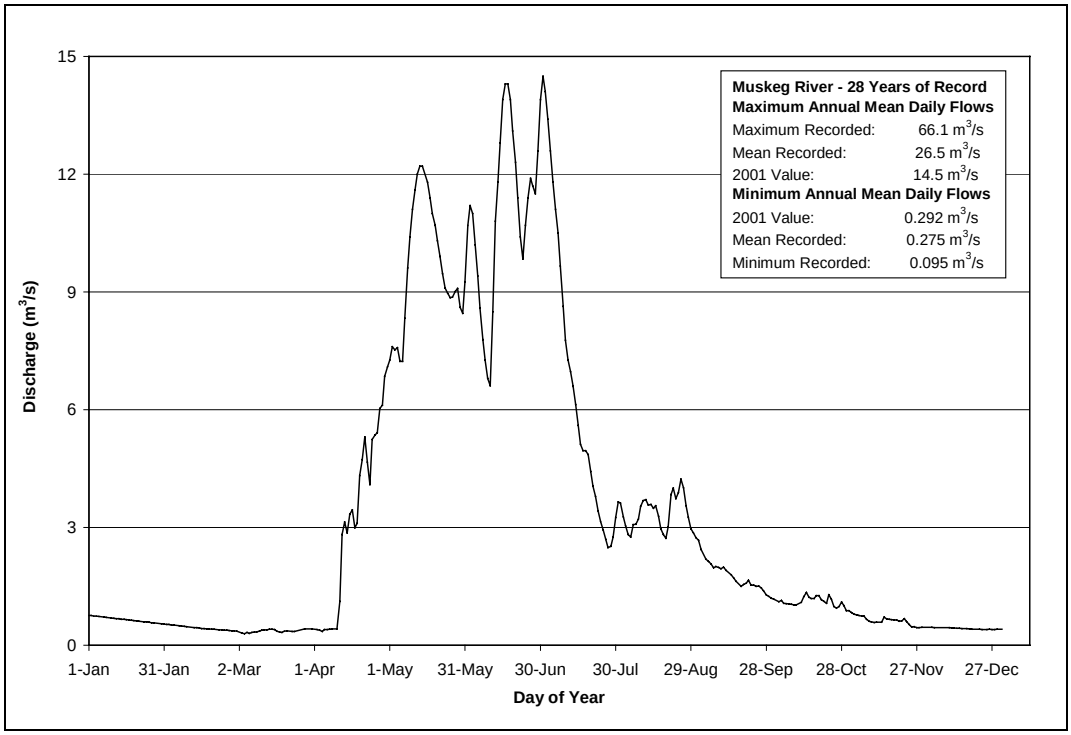


Figure I-6 Annual Mean Daily Flow Hydrograph for Jackpine Creek, 2001

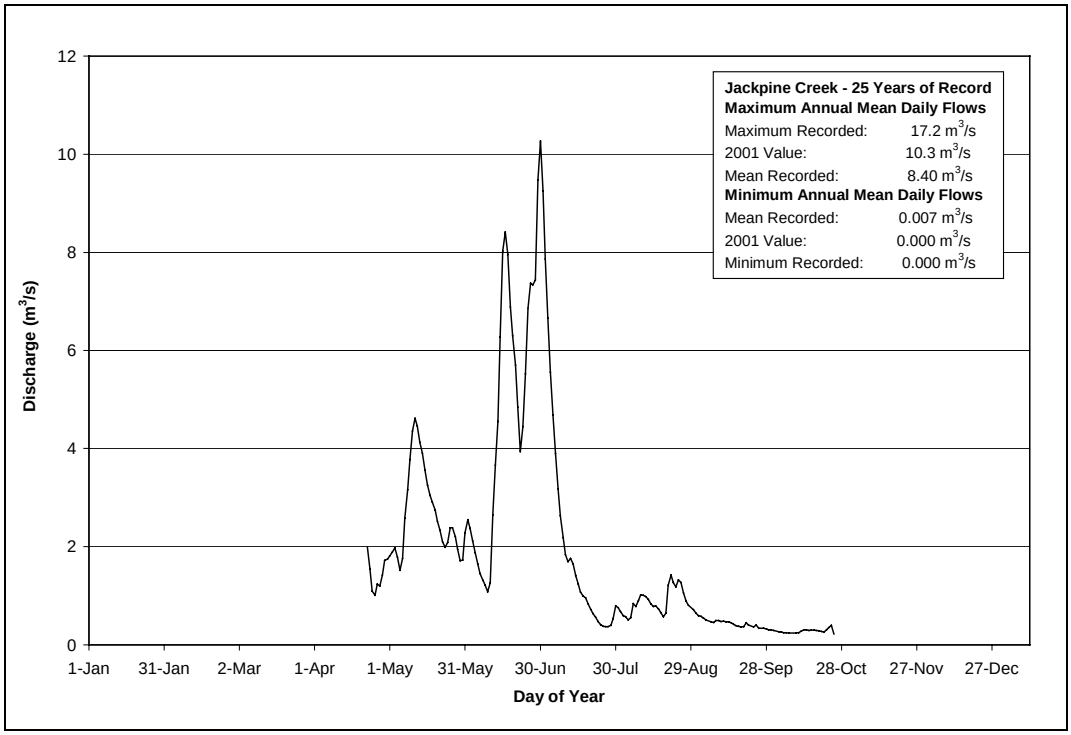


Figure I-7 Annual Mean Dail Flow Hydrograph for the Mackay River, 2001

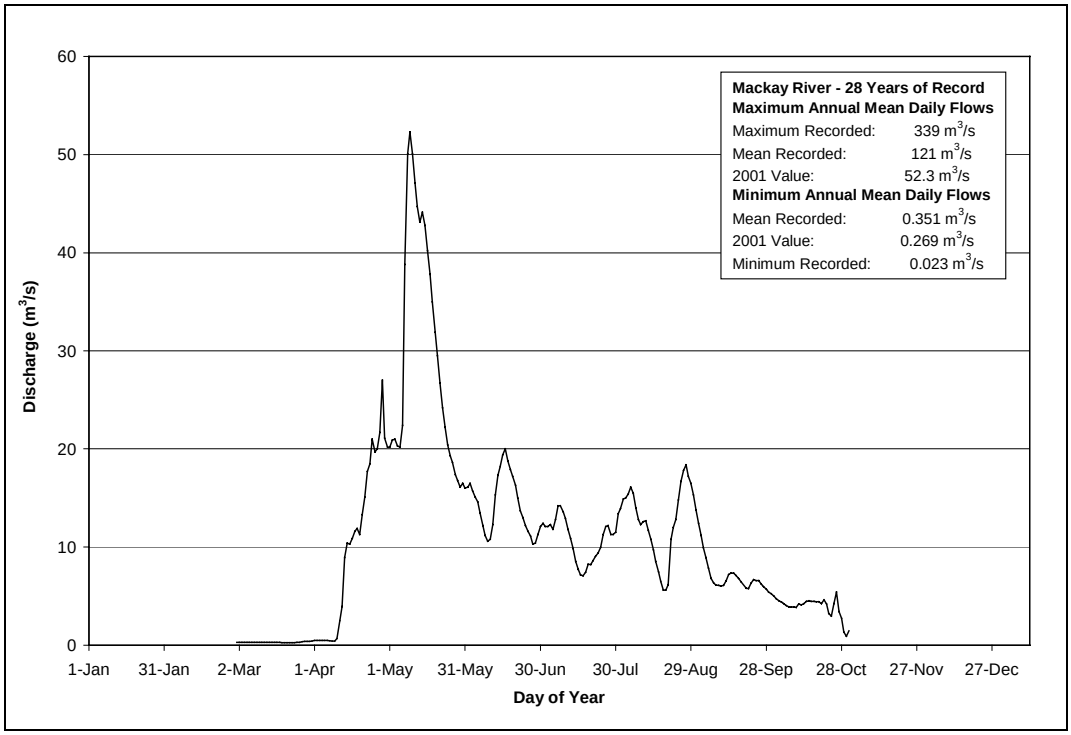
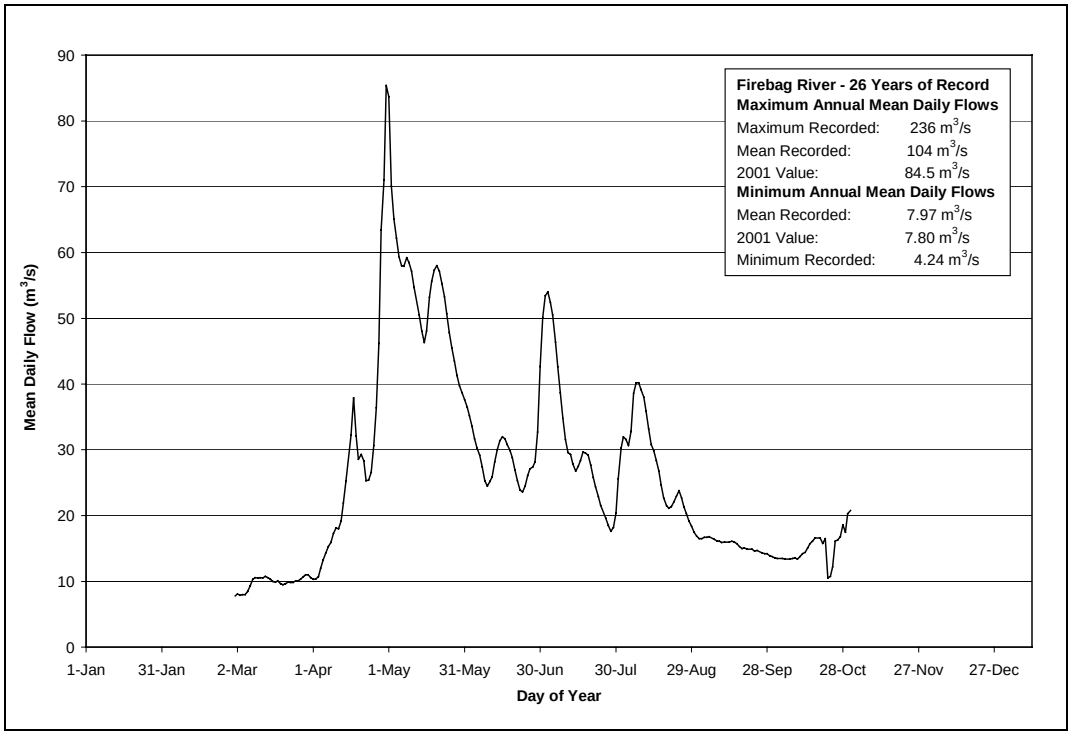


Figure I-8 Annual Mean Daily Flow Hydrograph for Firebag River, 2001



APPENDIX II

2001 DAILY CLIMATIC DATA AT AURORA CLIMATE STATION

Table II-1 Climatic Data Recorded at Aurora Climate Station, January – December, 2001

Year	Month	Day	Temperature			Total Rainfall (mm)	Total Snowfall (cm)	Mean Relative Humidity (%)	Total Global Solar Radiation ($kW \cdot h/m^2$)	Wind Speed and Direction				
										Mean Daily Wind		Maximum Sustained Gusts		
			Minimum (°C)	Mean (°C)	Maximum (°C)					Speed (km/h)	Direction (degrees)	5 Second (km/h)	2 Minute (km/h)	10 Minute (km/h)
2001	January	1	-8.5	-7.5	-4.1	0.0	0.0	94.5	0.13	3.3	100.7	17.2	12.2	8.9
2001	January	2	-12.9	-6.5	-2.9	0.0	0.0	96.5	0.41	3.3	157.9	14.6	8.4	7.1
2001	January	3	-11.3	-8.5	-0.6	0.0	0.0	93.2	0.09	3.7	156.3	22.2	13.5	11.5
2001	January	4	-17.7	-7.4	1.1	0.0	0.0	84.7	0.36	5.0	147.4	28.9	19.1	15.5
2001	January	5	-16.6	-12.4	-8.3	0.0	0.0	89.2	0.08	3.7	116.1	24.1	13.6	10.5
2001	January	6	-23.4	-15.9	-10.3	0.0	0.0	84.3	0.21	3.0	129.8	17.4	11.0	8.2
2001	January	7	-23.3	-12.8	-4.0	0.0	0.0	88.9	0.71	3.4	186.2	15.5	8.8	7.1
2001	January	8	-14.2	-8.9	-3.4	0.0	0.0	87.5	0.80	4.4	199.5	16.9	9.7	7.8
2001	January	9	-10.9	-4.6	0.8	0.0	0.0	87.1	0.70	4.3	197.1	19.3	10.3	7.8
2001	January	10	-14.5	-8.0	-0.3	0.0	0.0	90.8	0.75	3.5	202.2	14.9	8.3	7.0
2001	January	11	-14.7	-10.8	-4.0	0.0	0.0	90.5	0.66	5.0	113.0	22.9	13.6	11.2
2001	January	12	-17.4	-14.0	-12.5	0.0	0.0	86.7	0.28	2.7	102.2	18.0	11.2	8.5
2001	January	13	-19.2	-14.0	-9.8	0.0	0.0	87.1	0.77	4.9	201.7	25.2	14.6	10.6
2001	January	14	-23.4	-16.3	-9.7	0.0	0.0	87.5	0.76	1.9	195.0	16.9	8.8	7.0
2001	January	15	-25.2	-15.3	-6.2	0.0	0.0	84.1	0.67	5.5	188.7	23.1	13.5	10.1
2001	January	16	-8.0	-3.3	1.4	0.0	0.0	80.6	0.61	5.3	217.1	25.7	12.5	9.7
2001	January	17	-12.5	-4.3	0.2	0.0	0.0	89.5	0.34	4.3	143.2	23.7	15.1	10.6
2001	January	18	-19.3	-11.3	-1.9	0.0	0.0	90.8	0.79	2.3	232.4	15.2	10.1	5.7
2001	January	19	-12.2	-6.2	-1.2	0.0	0.0	92.9	0.76	4.2	194.3	14.1	8.0	7.0
2001	January	20	-10.1	-5.3	1.2	0.0	0.0	89.8	0.75	4.8	186.4	16.7	9.9	8.1
2001	January	21	-9.5	-3.6	1.9	0.0	0.0	85.1	0.97	4.1	214.9	19.8	8.0	6.4
2001	January	22	-16.4	-9.0	-0.8	0.0	0.0	87.0	1.00	1.8	213.1	11.1	5.8	4.8
2001	January	23	-22.6	-14.4	-6.4	0.0	0.0	86.1	0.83	3.2	184.5	20.7	13.6	11.8
2001	January	24	-11.5	-6.0	0.4	0.0	0.0	74.0	1.07	4.9	182.4	20.5	12.0	9.2
2001	January	25	-15.8	-10.1	-3.8	0.0	0.0	91.8	0.88	2.9	163.5	16.8	10.0	7.0
2001	January	26	-14.0	-8.7	-1.3	0.0	0.8	86.3	0.93	5.1	174.7	21.1	15.4	10.6
2001	January	27	-16.3	-8.7	-1.7	0.0	0.0	88.3	0.79	4.8	173.5	17.5	10.5	8.3
2001	January	28	-7.1	-1.5	4.0	0.0	0.0	81.2	0.73	3.0	202.8	18.4	10.8	7.6
2001	January	29	-15.6	-8.1	-5.1	0.0	1.2	95.7	0.26	6.2	44.1	23.6	13.1	11.0
2001	January	30	-19.9	-17.9	-15.6	0.0	1.4	87.2	0.60	4.1	50.3	20.8	11.8	9.5
2001	January	31	-31.9	-21.7	-16.4	0.0	2.3	83.4	1.16	4.6	165.0	26.1	16.8	13.0

Table II-1 Climatic Data Recorded at Aurora Climate Station, January – December, 2001 (continued)

Year	Month	Day	Temperature			Total Rainfall (mm)	Total Snowfall (cm)	Mean Relative Humidity (%)	Total Global Solar Radiation ($kW \cdot h/m^2$)	Wind Speed and Direction				
										Mean Daily Wind		Maximum Sustained Gusts		
			Minimum (°C)	Mean (°C)	Maximum (°C)					Speed (km/h)	Direction (degrees)	5 Second (km/h)	2 Minute (km/h)	10 Minute (km/h)
2001	February	1	-17.1	-8.0	-1.3	0.0	0.0	94.0	0.84	6.6	192.0	25.3	13.4	11.0
2001	February	2	-9.9	-3.7	1.3	0.0	0.0	97.0	1.12	2.5	192.9	14.4	7.2	6.2
2001	February	3	-7.2	-1.1	2.2	0.0	0.0	93.4	0.53	3.4	198.7	19.6	9.6	7.4
2001	February	4	-10.8	-7.0	-1.3	0.0	0.3	93.7	0.44	3.8	117.5	18.2	11.7	9.8
2001	February	5	-16.9	-12.9	-9.4	0.0	0.0	86.2	0.49	3.1	149.7	20.1	13.5	11.2
2001	February	6	-29.1	-21.3	-15.0	0.0	0.4	79.5	0.68	2.3	93.0	12.7	7.9	6.2
2001	February	7	-34.0	-27.8	-18.0	0.0	0.0	72.3	0.73	1.6	140.1	11.6	7.3	6.0
2001	February	8	-38.9	-30.5	-18.6	0.0	0.0	69.0	0.89	2.6	189.8	9.4	7.5	6.0
2001	February	9	-38.0	-26.3	-13.9	0.0	0.0	67.6	1.07	4.5	181.6	22.6	14.0	11.9
2001	February	10	-24.1	-18.3	-13.6	0.0	0.8	75.4	0.97	4.6	221.7	18.8	12.5	11.3
2001	February	11	-25.4	-19.6	-15.7	0.0	0.0	77.4	1.24	3.1	184.8	17.4	9.5	7.3
2001	February	12	-30.6	-22.5	-12.2	0.0	0.0	76.6	1.47	3.2	113.5	21.6	13.5	10.2
2001	February	13	-30.4	-18.2	-8.7	0.0	0.0	74.5	1.44	4.1	198.2	25.3	14.2	11.1
2001	February	14	-18.4	-15.2	-9.4	0.0	0.0	85.6	1.15	5.7	107.9	29.2	16.1	12.4
2001	February	15	-19.5	-18.0	-15.9	0.0	0.5	81.4	1.07	4.5	110.1	24.2	13.8	11.3
2001	February	16	-26.0	-16.5	-9.9	0.0	0.0	77.7	1.99	4.2	215.3	26.7	12.2	9.2
2001	February	17	-25.3	-15.2	-5.7	0.0	0.0	76.5	2.08	3.9	176.3	15.9	9.7	7.1
2001	February	18	-31.4	-16.7	-11.4	0.0	0.8	74.9	1.42	5.1	80.7	25.5	14.3	12.6
2001	February	19	-35.1	-24.8	-11.6	0.0	0.2	66.4	2.17	4.0	130.7	28.8	14.5	11.4
2001	February	20	-37.4	-22.4	-8.1	0.0	0.0	60.6	2.24	4.7	185.0	19.9	12.3	10.4
2001	February	21	-24.3	-15.0	-7.4	0.0	0.0	75.2	1.65	3.0	141.0	15.7	9.6	8.4
2001	February	22	-19.9	-13.6	-7.4	0.0	0.0	79.3	1.77	5.2	77.9	24.7	15.6	11.0
2001	February	23	-23.7	-17.3	-11.8	0.0	0.0	78.3	2.11	7.1	37.5	24.7	16.7	12.5
2001	February	24	-38.6	-28.1	-18.6	0.0	0.0	67.7	2.62	2.8	138.2	14.8	9.9	7.7
2001	February	25	-39.9	-31.6	-19.9	0.0	3.0	62.8	2.67	1.8	139.2	9.7	6.9	5.2
2001	February	26	-39.1	-24.2	-9.9	0.0	2.8	56.2	2.77	5.4	188.2	23.7	13.3	10.4
2001	February	27	-15.5	-5.7	4.9	0.0	3.6	63.3	2.24	6.1	196.4	19.9	11.1	8.5
2001	February	28	-3.7	3.7	11.6	0.0	0.8	59.9	1.43	4.3	226.9	24.8	15.2	9.2

Table II-1 Climatic Data Recorded at Aurora Climate Station, January – December, 2001 (continued)

Year	Month	Day	Temperature			Total Rainfall (mm)	Total Snowfall (cm)	Mean Relative Humidity (%)	Total Global Solar Radiation ($kW \cdot h/m^2$)	Wind Speed and Direction				
										Mean Daily Wind		Maximum Sustained Gusts		
			Minimum (°C)	Mean (°C)	Maximum (°C)					Speed (km/h)	Direction (degrees)	5 Second (km/h)	2 Minute (km/h)	10 Minute (km/h)
2001	March	1	-8.0	1.9	7.1	0.0	0.3	60.9	2.50	6.4	263.7	33.7	24.6	19.5
2001	March	2	-10.4	-6.1	-1.5	0.0	0.3	85.9	1.89	6.6	47.6	22.1	14.2	10.9
2001	March	3	-7.9	-3.7	1.2	0.0	0.0	94.5	0.52	2.8	123.0	15.6	9.9	6.9
2001	March	4	-15.2	-4.7	8.5	0.0	0.3	81.9	3.04	3.2	208.4	14.3	9.6	9.4
2001	March	5	-12.7	-4.6	-1.2	0.0	0.0	90.2	1.10	5.2	177.6	26.1	15.8	12.6
2001	March	6	-13.7	-4.3	7.8	0.0	0.3	82.6	2.18	3.8	224.2	17.6	10.7	8.1
2001	March	7	-16.9	-2.6	10.5	0.0	0.3	63.3	2.59	5.1	176.8	29.4	15.1	12.1
2001	March	8	-6.7	2.5	11.9	0.0	0.0	58.3	2.93	5.5	206.4	27.3	19.8	15.1
2001	March	9	-18.9	-8.4	1.0	0.0	0.0	59.8	3.10	8.2	46.4	30.6	18.8	14.1
2001	March	10	-21.1	-10.0	-3.2	0.0	0.3	75.4	1.42	2.6	179.9	18.0	10.7	6.9
2001	March	11	-9.2	-4.5	2.9	0.0	0.3	87.0	1.64	4.2	125.1	18.5	10.1	8.4
2001	March	12	-6.1	2.2	7.7	0.0	0.5	76.3	2.04	6.0	246.3	31.4	22.9	18.3
2001	March	13	-9.5	-1.5	7.3	0.0	4.6	77.0	3.43	4.7	169.6	22.7	12.8	11.0
2001	March	14	-11.7	-5.2	-0.7	0.0	2.5	72.0	2.73	5.1	53.5	20.3	13.5	10.3
2001	March	15	-15.1	-7.5	2.8	0.0	0.5	73.8	3.59	3.0	104.9	16.4	10.7	8.1
2001	March	16	-18.5	-4.3	9.2	0.0	0.0	67.5	3.67	4.2	198.8	24.5	12.8	10.0
2001	March	17	-7.3	1.7	11.5	0.0	0.0	55.0	3.87	4.4	185.7	21.6	11.6	8.1
2001	March	18	-17.4	-9.6	0.6	0.0	0.3	71.5	3.62	10.1	45.4	29.2	18.8	16.2
2001	March	19	-23.2	-16.5	-12.4	0.0	0.0	72.1	1.84	9.1	227.1	30.6	20.4	16.0
2001	March	20	-26.5	-19.7	-12.7	0.0	0.0	50.5	4.37	5.8	246.6	30.8	18.3	14.7
2001	March	21	-32.2	-21.2	-12.7	0.0	0.5	65.1	3.42	3.2	171.6	24.7	16.0	12.5
2001	March	22	-30.7	-22.1	-14.8	0.0	0.0	58.8	3.74	4.4	226.8	24.9	17.9	14.7
2001	March	23	-33.5	-22.7	-12.7	0.0	0.0	48.9	4.51	3.8	213.4	20.5	14.5	9.6
2001	March	24	-32.6	-19.0	-6.9	0.0	0.5	51.5	4.54	3.2	214.6	16.6	9.3	8.0
2001	March	25	-14.6	-5.6	3.2	0.0	2.0	41.7	4.67	9.7	171.4	31.9	18.7	15.0
2001	March	26	-5.6	-2.0	2.7	0.0	0.8	61.8	2.19	8.0	175.9	24.9	14.7	11.8
2001	March	27	-10.1	0.8	11.0	0.0	1.0	61.5	4.77	5.4	205.9	29.1	15.6	10.8
2001	March	28	-5.0	1.1	5.9	0.0	0.0	72.0	1.78	5.8	186.6	23.4	15.8	11.6
2001	March	29	-6.2	0.4	6.6	0.0	1.0	78.6	3.17	7.6	248.0	39.2	23.5	18.8
2001	March	30	-10.0	-5.2	1.3	0.0	2.3	62.4	4.33	7.9	248.7	27.9	19.7	15.6
2001	March	31	-18.2	-4.3	6.6	0.0	4.6	55.5	4.91	6.6	152.7	25.2	16.6	13.9

Table II-1 Climatic Data Recorded at Aurora Climate Station, January – December, 2001 (continued)

Year	Month	Day	Temperature			Total Rainfall (mm)	Total Snowfall (cm)	Mean Relative Humidity (%)	Total Global Solar Radiation ($kW \cdot h/m^2$)	Wind Speed and Direction				
										Mean Daily Wind		Maximum Sustained Gusts		
			Minimum (°C)	Mean (°C)	Maximum (°C)					Speed (km/h)	Direction (degrees)	5 Second (km/h)	2 Minute (km/h)	10 Minute (km/h)
2001	April	1	-3.6	1.8	8.0	0.0	3.0	53.9	3.48	5.8	165.3	23.4	15.0	11.3
2001	April	2	-6.1	-1.2	1.8	0.0	0.5	83.5	2.37	7.0	43.6	25.7	16.0	11.4
2001	April	3	-13.6	-1.4	9.2	0.0	0.0	62.2	5.37	3.5	145.8	15.5	10.7	7.8
2001	April	4	-1.1	4.6	10.2	0.0	0.0	44.8	5.43	10.5	188.7	42.4	21.7	16.4
2001	April	5	-2.4	3.9	11.4	0.0	0.0	64.6	3.96	5.6	229.0	28.8	17.5	13.5
2001	April	6	-4.5	0.0	4.8	0.0	0.0	72.0	5.22	9.0	64.2	32.7	21.0	16.7
2001	April	7	-7.8	-1.3	5.6	0.0	0.0	62.9	4.95	8.2	45.3	29.2	18.1	13.8
2001	April	8	-2.7	1.9	8.4	0.0	0.0	67.0	3.53	3.3	188.7	13.6	8.9	7.8
2001	April	9	0.3	2.4	6.2	3.2	0.0	94.0	1.90	3.5	135.5	17.9	11.2	8.2
2001	April	10	-5.0	-0.3	2.4	0.0	0.0	75.4	4.82	8.7	51.6	34.4	22.6	16.9
2001	April	11	-10.8	-2.8	3.4	0.2	0.0	62.7	5.78	5.0	35.3	23.2	15.5	12.3
2001	April	12	-11.0	-1.0	8.0	0.0	0.0	59.7	5.07	3.5	112.8	21.6	11.8	9.3
2001	April	13	-4.3	2.5	9.8	0.0	0.0	51.3	4.83	4.3	167.6	20.7	14.3	10.9
2001	April	14	-6.6	-0.4	6.0	0.0	0.0	52.5	5.99	5.4	65.8	23.9	16.6	11.0
2001	April	15	-11.5	-2.4	5.9	0.0	0.0	37.2	6.21	5.3	163.5	21.0	14.5	10.8
2001	April	16	-6.5	2.5	10.9	0.0	0.0	31.3	6.15	7.9	185.5	30.1	20.1	13.9
2001	April	17	0.0	7.0	14.1	0.0	0.0	31.1	5.63	10.8	167.4	34.3	23.4	17.7
2001	April	18	2.9	5.0	7.3	4.4	0.0	84.9	1.40	4.2	227.0	21.7	11.3	9.1
2001	April	19	-4.6	0.2	3.2	0.2	0.0	89.2	1.23	6.5	90.2	34.2	17.7	16.8
2001	April	20	-10.8	-5.6	0.2	0.0	0.0	49.1	6.41	8.6	51.2	35.7	20.4	16.8
2001	April	21	-14.5	-1.8	7.7	0.0	0.0	54.0	5.58	4.2	224.6	22.1	15.4	10.0
2001	April	22	-6.4	2.9	10.9	0.0	0.0	51.2	6.15	4.6	236.8	27.3	18.4	13.4
2001	April	23	-7.8	4.4	14.0	0.0	0.0	59.8	4.42	4.2	132.3	35.8	16.8	12.6
2001	April	24	-3.6	7.6	16.9	0.0	0.0	63.8	3.84	4.6	184.1	26.2	14.1	10.5
2001	April	25	-1.9	9.0	14.8	1.8	0.0	52.6	4.80	13.1	235.4	57.9	34.3	27.8
2001	April	26	-5.3	7.5	18.3	0.0	0.0	54.2	5.82	4.8	182.8	22.1	14.4	9.9
2001	April	27	-3.6	12.3	26.8	0.0	0.0	47.7	5.64	4.6	196.7	34.4	19.9	15.7
2001	April	28	1.3	14.7	24.8	0.0	0.0	50.2	3.37	4.1	212.6	30.5	17.2	14.0
2001	April	29	1.5	11.9	18.1	0.0	0.0	43.1	6.62	7.1	270.8	37.6	20.3	15.1
2001	April	30	-1.7	7.9	16.8	0.0	0.0	46.6	6.56	6.4	239.2	36.3	21.3	15.6

Table II-1 Climatic Data Recorded at Aurora Climate Station, January – December, 2001 (continued)

Year	Month	Day	Temperature			Total Rainfall (mm)	Total Snowfall (cm)	Mean Relative Humidity (%)	Total Global Solar Radiation ($kW \cdot h/m^2$)	Wind Speed and Direction				
										Mean Daily Wind		Maximum Sustained Gusts		
			Minimum (°C)	Mean (°C)	Maximum (°C)					Speed (km/h)	Direction (degrees)	5 Second (km/h)	2 Minute (km/h)	10 Minute (km/h)
2001	May	1	-4.6	5.6	15.6	0.0	0.0	63.9	5.88	5.4	175.6	31.9	20.7	16.8
2001	May	2	-4.1	6.4	15.2	0.0	0.0	63.0	5.63	4.0	223.4	34.9	18.3	15.5
2001	May	3	2.7	12.2	19.9	0.0	0.0	41.7	6.34	6.3	225.4	29.2	15.5	11.5
2001	May	4	5.1	13.5	19.3	0.0	0.0	34.7	6.85	7.0	256.3	37.3	20.8	16.5
2001	May	5	3.8	8.2	13.2	3.2	0.0	77.5	2.11	5.9	128.2	26.7	15.7	13.4
2001	May	6	-2.2	3.0	7.7	13.8	0.0	91.7	1.57	9.1	239.8	37.8	19.3	15.9
2001	May	7	-5.2	4.1	12.7	0.0	0.0	67.0	7.10	4.1	142.6	19.1	11.5	8.5
2001	May	8	-0.4	7.2	15.0	0.6	0.0	59.4	4.58	4.4	187.5	29.4	20.0	13.6
2001	May	9	-2.1	6.7	15.0	1.4	0.0	68.4	5.65	5.0	210.9	34.2	22.1	17.6
2001	May	10	-3.1	7.7	16.8	0.0	0.0	57.3	5.72	4.5	204.0	23.7	16.7	12.1
2001	May	11	-3.7	9.8	19.3	0.0	0.0	46.0	6.25	4.1	234.9	27.7	17.0	12.1
2001	May	12	-1.2	12.4	20.4	0.0	0.0	46.6	6.63	3.9	165.3	20.5	12.4	8.1
2001	May	13	5.5	14.3	22.4	2.4	0.0	48.2	4.22	6.5	231.8	33.5	15.7	13.3
2001	May	14	-2.2	11.4	20.6	0.0	0.0	42.0	5.50	4.8	226.6	31.2	17.0	11.8
2001	May	15	3.7	9.5	13.2	0.6	0.0	68.1	1.89	5.2	100.3	28.4	16.6	12.9
2001	May	16	-0.6	9.0	18.2	0.0	0.0	60.0	7.80	5.9	188.8	34.6	20.0	14.6
2001	May	17	-1.3	8.3	16.5	0.2	0.0	62.1	4.60	6.7	297.5	41.2	23.8	18.6
2001	May	18	3.4	7.9	13.0	0.8	0.0	65.3	4.92	6.9	286.7	37.3	23.4	17.7
2001	May	19	-1.2	7.7	16.5	0.0	0.0	63.7	5.26	5.4	174.1	34.0	22.8	18.6
2001	May	20	-1.8	4.7	8.8	0.0	0.0	65.0	3.59	5.6	189.4	33.8	19.4	13.9
2001	May	21	-6.1	5.5	14.0	0.0	0.0	62.0	7.57	4.6	130.9	26.6	16.6	12.1
2001	May	22	-4.4	10.7	20.7	0.0	0.0	51.1	6.21	4.4	189.1	22.4	14.3	10.0
2001	May	23	5.2	18.1	27.3	0.0	0.0	41.1	7.66	6.3	226.6	36.1	20.2	15.4
2001	May	24	6.0	14.6	23.3	2.0	0.0	68.6	3.63	2.9	179.1	33.5	13.0	10.7
2001	May	25	6.3	15.4	26.0	0.0	0.0	66.8	6.25	3.5	133.6	32.8	18.6	13.8
2001	May	26	9.0	14.1	21.1	18.8	0.0	68.5	4.36	5.4	95.9	25.4	15.1	11.3
2001	May	27	5.9	16.5	22.7	0.2	0.0	54.3	6.05	8.5	128.0	35.5	22.5	16.4
2001	May	28	12.8	20.0	26.3	0.0	0.0	53.4	7.37	13.5	159.3	43.6	25.7	21.6
2001	May	29	11.5	18.8	26.8	5.2	0.0	61.2	4.94	10.3	173.6	40.9	23.2	17.7
2001	May	30	4.1	9.6	13.0	13.4	0.0	94.4	2.24	4.2	166.2	21.8	10.9	8.2
2001	May	31	3.3	6.0	9.7	0.6	0.0	87.6	2.33	2.9	146.5	16.0	8.7	6.5

Table II-1 Climatic Data Recorded at Aurora Climate Station, January – December, 2001 (continued)

Year	Month	Day	Temperature			Total Rainfall (mm)	Total Snowfall (cm)	Mean Relative Humidity (%)	Total Global Solar Radiation ($kW \cdot h/m^2$)	Wind Speed and Direction				
										Mean Daily Wind		Maximum Sustained Gusts		
			Minimum (°C)	Mean (°C)	Maximum (°C)					Speed (km/h)	Direction (degrees)	5 Second (km/h)	2 Minute (km/h)	10 Minute (km/h)
2001	June	1	6.0	13.9	23.9	0.0	0.0	65.2	7.18	4.5	157.9	26.1	15.4	10.1
2001	June	2	10.0	19.5	25.7	0.0	0.0	46.0	7.14	10.5	159.8	44.0	26.1	19.4
2001	June	3	8.6	18.8	25.7	0.0	0.0	47.5	7.13	5.8	172.7	24.0	14.7	12.2
2001	June	4	5.8	18.2	26.6	0.0	0.0	44.8	8.59	5.3	177.3	30.3	14.8	11.2
2001	June	5	5.9	19.0	28.0	0.0	0.0	38.7	8.64	5.5	177.7	35.8	17.8	11.6
2001	June	6	5.1	17.7	28.6	0.0	0.0	45.3	7.87	3.4	181.1	24.4	15.7	10.2
2001	June	7	7.1	16.9	25.7	0.0	0.0	56.0	6.50	4.5	175.0	25.2	17.2	11.6
2001	June	8	5.2	15.1	25.7	7.8	0.0	79.1	5.86	2.8	202.2	18.2	9.3	6.7
2001	June	9	7.4	15.7	25.7	0.0	0.0	74.8	6.34	3.4	163.0	30.1	16.1	12.4
2001	June	10	11.1	13.4	19.7	24.2	0.0	91.6	1.64	2.9	91.9	15.7	9.8	7.2
2001	June	11	6.5	14.7	22.4	0.0	0.0	73.9	6.88	4.1	57.8	22.9	12.6	9.7
2001	June	12	5.3	14.0	22.5	0.0	0.0	69.4	5.12	2.5	229.7	19.6	12.0	9.0
2001	June	13	5.5	12.8	21.8	1.6	0.0	75.6	5.81	3.4	188.1	29.4	16.0	12.4
2001	June	14	7.8	14.7	21.0	0.2	0.0	72.4	5.56	3.7	108.8	37.1	18.0	14.7
2001	June	15	5.1	13.2	20.1	0.0	0.0	58.8	8.38	6.1	36.3	30.3	17.0	13.3
2001	June	16	5.4	12.1	17.5	0.0	0.0	65.0	4.88	3.2	147.7	19.8	11.4	10.0
2001	June	17	6.6	14.0	21.6	0.2	0.0	58.7	7.41	3.6	159.8	23.1	14.2	8.8
2001	June	18	5.2	13.1	18.2	0.8	0.0	68.7	6.40	4.4	161.7	26.3	13.5	9.9
2001	June	19	1.7	14.2	24.3	0.0	0.0	61.5	7.04	2.6	231.0	16.9	9.3	8.1
2001	June	20	5.6	20.0	30.3	0.0	0.0	51.1	8.47	4.9	228.7	28.9	14.9	11.9
2001	June	21	11.4	21.4	29.0	0.0	0.0	49.8	8.17	5.0	232.5	38.1	18.0	13.6
2001	June	22	11.2	15.3	22.3	5.2	0.0	84.3	3.12	3.4	219.7	33.9	21.5	11.4
2001	June	23	5.2	9.5	12.7	7.0	0.0	86.6	3.25	5.4	62.9	26.4	13.8	9.8
2001	June	24	2.0	7.9	12.1	3.4	0.0	89.0	1.85	3.7	60.6	20.7	12.0	8.7
2001	June	25	4.0	10.9	17.7	0.2	0.0	78.2	5.50	3.6	100.4	26.6	13.6	10.8
2001	June	26	4.3	13.1	21.0	0.0	0.0	65.2	6.95	2.6	154.5	13.9	8.0	6.5
2001	June	27	3.3	13.0	21.0	2.6	0.0	74.9	4.16	3.5	161.0	22.8	12.6	8.9
2001	June	28	11.2	12.1	13.0	18.8	0.0	98.6	0.96	6.1	58.5	25.1	13.7	10.5
2001	June	29	5.1	12.6	18.8	0.0	0.0	74.2	6.34	4.5	129.1	28.1	17.9	11.4
2001	June	30	-0.5	12.1	21.3	0.0	0.0	65.8	7.11	2.5	199.2	16.3	9.8	7.8

Table II-1 Climatic Data Recorded at Aurora Climate Station, January – December, 2001 (continued)

Year	Month	Day	Temperature			Total Rainfall (mm)	Total Snowfall (cm)	Mean Relative Humidity (%)	Total Global Solar Radiation ($kW \cdot h/m^2$)	Wind Speed and Direction				
										Mean Daily Wind		Maximum Sustained Gusts		
			Minimum (°C)	Mean (°C)	Maximum (°C)					Speed (km/h)	Direction (degrees)	5 Second (km/h)	2 Minute (km/h)	10 Minute (km/h)
2001	July	1	9.9	15.4	20.1	0.0	0.0	75.2	5.38	5.4	181.3	24.0	16.2	11.3
2001	July	2	5.8	15.7	24.6	0.2	0.0	68.8	6.31	4.2	200.1	40.4	19.3	13.8
2001	July	3	1.5	13.7	24.6	0.0	0.0	60.7	8.58	3.0	211.6	21.5	11.3	8.0
2001	July	4	5.5	20.8	31.7	6.4	0.0	55.4	8.00	5.7	192.1	35.1	23.4	18.0
2001	July	5	13.9	18.1	23.8	1.4	0.0	72.5	5.06	4.1	240.5	32.7	17.9	11.6
2001	July	6	13.3	18.7	24.3	0.0	0.0	53.7	6.54	7.6	296.9	41.4	22.1	17.2
2001	July	7	9.2	17.4	25.1	0.0	0.0	69.2	5.78	3.0	243.0	31.2	19.1	13.2
2001	July	8	8.1	17.2	24.7	0.0	0.0	58.4	8.17	6.7	279.1	41.8	21.5	17.2
2001	July	9	4.2	18.1	29.2	0.0	0.0	60.8	8.17	2.8	208.3	19.8	12.1	9.2
2001	July	10	12.6	22.3	31.6	2.6	0.0	60.7	6.45	5.6	174.8	26.4	16.2	11.5
2001	July	11	10.5	17.8	24.1	9.6	0.0	85.6	4.47	3.6	217.6	19.3	11.1	8.3
2001	July	12	6.6	16.5	26.2	0.0	0.0	66.9	8.24	3.6	267.0	23.7	14.1	10.6
2001	July	13	5.5	18.7	27.8	0.0	0.0	61.4	7.50	4.6	200.2	30.1	17.4	10.7
2001	July	14	12.3	17.5	23.1	0.2	0.0	80.1	4.24	2.9	196.4	20.7	12.9	9.5
2001	July	15	10.5	19.7	29.2	0.0	0.0	69.6	7.70	2.8	194.0	17.8	10.3	6.6
2001	July	16	10.6	20.0	28.6	1.4	0.0	76.2	4.81	3.4	129.8	21.5	13.9	10.1
2001	July	17	16.5	19.7	26.2	9.2	0.0	91.1	3.20	3.4	102.0	21.5	14.4	10.3
2001	July	18	10.6	19.7	26.2	0.0	0.0	69.6	5.40	4.5	159.8	31.1	15.0	11.8
2001	July	19	11.5	19.6	25.6	0.8	0.0	72.6	6.58	4.8	164.6	26.0	15.6	12.0
2001	July	20	8.3	17.3	25.9	0.0	0.0	74.3	6.54	2.7	205.8	12.7	7.8	5.8
2001	July	21	8.9	17.1	23.7	0.2	0.0	86.2	4.10	3.8	119.1	30.9	15.6	10.9
2001	July	22	7.2	15.2	21.0	0.0	0.0	71.1	6.94	5.6	69.6	28.8	14.4	11.5
2001	July	23	2.5	15.1	24.7	0.0	0.0	66.4	7.90	3.8	187.3	22.9	12.0	8.2
2001	July	24	7.5	17.9	27.2	0.0	0.0	62.0	6.55	5.1	157.5	26.3	15.5	10.9
2001	July	25	9.0	16.5	27.4	3.4	0.0	78.3	4.14	3.4	147.4	30.1	17.2	12.1
2001	July	26	6.5	15.1	23.7	0.6	0.0	86.1	3.85	1.9	219.0	17.4	10.8	8.2
2001	July	27	9.2	17.2	25.5	0.0	0.0	74.2	6.18	3.0	141.2	16.6	10.1	8.3
2001	July	28	10.5	18.5	27.4	10.4	0.0	74.9	5.17	3.5	154.9	20.3	13.4	9.7
2001	July	29	13.3	15.1	17.6	10.4	0.0	95.3	1.16	6.6	86.2	33.9	16.6	12.8
2001	July	30	12.8	18.2	26.1	1.6	0.0	77.8	6.31	4.6	283.6	24.9	15.0	12.9
2001	July	31	7.7	16.6	25.5	0.0	0.0	75.8	6.46	2.4	228.4	16.8	10.3	8.0

Table II-1 Climatic Data Recorded at Aurora Climate Station, January – December, 2001 (continued)

Year	Month	Day	Temperature			Total Rainfall (mm)	Total Snowfall (cm)	Mean Relative Humidity (%)	Total Global Solar Radiation ($kW \cdot h/m^2$)	Wind Speed and Direction				
										Mean Daily Wind		Maximum Sustained Gusts		
			Minimum (°C)	Mean (°C)	Maximum (°C)					Speed (km/h)	Direction (degrees)	5 Second (km/h)	2 Minute (km/h)	10 Minute (km/h)
2001	August	1	6.5	18.0	27.5	0.0	0.0	68.0	6.46	3.7	186.5	22.9	10.6	8.4
2001	August	2	10.3	18.7	28.5	1.2	0.0	75.3	5.64	3.0	198.9	17.1	10.3	8.3
2001	August	3	8.5	18.8	27.5	0.0	0.0	69.3	5.91	2.7	186.8	16.7	9.4	7.1
2001	August	4	13.0	18.5	27.4	0.4	0.0	81.2	5.03	3.7	91.8	18.3	12.7	8.8
2001	August	5	9.9	16.6	24.2	3.4	0.0	68.2	6.86	5.1	232.9	33.9	16.9	12.1
2001	August	6	6.0	17.1	26.1	0.0	0.0	63.3	6.84	5.1	249.5	27.8	17.4	11.9
2001	August	7	7.1	15.0	24.8	16.2	0.0	79.4	5.16	3.9	205.0	24.9	12.7	10.9
2001	August	8	8.5	12.9	18.5	2.8	0.0	84.8	4.00	3.3	280.8	27.5	17.6	10.9
2001	August	9	8.7	15.2	23.8	0.0	0.0	79.3	3.61	2.9	221.9	18.4	11.4	7.4
2001	August	10	8.5	16.0	23.1	0.0	0.0	79.0	3.56	2.9	153.4	21.2	13.1	9.4
2001	August	11	7.0	14.2	20.7	0.4	0.0	71.4	6.52	3.1	87.4	16.1	11.0	7.2
2001	August	12	2.4	15.8	27.9	0.0	0.0	73.2	6.18	2.9	194.4	13.8	8.0	5.7
2001	August	13	12.3	20.0	27.3	0.0	0.0	72.9	4.95	3.6	136.8	22.5	11.2	8.4
2001	August	14	8.0	15.4	22.3	1.6	0.0	82.9	3.46	3.9	252.5	26.5	13.9	11.4
2001	August	15	4.9	17.9	30.4	0.0	0.0	69.4	6.14	3.6	221.7	20.9	10.6	7.9
2001	August	16	10.2	18.8	27.6	0.0	0.0	69.3	6.10	3.7	201.1	18.5	11.0	8.4
2001	August	17	7.4	19.6	31.7	0.0	0.0	65.8	6.44	3.4	180.1	17.0	8.7	7.1
2001	August	18	10.7	19.7	28.6	0.0	0.0	72.5	4.03	2.9	196.5	15.0	7.8	6.6
2001	August	19	10.5	13.9	17.0	21.4	0.0	94.8	1.58	3.8	199.7	22.7	11.8	9.1
2001	August	20	10.0	13.2	20.4	5.6	0.0	85.6	2.97	5.0	258.2	31.9	16.5	11.2
2001	August	21	5.4	13.6	22.3	0.2	0.0	78.5	5.49	3.4	195.9	23.2	12.0	9.8
2001	August	22	4.5	14.7	24.9	0.0	0.0	76.5	4.16	3.4	56.3	19.7	11.8	9.1
2001	August	23	12.3	17.6	27.5	25.8	0.0	81.4	3.81	3.5	156.7	42.8	19.8	16.3
2001	August	24	9.0	14.7	21.6	0.2	0.0	74.1	5.55	4.8	236.8	30.8	17.0	13.0
2001	August	25	7.6	15.5	22.1	0.0	0.0	58.7	5.80	5.7	265.2	32.9	18.8	13.1
2001	August	26	3.7	14.5	22.6	0.0	0.0	74.5	4.49	2.9	226.2	21.1	10.4	7.1
2001	August	27	5.8	15.9	27.8	0.2	0.0	78.3	4.68	3.1	204.5	22.0	13.1	10.3
2001	August	28	9.9	15.1	21.1	0.6	0.0	87.8	2.43	2.9	253.3	20.5	12.9	8.8
2001	August	29	7.3	14.2	21.9	0.4	0.0	84.7	3.72	2.7	199.6	19.3	13.0	9.5
2001	August	30	3.4	14.7	24.6	0.2	0.0	72.0	5.04	4.4	180.5	23.1	12.8	8.9
2001	August	31	9.2	16.6	22.4	0.0	0.0	74.7	3.58	4.1	164.1	23.0	11.2	9.0

Table II-1 Climatic Data Recorded at Aurora Climate Station, January – December, 2001 (continued)

Year	Month	Day	Temperature			Total Rainfall (mm)	Total Snowfall (cm)	Mean Relative Humidity (%)	Total Global Solar Radiation ($kW \cdot h/m^2$)	Wind Speed and Direction				
										Mean Daily Wind		Maximum Sustained Gusts		
			Minimum (°C)	Mean (°C)	Maximum (°C)					Speed (km/h)	Direction (degrees)	5 Second (km/h)	2 Minute (km/h)	10 Minute (km/h)
2001	September	1	11.7	15.7	23.1	4.2	0.0	81.7	2.94	2.7	237.4	19.2	9.4	6.9
2001	September	2	5.3	13.5	21.2	0.2	0.0	73.0	5.26	4.1	249.0	25.5	12.2	9.7
2001	September	3	1.2	10.0	18.2	0.0	0.0	79.3	2.03	3.2	175.5	18.8	9.9	7.9
2001	September	4	6.5	12.8	19.4	0.0	0.0	60.8	4.74	4.2	236.9	26.5	14.0	10.0
2001	September	5	1.1	9.4	20.7	8.8	0.0	83.4	4.00	3.2	214.1	27.4	18.3	13.7
2001	September	6	2.1	8.7	13.6	1.2	0.0	87.7	2.02	3.1	211.5	20.5	9.2	6.7
2001	September	7	5.1	10.7	17.6	4.6	0.0	90.6	3.33	2.5	175.7	18.7	12.6	8.2
2001	September	8	3.7	10.6	18.7	0.6	0.0	78.5	3.34	5.3	230.8	27.0	15.4	12.7
2001	September	9	4.8	8.7	15.4	0.0	0.0	85.1	2.46	2.0	236.7	15.8	8.8	6.3
2001	September	10	4.5	8.8	14.6	1.4	0.0	92.0	2.43	1.7	235.5	16.0	9.7	9.1
2001	September	11	3.3	8.1	13.1	0.0	0.0	91.6	1.95	1.7	156.1	12.2	7.5	4.9
2001	September	12	3.1	8.7	14.3	0.0	0.0	87.6	2.11	1.7	189.9	10.4	6.9	5.5
2001	September	13	3.1	12.2	20.6	0.2	0.0	74.3	4.12	5.3	184.0	24.6	12.6	10.9
2001	September	14	4.1	13.7	25.6	0.2	0.0	74.9	4.65	3.2	196.2	13.8	6.9	4.9
2001	September	15	3.6	14.6	27.5	0.0	0.0	70.2	4.33	3.7	157.0	25.3	12.9	10.2
2001	September	16	3.4	10.5	17.3	0.0	0.0	77.9	3.88	3.8	56.4	20.5	10.3	7.3
2001	September	17	3.5	11.4	21.2	0.0	0.0	74.1	3.87	3.7	172.6	18.0	9.6	6.8
2001	September	18	1.2	11.2	22.3	2.4	0.0	83.3	3.57	1.7	189.6	16.7	10.2	7.5
2001	September	19	7.9	9.6	12.7	3.4	0.0	98.6	0.50	3.3	85.1	14.7	8.3	6.8
2001	September	20	5.9	8.6	12.0	0.8	0.0	90.3	1.95	2.1	222.4	16.4	12.0	7.8
2001	September	21	1.7	7.3	11.4	0.0	0.0	84.9	1.82	2.6	91.7	15.4	10.0	7.2
2001	September	22	-1.6	7.5	16.0	0.0	0.0	78.4	2.68	6.5	169.7	27.7	15.5	11.9
2001	September	23	6.3	15.0	25.3	0.2	0.0	65.3	3.84	5.9	183.4	25.8	12.7	10.2
2001	September	24	5.2	13.7	22.9	0.0	0.0	67.3	3.83	4.1	144.2	24.6	13.4	10.3
2001	September	25	2.1	13.1	27.3	0.0	0.0	74.8	3.67	2.2	214.5	15.3	9.8	7.5
2001	September	26	3.1	16.7	30.5	0.0	0.0	61.3	3.48	5.9	140.0	37.4	20.5	18.0
2001	September	27	2.1	13.0	18.7	0.0	0.0	69.3	2.18	6.0	228.2	31.3	15.9	12.9
2001	September	28	-1.4	8.0	17.7	0.0	0.0	69.8	3.02	3.5	197.8	20.3	10.8	7.4
2001	September	29	1.8	9.9	19.6	0.0	0.0	70.9	3.30	5.2	179.3	21.9	12.6	9.7
2001	September	30	8.2	12.6	17.2	0.0	0.0	44.1	3.45	7.4	268.9	34.7	17.4	14.5

Table II-1 Climatic Data Recorded at Aurora Climate Station, January – December, 2001 (continued)

Year	Month	Day	Temperature			Total Rainfall (mm)	Total Snowfall (cm)	Mean Relative Humidity (%)	Total Global Solar Radiation ($kW \cdot h/m^2$)	Wind Speed and Direction				
										Mean Daily Wind		Maximum Sustained Gusts		
			Minimum (°C)	Mean (°C)	Maximum (°C)					Speed (km/h)	Direction (degrees)	5 Second (km/h)	2 Minute (km/h)	10 Minute (km/h)
2001	October	1	-1.3	7.2	16.2	0.0	0.0	57.4	3.14	4.9	248.7	32.9	23.2	17.2
2001	October	2	-3.4	4.1	14.4	0.0	0.0	75.0	2.02	3.9	206.3	26.3	14.6	10.6
2001	October	3	0.7	5.1	11.3	0.2	0.0	70.2	2.05	7.8	208.8	35.9	24.0	18.8
2001	October	4	-4.7	1.5	7.4	0.0	0.0	61.6	2.81	5.3	222.0	24.3	14.1	10.5
2001	October	5	-6.2	0.3	8.1	0.0	0.0	75.8	2.02	2.7	156.4	11.6	6.6	5.7
2001	October	6	-6.9	4.5	17.9	0.0	0.0	65.7	3.01	4.0	204.6	25.0	13.3	9.7
2001	October	7	-2.4	6.6	17.7	0.0	0.0	62.0	2.95	4.7	206.2	31.2	13.8	11.8
2001	October	8	-2.0	6.3	17.0	0.0	0.0	63.7	2.81	4.3	213.0	25.8	13.2	11.1
2001	October	9	-3.8	4.0	13.0	0.6	0.0	76.3	1.51	3.8	215.1	21.0	11.4	9.2
2001	October	10	-4.9	4.3	14.4	0.2	0.0	75.5	2.62	4.6	181.4	20.8	11.2	8.7
2001	October	11	3.9	5.9	7.5	7.8	0.0	93.9	0.57	3.2	201.5	15.2	10.2	8.7
2001	October	12	-1.1	3.5	7.2	0.0	0.0	90.9	1.78	3.8	192.5	19.6	10.3	7.2
2001	October	13	1.0	4.4	8.2	0.4	0.0	86.4	1.07	5.5	288.9	30.1	20.0	15.0
2001	October	14	0.2	2.4	5.0	0.8	0.0	85.3	0.89	4.9	250.4	33.9	19.8	16.8
2001	October	15	-5.6	0.1	6.2	0.0	0.0	81.1	2.18	3.3	246.5	16.7	11.2	10.3
2001	October	16	-5.8	2.3	7.2	0.0	0.0	71.4	0.94	5.2	168.6	26.1	18.2	13.6
2001	October	17	-6.1	1.6	5.9	0.2	0.0	73.0	2.27	7.9	302.6	38.4	25.2	20.1
2001	October	18	-9.6	-3.7	3.5	0.0	0.0	78.1	2.32	3.3	102.3	19.3	10.9	8.9
2001	October	19	-5.3	-3.8	-2.4	0.0	0.0	81.9	0.65	4.3	38.0	18.3	11.9	9.3
2001	October	20	-7.5	-6.7	-5.3	0.0	0.0	92.1	0.60	4.3	74.0	18.1	10.1	7.6
2001	October	21	-7.3	-4.8	-2.4	0.0	0.0	86.3	0.91	2.0	218.8	9.2	7.2	5.2
2001	October	22	-11.8	-6.0	-3.2	0.0	0.0	86.5	0.58	3.8	147.2	18.4	11.6	8.3
2001	October	23	-13.2	-7.1	-1.6	0.0	0.0	87.3	1.18	3.5	179.5	16.9	9.9	7.4
2001	October	24	-15.5	-7.5	-1.1	0.0	0.0	84.0	1.03	3.0	183.1	12.2	7.4	5.5
2001	October	25	-5.7	-3.4	-1.5	0.0	0.0	91.0	0.39	1.4	119.1	8.7	6.5	5.4
2001	October	26	-8.3	-0.6	3.7	0.0	0.0	77.1	0.73	7.6	162.1	40.6	27.1	20.1
2001	October	27	-6.9	-0.4	3.6	0.2	0.0	75.4	0.90	5.2	270.6	23.8	16.3	11.7
2001	October	28	-15.3	-7.9	0.2	0.0	1.0	81.9	1.83	1.6	169.3	8.8	5.4	4.3
2001	October	29	-14.6	-4.4	8.3	0.0	1.0	78.6	1.77	4.3	205.4	22.7	13.1	10.6
2001	October	30	-6.3	-0.6	7.2	0.0	1.0	82.3	1.59	4.6	193.5	21.0	13.3	8.9
2001	October	31	-8.3	-2.3	2.7	0.0	0.0	89.0	0.45	1.9	171.5	9.5	6.6	6.1

Table II-1 Climatic Data Recorded at Aurora Climate Station, January – December, 2001 (continued)

Year	Month	Day	Temperature			Total Rainfall (mm)	Total Snowfall (cm)	Mean Relative Humidity (%)	Total Global Solar Radiation ($kW \cdot h/m^2$)	Wind Speed and Direction				
										Mean Daily Wind		Maximum Sustained Gusts		
			Minimum (°C)	Mean (°C)	Maximum (°C)					Speed (km/h)	Direction (degrees)	5 Second (km/h)	2 Minute (km/h)	10 Minute (km/h)
2001	November	1	-4.1	-0.5	3.2	0.0	0.5	97.4	0.63	2.8	228.2	14.9	10.2	8.7
2001	November	2	-1.6	2.8	8.2	0.0	2.3	68.6	1.74	5.9	224.4	29.7	14.1	11.1
2001	November	3	-5.2	1.0	5.4	0.0	0.0	65.9	1.31	5.1	198.5	19.0	11.6	9.4
2001	November	4	-2.5	3.4	9.1	0.0	0.0	65.0	0.86	4.7	222.1	19.6	10.5	8.2
2001	November	5	-7.8	-1.1	4.9	0.0	0.0	77.8	1.42	3.4	218.6	24.1	15.8	13.5
2001	November	6	-15.8	-8.8	-0.4	0.0	0.0	86.4	1.33	1.7	207.4	13.8	8.5	6.0
2001	November	7	-13.7	-6.9	-0.8	0.0	0.0	92.3	1.05	4.2	180.7	15.4	9.9	7.5
2001	November	8	-4.7	-2.9	-0.9	0.0	1.8	92.5	0.12	3.0	116.5	14.0	9.3	7.1
2001	November	9	-6.5	-2.2	2.3	0.0	2.3	96.4	0.34	2.7	184.7	16.0	9.6	8.4
2001	November	10	-12.5	-7.8	-3.5	0.0	0.0	96.5	0.50	4.1	88.7	19.5	12.1	9.8
2001	November	11	-9.2	-4.7	1.4	0.0	0.0	95.8	0.72	2.5	168.8	20.7	8.9	7.1
2001	November	12	-9.5	-4.3	1.6	0.0	0.0	97.2	0.64	2.1	225.6	15.0	8.4	7.6
2001	November	13	-4.2	-1.3	3.9	0.0	1.0	95.2	0.85	2.8	146.9	15.6	8.5	7.1
2001	November	14	-0.9	0.1	1.7	0.0	7.9	101.0	0.21	2.5	145.2	13.4	6.9	5.6
2001	November	15	-6.4	-0.5	3.9	0.0	0.3	95.5	0.55	4.1	159.1	27.2	14.6	12.3
2001	November	16	-1.7	2.6	6.8	0.0	1.0	83.3	1.06	5.9	193.8	25.3	14.9	13.5
2001	November	17	-3.6	1.1	3.8	0.0	0.0	65.3	0.90	5.6	277.0	31.9	13.1	9.3
2001	November	18	-9.2	-4.7	1.2	0.0	0.0	78.2	0.96	3.2	211.2	14.6	7.9	6.3
2001	November	19	-12.7	-6.6	-1.6	0.0	0.0	81.2	0.40	3.8	204.3	16.4	8.5	7.6
2001	November	20	-13.3	-6.4	-4.2	0.0	0.0	97.6	0.17	3.2	53.6	18.4	10.7	8.4
2001	November	21	-5.0	-3.7	-2.0	0.0	0.0	90.5	0.26	4.3	160.3	19.0	12.7	10.2
2001	November	22	-2.8	-1.2	-0.1	0.0	0.0	93.0	0.23	5.2	199.8	17.9	10.8	8.9
2001	November	23	-11.7	-4.3	-1.1	0.0	0.0	84.8	0.27	5.8	92.1	31.1	15.1	12.4
2001	November	24	-21.5	-15.5	-11.7	0.0	0.0	82.8	0.41	6.8	49.0	23.6	16.6	13.3
2001	November	25	-22.0	-16.9	-10.8	0.0	0.0	81.9	0.29	4.2	73.3	17.3	11.0	7.7
2001	November	26	-13.2	-11.3	-10.3	0.0	0.0	81.1	0.38	8.1	165.7	25.8	16.0	13.6
2001	November	27	-12.4	-10.7	-9.5	0.0	1.5	87.4	0.37	7.6	164.1	22.5	14.1	11.2
2001	November	28	-17.9	-13.4	-11.3	0.0	0.0	84.0	0.60	5.3	130.2	18.6	11.5	9.2
2001	November	29	-19.2	-16.6	-14.2	0.0	0.0	87.6	0.25	5.1	46.4	17.4	11.6	9.2
2001	November	30	-22.3	-15.8	-13.6	0.0	1.0	87.8	0.26	3.3	123.5	16.6	10.1	8.1

Table II-1 Climatic Data Recorded at Aurora Climate Station, January – December, 2001 (continued)

Year	Month	Day	Temperature			Total Rainfall (mm)	Total Snowfall (cm)	Mean Relative Humidity (%)	Total Global Solar Radiation ($kW \cdot h/m^2$)	Wind Speed and Direction				
										Mean Daily Wind		Maximum Sustained Gusts		
			Minimum (°C)	Mean (°C)	Maximum (°C)					Speed (km/h)	Direction (degrees)	5 Second (km/h)	2 Minute (km/h)	10 Minute (km/h)
2001	December	1	-23.1	-15.0	-10.5	0.0	0.5	87.3	0.31	2.7	144.5	21.2	13.1	10.2
2001	December	2	-23.3	-12.7	-9.1	0.0	3.6	88.8	0.10	2.3	213.2	12.4	7.4	5.7
2001	December	3	-28.2	-21.2	-16.0	0.0	0.0	83.1	0.18	2.9	202.2	12.5	6.5	5.8
2001	December	4	-29.6	-25.1	-19.0	0.0	0.0	80.1	0.25	2.7	206.4	16.1	9.6	7.0
2001	December	5	-26.0	-20.6	-17.6	0.0	0.0	84.4	0.07	1.8	152.1	10.0	8.0	5.1
2001	December	6	-23.7	-17.6	-12.3	0.0	4.3	86.3	0.13	1.2	220.3	10.0	5.3	4.0
2001	December	7	-23.2	-18.2	-12.2	0.0	0.8	83.1	0.19	3.0	242.9	21.0	11.8	10.5
2001	December	8	-15.9	-9.5	-3.2	0.0	2.5	92.7	0.07	3.4	208.7	28.0	19.7	15.1
2001	December	9	-28.6	-20.6	-11.3	0.0	0.0	78.8	0.20	4.1	219.2	24.6	15.1	11.4
2001	December	10	-36.7	-31.4	-23.6	0.0	0.0	73.3	0.19	1.5	126.0	10.0	6.8	5.8
2001	December	11	-38.4	-27.5	-16.7	0.0	0.0	75.4	0.03	2.6	214.5	18.8	10.4	8.6
2001	December	12	-16.8	-12.2	-8.4	0.0	0.3	86.4	0.05	4.1	195.4	16.5	11.6	8.5
2001	December	13	-13.9	-9.3	-7.4	0.0	0.5	93.6	0.03	1.7	215.0	14.2	8.9	7.0
2001	December	14	-9.3	-7.2	-6.3	0.0	3.3	94.3	0.03	4.2	85.0	15.6	10.2	9.2
2001	December	15	-23.3	-12.5	-8.3	0.0	3.6	90.8	0.06	3.6	245.4	23.3	12.2	9.5
2001	December	16	-25.1	-19.3	-13.0	0.0	0.0	86.5	0.10	1.6	198.6	10.7	6.3	4.9
2001	December	17	-20.0	-13.8	-7.8	0.0	0.3	87.2	0.03	4.6	185.7	33.7	19.3	16.2
2001	December	18	-26.6	-22.2	-15.3	0.0	0.0	83.2	0.18	2.5	198.8	11.4	6.8	5.9
2001	December	19	-25.1	-16.9	-9.8	0.0	0.0	85.7	0.08	2.6	213.0	15.3	9.5	7.4
2001	December	20	-24.1	-18.6	-12.9	0.0	0.0	86.5	0.20	2.3	215.5	11.7	7.6	6.1
2001	December	21	-25.4	-19.0	-13.2	0.0	0.0	86.6	0.20	3.3	200.3	13.3	7.3	6.3
2001	December	22	-21.1	-15.3	-9.5	0.0	0.0	87.6	0.23	4.3	188.4	17.4	10.0	8.5
2001	December	23	-21.4	-13.4	-8.6	0.0	0.0	87.7	0.17	5.6	189.0	18.6	9.9	8.5
2001	December	24	-15.4	-10.0	-5.3	0.0	0.5	89.9	0.24	5.8	180.4	16.6	10.8	8.1
2001	December	25	-10.6	-6.6	-0.7	0.0	1.0	92.5	0.68	4.0	185.6	17.2	10.9	7.9
2001	December	26	-15.1	-11.1	-7.7	0.0	0.0	94.1	0.27	1.6	178.2	7.6	5.8	4.5
2001	December	27	-18.7	-14.1	-11.3	0.0	0.0	91.1	0.22	3.0	99.7	17.5	12.3	8.5
2001	December	28	-27.8	-20.6	-15.3	0.0	0.0	85.0	0.16	1.0	177.8	7.8	4.0	3.1
2001	December	29	-29.2	-24.7	-18.5	0.0	0.0	81.2	0.21	1.9	192.5	8.3	4.8	4.4
2001	December	30	-28.0	-21.2	-16.0	0.0	0.0	84.4	0.16	1.2	243.9	10.1	5.4	4.4
2001	December	31	-22.8	-18.4	-16.4	0.0	0.0	87.1	0.22	3.0	201.2	13.5	6.9	5.3

Table II-2 2001 Mean Daily Atmospheric Pressure (kPa) at Kearl Lake Outlet (Elevation 330 m)

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	97.806	97.009	96.260	97.248	96.850	97.858	98.114	97.701	96.354	98.090	96.591	96.910
2	97.744	96.655	97.106	98.294	98.115	97.266	97.994	97.513	96.937	97.773	96.939	96.696
3	97.125	96.976	97.773	99.221	97.783	97.866	98.555	97.445	97.069	98.487	98.077	97.129
4	96.949	97.595	98.635	97.986	97.334	98.241	97.754	96.914	97.521	99.236	97.165	97.277
5	96.417	98.490	98.501	96.669	96.348	98.194	96.798	97.393	97.424	97.986	97.924	97.385
6	97.707	99.041	98.574	97.324	97.273	98.056	96.784	97.746	96.912	97.242	98.491	96.987
7	97.649	99.442	98.439	97.885	98.376	97.897	97.274	98.004	97.807	97.005	98.596	97.773
8	96.332	99.669	97.607	98.017	97.631	97.686	97.782	98.563	97.313	96.769	97.704	96.077
9	96.464	99.032	98.641	97.440	97.633	97.298	98.275	98.353	97.341	97.136	97.622	97.209
10	96.865	98.441	97.269	97.933	97.941	96.841	97.814	97.826	98.175	96.764	98.564	97.904
11	97.826	98.817	96.246	98.609	97.948	97.121	97.698	98.350	98.929	96.242	98.083	98.035
12	99.069	98.544	95.876	97.896	97.838	97.634	98.491	98.453	99.105	96.241	97.056	97.037
13	98.487	98.470	96.703	97.433	96.847	97.672	98.366	97.979	98.496	96.776	96.581	96.315
14	98.641	97.810	98.124	98.480	96.738	97.498	97.392	98.170	98.289	97.936	96.601	95.734
15	98.896	99.160	97.812	99.606	96.679	97.863	97.220	97.941	97.919	98.700	96.971	96.447
16	97.441	99.434	97.285	99.447	96.840	98.369	97.327	98.171	98.580	97.275	97.006	96.084
17	98.304	98.277	97.375	97.901	96.589	98.338	97.081	98.130	98.169	96.826	98.024	96.251
18	98.201	98.411	97.919	96.944	96.924	98.175	97.105	97.412	97.426	96.722	98.813	97.608
19	97.323	98.586	97.427	97.546	97.091	98.327	97.166	97.037	97.442	97.296	97.561	97.606
20	97.629	98.819	98.822	98.896	98.004	98.146	97.436	96.911	97.840	97.932	97.308	98.315
21	97.443	98.209	99.290	98.503	97.984	97.709	97.503	97.273	98.129	98.159	97.046	97.955
22	98.229	98.363	99.873	98.029	98.008	97.133	98.025	97.590	98.509	97.476	96.493	98.094
23	98.809	98.234	100.482	97.621	97.902	97.663	98.180	96.781	97.736	97.220	97.603	98.699
24	97.408	99.073	100.370	97.441	98.029	97.847	97.839	97.033	97.614	98.053	99.166	98.724
25	98.187	99.418	99.144	97.336	98.336	97.904	98.073	97.321	97.414	98.716	99.618	98.635
26	97.685	99.267	97.765	97.900	98.421	98.740	98.206	97.695	96.774	97.984	99.811	98.955
27	97.303	97.368	97.429	97.104	98.131	98.682	97.793	97.727	97.313	96.895	99.495	98.501
28	96.312	95.960	96.447	95.961	97.549	97.898	97.196	97.468	97.944	98.266	98.649	99.453
29	96.528	-	96.844	96.139	96.978	98.636	96.338	97.854	97.897	98.354	97.720	99.766
30	97.360	-	97.995	96.197	97.070	98.914	96.852	97.884	97.927	97.030	97.637	99.429
31	98.722	-	97.651	-	98.057	-	97.465	96.786	-	96.020	-	99.526
min	96.312	95.960	95.876	95.961	96.348	96.841	96.338	96.781	96.774	96.020	96.493	95.734
mean	97.641	98.377	97.981	97.785	97.547	97.918	97.593	97.657	97.791	97.484	97.873	97.694
max	99.069	99.669	100.482	99.606	98.421	98.914	98.555	98.563	99.105	99.236	99.811	99.766

Notes: P - partial daily average. March to December values derived based on record from Ft. McMurray Airport

Table II-3 Hourly Wind Rose [km/h] at Aurora Climate Station (1995- 2001)

Bins	N	NE	E	SE	S	SW	W	NW
<1	762	535	248	534	1340	681	587	541
6	2424	4869	1266	2471	11800	4081	2667	2958
12	1075	3274	333	678	3923	760	850	1505
20	63	195	13	95	260	2	19	344
29	1	0	0	2	0	0	0	29
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	4.8	5.6	4.3	4.6	4.8	4.0	4.4	5.9

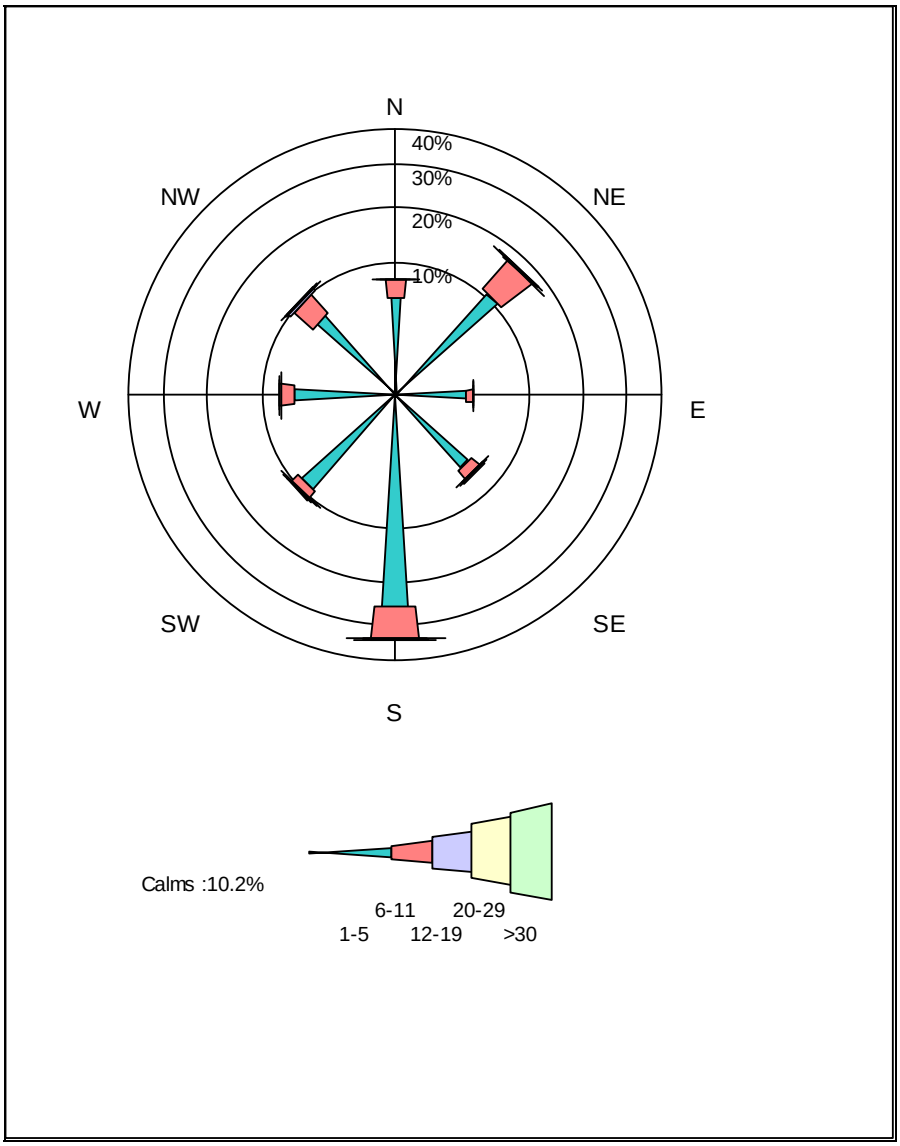
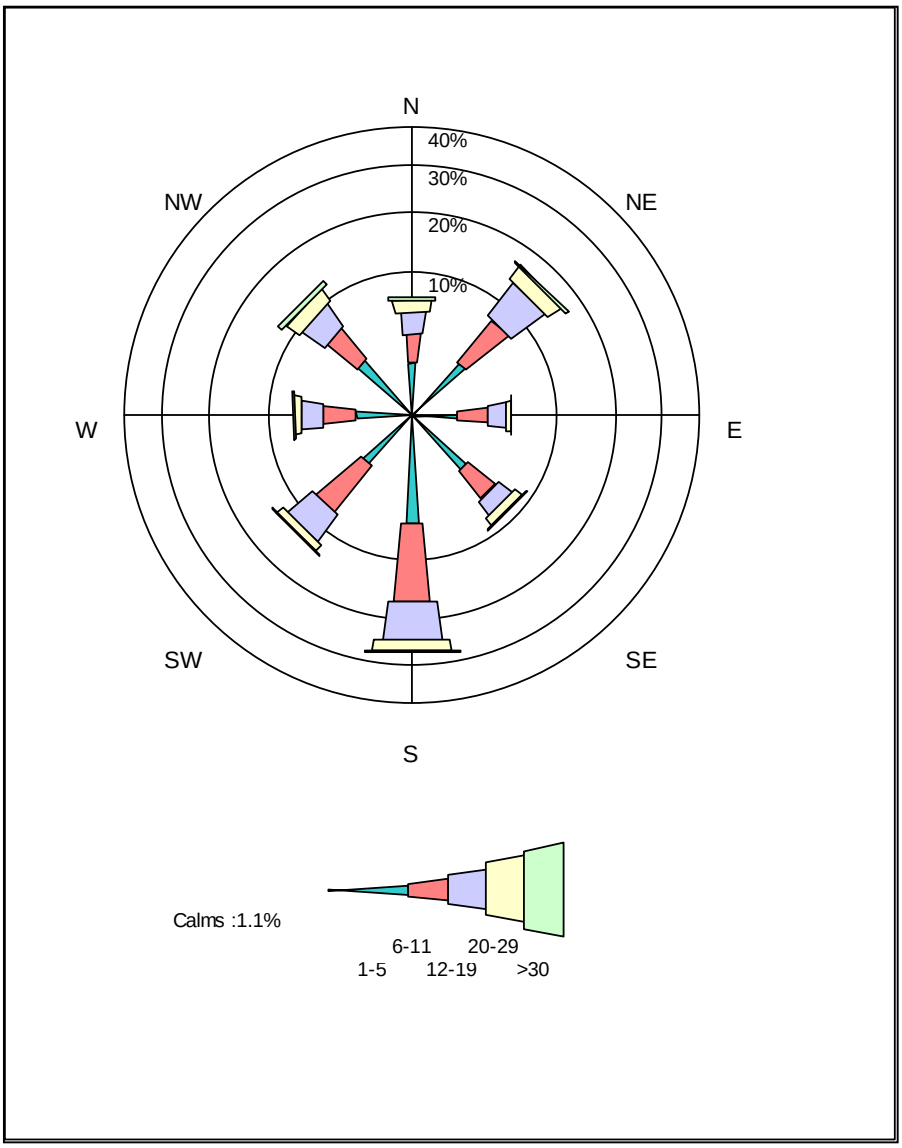


Table II-4 5 Second Gust Wind Rose [km/h] at Aurora Climate Station (1995-2001)

Bins	N	NE	E	SE	S	SW	W	NW
<1	60	59	38	62	147	85	59	51
6	672	1227	494	1272	2840	1056	772	1286
12	992	2617	905	1592	5723	2756	1211	1813
20	1035	2983	766	1071	4002	2334	1042	1730
29	662	1513	298	540	1351	667	488	1091
100	194	260	42	145	262	88	134	456
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	42.8	52.5	60.4
average	14.1	13.9	12.0	11.5	11.6	12.1	12.6	14.2



APPENDIX III

UPDATED CLIMATIC AND HYDROLOGIC DATABASE

The database CD included in this appendix contains data from RAMP and regional data collected by Environment Canada. 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.

Table III-1 Directory of Database CD in Appendix lll

DATABASE_CD			
RAMP Data		Environment Canada Data	
Hydrology	Climate	Hydrology	Climate
Stream Gauging Data S1-Alsands Drain-95to01.xls S2-Jackpine Creek-95to01.xls S3-Iyinimin Creek-95to01.xls S4-Blackfly Creek-95to98.xls S5A-Muskeg River Aurora-95to01.xls S6-Mills Creek-96to01.xls S7-Muskeg River 7DA8-98to01.xls S8-Stanley Creek-99to01.xls S9-Kearl Lake Outlet-98to01.xls S10-Wapasu Creek-98to01.xls S11-Poplar Creek-95to01.xls S12-Fort Creek-00to01.xls S13-Albian Sands Pond #3-00to01.xls S14-Ells River-01to01.xls S15-Tar River-01to01.xls S16-Calumet River-01to01.xls S17-Upland Tar River-01to01.xls S18-Upland Calumet River-01to01.xls S19-Lowland Tar River-01to01.xls S20-Upland Muskeg River-01to01.xls S21-Shelley Creek-01to01.xls S22-Muskeg Creek-01to01.xls S23-Aurora Boundary-01to01.xls S24-Athabasca River-01to01.xls S28-Khahago Creek-01to01.xls L1-McClelland Lake-97to01.xls L2-Kearl Lake-99to01.xls L3-Isadore's Lake-00to01.xls Other Data Muskeg-Ice Observations-97to01.xls Muskeg-TSS Observations-97to01.xls	Aurora Climate Station Aurora-Climate-95to01.xls Aurora-Raw Data-95to01.xls Aurora-Wind Roses-95to01.xls Other Climatic Data Iyinimin-TBRG-99to01.xls Kearl-Barometer-99to01.xls Calumet-Climatic-01to01.xls Snow Survey Data Muskeg-Snow Survey-97.xls Muskeg-Snow Survey-98.xls Muskeg-Snow Survey-99.xls Muskeg-Snow Survey-00.xls Muskeg-Snow Survey-01.xls Fort Hills-Snow Survey-00.xls CNRL-Snow Survey-01.xls	Daily Mean Environment Canada Data Regional-Daily Discharges-01 Update.xls	Daily Environment Canada Data Regional-Daily Climate-01 Update.xls Hourly Environment Canada Data Ft McMurray A-Hourly Temperature-53to01.xls Ft McMurray A-Hourly Wind-53to01.xls Ft McMurray A-Hourly Pressure-53to01.xls Mildred Lake-Hourly Climate-85to01.xls

APPENDIX IV

1997-2001 SNOW COURSE SURVEY DATA

Table IV-1 Summary of 2001 Snow Course Survey Data in Muskeg River Basin

Terrain Type	Survey Plot No	Date of Survey	GPS Location	Snow Density (g/cm^3)	Snow Depth (cm)	Snow Water Equivalent (mm)	Description of Vegetation	Snow Cover Appearance
flat low lying	FL-01-1	18-Mar-01	6359714 N 463121 E	0.132	35.6	47.1	- Willows (2.5 m tall) (95%): spruce - 1%; tamarack - 5%. young alders, surrounded by spruce and jack pine.	- Crust on top 0 - 2 cm, Clean, dry, compacted, Medium coarse grained, Ice bottom.
	FL-01-2	18-Mar-01	6342341 N 474414 E	0.225	32.2	72.4	- Willow (3 m tall) (94%): black spruce - 1% (ht. 15 m, dia. 6 cm); alders - 5%. grass.	- Crust on top 0 - 3 cm, Clean, dry, compacted, Medium coarse grained, Ice bottom.
	FL-01-3	18-Mar-01	6345603 N 483835 E	0.155	40.7	63.2	- Willow (<2.5 m tall) (50%): cattails - 30%; grass - 15%; young birch and dogwood - 5%. Surrounded by white spruce.	- Crust on top 0 - 5 cm, Clean, dry, compacted, Medium coarse grained, Ice bottom.
	FL-01-4	18-Mar-01	6345500 N 477884 E	0.226	29.2	66.2	- Willow (3 m tall) (50%): alders (3 m tall) - 45%; grass and dogwood - 5%. Surrounded by white spruce, aspen, and sparse jack pine.	- Crust on top 0 -7 cm, Clean, dry, compacted, coarse grained.
open land	OP-01-1	18-Mar-01	6359769 N 462375 E	0.161	30.5	49.1	- Grass, young alders, wild rose. Surrounded by aspen.	- Crust on top 0 - 5 cm, Clean, dry, compact, medium coarse grained.
	OP-01-3	19-Mar-01	6346589 N 463790 E	0.218	33.7	73.3	- Small fireweed and grass, Surrounded by aspen and spruce.	- Soft new snow on top 0 – 4 cm, Crust 4cm - 7cm dusty, Below clean, dry, compacted, medium coarse grained.
	OP-01-4	19-Mar-01	6344127 N 464169 E	0.195	32	62.4	- Young aspen, young alders, wild rose, dogwood, buffaloberry.	- Soft new snow on top 0 – 3 cm, Crust 4 cm - 8cm dusty, Below clean, dry, compacted, medium coarse grained.
open lake	OP-01-2	18-Mar-01	6349023 N 484935 E	0.228	28.7	63.0	- Surrounded by aspen and spruce, along the shoreline.	- Crust on top 0 - 10 cm, Clean, dry, compacted, windswept, ice bottom.
mixed deciduous	MD-01-1	18-Mar-01	6359809 N 463318 E	0.252	28.2	70.9	- Canopy (60%): aspen - 50% (ht. 22 m, dia. 14 cm); white spruce - 50% (ht. 22 m, dia. 13 cm). Understorey: young spruce, cranberry, dead trees and Labrador tea.	- Crust on top 0 - 7 cm, Clean, dry, compacted, leaves, medium coarse grained.
	MD-01-2	18-Mar-01	6339912 N 474442 E	0.196	36.3	71.2	- Canopy (70%): aspen - 70% (ht. 25 m, dia. 15 cm); white spruce - 30% (ht. 15 m, dia. 12 cm). Understorey: young spruce, cranberry, wild rose, Labrador tea and fireweed.	- Crust on top 0 - 1 cm, Clean, dry, compacted, leaves, medium coarse grained.
	MD-01-3	18-Mar-01	6343799 N 475881 E	0.155	29.3	45.4	- Canopy (50%): aspen - 90% (av. ht.22 m, dia. 15 cm); white spruce - 10% (av. ht. 20 m dia. 20 cm). Understorey: grass, wild rose and alder.	- Crust on top 0 - 3 cm, Clean, dry, compacted, medium coarse grained, ** exposed ground underneath, spruce tree.
	MD-01-4	18-Mar-01	6348324 N 483912 E	0.167	28.5	47.6	- Canopy (80%): white spruce - 80% (ht. 25 m, dia. 11 cm); aspen - 19% (ht. 22 m, dia. 9 cm); birch - 1% (ht. 25 m, dia. 28 cm). Understorey: wild rose/cranberry.	- Crust on top 0- 4 cm, Clean, dry, compacted, Clean, dry, compacted, needles, leaves, medium coarse grained.
jack pine	JP-01-1	18-Mar-01	6362376 N 462622 E	0.149	25.3	37.8	- Canopy (70%): jack pine - 100% (ht. 25 m, dia. 12 cm). Understorey: wild rose, alders, buffaloberry and cranberry. Surrounded by aspen.	- Crust on top 0 - 5 cm, Clean, dry compacted, needles, coarse grained.
	JP-01-2	18-Mar-01	6348977 N 481256 E	0.138	33.3	45.8	- Canopy (70%): jack pine - 99% (av. ht. 25m, dia.12cm); aspen - 1% (ht. 20m, dia. 6cm). Understorey: young spruce, wild rose and cranberry.	- Crust on top 0 - 5 cm, Clean, dry, compact, needles, medium coarse grained.
	JP-01-3	18-Mar-01	6345883 N 478550 E	0.119	26.7	31.9	- Canopy (65%): jack pine - 85% (ht. 22 m, dia. 12 cm); aspen - 15% (ht. 22 m, dia. 10 cm). Understorey: Labrador tea, alders, cranberry and dead trees.	- Crust on top 0 - 4 cm, Clean, dry, compacted, needles.
	JP-01-4	18-Mar-01	6344966 N 477018 E	0.136	29.3	39.7	- Canopy (60%): jack pine - 95% (ht. 25 m, dia. 15 cm); black/white spruce - 4% (ht. 20m, dia.8cm); aspen - 1% (ht. 25 m, dia.12 cm). Understorey: alders and Labrador tea	- Crust on top 0 - 3 cm, Clean, dry, compacted, needles.

Table IV-2 Summary of 2000 Snow Course Survey Data in Muskeg River Basin

Terrain Type	Survey Plot No	Date of Survey	GPS Location	Snow Density (g/cm^3)	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. 2.0 m).	- 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 (3 m tall) (80%). Understorey: 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 (3 m tall) (50%): alder - 10%; fireweed 18%. Area surrounded by jack pine.	- 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, jack pine - 1% (5 cm dia. 3 m ht.).	- 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 20%) 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 (2 m ht., dia. 7 cm). clover/buffaloberry /fireweed willows, 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 20 m, dia.20 cm, white spruce (3 m –5 m). Understorey (20%): alder (2 m 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%): aspen poplar (av. ht 25 m dia. 15 cm); spruce - 2% (ht. 5 m dia. 10 cm). Understorey (20 %): alder (av. ht. 2 m).	- 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. 15 m dia. 10 cm). Understorey: 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. 12 m dia, 7 cm). Understorey: 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.-20 m, dia. 15 cm). Understorey: 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. 18 m, dia.20 cm); white spruce - 15% (ht. 15 m, dia. 15 cm). Understorey: 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. 14 m, dia. 10 cm). Understorey: 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. 22 m, dia. 25 cm); aspen - 20% (ht 20 m, dia.10 cm). Understorey: ledum, moss and wild rose.	- white, wet, coarse grained.

Table IV-3 Summary of 1999 Snow Course Survey Data in Muskeg River Basin

Terrain Type	Survey Plot No	Date of Survey	GPS Location	Snow Density (g/cm^3)	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. 2.5 m.	- white, wet, loose coarse grained.
	FL99-2	16-Mar-99	6351787 N 476015 E	0.175	33.5	58.8	- Understorey of willow (5 m tall) 80% Understorey - 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	- understorey willow (3 m 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 (5 m ht); willow (2 m ht); mosses and willow - 40% cover understorey.	- 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 (2 m 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 20 m, dia. 20 cm, white spruce 3 m-5 m, understorey 20%, alder 2 m 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 25 m dia. 15 cm); spruce - 2% (ht. 5 m dia. 10 cm). Understorey (20 %): alder (av. ht. 2 m).	- 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. 15 m dia. 10 cm). Understorey: 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. 12 m dia, 7 cm). Understorey: 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.-20 m, dia. 15 cm). Understorey: 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). Understorey: 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. 14 m, dia. 10 cm). Understorey: 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. 22 m, dia. 25 cm); aspen - 20% (ht 20 m, dia.10 cm). Understorey: Labrador tea, moss and wild rose.	- white, wet, coarse grained.

Table IV-4 Summary of 1998 Snow Course Survey Data in Muskeg River Basin

Terrain Type	Survey Plot No	Date of Survey	GPS Location	Snow Density (g/cm^3)	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 Understorey - dogwood 10%, wild rose 30% bunch of grass (1m to 1.5 m tall) 40% aspen poplar (less 0.6 m 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	- Understorey: of willow (2 m 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	- Understorey: willow (3 m 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	- Understorey: willow clusters (1.5 m tall) 60% grass (0.5 m 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 30 m 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. 20 m, dia. 15 cm); poplar - 40% (ht. 17 m, dia. 20 cm). Understorey: 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. 20 m, dia. 15 cm); jack pine - 30% (ht. 25 m, dia. 22 cm); poplar 20% (ht 15 m dia. 12 cm). Understorey: wild rose 60% white spruce ht <1 m 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. 15 m dia. 15 cm). Understorey: 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.-22 m, dia. 18 cm). Understorey: <5 m 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. 25 m, dia.17 cm); white spruce 20% (ht. 15 m, dia. 10 cm). Understorey: 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. 25 m, dia. 20 cm). Understorey: 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. 30 m, dia. 30 cm); white spruce - 1% (ht 25 m). Understorey: Labrador tea, moss and wild rose.	- white, wet, coarse grained.

Table IV-5 Summary of 1997 Snow Course Survey Data in Muskeg River Basin

Terrain Type	Survey Plot No	Date of Survey	GPS Location	Snow Density (g/cm^3)	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	- Understorey: dead willow - 30%.	- white loose to compacted coarse granular.
	FL97-2	17-Mar-97	6340621.5N 468767.5E	0.170	50.4	85.6	- Understorey: willow - 50% (av. ht. – 3 m).	- white, clean loose, coarse granular.
	FL97-3	17-Mar-97	6339612.9N 464993.0E	0.189	76.5	144.6	- Understorey: willow - 40% (av. ht.-2 m), black spruce - < 2% (av. ht. – 2 m).	- white, clean, loose coarse granular.
	FL97-4	19-Mar-97	6343441.8N 473432.3E	0.179	65.6	117.2	- Understorey: willow - 60% to 65% (av. ht. – 3 m to 3.5 m), bog birch - 5% (av. ht.- <1 m).	- 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 forbs 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 and 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, aspen poplar (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, aspen poplar 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.- 17 m, dia.- 20 cm); aspen poplar - 60% (av. ht.- 18 m, dia.-15 cm). Understorey: 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.-18 m, dia.- 18 cm); aspen poplar - 55% (av. ht. – 24 m, dia.-20 cm). Understorey: green alder-20% ht. 2 m - aspen poplar-15%, ht. 0.5 m - white spruce 10%, ht. 2 m to 2.5 m.	- 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.-20 m, dia.- 19 cm); aspen poplar - 70% (av. ht. – 23 m, dia.-20 cm). Understorey: green alder 40%, ht. 2.5 m - aspen poplar -5%, ht.- 1.0 m.	- 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.-18 m, dia.- 15 cm); aspen poplar - 50% (av. ht.-20 m, dia.- 18 cm); white birch <2% (ht. 14 m). Understorey: green alder 20%, ht.- 2 m -white birch 15%, ht. 3.5 m -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.-18 m, dia. 18 cm); aspen poplar - 5% (av. ht.-16 m, dia.- 10 cm). Understorey: buffaloberry (10%), aspen poplar (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. 20 m, dia.17 cm). Understorey: 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. 20 m, dia. 16 cm); aspen poplar - 2% (av. ht. 20 m, dia. 11 cm). Understorey: 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. 21 m, dia. 19 cm). Understorey: green alder 35%, ht. 1 m to 1.5 m. - Labrador tea <2%.	- white, loose to slightly compacted, clean, coarse granular with pine needles interspersed among snow.

APPENDIX V

CLIMATIC AND HYDROLOGIC MONITORING STATION FACTSHEETS

AURORA CLIMATE STATION

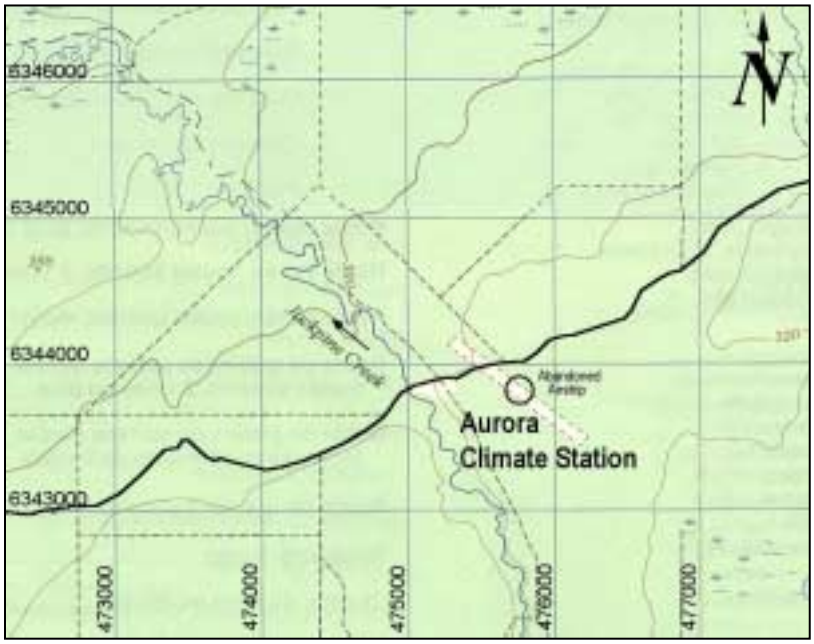
C1

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.

Period of Record:	May 1995 to Present		
Access:	400 m long 4WD track south of Canterra Road		
Benchmark:	n/a (ground elevation approximately 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.

MCCLELLAND LAKE HYDROMETRIC STATION

L 1

FACTSHEET

LOCATION AND PURPOSE

Established 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.

Period of Record:	July 1997 to Present		
Access:	Helicopter		
Benchmark:	Rebar in PVC housing, elevation 295.84 m (geodetic)		
Drainage Area:	191 km^2		
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	703010
Keller 8363K 10 psi Pressure Transducer	Measure water levels	964640

KEARL LAKE HYDROMETRIC STATION

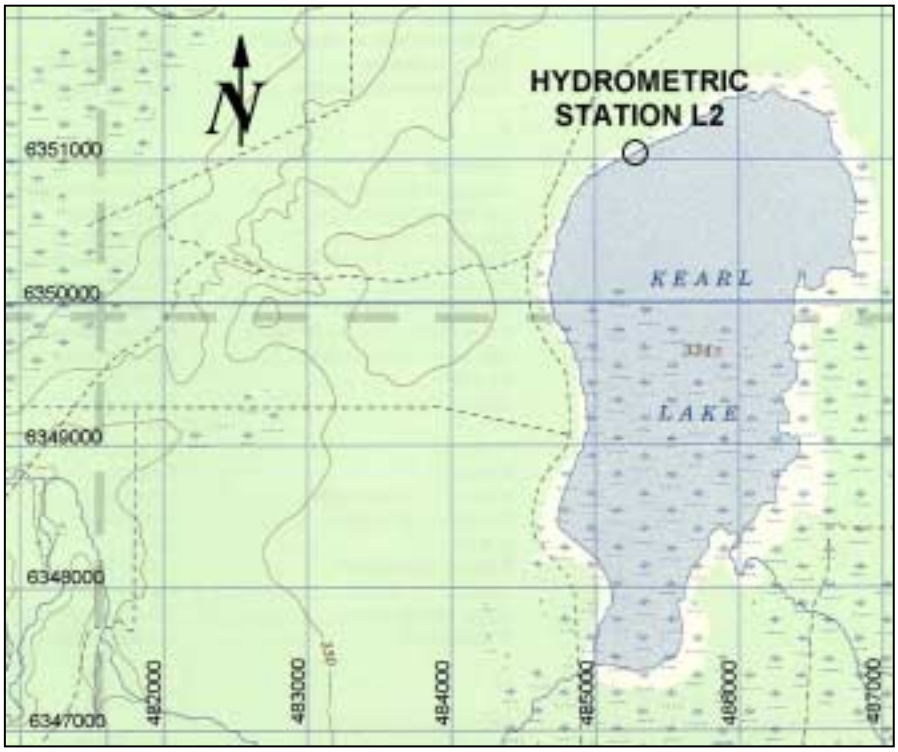
L 2

FACTSHEET

LOCATION AND PURPOSE

Established to monitor water levels on Kearl Lake.

Period of Record:	April 1999 to Present		
Access:	4WD road access		
Benchmark:	Rebar in PVC housing, elevation 333.41 m (geodetic)		
Drainage Area:	72.6 km^2		
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.
Lakewood UltraLogger RX-2	Record data	908201
Keller 8363K 3 psi Pressure Transducer	Measure water levels	3498

ISADORE'S LAKE HYDROMETRIC STATION

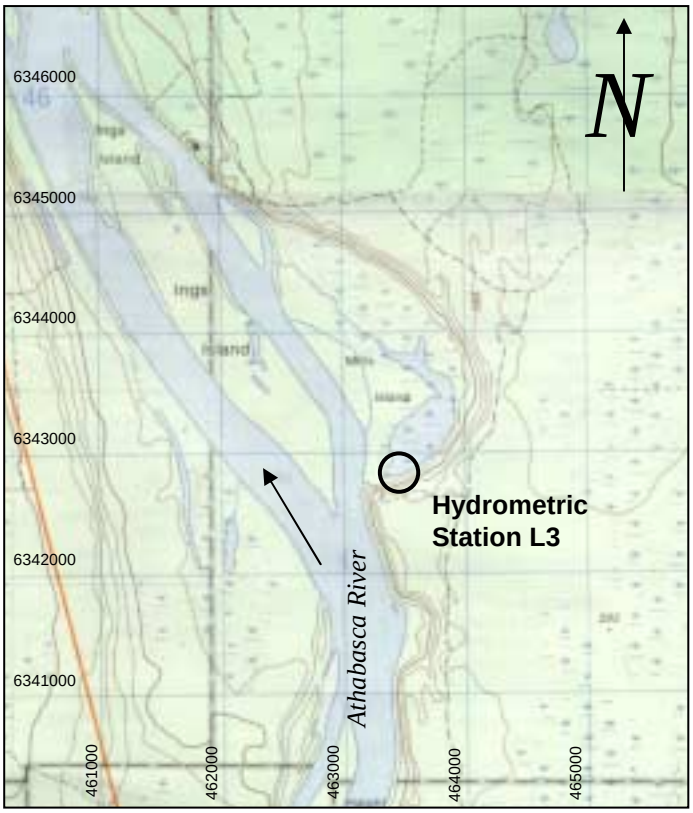
L 3

FACTSHEET

LOCATION AND PURPOSE

Established to monitor water levels on Isadore's Lake.

Period of Record:	February 2000 to Present	
Access:	4WD road access off Highway 63; foot access down slope	
Benchmark:	Temporary benchmark nail in tree, elevation 235.91 m (geodetic)	
Drainage Area:	28.0 km^2	
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 Levelogger LT*	Measure and record water levels	3001

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

ALSANDS DRAIN HYDROMETRIC STATION

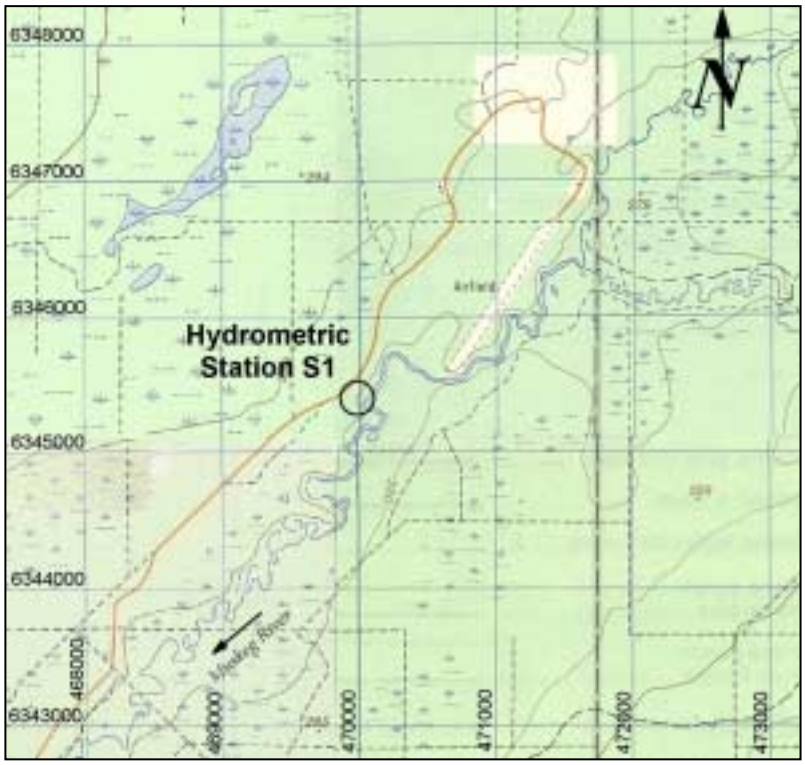
S1

FACTSHEET

LOCATION AND PURPOSE

Established to monitor discharge from the Alsands settling pond, on the Albian Sands Muskeg River Mine project. Drainage from the Syncrude Aurora North project is conveyed to the Muskeg River via this outlet but is scheduled to stop at the end of 2002. The current weir was installed by Syncrude in September 1998.

Period of Record:	August 1995 to Present		
Access:	2WD road access through Albian Sands Muskeg River Mine project		
Benchmark:	Top of pile support on right hand side of weir, elevation 280.015 m (geodetic)		
Drainage Area:	15.8 km^2		
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.
Optimum Instruments DD-128 datalogger with modem	Record and transmit data	0105010289
Keller 730-130-0003 psi pressure transducer	Measure water levels	0101878
Thermistor x 2	Pond/transducer temperatures	-
0.7 m deep, 135° V-notch weir	Assist in flow measurement	-

JACKPINE CREEK HYDROMETRIC STATION

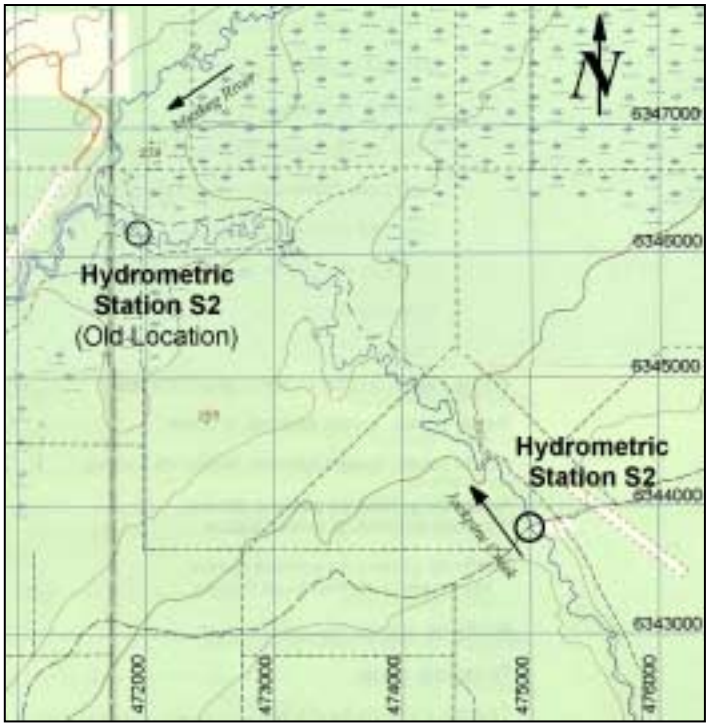
S2

FACTSHEET

LOCATION AND PURPOSE

Established to monitor discharge on Jackpine Creek upstream of the Muskeg River. Replaced an Environment Canada hydrometric 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.

Period of Record:	May 1995 to Present		
Access:	2WD access on Canterra Road		
Benchmark:	Steel bar in PVC housing, elevation 297.99 m (geodetic).		
Drainage Area:	358 km^2		
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



EQUIPMENT

Component	Function	Serial No.
Lakewood UltraLogger RX-1A	Record data	2031498
Thermistor	Water temperature	-
Keller 8363K 2 psi Pressure Transducer	Measure water levels	984631

IYINIMIN CREEK HYDROMETRIC STATION

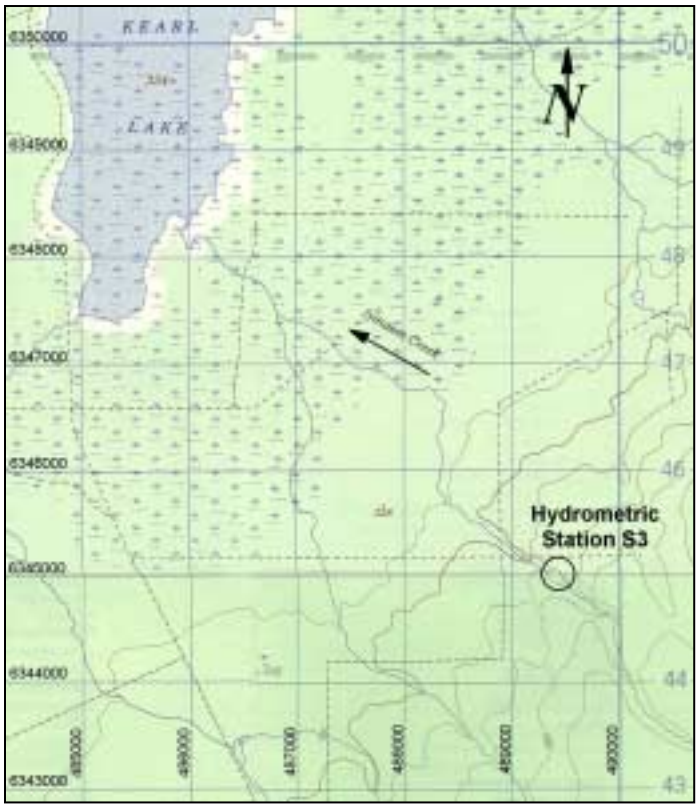
S3

FACTSHEET

LOCATION AND PURPOSE

Established to monitor discharge on Iyinimin Creek upstream of Kearl Lake. This station is intended to characterize runoff from the north/west slopes of Muskeg Mountain and provide input to Kearl Lake water balance calculations. A rain gauge was added to the station in 1998.

Period of Record:	May 1995 to October 1999; May 2001 to Present		
Access:	Helicopter		
Benchmark:	Rebar in 100 mm PVC housing, elevation 360.61 m (geodetic)		
Drainage Area:	32.3 km^2		
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	971024
Lakewood RG-306 Tipping Bucket Rain Gauge	Measure rainfall	69127

BLACKFLY CREEK HYDROMETRIC STATION

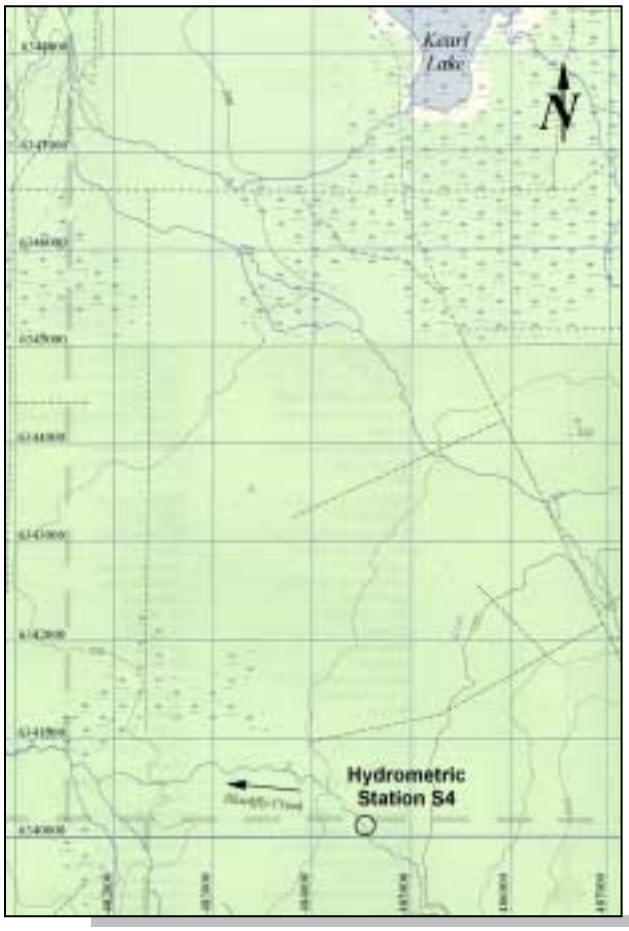
S4

FACTSHEET

LOCATION AND PURPOSE

Established in to monitor discharge on Blackfly Creek, an upland tributary of the Muskeg River. This station is intended to characterize runoff from the west slopes of Muskeg Mountain. It may be recommissioned when local oil sands leases are developed.

Period of Record:	May 1995 to October 1998		
Access:	Helicopter		
Benchmark:	Rebar in 100 mm PVC housing, elevation 340.16 m (geodetic)		
Drainage Area:	31.1 km^2		
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	*
Keller 8363K 8 psi Pressure Transducer	Measure water levels	*

* Not currently installed

MUSKEG RIVER AURORA HYDROMETRIC STATION

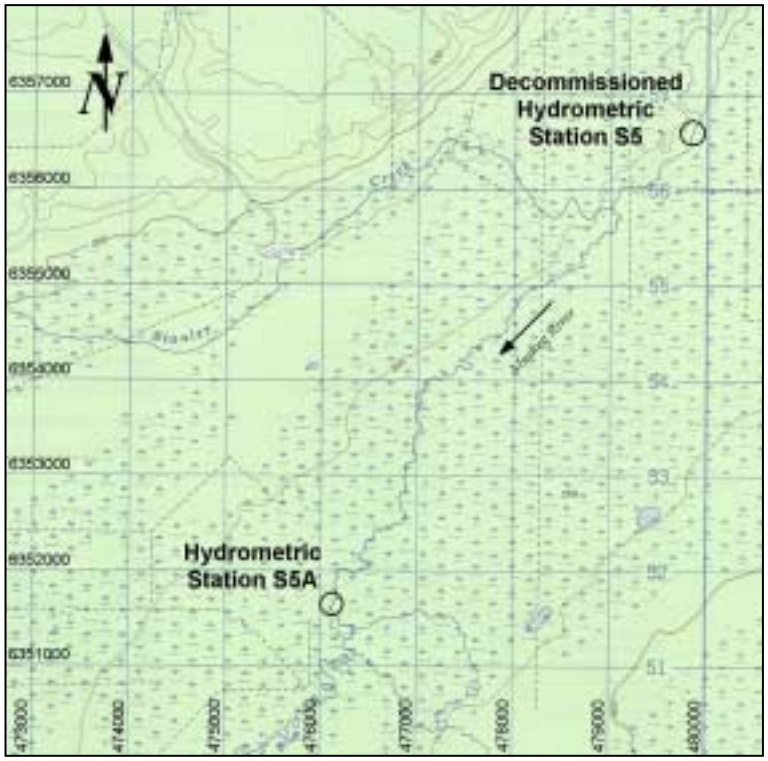
S5A

FACTSHEET

LOCATION AND PURPOSE

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

Period of Record:	August 1995 to Present		
Access:	2WD road via the Syncrude Aurora North mine site		
Benchmark:	Rebar in 100 mm PVC housing, elevation 282.38 m (geodetic)		
Drainage Area:	552 km^2 (was 390 km^2 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



EQUIPMENT

Component	Function	Serial No.
Optimum Instruments DD-128 datalogger with modem	Record data	0110220407
Thermistor	Water temperature	-
Keller 8363K 8 psi Pressure Transducer	Measure water levels	971023

MILLS CREEK HYDROMETRIC STATION

S6

FACTSHEET

LOCATION AND PURPOSE

Established to monitor discharge on Mills Creek, downstream of the Mills Creek fen and upstream of Isadore's Lake.

Period of Record:	May 1997 to Present		
Access:	2WD road access along Highway 63 (paved)		
Benchmark:	Rebar in 100 mm PVC housing, elevation 273.60 m (geodetic)		
Drainage Area:	23.8 km^2		
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 5 psi Pressure Transducer	Measure water levels	2025
0.7 m composite 90° V-notch weir	Assist in flow measurement	-

MUSKEG RIVER WSC HYDROMETRIC STATION

S 7

FACTSHEET

LOCATION AND PURPOSE

Established to monitor winter discharge on the Muskeg River at the Environment Canada hydrometric station 07DA008. The Environment Canada hydrometric station has operated since 1975 but discharges are only published for the March-October period.

Period of Record:	October 1999 to Present		
Access:	2WD access from spur road off of Canterra Road (gravel)		
Benchmark:	Temporary nail in tree, elevation 275.565 m (geodetic)		
Drainage Area:	1460 km^2		
Coordinates:	UTM:	6338944 N, 465408 E	Lat/Long: 57°11'32" N, 111°34'21" W
	LSD:	SE-32-94-10-W4	NTS Map: 74E/4

EQUIPMENT

Component	Function	Serial No.
Optimum Instruments DD-128 datalogger with modem	Record and transmit data	0105010269
Keller 730-130-0003 psi pressure transducer	Measure water levels	0101346

STANLEY CREEK HYDROMETRIC STATION

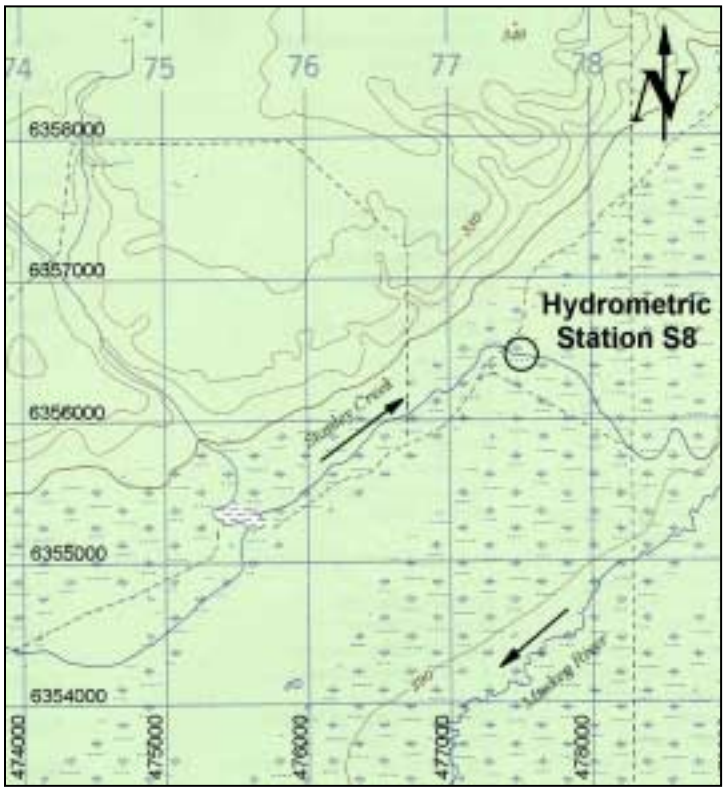
S8

FACTSHEET

LOCATION AND PURPOSE

Established to monitor water levels on Stanley Creek upstream of the Muskeg River. The creek has an ill-defined channel flowing through muskeg, so a rating curve cannot be derived to calculate discharges.

Period of Record:	September 1999 to Present		
Access:	Helicopter		
Benchmark:	Rebar in PVC housing, elevation 292.15 m (geodetic)		
Drainage Area:	71.8 km^2		
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	96324-02
Keller 2 psi Pressure Transducer	Measure water level	984630

KEARL LAKE OUTLET HYDROMETRIC STATION

S9

FACTSHEET

LOCATION AND PURPOSE

Established to monitor discharge on the Kearl Lake Outlet channel to provide data for the Kearl Lake water balance and to assess the effects of development on the lake. The station is located just upstream of a twin culvert installation.

Period of Record:	March 1998 to October 1999; May 2001 to Present		
Access:	2WD road (gravel)		
Benchmark:	Rebar in PVC housing, elevation 330.40 m (geodetic)		
Drainage Area:	73.6 km^2		
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	41036-08
Thermistor	Water temperature	-
Keller LE8363K 3 psi Pressure Transducer	Measure water level	3498

WAPASU CREEK HYDROMETRIC STATION

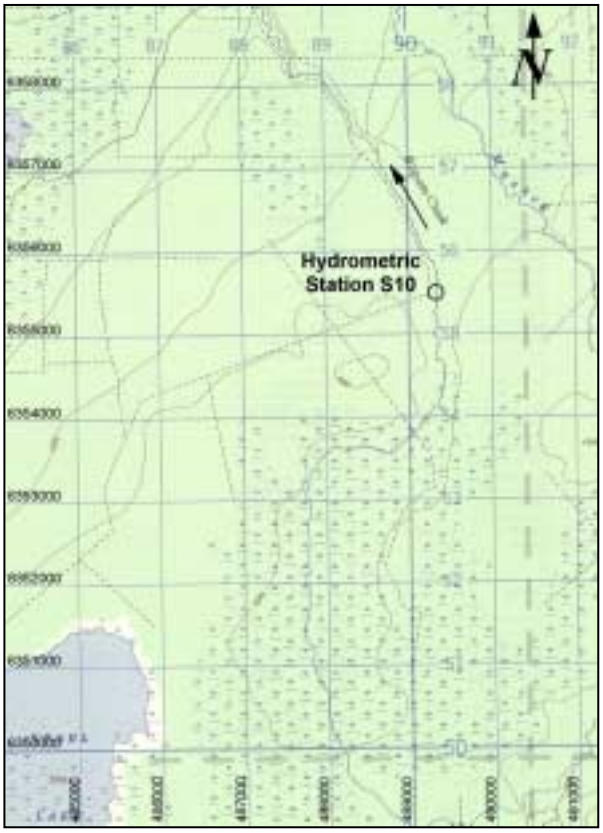
S10

FACTSHEET

LOCATION AND PURPOSE

Established to monitor discharge on Wapasu Creek upstream of the Muskeg River.

Period of Record:	March 1998 to October 1999; May 2001 to Present		
Access:	2WD road access on Canterra Road		
Benchmark:	Rebar in PVC housing, elevation 320.16 m (geodetic)		
Drainage Area:	90.7 km^2		
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	203095
Keller 8363K 5 psi Pressure Transducer	Measure water levels	1747

POPLAR CREEK HYDROMETRIC STATION

S11

FACTSHEET

LOCATION AND PURPOSE

Established to monitor discharge on Poplar Creek upstream of the Athabasca River. The station is at the site of Environment Canada hydrometric station (07DA007) that operated from 1973 to 1986.

Period of Record:	May 1997 to Present	
Access:	2WD access on Hwy 63 (paved)	
Benchmark:	Brass cap on southeast bridge abutment, elevation 245.55 m (geodetic)	
Drainage Area:	422 km^2 (artificially controlled)	
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	96303
Keller 8363K 8 psi Pressure Transducer	Measure water levels	971024

FORT CREEK HYDROMETRIC STATION

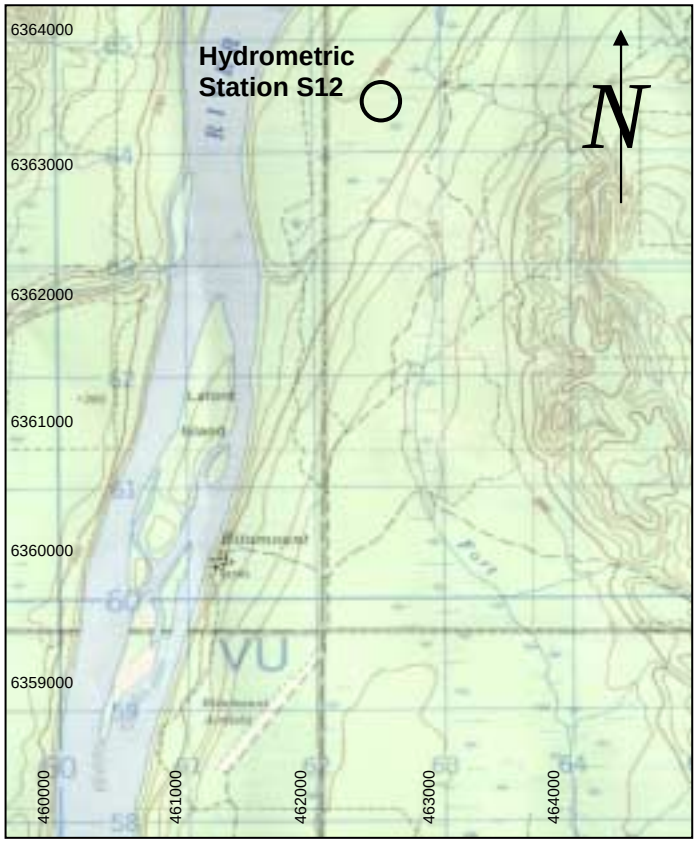
S12

FACTSHEET

LOCATION AND PURPOSE

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

Period of Record:	May 2000 to Present	
Access:	4WD 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^2	
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
Thermistor	Water temperature	-
Keller 8363K 10 psi Pressure Transducer	Measure water levels	971332

ALBIAN POND #3 OUTLET HYDROMETRIC STATION

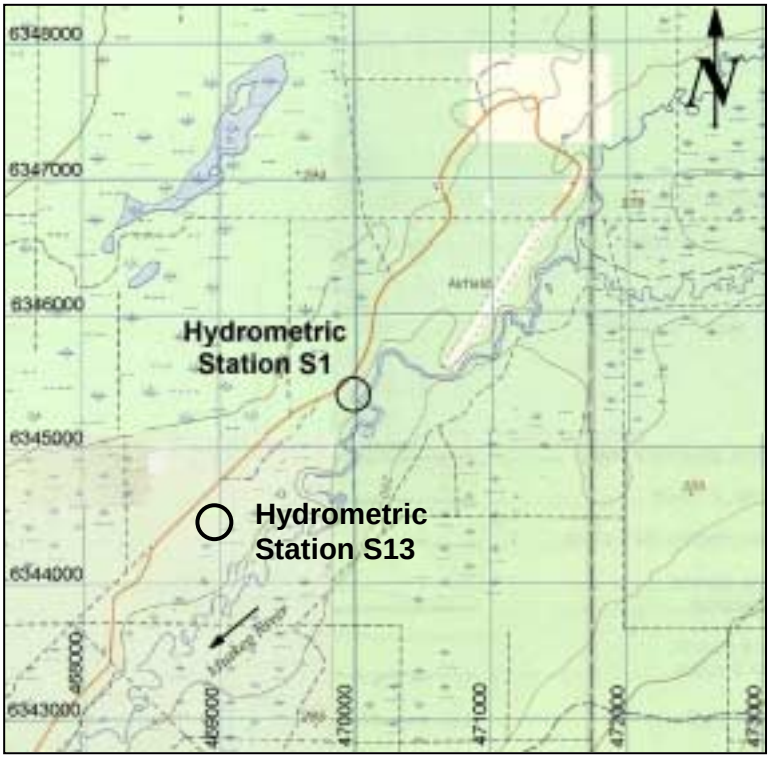
S13

FACTSHEET

LOCATION AND PURPOSE

Established to monitor discharge from Albian Sands Polishing Pond #3 into the Muskeg River.

Period of Record:	March 2000 to Present	
Access:	2WD from Albian Sands 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.
Optimum Instruments DD-128 data logger with modem	Record and transmit data	0105010291
Keller 730-130-0003 psi pressure transducer	Measure water levels	0101878

ELLS RIVER HYDROMETRIC STATION

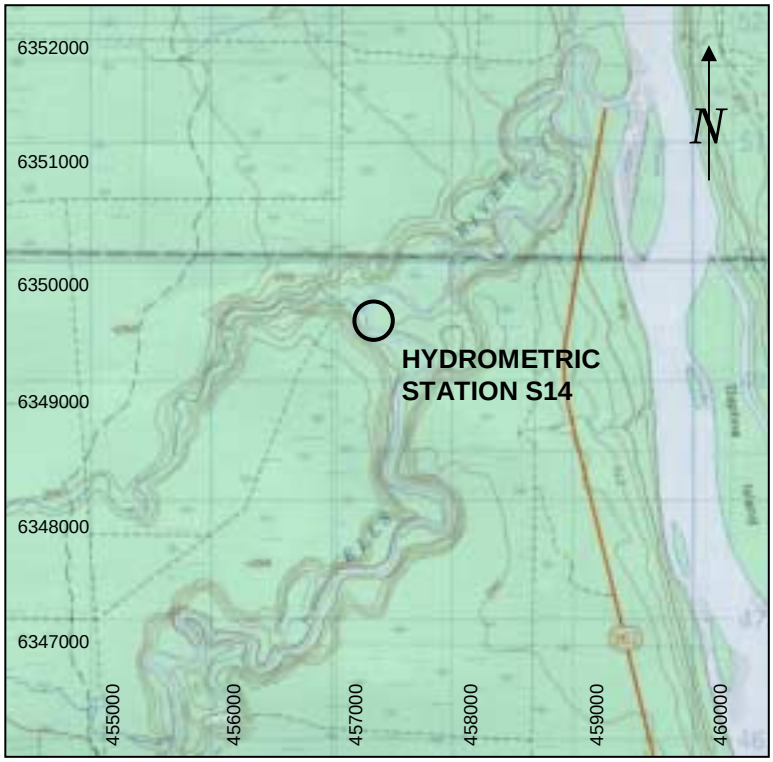
S14

FACTSHEET

LOCATION AND PURPOSE

Established to monitor discharge on the Ells River in the vicinity of the inactive Environment Canada hydrometric station 07DA017. The station is located approximately 150 m upstream of the confluence with Joslyn Creek.

Period of Record:	May 2001 to Present		
Access:	Helicopter		
Benchmark:	T-bar on upper bank, elevation 100.199 m (local)		
Drainage Area:	2450 km^2		
Coordinates:	UTM: 457310 E, 6349466 N	Lat/Long:	57°17’10” N, 111°42’30” W
	LSD: NW-34-95-11-W4	NTS Map:	74E/5



EQUIPMENT

Component	Function	Serial No.
Optimum Instruments DD-128 datalogger and modem	Record and transmit data	0105010275
Global water conductivity probe	Measure conductivity	-
Thermistor	Measure water temperature	-
Keller 730-130-0005 psi pressure transducer	Measure water levels	0101345

TAR RIVER HYDROMETRIC STATION

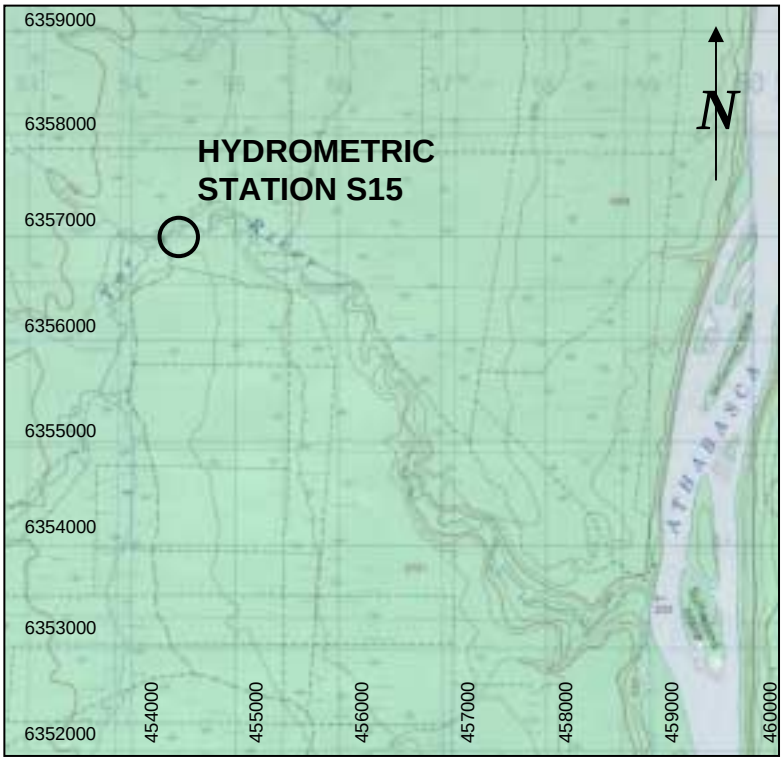
S15

FACTSHEET

LOCATION AND PURPOSE

Established to monitor discharge in the Tar River near the inactive Environment Canada hydrometric station 07DA015. Located approximately 100 m downstream of abandoned Environment Canada hydrometric station.

Period of Record:	May 2001 to Present		
Access:	4WD road access through CNRL Horizon project		
Benchmark:	T-bar on upper bank, elevation 100.590 m (local)		
Drainage Area:	301 km^2		
Coordinates:	UTM: 454453 E, 6356983 N	Lat/Long:	57°21’12” N, 111°45’25” W
	LSD: SW-29-96-11-W4	NTS Map:	74E/5



EQUIPMENT

Component	Function	Serial No.
Optimum Instruments DD-128 data logger and modem	Record and transmit data	0102010273
Thermistor	Measure water temperature	-
Global Water conductivity sensor	Measure water conductivity	14007
Keller 730-130-0003 psi pressure transducer	Measure water levels	0101354

CALUMET RIVER HYDROMETRIC STATION

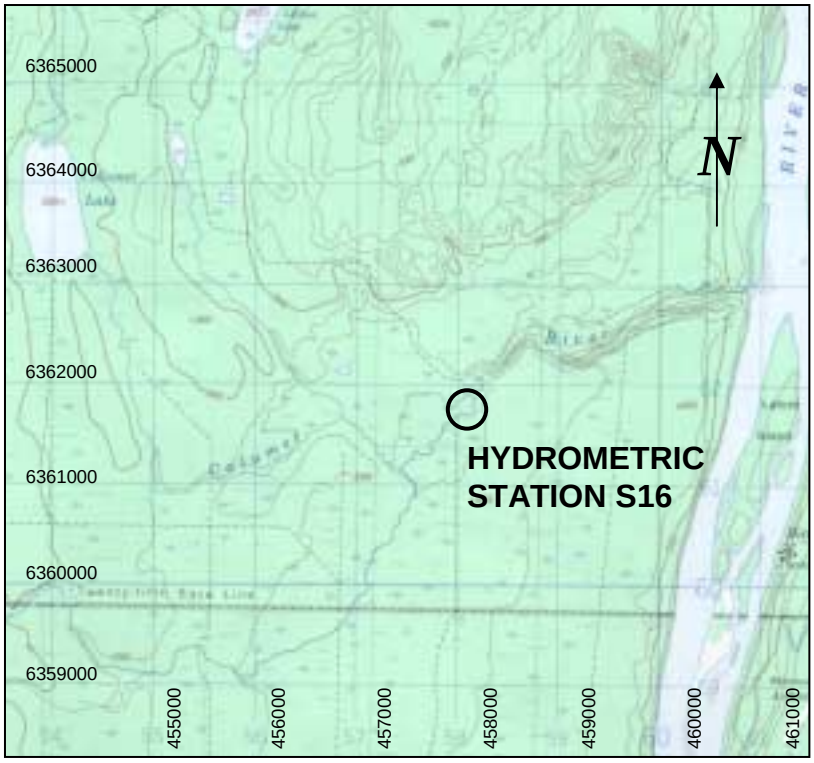
S16

FACTSHEET

LOCATION AND PURPOSE

Established in May, 2001 to monitor discharge on the Calumet River near the inactive Environment Canada hydromatric station 07DA014. Located approximately 2 km upstream of abandoned Environment Canada hydrometric station.

Access:	Helicopter		
Benchmark:	T-bar on upper bank, elevation 100.623 m (local)		
Drainage Area:	182 km^2		
Coordinates:	UTM: 458152 E, 6361693 N	Lat/Long:	57°23'46" N, 111°41'47" W
	LSD: SE-10-97-11-W4	NTS Map:	74E/5



EQUIPMENT

Component	Function	Serial No.
Optimum Instruments DD-128 datalogger and modem	Record and transmit data	0104170277
Tipping bucket rain gauge (metric)	Measure rainfall	-
Tipping bucket rain gauge with snow adaptor (imperial)	Measure snowfall	-
Thermistor	Measure water temperature	-
Thermistor with shield	Measure air temperature	-
Keller 730-130-0003 psi pressure transducer	Measure water levels	0101349

TAR RIVER UPLAND HYDROMETRIC STATION

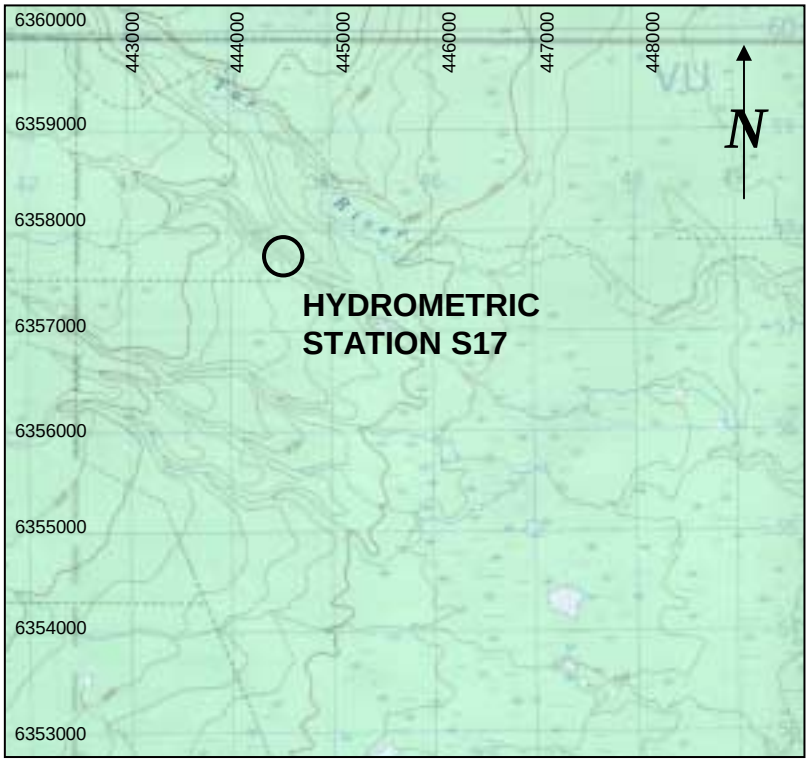
S17

FACTSHEET

LOCATION AND PURPOSE

Established to monitor discharge on an upland tributary of the Tar River.

Period of Record:	May 2001 to Present		
Access:	Helicopter to abandoned wellpad northwest of station, foot access on cutline		
Benchmark:	T-bar on upper bank, elevation 99.963 m (local)		
Drainage Area:	13.8 km^2		
Coordinates:	UTM: 444486 E, 6357804 N	Lat/Long:	57°21’35” N, 111°55’22” W
	LSD: NW-29-96-12-W4	NTS Map:	74E/5



EQUIPMENT

Component	Function	Serial No.
Optimum Instruments DD-128 datalogger and modem	Record and transmit data	0104170272
Thermistor	Measure water temperature	-
Global Water conductivity sensor	Measure water conductivity	-
Keller 730-130-0003 psi pressure transducer	Measure water levels	0101356

CALUMET RIVER UPLAND HYDROMETRIC STATION

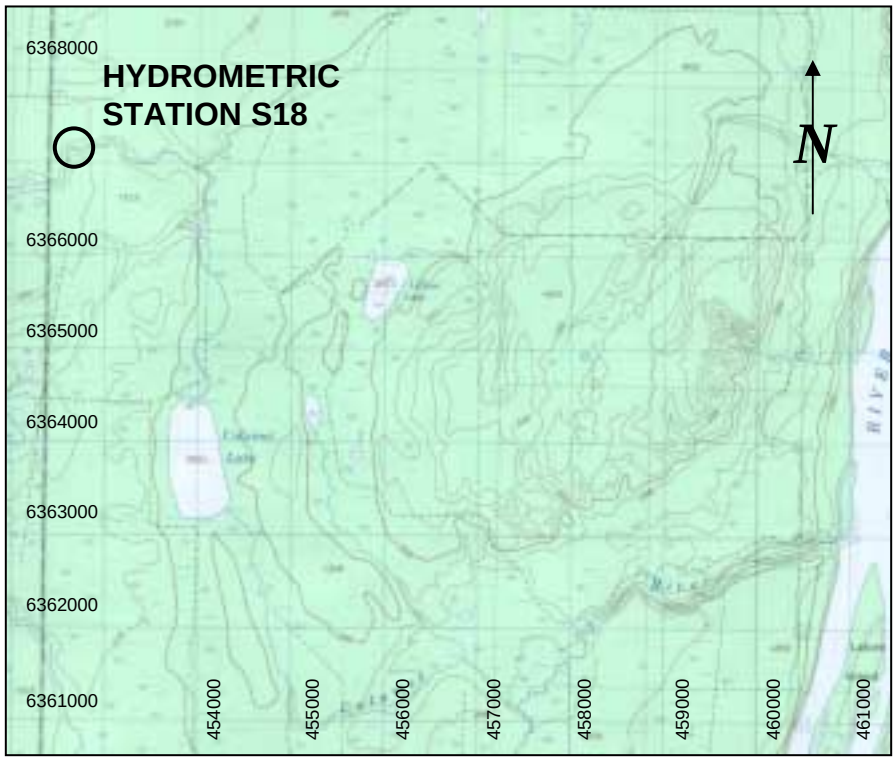
S18

FACTSHEET

LOCATION AND PURPOSE

Established to monitor discharge on a typical Calumet River upland tributary to characterize runoff from the east slopes of the Birch Mountains.

Period of Record:	May 2001 to Present		
Access:	Helicopter		
Benchmark:	Temporary nail in tree, elevation 100.000 m (local)		
Drainage Area:	48 km^2		
Coordinates:	UTM: 452701 E, 6367135 N	Lat/Long:	57°26’40” N, 111°47’17” W
	LSD: SW-30-97-11-W4	NTS Map:	74E/5



EQUIPMENT

Component	Function	Serial No.
Optimum Instruments DD-128 datalogger and modem	Record and transmit data	0105010271
Keller 730-130-0003 psi pressure transducer	Measure water levels	0101351

TAR RIVER LOWLAND HYDROMETRIC STATION

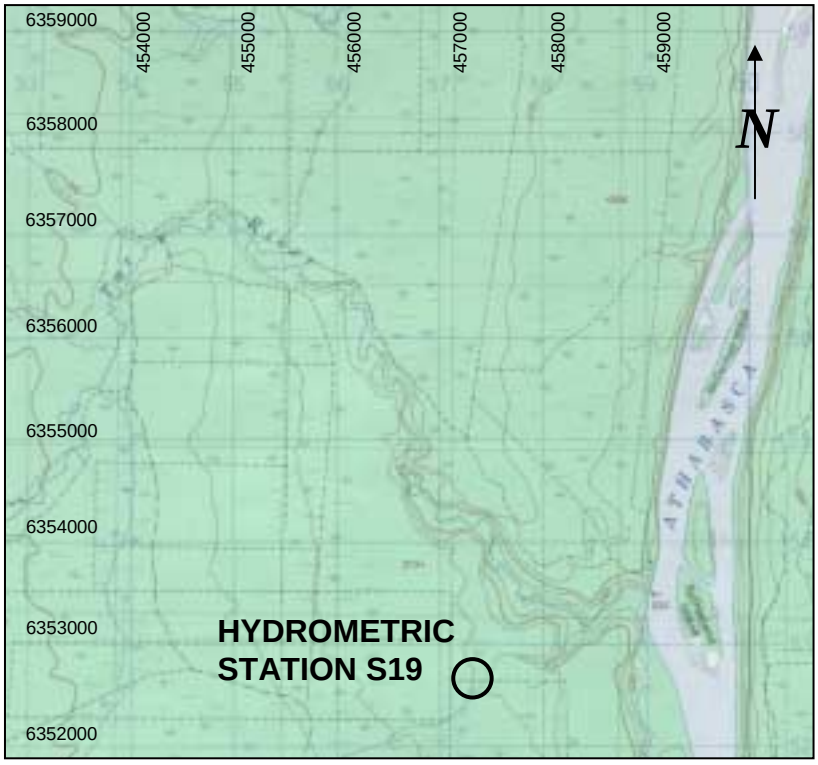
S19

FACTSHEET

LOCATION AND PURPOSE

Established to monitor discharge and characterize flows on a Tar River lowland tributary. This channel is the likely discharge point for initial mine overburden dewatering activities.

Period of Record:	May 2001 to Present		
Access:	2WD road access through CNRL Horizon project (gravel)		
Benchmark:	Temporary nail in tree stump, elevation 100.000 m (local)		
Drainage Area:	11.5 km^2		
Coordinates:	UTM: 457329 E, 6352849 N	Lat/Long:	57°19'00" N, 111°42'30" W
	LSD: NW-10-96-11-W4	NTS Map:	74E/5



EQUIPMENT

Component	Function	Serial No.
Optimum Instruments DD-128 data logger and modem	Record and transmit data	0105010276
Thermistor	Measure water temperature	-
Keller 730-130-0003 psi Pressure Transducer	Measure water levels	0101355

MUSKEG RIVER UPLAND HYDROMETRIC STATION

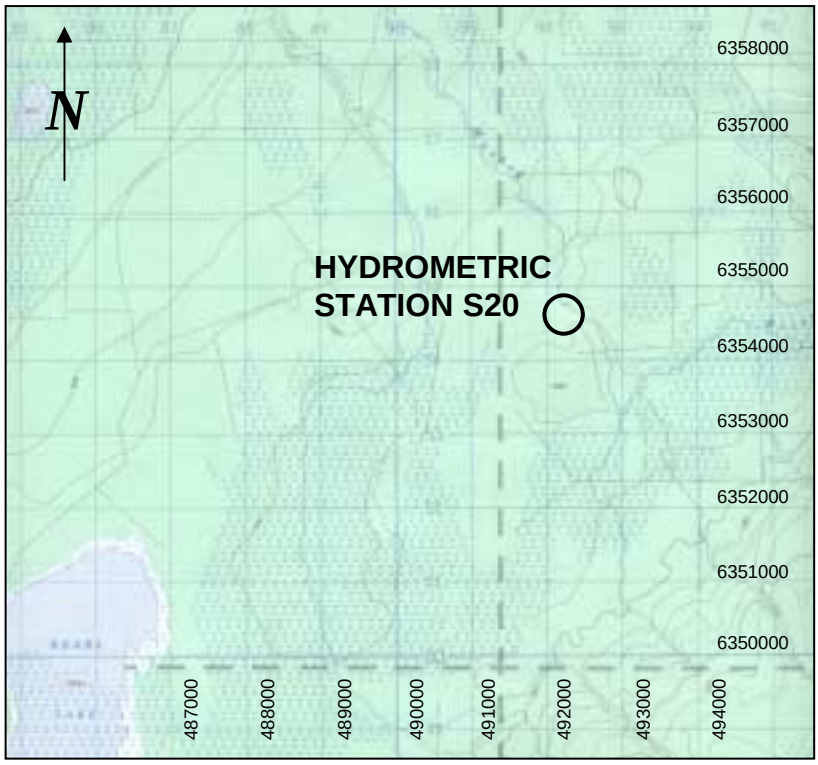
S20

FACTSHEET

LOCATION AND PURPOSE

Established to monitor discharge on the upper reach of the Muskeg River.

Period of Record:	May 2001 to Present		
Access:	2WD road access on Canterra Road, then by foot via cutline		
Benchmark:	T-bar on upper bank, elevation 99.763 m (local)		
Drainage Area:	157 km^2		
Coordinates:	UTM: 492178 E, 6354787 N	Lat/Long:	57°20’09” N, 111°07’48” W
	LSD: SE-19-96-7-W4	NTS Map:	74E/6



EQUIPMENT

Component	Function	Serial No.
Optimum Instruments DD-128 datalogger and modem	Record and transmit data	0104170269
Thermistor	Measure water temperature	-
Keller 730-130-0003 psi pressure transducer	Measure water levels	0101350

SHELLEY CREEK HYDROMETRIC STATION

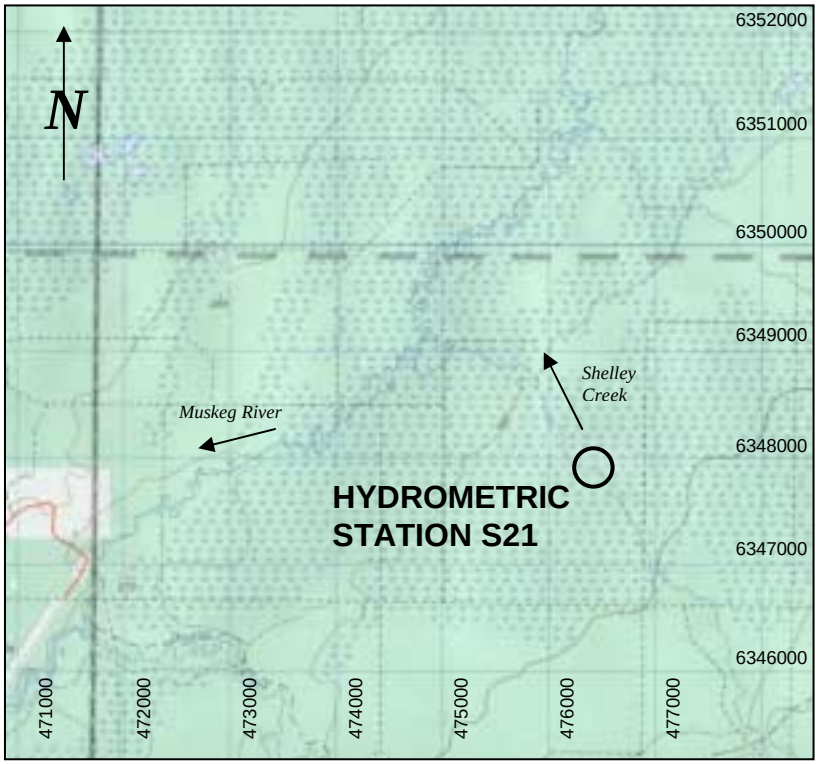
S21

FACTSHEET

LOCATION AND PURPOSE

Established to monitor water level and discharge on Shelley Creek upstream of the Muskeg River.

Period of Record:	May 2001 to Present		
Access:	2WD road access on Canterra Road		
Benchmark:	Temporary nail in tree, elevation 100.000 m (local)		
Drainage Area:	16 km^2		
Coordinates:	UTM: 476419 E, 6347933 N	Lat/Long:	57°16'26" N, 111°23'28" W
	LSD: NE-28-95-9-W4	NTS Map:	74E/6



EQUIPMENT

Component	Function	Serial No.
Optimum Instruments DD-128 datalogger with modem	Record and transmit data	0104170274
Keller 730-130-0003 psi pressure transducer	Measure water levels	0101346

MUSKEG CREEK HYDROMETRIC STATION

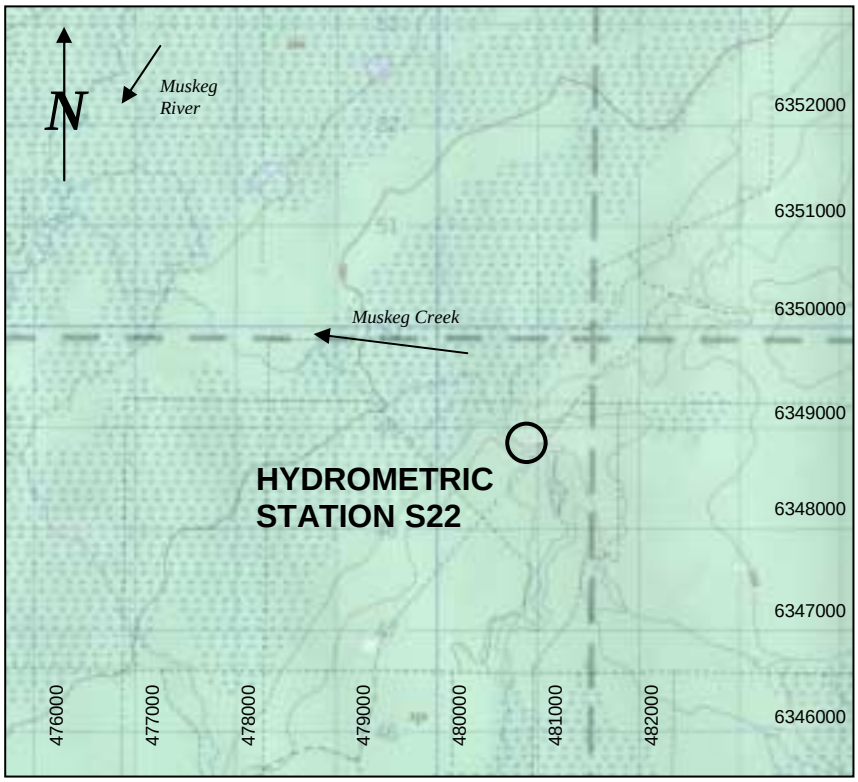
S22

FACTSHEET

LOCATION AND PURPOSE

Established to monitor discharge on Muskeg Creek upstream of the Muskeg River.

Period of Record:	May 2001 to Present		
Access:	2WD road access on Canterra Road		
Benchmark:	T-bar on upper bank, elevation 99.061 m (local)		
Drainage Area:	157 km^2		
Coordinates:	UTM: 481036 E, 6348856 N	Lat/Long:	57°16'56" N, 111°18'52" W
	LSD: SE-36-95-9-W4	NTS Map:	74E/6



EQUIPMENT

Component	Function	Serial No.
Optimum Instruments DD-128 datalogger and modem	Record and transmit data	0104170270
Thermistor	Measure water temperature	-
Global Water conductivity sensor	Measure water conductivity	14006
Keller 730-130-0003 psi pressure transducer	Measure water levels	0101348

AURORA BOUNDARY WEIR HYDROMETRIC STATION

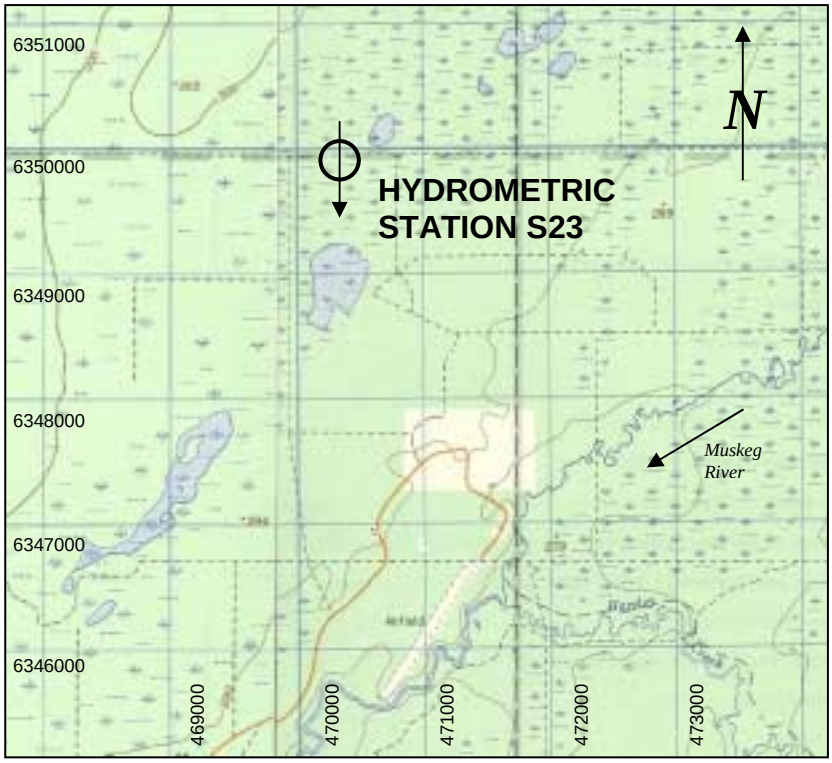
S23

FACTSHEET

LOCATION AND PURPOSE

Established to monitor clean water discharge from the Syncrude Aurora North Mine site to the Albian Sands Energy Muskeg River Mine site. This channel eventually conveys water to the Muskeg River via the Alsands Drain (RAMP Station S1).

Period of Record:	January 2001 to Present		
Access:	2WD road access through Syncrude Aurora North Mine		
Benchmark:	Top of stilling well, elevation 295.270 m (geodetic)		
Drainage Area:	Disturbed mine area; includes muskeg and overburden dewatering flow		
Coordinates:	UTM: 470315 E, 6349946 N	Lat/Long:	57°17'30" N, 111°29'33" W
	LSD: NW-36-95-10-W4	NTS Map:	74E/6



EQUIPMENT

Component	Function	Serial No.
Optimum Instruments DD-128 datalogger and modem	Record and transmit data	0105010290
Thermistor	Measure water temperature	-
Keller 8363K 5 psi Pressure Transducer	Measure water levels	1749
0.7 m deep, 120° V-notch weir	Assist in flow measurement	-

ATHABASCA RIVER HYDROMETRIC STATION

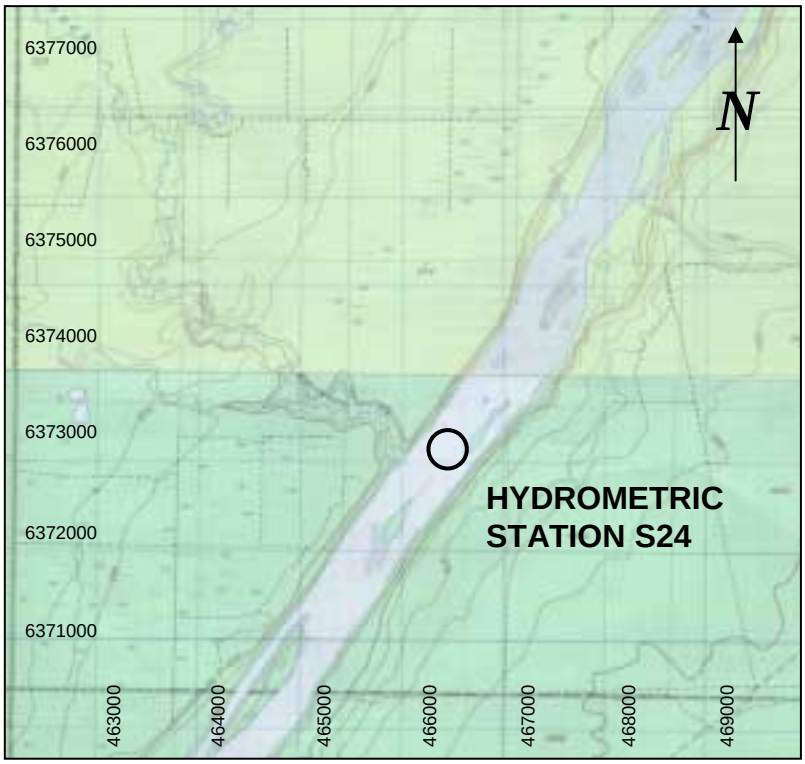
S24

FACTSHEET

LOCATION AND PURPOSE

Established to monitor discharge on the Athabasca River downstream of existing and proposed mine developments.

Period of Record:	May 2001 to Present		
Access:	Boat (summer) or snowmobile (winter)		
Benchmark:	T-bar on upper bank, elevation 100.251 m (local)		
Drainage Area:	146,000 km^2		
Coordinates:	UTM: 466313 E, 6372760 N	Lat/Long:	57°29'46" N, 111°33'43" W
	LSD: NE-9-98-10-W4	NTS Map:	74E/5



EQUIPMENT

Component	Function	Serial No.
Optimum Instruments DD-128 datalogger and modem	Record and transmit data	0104170278
Keller 735-130-00015 psi pressure transducer	Measure water levels	0101879

SUSAN LAKE OUTLET CK. HYDROMETRIC STATION

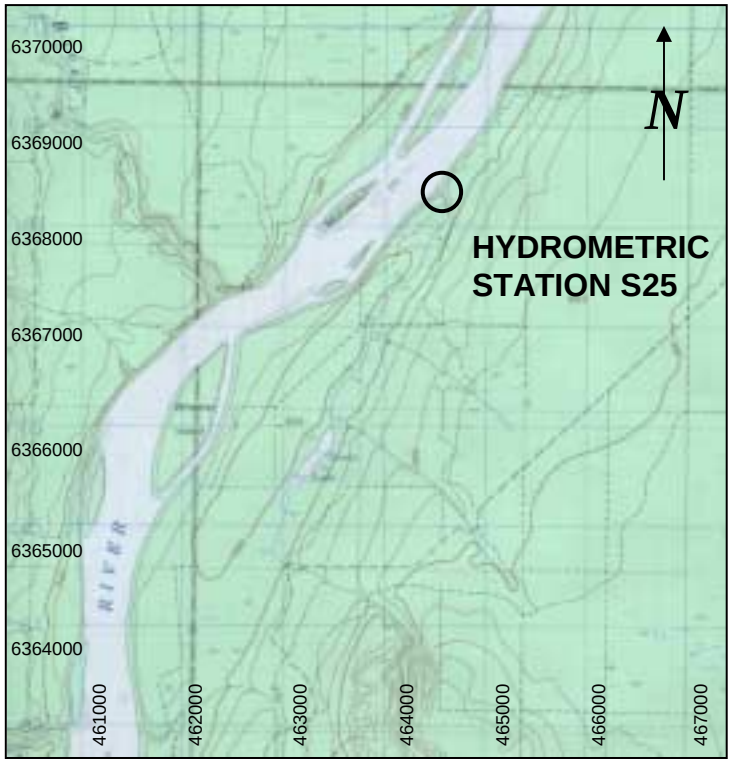
S25

FACTSHEET

LOCATION AND PURPOSE

Established May 2002 to monitor discharge from Susan Lake into the Athabasca River. Located approximately 100 m upstream of the mouth.

Period of Record:	Scheduled for Installation in May 2002		
Access:	Boat		
Benchmark:	Temporary nail in tree, elevation 100.000 m (local)		
Drainage Area:	13.6 km^2		
Coordinates:	UTM: 464491 E, 6368503 N	Lat/Long:	57°27’28” N, 111°35’31” W
	LSD: SE-32-97-10-W4	NTS Map:	74E/5



EQUIPMENT

Component	Function	Serial No.
Optimum Instruments DD-128 datalogger with modem	Record and transmit data	To Be Installed
Thermistor	Measure water temperature	To Be Installed
Keller 730-130-0003 psi pressure transducer	Measure water levels	To Be Installed

MACKAY RIVER WSC HYDROMETRIC STATION

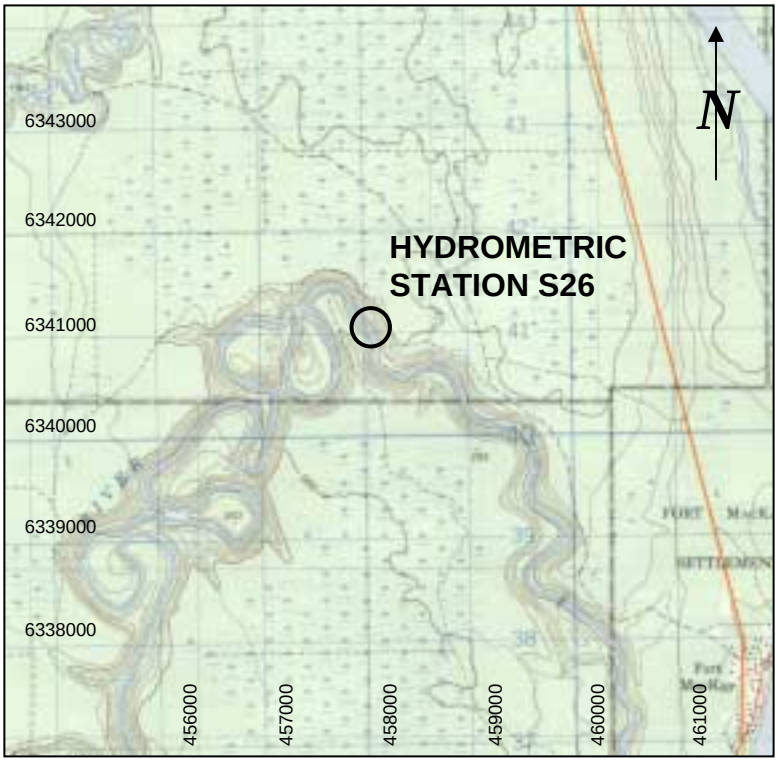
S26

FACTSHEET

LOCATION AND PURPOSE

Established to monitor winter discharge on the Mackay River at the Water Survey of Canada gauging station 07DB001. The WSC station has operated since 1972 but discharges are currently only published for the March-October period.

Period of Record:	November 2001 to Present		
Access:	Helicopter		
Benchmark:	Mark (yellow circle) on boulder, elevation 100.000 m (local)		
Drainage Area:	5570 km^2		
Coordinates:	UTM: 458031 E, 6341078 N	Lat/Long:	57°12’39” N, 111°41’41” W
	LSD: SE-3-95-11-W4	NTS Map:	74E/4



EQUIPMENT

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

FIREBAG RIVER WSC HYDROMETRIC STATION

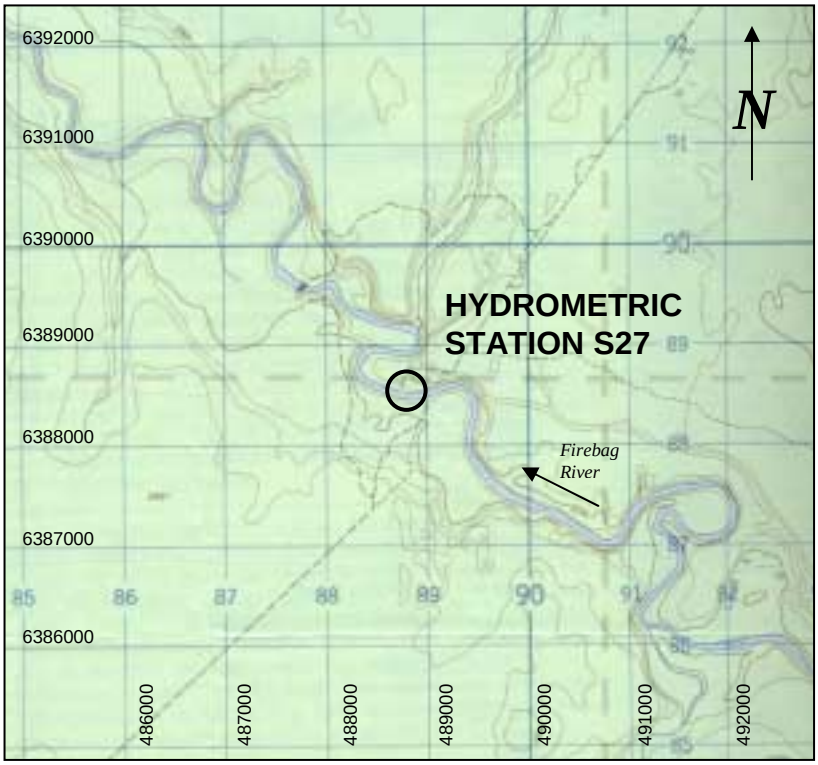
S27

FACTSHEET

LOCATION AND PURPOSE

Established to monitor winter discharge on the Firebag River just upstream of Environment Canada hydrometric station 07DC001. The Environment Canada hydrometric station has operated since 1971 but discharges are currently only published for the March-October period.

Period of Record:	November 2001 to Present		
Access:	Helicopter or Winter Road		
Benchmark:	Temporary nail in tree, elevation 100.000 m (local)		
Drainage Area:	5990 km^2		
Coordinates:	UTM: 488685 E, 6388706 N	Lat/Long:	57°38'26" N, 111°11'22" W
	LSD: SE-35-99-8-W4	NTS Map:	74E/11



EQUIPMENT

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

KHAHAGO CREEK HYDROMETRIC STATION

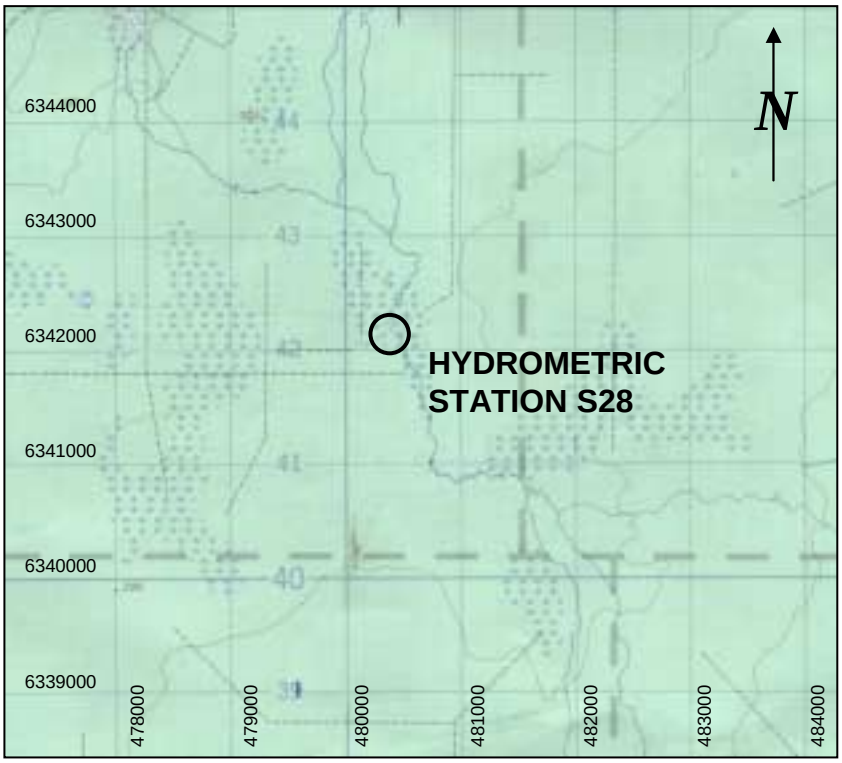
S28

FACTSHEET

LOCATION AND PURPOSE

Established to monitor discharge on Khahago Creek at the upstream boundary of oil sands Lease 13. An OSLO hydrometric station existed at this site in 1988-1989.

Period of Record:	June 2001 to Present		
Access:	Helicopter		
Benchmark:	Temporary nail in tree, elevation 100.000 m (local)		
Drainage Area:	212 km^2		
Coordinates:	UTM: 480489 E, 6342185 N	Lat/Long:	57°13'21" N, 111°19'23" W
	LSD: SW-12-95-9-W4	NTS Map:	74E/3



EQUIPMENT

Component	Function	Serial No.
Optimum Instruments DD-128 datalogger and modem	Record and transmit data	0105010290
Thermistor	Measure water temperature	-
Keller 730-130-0003 psi pressure transducer	Measure water levels	0101352

APPENDIX VI

2001 MANUAL DISCHARGE MEASUREMENTS FOR DEVELOPING STAGE-DISCHARGE RATING CURVES AT HYDROLOGIC STATIONS

Table VI-1 Summary of 2001 Manual Discharge Measurements

Station No.	Stream Name	Winter Discharge (m^3/s)	Date	Snowmelt Discharge (m^3/s)	Date	Summer Discharge (m^3/s)	Date
S1	Alsands Drain	0.095	Jan 16	*	Apr 3	*	Aug 6
		No Flow	Feb 15	0.178	Apr 20	*	Aug 7
		No Flow	Dec 6	0.149	May 15	*	Aug 11
						0.01	Sep 12
						*	Sep 18
						No Flow	Oct 29
S2	Jackpine Creek	No Flow	Jan 16	*	Apr 21	3.363	Jul 8
				4.32	May 11	1.113	Aug 6
				3.882	Jun 12	*	Sep 10
						0.256	Oct 27
S3	Iyinimin Creek			0.342	Jun 12	0.118	Jul 10
						0.010	Oct 25
S4	Blackfly Creek	station not operational in 2001					
S5A	Muskeg River Aurora	0.182	Jan 17	*	Apr 20	*	Jul 9
		0.208	Feb 16	*	May 15	0.930	Aug 7
		0.129	Dec 5	3.932	Jun 13		
S6	Mills Creek	0.014	Jan 17	0.024	Apr 20	0.043	Jul 8
		0.018	Feb 15	0.025	May 11	*	Jul 9
		*	Dec 5	0.057	Jun 13	*	Aug 7
						0.019	Sep 10
						0.020	Oct 29
S7	Muskeg River 7DA8	0.649	Jan 16	*	Apr 24	*	Jul 8
		0.421	Feb 16	*	May 11	*	Sep 12
		0.788	Nov 2	*	Jun 13	*	Oct 29
		0.533	Dec 6				
S8	Stanley Creek	no stream discharges measured at this station					
S9	Kearl Lake Outlet	*	Feb 15	0.022	Apr 21	0.092	Jul 8
				0.080	May 11	0.026	Aug 6
				0.150	Jun 10	0.006	Sep 19
						No Flow	Oct 24
S10	Wapasu Creek			0.265	Apr 20	0.650	Jul 8
				1.351	May 11	0.181	Aug 6
				0.548	Jun 10	0.104	Sep 19
						0.041	Oct 27
S11	Poplar Creek			1.072	Apr 24	0.936	Jul 9
				6.499	May 11	0.012	Sep 12
				0.845	Jun 13	0.020	Oct 27
S12	Fort Creek	No Flow	Jan 17	No Flow	Apr 21	0.055	Jul 9
		No Flow	Feb 15	0.140	May 11	0.026	Aug 7
		0.002	Dec 3	0.201	Jun 13	0.019	Sep 10
						0.025	Oct 28
S13	Albian Sands Pond #3	*	Jan 16	No Flow	Apr 20	No Flow	Jul 8
		No Flow	Dec 6	No Flow	May 11	No Flow	Sep 12
						No Flow	Oct 27
S14	Ells River	1.173	Mar 15	17.916	May 13	7.129	Jun 21
				*	Jun 11	14.889	Aug 9
						8.741	Sep 15
						*	Oct 31
S15	Tar River	No Flow	Mar 14	4.754	May 9	0.704	Jul 8
		0.098	Dec 7	1.269	Jun 11	1.191	Aug 6
						0.330	Sep 11
						0.037	Oct 30

Station No.	Stream Name	Winter Discharge (m^3/s)	Date	Snowmelt Discharge (m^3/s)	Date	Summer Discharge (m^3/s)	Date
S16	Calumet River			1.023	May 12	0.157	Jul 10
				0.536	Jun 11	0.364	Aug 9
						0.088	Sep 15
						0.012	Oct 31
S17	Upland Tar River			0.114	May 12	No Flow	Aug 9
				0.167	May 12	0.001	Sep 15
				0.024	Jun 11	No Flow	Oct 31
S18	Upland Calumet River			0.167	May 12	*	Jul 10
				0.231	Jun 11	*	Aug 9
						*	Oct 31
S19	Lowland Tar River	0.044	Dec 7	0.031	May 9	0.024	Jun 21
				0.068	Jun 13	0.030	Jul 4
						0.021	Jul 8
						0.026	Aug 6
						0.004	Sep 11
						0.003	Oct 30
S20	Upland Muskeg River			0.306	Apr 21	0.904	Jul 8
				1.218	May 8	0.435	Aug 6
				0.575	Jun 10	*	Sep 19
						*	Oct 27
S21	Shelley Creek	1.173	Mar 21	0.051	May 14	0.092	Jul 10
				0.061	Jun 12	0.018	Aug 9
						No Flow	Sep 20
						*	Oct 26
S22	Muskeg Creek			0.196	Apr 21	1.730	Jul 8
				2.623	May 8	0.493	Aug 6
				2.542	Jun 12	0.346	Sep 10
						0.085	Oct 27
S23	Aurora Boundary Weir	No Flow	Feb 16	*	Apr 20	No Flow	Jul 9
		0.034	Mar 18	0.086	May 15	*	Aug 7
		*	Dec 4	0.170	Jun 13		
		No Flow	Dec 5				
S24	Athabasca River					774.6	Jun 20
						1116.1	Jul 4
						1496.9	Aug 11
						676	Aug 31
						245.2	Oct 3
S28	Khahago Creek	0.059	Nov 1	*	Jun 12	*	Jul 10
						*	Aug 9
						*	Sep 17
						0.139	Sep 19
						*	Sep 20
						*	Oct 25
L1	McClelland Lake			0.108	May 14	0.059	Jul 10
				0.049	Jun 12	*	Sep 15
						*	Oct 26
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, equipment malfunction or well-developed rating curve).

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

STREAM NAME: Alsands Drain
LOCATION: S1
COORDINATES: 6345534N / 470006E

MEASUREMENT DATE: 16 January 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1110 hrs.
MEASUREMENT END TIME: 1145 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00	0.30	0.00			0.000	0.15	0.000
1	0.30	0.30	0.05			0.160	0.3	0.002
2	0.60	0.30	0.12			0.440	0.3	0.015
3	0.90	0.30	0.12			0.690	0.3	0.023
4	1.20	0.30	0.10			0.440	0.3	0.012
5	1.50	0.30	0.28			0.120	0.3	0.009
6	1.80	0.30	0.14			0.660	0.3	0.026
7	2.10	0.30	0.08			0.450	0.25	0.008
Right Bank	2.30	0.30	0.00			0.000	-1.05	0.000
								0.095

Notes. 1) Flow underneath ice cover
2.) Water elevation 279.571m (1130 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

STREAM NAME: Alsands Drain
LOCATION: S1
COORDINATES: 6345534N / 470006E

MEASUREMENT DATE: 15 February 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1210 hrs.
MEASUREMENT END TIME: 1245 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank								0.000
1								0.000
2								0.000
3								0.000
4								0.000
5								0.000
6								0.000
7								0.000
Right Bank								0.000
								0.000

Notes.
1.) Data downloaded from the data logger
2.) Water level not surveyed
3.) No flow

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7030
DISCHARGE DATA

STREAM NAME: Alsands Drain
LOCATION: S1
COORDINATES: 6345534N / 470006E

MEASUREMENT DATE: 03 April 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: NS
COMPUTATIONS BY: NO

MEASUREMENT START TIME:
MEASUREMENT END TIME:

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY			WIDTH (m)	DISCHARGE (m^3/sec)
				0.2 Depth (m/sec)	0.8 Depth (m/sec)	0.6 Depth (m/sec)		

Notes.
1.) Installed transducer and data logger
2) No flow measurements taken
3.) Head above v-notch is 2 3cm

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7030
DISCHARGE DATA

STREAM NAME: Alsands Drain
LOCATION: S1
COORDINATES: 6345534N / 470006E

MEASUREMENT DATE: 20 April 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: LL/RS

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

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.00			0.000	0.15	0.000
1	0.30		0.04			0.000	0.3	0.000
2	0.60		0.06			0.550	0.25	0.008
3	0.80		0.10			0.650	0.2	0.013
4	1.00		0.16			0.290	0.2	0.009
5	1.20		0.10			0.660	0.2	0.013
6	1.40		0.12			0.920	0.2	0.022
7	1.60		0.23			0.660	0.2	0.030
8	1.80		0.14			0.970	0.2	0.027
9	2.00		0.12			1.000	0.2	0.024
10	2.20		0.10			0.640	0.2	0.013
11	2.40		0.12			0.770	0.2	0.018
12	2.60		0.05			-0.100	0.175	-0.001
Right Bank	2.75		0.00			0.000	-1.3	0.000
								0.178

Notes. 1) Water elevation 279 608m (1330 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Alsands Drain
LOCATION: S1
COORDINATES: 6345534N / 470006E

MEASUREMENT DATE: 15 May 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/CK
COMPUTATIONS BY: LL

MEASUREMENT START TIME: 1100 hrs.
MEASUREMENT END TIME: 1330 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00		0.00			0.000	0.1	0.000
1	0.20		0.06			0.320	0.2	0.004
2	0.40		0.12			0.410	0.2	0.010
3	0.60		0.12			0.680	0.2	0.016
4	0.80		0.12			0.550	0.2	0.013
5	1.00		0.12			0.580	0.2	0.014
6	1.20		0.10			0.610	0.2	0.012
7	1.40		0.12			0.140	0.2	0.003
8	1.60		0.10			0.980	0.2	0.020
9	1.80		0.14			1.030	0.2	0.029
10	2.00		0.15			0.740	0.2	0.022
11	2.20		0.04			0.510	0.275	0.006
Right Bank	2.55		0.00			0.000	-1.1	0.000
								0.149

Notes 1.) Water elevation 279.622m (1207 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Alsands Drain
LOCATION: S1
COORDINATES: 6345534N / 470006E

MEASUREMENT DATE: 06 August 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 11435 hrs.
MEASUREMENT END TIME: 1550 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes
1) Water elevation 279.345m (1515 hrs)
2) Thermograph downstream of weir was lost (saw wire but no thermograph)
3.) Slight flow over weir, no measurements taken

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Alsands Drain
LOCATION: S1
COORDINATES: 6345534N / 470006E

MEASUREMENT DATE: 07 August 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 1515 hrs.
MEASUREMENT END TIME: 1700 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes:
1.) Water elevation 279.361m (1658 hrs)
2) Reinstalled the pressure probe and temperature thermistor
3) Heavy rain
4) No flow measurements taken

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Alsands Drain
LOCATION: S1
COORDINATES: 6345534N / 470006E

MEASUREMENT DATE: 11 August 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/TC
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 1500 hrs.
MEASUREMENT END TIME: 1545 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes:
1.) Water elevation 279.387m (1530 hrs)
2.) Tested the pressure probe (s/n 0101878 - 3 psig) - not working
3.) Reinstalled a new proble (s/n 0102529 - 15 psi - Albion Intake) - programmed
4.) Slight flow over weir and from diversion pipe, no measurements taken

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Alsands Drain
LOCATION: S1
COORDINATES: 6345534N / 470006E

MEASUREMENT DATE: 12 Sep 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: NS
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 1608 hrs.
MEASUREMENT END TIME: 1614 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.00			0.000	0.3	0.000
	0.60		0.00			-0.010	0.4	0.000
	0.80		0.04			0.250	0.2	0.002
	1.00		0.13			0.010	0.2	0.000
	1.20		0.09			-0.060	0.2	-0.001
	1.40		0.07			-0.030	0.2	0.000
	1.60		0.07			0.060	0.15	0.001
	1.70		0.08			0.080	0.1	0.001
	1.80		0.12			0.080	0.15	0.001
	2.00		0.13			0.190	0.2	0.005
	2.20		0.08			0.130	0.2	0.002
	2.40		0.12			-0.060	0.2	-0.001
	2.60		0.04			0.060	0.2	0.000
	2.80		0.02			0.000	0.25	0.000
Right Bank	3.10		0.00			0.000	-1.4	0.000
								0.010

Notes: 1) Water elevation 279.529m (1605 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Alsands Drain
LOCATION: S1
COORDINATES: 6345534N / 470006E

MEASUREMENT DATE: 18 Sep 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: NS
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 0850 hrs.
MEASUREMENT END TIME: 0940 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes
1.) Water elevation 279.56m (0850 hrs)
2.) Replaced transducer and reprogrammed
3.) No flow measurements taken

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Alsands Drain
LOCATION: S1
COORDINATES: 6345534N / 470006E

MEASUREMENT DATE: 29 Oct 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: JG
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 0846 hrs.
MEASUREMENT END TIME:

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank								0.000
1								0.000
2								0.000
3								0.000
4								0.000
5								0.000
6								0.000
7								0.000
Right Bank								0.000
								0.000

Notes:
1.) Water elevation 279.328m (0900 hrs)
2.) No flow over the weir at arrival (0846 hrs)
3) Water flows on top of ice over the weir (0930 hrs)
4) No flow measurements taken

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

STREAM NAME: Alsands Drain
LOCATION: S1
COORDINATES: 6345534N / 470006E

MEASUREMENT DATE: 06 December 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JE
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1115 hrs.
MEASUREMENT END TIME: 1130 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank								0.000
1								0.000
2								0.000
3								0.000
4								0.000
5								0.000
6								0.000
7								0.000
Right Bank								0.000
								0.000

Notes
1) No water flow over the weir - ice covered
2) Water elevation 279.268m, top of ice elevation 279.348m (1124 hrs) by transducer
3) Water elevation 279.33m, top of ice elevation 279 344m at V-notch weir

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

STREAM NAME: Jackpine Creek
LOCATION: S2
COORDINATES: 6343680N / 475132E

MEASUREMENT DATE: 16 January 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 1520 hrs.
MEASUREMENT END TIME: 1545 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank								0.000
1								0.000
2								0.000
3								0.000
4								0.000
5								0.000
6								0.000
7								0.000
Right Bank								0.000
								0.000

Notes: 1.) No flow

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7030
DISCHARGE DATA

STREAM NAME: Jackpine Creek
LOCATION: S2
COORDINATES: 6343680N / 475132E

MEASUREMENT DATE: 21 April 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1310 hrs.
MEASUREMENT END TIME: 1410 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes:
1) Slush ice at bottom of creek - unsafe
2) No flow measurements taken
3) Installed transducer and data logger
3) Water elevation at transducer 297 233m (1330 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Jackpine Creek
LOCATION: S2
COORDINATES: 6343680N / 475132E

MEASUREMENT DATE: 11 May 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: CK/NS
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1525 hrs.
MEASUREMENT END TIME: 1615 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	6.80		0.00			0.000	3.75	0.000
1	7.50		0.30			-0.070	0.85	-0.018
2	8.50		0.58			0.080	0.75	0.035
3	9.00		0.86	0.15	0.05	0.100	0.75	0.065
4	10.00		1.18	0.25	0.36	0.305	1.00	0.360
5	11.00		1.62	0.46	0.40	0.430	1.00	0.697
6	12.00		1.72	0.97	0.95	0.960	1.00	1.651
7	13.00		1.62	1.11	0.63	0.870	1.00	1.409
8	14.00		1.40	0.19	0.07	0.130	0.75	0.137
9	14.50		1.00			0.070	0.50	0.035
10	15.00		0.95			-0.040	0.50	-0.019
11	15.50		0.32			-0.130	0.75	-0.031
Right Bank	16.50		0.00			0.000	-7.75	0.000
								4.320

Notes. 1.) Water elevation at transducer 297 177m

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Jackpine Creek
LOCATION: S2
COORDINATES: 6343680N / 475132E

MEASUREMENT DATE: 12 June 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/ME
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 0815 hrs.
MEASUREMENT END TIME: 0900 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.00			0.000	0.50	0.000
1	1.00		0.30			0.530	1.00	0.159
2	2.00		0.34			0.470	1.00	0.160
3	3.00		0.42			0.460	1.00	0.193
4	4.00		0.50			0.680	1.00	0.340
5	5.00		0.60			0.490	1.00	0.294
6	6.00		0.62			0.620	1.00	0.384
7	7.00		0.62			0.560	1.00	0.347
8	8.00		0.64			0.520	1.00	0.333
9	9.00		0.70			0.720	1.00	0.504
10	10.00		0.56			0.720	1.00	0.403
11	11.00		0.44			0.810	1.00	0.356
12	12.00		0.32			0.700	1.00	0.224
13	13.00		0.26			0.680	1.00	0.177
14	14.00		0.24			0.030	1.00	0.007
15	15.00		0.02			0.020	0.60	0.000
Right Bank	15.20		0.00			0.000	-7.50	0.000
								3.882

Notes 1.) Water elevation at transducer 297.138m (0845 hrs)
2) Installed thermistor

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Jackpine Creek
LOCATION: S2
COORDINATES: 6343680N / 475132E

MEASUREMENT DATE: 8 July 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1315 hrs.
MEASUREMENT END TIME: 1355 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	1.00		0.00			0.000	0.75	0.000
1	1.50		0.34			0.520	0.50	0.088
2	2.00		0.30			0.420	0.50	0.063
3	2.50		0.15			0.530	0.50	0.040
4	3.00		0.35			0.470	0.50	0.082
5	3.50		0.36			0.660	0.50	0.119
6	4.00		0.38			0.670	0.50	0.127
7	4.50		0.48			0.620	0.50	0.149
8	5.00		0.48			0.650	0.50	0.156
9	5.50		0.40			0.820	0.50	0.164
10	6.00		0.48			0.550	0.50	0.132
11	6.50		0.46			0.670	0.50	0.154
12	7.00		0.48			0.720	0.50	0.173
13	7.50		0.62			0.860	0.50	0.267
14	8.00		0.60			0.640	0.50	0.192
15	8.50		0.58			0.660	0.50	0.191
16	9.00		0.58			0.740	0.50	0.215
17	9.50		0.54			0.840	0.50	0.227
18	10.00		0.46			0.710	0.50	0.163
19	10.50		0.41			0.720	0.50	0.148
20	11.00		0.39			0.640	0.50	0.125
21	11.50		0.30			0.680	0.50	0.102
22	12.00		0.28			0.690	0.50	0.097
23	12.50		0.22			0.510	0.50	0.056
24	13.00		0.22			0.690	0.50	0.076
25	13.50		0.24			0.470	0.50	0.056
26	14.00		0.06			0.050	0.55	0.002
Right Bank	14.60		0.00			0.000	-7.00	0.000
								3.363

Notes 1) Water elevation at transducer 297 122m (1340 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Jackpine Creek
LOCATION: S2
COORDINATES: 6343680N / 475132E

MEASUREMENT DATE: 6 August 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1330 hrs.
MEASUREMENT END TIME: 1350 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.50		0.00			0.000	0.50	0.000
1	1.00		0.19			0.120	0.50	0.011
2	1.50		0.20			0.200	0.50	0.020
3	2.00		0.20			-0.010	0.50	-0.001
4	2.50		0.17			0.130	0.50	0.011
5	3.00		0.18			0.160	0.50	0.014
6	3.50		0.18			0.330	0.50	0.030
7	4.00		0.24			0.370	0.50	0.044
8	4.50		0.28			0.450	0.50	0.063
9	5.00		0.38			0.300	0.50	0.057
10	5.50		0.40			0.290	0.50	0.058
11	6.00		0.32			0.450	0.50	0.072
12	6.50		0.44			0.410	0.50	0.090
13	7.00		0.42			0.580	0.50	0.122
14	7.50		0.40			0.600	0.50	0.120
15	8.00		0.36			0.110	0.50	0.020
16	8.50		0.34			0.430	0.50	0.073
17	9.00		0.38			0.390	0.50	0.074
18	9.50		0.34			0.670	0.50	0.114
19	10.00		0.33			0.450	0.50	0.074
20	10.50		0.22			0.270	0.50	0.030
21	11.00		0.10			0.000	0.50	0.000
22	11.50		0.12			0.040	0.50	0.002
23	12.00		0.10			0.050	0.50	0.003
24	12.50		0.12			0.220	0.43	0.011
Right Bank	12.85		0.00			0.000	-6.25	0.000
								1.113

Notes 1) Water elevation at transducer 296 951m (1335 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Jackpine Creek
LOCATION: S2
COORDINATES: 6343680N / 475132E

MEASUREMENT DATE: 10 September 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: NS
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 1655 hrs.
MEASUREMENT END TIME:

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes: 1.) Water elevation at transducer 296 873m (1655 hrs)
2) No flow measurements taken

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Jackpine Creek
LOCATION: S2
COORDINATES: 6343680N / 475132E

MEASUREMENT DATE: 27 October 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JG
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1354 hrs.
MEASUREMENT END TIME: 1402 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	3.90		0.00			0.000	2.50	0.000
1	5.00		0.07			0.100	1.05	0.007
2	6.00		0.08			0.140	1.00	0.011
3	7.00		0.17			0.010	1.00	0.002
4	8.00		0.12			0.240	1.00	0.029
5	9.00		0.27			0.500	1.00	0.135
6	10.00		0.24			0.280	1.00	0.067
7	11.00		0.12			0.040	1.00	0.005
Right Bank	12.00		0.00			0.000	-5.50	0.000
								0.256

Notes 1.) Water elevation at transducer 296 809m (1354 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Iyinimin Creek
LOCATION: S3
COORDINATES: 6345029N / 489491E

MEASUREMENT DATE: 12 June 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/ME
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1000 hrs.
MEASUREMENT END TIME: 1050 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.60		0.00			0.000	0.50	0.000
1	1.00		0.48			-0.010	0.30	-0.001
2	1.20		0.54			0.080	0.30	0.013
3	1.60		0.48			0.470	0.40	0.090
4	2.00		0.60			0.390	0.35	0.082
5	2.30		0.58			0.340	0.25	0.049
6	2.50		0.54			0.220	0.25	0.030
7	2.80		0.48			0.140	0.25	0.017
8	3.00		0.45			0.130	0.25	0.015
9	3.30		0.22			0.250	0.25	0.014
10	3.50		0.30			0.190	0.25	0.014
11	3.80		0.28			0.050	0.25	0.004
12	4.00		0.25			0.220	0.30	0.017
Right Bank	4.40		0.00			0.000	-2.00	0.000
								0.342

Notes
1.) Water elevation at transducer 359.179m (1045 hrs)
2.) Transducer above water level, reinstalled deeper into water

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Iyinimin Creek
LOCATION: S3
COORDINATES: 6345029N / 489491E

MEASUREMENT DATE: 10 July 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JE
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 0800 hrs.
MEASUREMENT END TIME: 0830 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.00			0.000	0.10	0.000
1	0.20		0.06			0.120	0.20	0.001
2	0.40		0.09			0.190	0.20	0.003
3	0.60		0.08			0.090	0.20	0.001
4	0.80		0.10			0.020	0.20	0.000
5	1.00		0.18			0.060	0.20	0.002
6	1.20		0.28			0.030	0.20	0.002
7	1.40		0.32			0.270	0.20	0.017
8	1.60		0.28			0.070	0.20	0.004
9	1.80		0.40			0.090	0.20	0.007
10	2.00		0.40			0.090	0.20	0.007
11	2.20		0.46			0.260	0.20	0.024
12	2.40		0.40			0.180	0.20	0.014
13	2.60		0.31			0.290	0.30	0.027
14	3.00		0.34			0.030	0.30	0.003
15	3.20		0.32			0.030	0.20	0.002
16	3.40		0.18			0.040	0.28	0.002
Right Bank	3.75		0.00			0.000	-1.70	0.000
								0.118

Notes: 1) Water elevation at transducer 359 013m (0815 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Iyinimin Creek
LOCATION: S3
COORDINATES: 6345029N / 489491E

MEASUREMENT DATE: 25 October 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JG
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1250 hrs.
MEASUREMENT END TIME: 1300 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00		0.00			0.000	0.10	0.000
1	0.20		0.08			0.010	0.20	0.000
2	0.40		0.10			0.050	0.20	0.001
3	0.60		0.16			0.050	0.20	0.002
4	0.80		0.14			0.060	0.20	0.002
5	1.00		0.10			0.070	0.20	0.001
6	1.20		0.08			0.050	0.20	0.001
7	1.40		0.11			0.050	0.20	0.001
8	1.60		0.06			0.080	0.20	0.001
9	1.80		0.06			0.100	0.20	0.001
10	2.00		0.04			0.040	0.23	0.000
Right Bank	2.25		0.00			0.000	-1.00	0.000
								0.010

Notes: 1) No water elevation surveyed

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

STREAM NAME: Muskeg River
LOCATION: S5A
COORDINATES: 6351600N / 476100E

MEASUREMENT DATE: 17 Jan 01
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 0900 hrs.
MEASUREMENT END TIME: 1100 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00	0.40	0.00			0.000	0.48	0.000
1	0.95	0.40	1.06	0.01	0.01	0.010	1.68	0.016
2	3.35	0.40	1.50	0.05	0.02	0.035	2.03	0.098
3	5.00	0.40	1.36	0.00	0.04	0.020	1.88	0.047
4	7.10	0.47	1.48	0.00	0.01	0.005	1.95	0.013
5	8.90	0.40	1.18	0.00	0.01	0.005	1.50	0.008
Right Bank	10.10	0.40	0.00			0.000	-4.45	0.000
								0.182

Notes: 1) Water elevation 281 017m (1030hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

STREAM NAME: Muskeg River
LOCATION: S5A
COORDINATES: 6351600N / 476100E

MEASUREMENT DATE: 16 February 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1000 hrs.
MEASUREMENT END TIME: 1220 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00	0.52	0.00			0.000	0.70	0.000
1	1.40	0.52	0.68			0.000	1.45	0.000
2	2.90	0.50	1.04	0.04	0.00	0.020	1.60	0.031
3	4.60	0.55	1.01	0.08	0.06	0.070	2.05	0.133
4	7.00	0.54	0.89	0.02	0.02	0.020	2.30	0.038
5	9.20	0.60	0.85	0.00	0.00	0.000	1.80	0.000
6	10.60	0.60	0.50			0.010	1.30	0.006
Right Bank	11.80	0.60	0.00			0.000	-5.30	0.000
								0.208

Notes. 1) Water elevation 281 035m (1120 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7030
DISCHARGE DATA

STREAM NAME: Muskeg River
LOCATION: S5A
COORDINATES: 6351600N / 476100E

MEASUREMENT DATE: 20 April 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: LL/RS

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

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes:
1) Unsafe condition - ice break up
2) No flow measurements taken
2) Water elevation 281.543m (1119 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Muskeg River
LOCATION: S5A
COORDINATES: 6351600N / 476100E

MEASUREMENT DATE: 15 May 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/CK
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1000 hrs.
MEASUREMENT END TIME: 1045 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes: 1.) No flow measurement taken (stopper from boat stolen)
2.) Water elevation 281 972m (1040 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Muskeg River
LOCATION: S5A
COORDINATES: 6351600N / 476100E

MEASUREMENT DATE: 13 June 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/ME
COMPUTATIONS BY: LL/RS

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

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00		0.00			0.000	0.40	0.000
1	0.80		0.90	0.02	0.03	0.025	0.90	0.020
2	1.80		1.39	0.06	0.07	0.065	1.00	0.090
3	2.80		2.10	0.10	0.11	0.105	1.00	0.221
4	3.80		2.31	0.19	0.17	0.180	1.00	0.416
5	4.80		2.40	0.15	0.10	0.125	1.00	0.300
6	5.80		2.40	0.20	0.18	0.190	1.00	0.456
7	6.80		2.40	0.20	0.17	0.185	1.00	0.444
8	7.80		2.45	0.20	0.17	0.185	1.00	0.453
9	8.80		2.35	0.14	0.19	0.165	1.00	0.388
10	9.80		2.40	0.21	0.24	0.225	1.00	0.540
11	10.80		2.12	0.11	0.16	0.135	1.00	0.286
12	11.80		1.82	0.17	0.10	0.135	1.00	0.246
13	12.80		1.10	0.05	0.06	0.055	1.00	0.061
14	13.80		0.40			0.030	1.00	0.012
Right Bank	14.80		0.00			0.000	-6.90	0.000
								3.932

Notes 1) Water elevation 281 947m (1240 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Muskeg River
LOCATION: S5A
COORDINATES: 6351600N / 476100E

MEASUREMENT DATE: 9 July 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1400 hrs.
MEASUREMENT END TIME: 1540 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes
1.) Water elevation 281.561m (1422 hrs)
2) No flow measurements taken

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Muskeg River
LOCATION: S5A
COORDINATES: 6351600N / 476100E

MEASUREMENT DATE: 7 August 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1030 hrs.
MEASUREMENT END TIME: 1330 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.80		0.00			0.000	1.00	0.000
1	2.00		0.73			-0.030	1.10	-0.024
2	3.00		1.39	0.03	0.02	0.025	1.00	0.035
3	4.00		1.66	0.08	0.06	0.070	1.00	0.116
4	5.00		1.74	0.08	0.08	0.080	1.00	0.139
5	6.00		1.79	0.03	0.05	0.040	1.00	0.072
6	7.00		1.76	0.05	0.07	0.060	1.00	0.106
7	8.00		1.68	0.12	0.10	0.110	1.00	0.185
8	9.00		1.72	0.13	0.08	0.105	1.00	0.181
9	10.00		1.59	0.05	0.04	0.045	1.00	0.072
10	11.00		1.50	0.02	0.02	0.020	1.00	0.030
11	12.00		1.11	0.02	0.01	0.015	1.00	0.017
12	13.00		0.35			0.010	0.95	0.003
Right Bank	13.90		0.00			0.000	-6.50	0.000
								0.930

Notes 1) Water elevation 281.287m (1137 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

STREAM NAME: Muskeg River
LOCATION: S5A
COORDINATES: 6351600N / 476100E

MEASUREMENT DATE: 5 December 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JE
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1055 hrs.
MEASUREMENT END TIME: 1115 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	2.80	0.33	0.00			0.000	1.65	0.000
1	3.30	0.33	0.56			-0.010	0.75	-0.004
2	4.30	0.32	1.01			0.010	0.90	0.008
3	5.10	0.31	1.11			0.030	0.90	0.028
4	6.10	0.28	1.27			0.040	1.00	0.047
5	7.10	0.28	1.23			0.030	1.10	0.037
6	8.30	0.28	1.28			0.040	1.15	0.054
7	9.40	0.28	1.16			0.000	1.10	0.000
8	10.50	0.28	1.26			0.000	1.05	0.000
9	11.50	0.32	1.15			-0.020	0.95	-0.020
10	12.40	0.32	0.79			-0.020	0.90	-0.013
11	13.30	0.32	0.60			-0.020	0.75	-0.008
Right Bank	13.90	0.32	0.00			0.000	-6.65	0.000
								0.129

Notes: 1.) Water elevation 281.057m, top of ice elevation 281.089m (1128 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

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

MEASUREMENT DATE: 17 January 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1345 hrs.
MEASUREMENT END TIME: 1420 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00	0.10	0.00			0.000	0.15	0.000
1	0.30	0.10	0.17			0.000	0.3	0.000
2	0.60	0.10	0.22			0.060	0.3	0.004
3	0.90	0.10	0.22			0.050	0.3	0.003
4	1.20	0.10	0.22			0.060	0.3	0.004
5	1.50	0.10	0.25			0.040	0.3	0.003
6	1.80	0.10	0.23			0.020	0.3	0.001
Right Bank	2.10	0.10	0.00			0.000	-0.9	0.000
								0.014

Notes. 1.) Water elevation at transducer 272 083m (1345 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

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

MEASUREMENT DATE: 15 February 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1500 hrs.
MEASUREMENT END TIME: 1600 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00	0.05	0.00			0.000	0.15	0.000
1	0.30	0.05	0.12			0.000	0.25	0.000
2	0.50	0.05	0.18			0.010	0.2	0.000
3	0.70	0.05	0.20			0.050	0.2	0.002
4	0.90	0.05	0.20			0.080	0.2	0.003
5	1.10	0.05	0.20			0.040	0.2	0.001
6	1.30	0.05	0.21			0.070	0.2	0.003
7	1.50	0.05	0.21			0.060	0.2	0.002
8	1.70	0.05	0.21			0.060	0.2	0.002
9	1.90	0.05	0.20			0.040	0.2	0.001
10	2.10	0.05	0.19			0.060	0.225	0.002
Right Bank	2.35	0.12	0.00			0.000	-1.05	0.000
								0.018

Notes: 1) Water elevation at transducer 272.089m (1537 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7030
DISCHARGE DATA

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

MEASUREMENT DATE: 20 April 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1200 hrs.
MEASUREMENT END TIME: 1245 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.00			0.000	0.1	0.000
1	0.20		0.14			-0.010	0.2	0.000
2	0.40		0.15			-0.010	0.2	0.000
3	0.60		0.18			0.000	0.2	0.000
4	0.80		0.20			0.040	0.2	0.002
5	1.00		0.25			0.080	0.2	0.004
6	1.20		0.28			0.100	0.2	0.006
7	1.40		0.28			0.100	0.2	0.006
8	1.60		0.24			0.080	0.2	0.004
9	1.80		0.18			0.060	0.2	0.002
10	2.00		0.16			0.030	0.2	0.001
11	2.20		0.16			0.030	0.2	0.001
12	2.40		0.10			0.020	0.2	0.000
13	2.60		0.10			-0.030	0.2	-0.001
14	2.80		0.10			-0.010	0.325	0.000
Right Bank	3.25		0.00			0.000	-1.4	0.000
								0.024

Notes 1) Water elevation at transducer 272 117m (1240 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7030
DISCHARGE DATA

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

MEASUREMENT DATE: 11 May 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: CK/NS
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1050 hrs.
MEASUREMENT END TIME: 1110 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.60		0.00			0.000	0.45	0.000
1	0.90		0.16			0.000	0.23	0.000
2	1.05		0.20			0.000	0.15	0.000
3	1.20		0.27			0.020	0.15	0.001
4	1.35		0.29			0.080	0.15	0.003
5	1.50		0.30			0.090	0.15	0.004
6	1.65		0.29			0.070	0.15	0.003
7	1.80		0.23			0.090	0.15	0.003
8	1.95		0.22			0.080	0.15	0.003
9	2.10		0.26			0.040	0.15	0.002
10	2.25		0.27			0.080	0.15	0.003
11	2.40		0.26			0.060	0.15	0.002
12	2.55		0.24			0.020	0.15	0.001
13	2.70		0.22			0.010	0.15	0.000
14	2.85		0.10			0.000	0.23	0.000
Right Bank	3.15		0.00			0.000	-1.43	0.000
								0.025

Notes: 1.) Water elevation at transducer 272 144m

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

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

MEASUREMENT DATE: 13 June 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/ME
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 0855 hrs.
MEASUREMENT END TIME: 0915 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.15		0.00			0.000	0.25	0.000
1	0.50		0.02			-0.030	0.33	0.000
2	0.80		0.10			0.000	0.25	0.000
3	1.00		0.10			0.000	0.20	0.000
4	1.20		0.12			0.010	0.20	0.000
5	1.40		0.16			0.010	0.20	0.000
6	1.60		0.18			0.010	0.20	0.000
7	1.80		0.18			0.000	0.20	0.000
8	2.00		0.20			-0.010	0.20	0.000
9	2.20		0.20			0.010	0.20	0.000
10	2.40		0.30			0.120	0.20	0.007
11	2.60		0.32			0.170	0.20	0.011
12	2.80		0.28			0.070	0.20	0.004
13	3.00		0.26			0.120	0.20	0.006
14	3.20		0.30			0.220	0.20	0.013
15	3.40		0.32			0.170	0.20	0.011
16	3.60		0.31			0.010	0.20	0.001
17	3.80		0.29			-0.010	0.20	-0.001
18	4.00		0.30			0.070	0.20	0.004
19	4.20		0.30			0.000	0.20	0.000
20	4.40		0.22			0.000	0.23	0.000
Right Bank	4.65		0.00			0.000	-2.20	0.000
								0.057

Notes: 1) Water elevation at transducer 272.171m (0912 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

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

MEASUREMENT DATE: 8 July 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1430 hrs.
MEASUREMENT END TIME: 1500 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.00			0.000	0.10	0.000
1	0.20		0.07			0.090	0.20	0.001
2	0.40		0.17			0.150	0.20	0.005
3	0.60		0.18			0.160	0.20	0.006
4	0.80		0.18			0.160	0.20	0.006
5	1.00		0.20			0.150	0.20	0.006
6	1.20		0.20			0.120	0.20	0.005
7	1.40		0.25			0.080	0.20	0.004
8	1.60		0.22			0.100	0.20	0.004
9	1.80		0.20			0.020	0.20	0.001
10	2.00		0.20			0.030	0.20	0.001
11	2.20		0.21			0.030	0.20	0.001
12	2.40		0.19			0.040	0.20	0.002
13	2.60		0.18			0.020	0.20	0.001
14	2.80		0.14			0.020	0.20	0.001
15	3.00		0.14			0.010	0.20	0.000
16	3.20		0.10			0.000	0.28	0.000
Right Bank	3.55		0.00			0.000	-1.60	0.000
								0.043

Notes. 1.) Water elevation at transducer 272 129m (1450 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

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

MEASUREMENT DATE: 09 July 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 1130 hrs.
MEASUREMENT END TIME: 1150 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes. 1) Water elevation at transducer 272 135m (1145 hrs)
2.) No flow measurements taken

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

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

MEASUREMENT DATE: 07 August 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 1430 hrs.
MEASUREMENT END TIME: 1435 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes
1) Water elevation at transducer 272.131m (1450 hrs)
2.) No flow measurements taken

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

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

MEASUREMENT DATE: 10 September 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: NS
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 1350 hrs.
MEASUREMENT END TIME: 1457 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.30		0.00			0.000	0.20	0.000
	0.40		0.06			0.050	0.10	0.000
	0.50		0.07			0.160	0.10	0.001
	0.60		0.05			0.350	0.10	0.002
	0.70		0.08			0.230	0.10	0.002
	0.80		0.05			0.350	0.10	0.002
	0.90		0.10			0.450	0.10	0.005
	1.00		0.08			0.320	0.10	0.003
	1.10		0.06			0.230	0.10	0.001
	1.20		0.06			0.100	0.10	0.001
	1.30		0.04			0.050	0.10	0.000
	1.40		0.04			0.080	0.10	0.000
	1.50		0.06			0.180	0.10	0.001
	1.60		0.06			0.160	0.10	0.001
	1.70		0.06			0.110	0.12	0.001
Right Bank	1.84		0.00			0.000	-0.85	0.000
								0.019

Notes: 1.) Water elevation at transducer 272.189m (1445 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

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

MEASUREMENT DATE: 29 October 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JG
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1024 hrs.
MEASUREMENT END TIME: 1035 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.00			0.000	0.10	0.000
1	0.20		0.12			0.110	0.20	0.003
2	0.40		0.16			0.120	0.20	0.004
3	0.60		0.16			0.090	0.20	0.003
4	0.80		0.20			0.070	0.20	0.003
5	1.00		0.22			0.100	0.20	0.004
6	1.20		0.17			0.060	0.20	0.002
7	1.40		0.16			0.040	0.20	0.001
8	1.60		0.13			0.020	0.20	0.001
9	1.80		0.11			0.000	0.31	0.000
Right Bank	2.21		0.00			0.000	-0.90	0.000
								0.020

Notes: 1.) Water elevation at transducer 272.109m (1024 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

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

MEASUREMENT DATE: 05 December 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JE
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1440 hrs.
MEASUREMENT END TIME: 1455 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00	0.03	0.00			0.000	0.1	0.000
1	0.20	0.03	0.08			0.020	0.2	0.000
2	0.40	0.03	0.08			0.080	0.2	0.001
3	0.60	0.03	0.10			0.070	0.2	0.001
4	0.80	0.03	0.10			0.120	0.2	0.002
5	1.00	0.03	0.12			0.130	0.2	0.003
6	1.20	0.03	0.10			0.120	0.21	0.003
Right Bank	1.42	0.03	0.00			0.000	-0.6	0.000
								0.011

Notes: 1) Transducer was removed Nov. 2001
2.) Water elevation at gauging station 272 082m, top of ice elevation 272.093m (1444 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

STREAM NAME: Muskeg River WSC
LOCATION: S7
COORDINATES: 6338944N / 465408E

MEASUREMENT DATE: 16 January 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

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

MEASUREMENT START TIME: 1555 hrs.
MEASUREMENT END TIME: 1700 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00	0.34	0.00			0.000	1.05	0.000
1	2.10	0.34	0.75			0.050	2.625	0.091
2	5.25	0.30	0.75			0.110	3.00	0.228
3	8.10	0.32	0.74			0.110	2.825	0.212
4	10.90	0.32	0.70			0.090	2.05	0.119
Right Bank	12.20	0.32	0.00			0.000	-5.45	0.000
								0.649

Notes 1.) Water elevation 271 809m (1541 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

STREAM NAME: Muskeg River WSC
LOCATION: S7
COORDINATES: 6338944N / 465408E

MEASUREMENT DATE: 16 February 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1250 hrs.
MEASUREMENT END TIME: 1350 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00	0.36	0.00			0.000	0.725	0.000
1	1.45	0.36	0.23			0.020	1.55	0.007
2	3.10	0.41	0.29			0.120	1.825	0.058
3	5.10	0.53	0.36			0.090	2	0.060
4	7.10	0.54	0.30			0.100	1.92	0.053
5	8.94	0.55	0.30			0.150	1.845	0.076
6	10.79	0.54	0.23			0.120	1.775	0.045
7	12.49	0.51	0.33			0.090	1.65	0.045
8	14.09	0.50	0.33			0.130	1.95	0.077
Right Bank	16.39	0.50	0.00			0.000	-7.045	0.000
								0.421

Notes 1) Water elevation 271 836m (1300 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

STREAM NAME: Muskeg River WSC
LOCATION: S7
COORDINATES: 6338944N / 465408E

MEASUREMENT DATE: 24 April 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1030 hrs.
MEASUREMENT END TIME: 1130 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes.
1) Water elevation 271 889m (1135 hrs)
2) Downloaded data from Solinst logger - Memory was full Data collected was from 14 June to Nov 28 2000
3.) No flow measurements taken

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

STREAM NAME: Muskeg River WSC
LOCATION: S7
COORDINATES: 6338944N / 465408E

MEASUREMENT DATE: 11 May 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: NS
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 1645 hrs
MEASUREMENT END TIME:

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes. 1.) Water elevation 272.112m (1645 hrs)
2.) No flow measurements taken

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

STREAM NAME: Muskeg River WSC
LOCATION: S7
COORDINATES: 6338944N / 465408E

MEASUREMENT DATE: 13 June 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/ME
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 1450 hrs
MEASUREMENT END TIME: 1530 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes:
1.) Water elevation 272.104m (1505 hrs)
2.) No flow measurements taken

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

STREAM NAME: Muskeg River WSC
LOCATION: S7
COORDINATES: 6338944N / 465408E

MEASUREMENT DATE: 08 July 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 1420 hrs
MEASUREMENT END TIME: 1445 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes. 1.) Water elevation 272 016m (1429 hrs)
2.) No flow measurements taken

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

STREAM NAME: Muskeg River WSC
LOCATION: S7
COORDINATES: 6338944N / 465408E

MEASUREMENT DATE: 12 September 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: NS
COMPUTATIONS BY: RS

MEASUREMENT START TIME:
MEASUREMENT END TIME:

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes: 1.) Water elevation 271.684m (1650 hrs)
2) No flow measurements taken

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

STREAM NAME: Muskeg River WSC
LOCATION: S7
COORDINATES: 6338944N / 465408E

MEASUREMENT DATE: 29 October 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: JG
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 1523 hrs.
MEASUREMENT END TIME: 1612 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes. 1.) Water elevation 97 882m
2) No flow measurements taken

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Muskeg River WSC
LOCATION: S7
COORDINATES: 6338944N / 465408E

MEASUREMENT DATE: 2 November 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JG
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1230 hrs.
MEASUREMENT END TIME: 1240 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	5.50		0.00			0.000	3	0.000
1	6.00		0.11			0.260	0.75	0.020
2	7.00		0.12			0.330	1	0.036
3	8.00		0.12			0.440	1	0.049
4	9.00		0.20			0.480	1	0.088
5	10.00		0.25			0.300	1	0.069
6	11.00		0.22			0.430	1	0.087
7	12.00		0.22			0.540	1	0.109
8	13.00		0.20			0.550	1	0.101
9	14.00		0.16			0.600	1	0.088
10	15.00		0.16			0.450	1	0.066
11	16.00		0.10			0.350	1.3	0.042
12	17.60		0.06			0.170	0.8	0.008
13	17.60		0.00			0.000	-8.65	0.000
14	0.30		0.00			0.000	-8.55	0.000
15	0.50		0.04			0.010	0.2	0.000
16	0.70		0.05			0.040	0.2	0.000
17	0.90		0.07			0.070	0.2	0.001
18	1.10		0.10			0.120	0.2	0.002
19	1.30		0.12			0.180	0.2	0.004
20	1.50		0.10			0.160	0.2	0.003
21	1.70		0.10			0.140	0.2	0.003
22	1.90		0.11			0.220	0.2	0.004
23	2.10		0.11			0.200	0.2	0.004
24	2.30		0.11			0.150	0.2	0.003
Right Bank	2.50		0.00			0.000	-1.15	0.000
								0.788

Notes (1) Water level 271 951 m based on new benchmark elevation 275 565m

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

STREAM NAME: Muskeg River WSC
LOCATION: S7A (New Location)
COORDINATES: 6338750N / 465550E

MEASUREMENT DATE: 6 December 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JE
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 0933 hrs.
MEASUREMENT END TIME: 0942 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	5.90	0.05	0.00			0.000	3.425	0.000
1	6.85	0.05	0.12			0.210	0.85	0.020
2	7.60	0.05	0.18			0.170	0.725	0.020
3	8.30	0.05	0.20			0.280	0.55	0.028
4	8.70	0.05	0.23			0.370	0.35	0.027
5	9.00	0.05	0.20			0.460	0.35	0.030
6	9.40	0.05	0.20			0.480	0.4	0.035
7	9.80	0.05	0.19			0.620	0.4	0.043
8	10.20	0.05	0.24			0.650	0.4	0.057
9	10.60	0.05	0.24			0.560	0.4	0.049
10	11.00	0.05	0.22			0.580	0.45	0.053
11	11.50	0.05	0.14			0.400	1.15	0.059
12	13.30	0.05	0.11			0.660	1.65	0.110
Right Bank	14.80	0.05	0.00			0.000	-6.65	0.000
								0.533

Notes 1) Water elevation 271 979m, top of the ice elevation 271 982m (0905 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

STREAM NAME: Kearl Lake Outlet
LOCATION: S9
COORDINATES: 6346750N / 483980E

MEASUREMENT DATE: 15 February 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 1330 hrs.
MEASUREMENT END TIME: 1345 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes 1.) Downloaded barometric data
2) No flow measurements taken and water level not surveyed

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7030
DISCHARGE DATA

STREAM NAME: Kearl Lake Outlet
LOCATION: S9
COORDINATES: 6346750N / 483980E

MEASUREMENT DATE: 21 April 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: RS

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

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00		0.00			0.000	0.15	0.000
1	0.30		0.44			-0.010	0.3	-0.001
2	0.60		0.48			0.020	0.3	0.003
3	0.90		0.54			0.020	0.3	0.003
4	1.20		0.52			0.020	0.3	0.003
5	1.50		0.52			0.030	0.3	0.005
6	1.80		0.50			0.020	0.3	0.003
7	2.10		0.42			-0.010	0.3	-0.001
8	2.40		0.40			0.020	0.3	0.002
9	2.70		0.42			0.030	0.3	0.004
10	3.00		0.44			0.030	0.3	0.004
11	3.30		0.42			-0.010	0.3	-0.001
12	3.60		0.37			0.000	0.3	0.000
13	3.90		0.32			-0.010	0.25	-0.001
Right Bank	4.10		0.00			0.000	-1.95	0.000
								0.022

Notes:
1) Installed Winspear transducer (temporary)
2) Water elevation 329.256m based on BM elevation 330.400m (0920 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Kearl Lake Outlet
LOCATION: S9
COORDINATES: 6346750N / 483980E

MEASUREMENT DATE: 11 May 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: NS/CK
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1430 hrs.
MEASUREMENT END TIME: 1440 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.25		0.10			0.000	0.25	0.000
1	0.50		0.22			0.000	0.28	0.000
2	0.80		0.26			-0.050	0.30	-0.004
3	1.10		0.30			-0.030	0.30	-0.003
4	1.40		0.33			-0.020	0.25	-0.002
5	1.60		0.34			0.070	0.20	0.005
6	1.80		0.40			0.080	0.20	0.006
7	2.00		0.42			0.070	0.20	0.006
8	2.20		0.48			0.060	0.20	0.006
9	2.40		0.49			0.150	0.20	0.015
10	2.60		0.50			0.110	0.20	0.011
11	2.80		0.49			0.080	0.20	0.008
12	3.00		0.46			0.250	0.18	0.020
13	3.15		0.42			0.190	0.15	0.012
14	3.30		0.36			-0.010	0.15	-0.001
Right Bank	3.45		0.00			0.000	-1.65	0.000
								0.080

Notes 1) Water elevation 329.323m based on BM elevation 331.033m (1425 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Kearl Lake Outlet
LOCATION: S9
COORDINATES: 6346750N / 483980E

MEASUREMENT DATE: 10 June 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/ME
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1210 hrs.
MEASUREMENT END TIME: 1430 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.00			0.000	0.25	0.000
1	0.50		0.20			0.040	0.50	0.004
2	1.00		0.36			0.040	0.50	0.007
3	1.50		0.48			0.080	0.50	0.019
4	2.00		0.50			0.090	0.50	0.023
5	2.50		0.52			0.100	0.50	0.026
6	3.00		0.52			0.090	0.50	0.023
7	3.50		0.52			0.080	0.50	0.021
8	4.00		0.42			0.090	0.50	0.019
9	4.50		0.28			0.070	0.40	0.008
Right Bank	4.80		0.00			0.000	-2.25	0.000
								0.150

Notes 1) Installed thermistor string
2) No survey of water elevation due to thunder and lightning

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Kearl Lake Outlet
LOCATION: S9
COORDINATES: 6346750N / 483980E

MEASUREMENT DATE: 8 July 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 0930 hrs.
MEASUREMENT END TIME: 0945 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00		0.00			0.000	0.15	0.000
1	0.30		0.20			0.020	0.25	0.001
2	0.50		0.23			0.030	0.20	0.001
3	0.70		0.28			0.050	0.20	0.003
4	0.90		0.27			0.030	0.20	0.002
5	1.10		0.30			0.060	0.20	0.004
6	1.30		0.34			0.080	0.20	0.005
7	1.50		0.38			0.070	0.20	0.005
8	1.70		0.42			0.080	0.20	0.007
9	1.90		0.42			0.080	0.20	0.007
10	2.10		0.40			0.070	0.20	0.006
11	2.30		0.40			0.090	0.20	0.007
12	2.50		0.42			0.080	0.20	0.007
13	2.70		0.44			0.070	0.20	0.006
14	2.90		0.42			0.070	0.20	0.006
15	3.10		0.42			0.060	0.20	0.005
16	3.30		0.40			0.070	0.20	0.006
17	3.50		0.39			0.080	0.20	0.006
18	3.70		0.34			0.040	0.20	0.003
19	3.90		0.31			0.030	0.20	0.002
20	4.10		0.30			0.030	0.20	0.002
21	4.30		0.27			0.040	0.20	0.002
Right Bank	4.50		0.00			0.000	-2.15	0.000
								0.092

Notes 1) Water elevation 329 256m based on BM elevation 330 40m (0945 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Kearl Lake Outlet
LOCATION: S9
COORDINATES: 6346750N / 483980E

MEASUREMENT DATE:6 August 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1217 hrs.
MEASUREMENT END TIME: 1245 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.00			0.000	0.30	0.000
1	0.60		0.19			0.020	0.40	0.002
2	0.80		0.20			0.010	0.20	0.000
3	1.00		0.24			0.030	0.20	0.001
4	1.20		0.32			0.020	0.20	0.001
5	1.40		0.34			0.020	0.20	0.001
6	1.60		0.35			0.030	0.20	0.002
7	1.80		0.36			0.030	0.20	0.002
8	2.00		0.36			0.030	0.20	0.002
9	2.20		0.37			0.030	0.20	0.002
10	2.40		0.40			0.020	0.20	0.002
11	2.60		0.40			0.020	0.20	0.002
12	2.80		0.40			0.020	0.20	0.002
13	3.00		0.40			0.010	0.20	0.001
14	3.20		0.39			0.010	0.20	0.001
15	3.40		0.38			0.010	0.20	0.001
16	3.60		0.38			0.020	0.20	0.002
17	3.80		0.30			0.020	0.20	0.001
18	4.00		0.28			0.020	0.20	0.001
19	4.20		0.24			0.010	0.29	0.001
Right Bank	4.57		0.00			0.000	-2.10	0.000
								0.026

Notes 1.) Water elevation 329.140m based on BM elevation 330.40m (1240 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Kearl Lake Outlet
LOCATION: S9
COORDINATES: 6346750N / 483980E

MEASUREMENT DATE: 19 September 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/NF
COMPUTATIONS BY: LL/NS/RS

MEASUREMENT START TIME: 0930 hrs.
MEASUREMENT END TIME: 0945 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.30		0.00			0.000	0.40	0.000
1	0.80		0.12			0.000	0.35	0.000
2	1.00		0.18			0.000	0.20	0.000
3	1.20		0.23			0.000	0.20	0.000
4	1.40		0.28			0.010	0.20	0.001
5	1.60		0.31			0.010	0.20	0.001
6	1.80		0.30			0.020	0.20	0.001
7	2.00		0.30			0.010	0.20	0.001
8	2.20		0.30			0.010	0.20	0.001
9	2.40		0.32			0.010	0.20	0.001
10	2.60		0.33			0.010	0.20	0.001
11	2.80		0.32			0.000	0.20	0.000
12	3.00		0.30			0.010	0.20	0.001
13	3.20		0.28			0.010	0.20	0.001
14	3.40		0.26			0.000	0.20	0.000
15	3.60		0.22			0.000	0.20	0.000
16	3.80		0.16			0.000	0.20	0.000
17	4.00		0.16			0.000	0.29	0.000
Right Bank	4.38		0.00			0.000	-2.00	0.000
								0.006

Notes: 1.) Water elevation 329.151m based on BM elevation 330.40m (0940 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Kearl Lake Outlet
LOCATION: S9
COORDINATES: 6346750N / 483980E

MEASUREMENT DATE: 24 October 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JG
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 0930 hrs.
MEASUREMENT END TIME:

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00	0.00	0.00					
1	0.40	0.14	0.12					
2	1.20	0.14	0.19					
3	2.00	0.12	0.26					
4	2.70	0.11	0.25					
5	3.30	0.12	0.22					
6	3.85	0.12	0.02					
Right Bank	4.50	0.00	0.00					
								0.000

Notes. 1) Water elevation 329 134m based on BM elevation 330 40m
2) Ice cover - no flow

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7030
DISCHARGE DATA

STREAM NAME: Wapasu Creek
LOCATION: S10
COORDINATES: 6355500N / 490350E

MEASUREMENT DATE: 20 April 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1530 hrs.
MEASUREMENT END TIME: 1700 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.00			0.000	0.05	0.000
1	0.10		0.30			0.490	0.15	0.022
2	0.30		0.32			0.470	0.2	0.030
3	0.50		0.32			0.460	0.2	0.029
4	0.70		0.34			0.510	0.2	0.035
5	0.90		0.34			0.520	0.2	0.035
6	1.10		0.32			0.510	0.2	0.033
7	1.30		0.29			0.490	0.2	0.028
8	1.50		0.28			0.470	0.2	0.026
9	1.70		0.24			0.350	0.2	0.017
10	1.90		0.22			0.200	0.2	0.009
11	2.10		0.22			0.050	0.2	0.002
12	2.30		0.20			-0.030	0.325	-0.002
Right Bank	2.75		0.00			0.000	-1.15	0.000
								0.265

Notes. 1) Temporary installation of transducer and data logger
2) Water elevation at transducer 319 827m based on BM elevation 320 16m

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Wapasu Creek
LOCATION: S10
COORDINATES: 6355500N / 490350E

MEASUREMENT DATE: 11 May 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: CK/NS
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1240 hrs.
MEASUREMENT END TIME: 1315 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.40		0.00			0.000	1.10	0.000
1	2.20		0.43			-0.040	1.15	-0.020
2	2.70		0.67	0.01	0.00	0.005	0.50	0.002
3	3.20		0.71	0.23	0.07	0.150	0.50	0.053
4	3.70		0.78	0.49	0.30	0.395	0.50	0.154
5	4.20		0.76	0.44	0.40	0.420	0.50	0.160
6	4.70		0.83	0.57	0.54	0.555	0.50	0.230
7	5.20		0.89	0.50	0.59	0.545	0.50	0.243
8	5.70		0.79	0.52	0.43	0.475	0.50	0.188
9	6.20		0.55	0.51	0.49	0.500	0.50	0.138
10	6.70		0.46			0.430	0.50	0.099
11	7.20		0.44			0.370	0.50	0.081
12	7.70		0.33			0.190	0.38	0.024
Right Bank	7.95		0.27			0.000	-3.85	0.000
								1.351

Notes 1.) Water elevation at transducer 320 229m based on abutment BM elevation 323 065m

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Wapasu Creek
LOCATION: S10
COORDINATES: 6355500N / 490350E

MEASUREMENT DATE: 10 June 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/ME
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1020 hrs.
MEASUREMENT END TIME: 1115 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.00			0.000	0.50	0.000
1	1.00		0.29			-0.040	0.75	-0.009
2	1.50		0.33			-0.050	0.50	-0.008
3	2.00		0.69			-0.020	0.50	-0.007
4	2.50		0.90	0.00	0.08	0.040	0.50	0.018
5	3.00		1.00	0.09	0.10	0.095	0.50	0.048
6	3.50		1.02	0.23	0.36	0.295	0.50	0.150
7	4.00		1.00	0.43	0.48	0.455	0.50	0.228
8	4.50		1.00	0.30	0.29	0.295	0.50	0.148
9	5.00		0.98	-0.01	0.10	0.045	0.50	0.022
10	5.50		0.84	-0.01	-0.04	-0.025	0.50	-0.011
11	6.00		0.57			-0.090	0.60	-0.031
Right Bank	6.70		0.00			0.000	-3.00	0.000
								0.548

Notes 1) Water elevation at transducer 319 961m based on BM elevation 320 16m (1100 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Wapasu Creek
LOCATION: S10
COORDINATES: 6355500N / 490350E

MEASUREMENT DATE: 8 July 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1140 hrs.
MEASUREMENT END TIME: 1205 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.60		0.000			0.000	0.50	0.000
1	1.00		0.150			0.040	0.45	0.003
2	1.50		0.140			0.050	0.50	0.004
3	2.00		0.310			0.080	0.40	0.010
4	2.30		0.500			0.150	0.35	0.026
5	2.70		0.560			0.220	0.35	0.043
6	3.00		0.600			0.490	0.25	0.074
7	3.20		0.590			0.730	0.20	0.086
8	3.40		0.570			0.690	0.20	0.079
9	3.60		0.530			0.790	0.20	0.084
10	3.80		0.470			0.790	0.20	0.074
11	4.00		0.430			0.760	0.20	0.065
12	4.20		0.420			0.550	0.20	0.046
13	4.40		0.400			0.220	0.20	0.018
14	4.60		0.380			0.220	0.20	0.017
15	4.80		0.380			0.070	0.20	0.005
16	5.00		0.300			0.090	0.20	0.005
17	5.20		0.260			0.040	0.20	0.002
18	5.40		0.250			0.050	0.20	0.003
19	5.60		0.200			0.040	0.20	0.002
20	5.80		0.200			0.030	0.20	0.001
21	6.00		0.200			0.070	0.20	0.003
22	6.20		0.130			0.030	0.26	0.001
Right Bank	6.52		0.000			0.000	-3.10	0.000
								0.650

Notes 1) Water elevation at transducer 319 954m based on BM elevation 320 16m (1155 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Wapasu Creek
LOCATION: S10
COORDINATES: 6355500N / 490350E

MEASUREMENT DATE: 6 August 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1030 hrs.
MEASUREMENT END TIME: 1050 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	1.30		0.000			0.000	0.75	0.000
1	1.50		0.040			0.010	0.35	0.000
2	2.00		0.140			0.060	0.40	0.003
3	2.30		0.280			0.100	0.25	0.007
4	2.50		0.300			0.230	0.25	0.017
5	2.80		0.380			0.410	0.30	0.047
6	3.10		0.320			0.310	0.30	0.030
7	3.40		0.280			0.680	0.30	0.057
8	3.70		0.250			0.070	0.30	0.005
9	4.00		0.220			0.050	0.30	0.003
10	4.30		0.220			0.080	0.30	0.005
11	4.60		0.220			0.030	0.30	0.002
12	4.90		0.140			0.060	0.30	0.003
13	5.20		0.090			0.030	0.33	0.001
Right Bank	5.55		0.000			0.000	-2.60	0.000
								0.181

Notes 1) No survey of water elevation

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Wapasu Creek
LOCATION: S10
COORDINATES: 6355500N / 490350E

MEASUREMENT DATE: 19 September 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/NF
COMPUTATIONS BY: LL/NS/RS

MEASUREMENT START TIME: 1050 hrs.
MEASUREMENT END TIME: 1130 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.40		0.000			0.000	0.30	0.000
1	0.60		0.140			-0.050	0.20	-0.001
2	0.80		0.160			0.000	0.15	0.000
3	0.90		0.230			0.060	0.10	0.001
4	1.00		0.240			0.190	0.10	0.005
5	1.10		0.240			0.360	0.10	0.009
6	1.20		0.200			0.380	0.10	0.008
7	1.30		0.240			0.270	0.10	0.006
8	1.40		0.220			0.200	0.10	0.004
9	1.50		0.220			0.230	0.10	0.005
10	1.60		0.240			0.370	0.10	0.009
11	1.70		0.280			0.550	0.10	0.015
12	1.80		0.260			0.510	0.10	0.013
13	1.90		0.220			0.350	0.10	0.008
14	2.00		0.240			0.210	0.10	0.005
15	2.10		0.260			0.210	0.10	0.005
16	2.20		0.260			0.190	0.10	0.005
17	2.30		0.240			0.110	0.10	0.003
18	2.40		0.250			0.090	0.10	0.002
19	2.50		0.240			0.040	0.10	0.001
20	2.60		0.220			0.020	0.10	0.000
21	2.70		0.200			0.010	0.10	0.000
22	2.80		0.200			0.010	0.10	0.000
23	2.90		0.180			0.010	0.10	0.000
24	3.00		0.160			0.000	0.29	0.000
Right Bank	3.47		0.000			0.000	-1.50	0.000
								0.104

Notes 1) Water elevation at transducer 319 717m based on BM elevation 320 16m (1100 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Wapasu Creek
LOCATION: S10
COORDINATES: 6355500N / 490350E

MEASUREMENT DATE: 27 October 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JG
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1150 hrs.
MEASUREMENT END TIME: 1210 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.000			0.000	0.10	0.000
1	0.20		0.090			-0.020	0.20	0.000
2	0.40		0.120			0.120	0.20	0.003
3	0.60		0.120			0.230	0.20	0.006
4	0.80		0.140			0.100	0.20	0.003
5	1.00		0.140			-0.020	0.20	-0.001
6	1.20		0.170			0.160	0.20	0.005
7	1.40		0.180			0.270	0.20	0.010
8	1.60		0.180			0.140	0.20	0.005
9	1.80		0.200			0.260	0.20	0.010
10	2.00		0.180			0.010	0.20	0.000
11	2.20		0.140			0.000	0.25	0.000
Right Bank	2.50		0.000			0.000	-1.10	0.000
								0.041

Notes 1) Water elevation at transducer 319 633m based on BM elevation 320.16m (1150 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7030
DISCHARGE DATA

STREAM NAME: Poplar Creek
LOCATION: S11
COORDINATES: 6307650N / 472000E

MEASUREMENT DATE: 24 April 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1330 hrs.
MEASUREMENT END TIME: 1450 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00		0.00			0.000	0.25	0.000
1	0.50		0.31			0.060	0.50	0.009
2	1.00		0.20			0.200	0.50	0.020
3	1.50		0.34			0.050	0.50	0.009
4	2.00		0.33			0.440	0.50	0.073
5	2.50		0.40			0.430	0.50	0.086
6	3.00		0.50			0.540	0.50	0.135
7	3.50		0.46			0.600	0.50	0.138
8	4.00		0.50			0.490	0.50	0.123
9	4.50		0.46			0.530	0.50	0.122
10	5.00		0.42			0.450	0.50	0.095
11	5.50		0.40			0.400	0.50	0.080
12	6.00		0.44			0.250	0.50	0.055
13	6.50		0.34			0.220	0.50	0.037
14	7.00		0.34			0.150	0.50	0.026
15	7.50		0.25			0.110	0.50	0.014
16	8.00		0.20			0.130	0.50	0.013
17	8.50		0.26			0.110	0.50	0.014
18	9.00		0.26			0.080	0.50	0.010
19	9.50		0 26			0.060	0.50	0.008
20	10.00		0.19			0.030	0.50	0.003
21	10.50		0.14			0.010	0.50	0.001
22	11.00		0.17			0.010	0.50	0.001
23	11.50		0.20			0.010	0.50	0.001
24	12.00		0.18			0.010	0.50	0.001
25	12.50		0.12			0.000	0.60	0.000
Right Bank	13 20		0.00			0.000	-6.25	0.000
								1.072

Notes 1) Water elevation at transducer 241 164m (1410 hrs)
2) Top of iron pin elevation 242 366m (Steel pin at the right bank - this is not the Alberta Survey pin)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7030
DISCHARGE DATA

STREAM NAME: Poplar Creek
LOCATION: S11
COORDINATES: 6307650N / 472000E

MEASUREMENT DATE: 11 May 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: CK/NS
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1730 hrs.
MEASUREMENT END TIME: 1800 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	10.10		0.30			0.000	5.35	0.000
1	10.70		0.48			0.110	0.45	0.024
2	11.00		0.52			0.550	0.65	0.186
3	12.00		0.52			0.900	1.00	0.468
4	13.00		0.52			1.000	1.00	0.520
5	14.00		0.67			0.970	1.00	0.650
6	15.00		0.63			0.900	1.00	0.567
7	16.00		0.56			0.850	1.00	0.476
8	17.00		0.57			0.920	1.00	0.524
9	18.00		0.50			1.010	1.00	0.505
10	19.00		0.52			0.870	1.00	0.452
11	20.00		0.53			0.760	1.00	0.403
12	21.00		0.52			0.900	1.00	0.468
13	22.00		0.48			0.710	1.00	0.341
14	23.00		0.43			0.810	1.00	0.348
15	24.00		0.46			0.740	1.00	0.340
16	25.00		0.42			0.550	0.80	0.185
17	25.60		0.38			0.180	0.40	0.027
18	25.80		0.25			0.290	0.20	0.014
Right Bank	26.00		0.00			0.000	-12.90	0.000
								6.499

Notes. 1) Water elevation at transducer 241 430m (1810hrs)
2) Top of Alberta Survey pin elevation 242.057m

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Poplar Creek
LOCATION: S11
COORDINATES: 6307650N / 472000E

MEASUREMENT DATE: 13 June 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/ME
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 0745 hrs.
MEASUREMENT END TIME: 0754 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.03		0.00			0.000	0.50	0.000
1	1.00		0.19			0.140	0.99	0.026
2	2.00		0.25			0.280	1.00	0.070
3	3.00		0.34			0.170	1.00	0.058
4	4.00		0.40			0.170	1.00	0.068
5	5.00		0.25			0.170	1.00	0.043
6	6.00		0.24			0.220	1.00	0.053
7	7.00		0.35			0.150	1.00	0.053
8	8.00		0.30			0.170	1.00	0.051
9	9.00		0.34			0.080	1.00	0.027
10	10.00		0.29			0.190	1.00	0.055
11	11.00		0.30			0.210	1.00	0.063
12	12.00		0.29			0.130	1.00	0.038
13	13.00		0.30			0.170	1.00	0.051
14	14.00		0.40			0.150	1.00	0.060
15	15.00		0.34			0.200	1.00	0.068
16	16.00		0.24			0.140	1.00	0.034
17	17.00		0.23			0.120	1.00	0.028
18	18.00		0.18			0.010	0.65	0.001
Right Bank	18.30		0.00			0.000	-9.00	0.000
								0.845

Notes: 1) Water elevation at transducer 241.081m (0815 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Poplar Creek
LOCATION: S11
COORDINATES: 6307650N / 472000E

MEASUREMENT DATE: 9 July 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1650 hrs.
MEASUREMENT END TIME: 1800 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00		0.00			0.000	0.50	0.000
1	1.00		0.28			0.130	1.00	0.036
2	2.00		0.36			0.200	1.00	0.072
3	3.00		0.29			0.220	1.00	0.064
4	4.00		0.39			0.210	1.00	0.082
5	5.00		0.27			0.170	1.00	0.046
6	6.00		0.34			0.180	1.00	0.061
7	7.00		0.32			0.140	1.00	0.045
8	8.00		0.27			0.170	1.00	0.046
9	9.00		0.27			0.160	1.00	0.043
10	10.00		0.23			0.160	1.00	0.037
11	11.00		0.25			0.180	1.00	0.045
12	12.00		0.25			0.200	1.00	0.050
13	13.00		0.31			0.190	1.00	0.059
14	14.00		0.36			0.180	1.00	0.065
15	15.00		0.35			0.230	1.00	0.081
16	16.00		0.29			0.150	1.00	0.044
17	17.00		0.29			0.180	1.00	0.052
18	18.00		0.07			0.100	1.25	0.009
Right Bank	19.50		0.00			0.000	-9.00	0.000
								0.936

Notes. 1) Water elevation at transducer 241.081m (1715 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Poplar Creek
LOCATION: S11
COORDINATES: 6307650N / 472000E

MEASUREMENT DATE: 12 September 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/NS
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1735 hrs.
MEASUREMENT END TIME: 1745 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	1.30		0.00			0.000	0.75	0.000
1	1.50		0.10			-0.020	0.35	-0.001
2	2.00		0.12			0.010	0.50	0.001
3	2.50		0.22			0.020	0.50	0.002
4	3.00		0.15			0.000	0.50	0.000
5	3.50		0.18			0.030	0.50	0.003
6	4.00		0.20			0.000	0.50	0.000
7	4.50		0.20			0.010	0.50	0.001
8	5.00		0.26			0.020	0.50	0.003
9	5.50		0.32			0.000	0.50	0.000
10	6.00		0.33			0.010	0.50	0.002
11	6.50		0.34			0.010	0.50	0.002
12	7.00		0.30			0.010	0.50	0.002
13	7.50		0.24			0.000	0.50	0.000
14	8.00		0.28			0.000	0.50	0.000
15	8.50		0.20			-0.010	0.50	-0.001
16	9.00		0.10			0.000	0.55	0.000
Right Bank	9.60		0.00			0.000	-4.50	0.000
								0.012

Notes 1) Water elevation at transducer 240 932m (1747 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Poplar Creek
LOCATION: S11
COORDINATES: 6307650N / 472000E

MEASUREMENT DATE: 27 October 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JG
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1600 hrs.
MEASUREMENT END TIME: 1620 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00		0.00			0.000	0.10	0.000
1	0.20		0.19			-0.010	0.25	0.000
2	0.50		0.10			-0.020	0.30	-0.001
3	0.80		0.11			0.000	0.25	0.000
4	1.00		0.21			0.010	0.25	0.001
5	1.30		0.22			0.000	0.25	0.000
6	1.50		0.17			0.060	0.20	0.002
7	1.70		0.17			0.130	0.20	0.004
8	1.90		0.20			0.090	0.20	0.004
9	2.10		0.23			0.010	0.20	0.000
10	2.30		0.21			0.000	0.20	0.000
11	2.50		0.23			0.010	0.20	0.000
12	2.70		0.26			0.010	0.20	0.001
13	2.90		0.22			0.040	0.20	0.002
14	3.10		0.20			0.080	0.20	0.003
15	3.30		0.23			0.000	0.20	0.000
16	3.50		0.30			0.000	0.20	0.000
17	3.70		0.20			0.020	0.20	0.001
18	3.90		0.12			0.070	0.35	0.003
Right Bank	4.40		0.00			0.000	-1.95	0.000
								0.020

Notes. 1.) Water elevation at transducer 240 932m (1600 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

STREAM NAME: Fort Creek
LOCATION: S12
COORDINATES: 6363400N / 462600E

MEASUREMENT DATE: 17 Jan 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1430 hrs.
MEASUREMENT END TIME: 1545 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank								0.000
1								0.000
2								0.000
3								0.000
4								0.000
5								0.000
6								0.000
7								0.000
Right Bank								0.000
								0.000

Notes: 1) No flow - frozen to bed
2.) Ice thickness 0.20m

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

STREAM NAME: Fort Creek
LOCATION: S12
COORDINATES: 6363400N / 462600E

MEASUREMENT DATE: 15 Feb 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL
COMPUTATIONS BY: NS/RS

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

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank								0.000
1								0.000
2								0.000
3								0.000
4								0.000
5								0.000
6								0.000
7								0.000
Right Bank								0.000
								0.000

Notes: 1) No flow - frozen to bed
2) Ice thickness 0.25m

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7030
DISCHARGE DATA

STREAM NAME: Fort Creek
LOCATION: S12
COORDINATES: 6363400N / 462600E

MEASUREMENT DATE: 21 Apr 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1400 hrs.
MEASUREMENT END TIME: 1445 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank								0.000
1								0.000
2								0.000
3								0.000
4								0.000
5								0.000
6								0.000
7								0.000
Right Bank								0.000
								0.000

Notes 1) No flow - frozen to bed

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Fort Creek
LOCATION: S12
COORDINATES: 6363400N / 462600E

MEASUREMENT DATE: 11 May 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: CK/NS
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 0955 hrs.
MEASUREMENT END TIME: 1005 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.40		0.00			0.000	0.30	0.000
1	0.60		0.18			0.340	0.18	0.011
2	0.75		0.20			0.680	0.15	0.020
3	0.90		0.19			0.680	0.15	0.019
4	1.05		0.22			0.730	0.15	0.024
5	1.20		0.20			0.740	0.15	0.022
6	1.35		0.18			0.640	0.15	0.017
7	1.50		0.15			0.550	0.15	0.012
8	1.65		0.11			0.370	0.15	0.006
9	1.80		0.07			0.630	0.15	0.007
10	1.95		0.05			0.140	0.15	0.001
Right Bank	2.10		0.00			0.000	-0.98	0.000
								0.140

Notes: 1.) Water elevation 251.107m (0910 hrs)
2.) Top of pin elevation 251.522m

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Fort Creek
LOCATION: S12
COORDINATES: 6363400N / 462600E

MEASUREMENT DATE: 13 June 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/ME
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1200 hrs.
MEASUREMENT END TIME: 1355 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.02		0.00			0.000	0.15	0.000
1	0.30		0.10			0.300	0.24	0.007
2	0.50		0.14			0.500	0.20	0.014
3	0.70		0.20			0.530	0.20	0.021
4	0.90		0.30			0.770	0.20	0.046
5	1.10		0.28			0.890	0.20	0.050
6	1.30		0.28			0.700	0.20	0.039
7	1.50		0.20			0.450	0.20	0.018
8	1.70		0.12			0.220	0.20	0.005
9	1.90		0.06			0.040	0.20	0.000
Right Bank	2.10		0.00			0.000	-0.95	0.000
								0.201

Notes: 1.) Water elevation at transducer 251 083m based on BM elevation 253.44m (nail by tree) (1350 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Fort Creek
LOCATION: S12
COORDINATES: 6363400N / 462600E

MEASUREMENT DATE: 9 July 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1515 hrs.
MEASUREMENT END TIME: 1555 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00		0.00			0.000	0.10	0.000
1	0.20		0.08			0.020	0.20	0.000
2	0.40		0.16			0.170	0.20	0.005
3	0.60		0.16			0.270	0.20	0.009
4	0.80		0.18			0.340	0.20	0.012
5	1.00		0.18			0.470	0.20	0.017
6	1.20		0.12			0.340	0.20	0.008
7	1.40		0.09			0.180	0.23	0.004
Right Bank	1.65		0.00			0.000	-0.70	0.000
								0.055

Notes 1) Water elevation at transducer 251.012m based on BM elevation 253.44m (nail by tree) (1525 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Fort Creek
LOCATION: S12
COORDINATES: 6363400N / 462600E

MEASUREMENT DATE: 7 August 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 0800 hrs.
MEASUREMENT END TIME: 0930 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.00			0.00	0.05	0.000
1	0.10		0.07			0.09	0.10	0.001
2	0.20		0.07			0.11	0.10	0.001
3	0.30		0.09			0.15	0.10	0.001
4	0.40		0.09			0.30	0.10	0.003
5	0.50		0.10			0.31	0.10	0.003
6	0.60		0.13			0.37	0.10	0.005
7	0.70		0.12			0.09	0.10	0.001
8	0.80		0.11			0.30	0.10	0.003
9	0.90		0.14			0.24	0.10	0.003
10	1.00		0.12			0.20	0.10	0.002
11	1.10		0.08			0.13	0.10	0.001
12	1.20		0.10			0.09	0.10	0.001
13	1.30		0.08			0.02	0.15	0.000
Right Bank	1.50		0.00			0.00	-0.65	0.000
								0.026

Notes: 1) Water elevation at transducer 251 083m based on BM elevation 253 44m (nail by tree)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Fort Creek
LOCATION: S12
COORDINATES: 6363400N / 462600E

MEASUREMENT DATE: 10 September 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/NS
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1245 hrs.
MEASUREMENT END TIME: 1357 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.30		0.00			0.00	0.20	0.000
1	0.40		0.06			0.05	0.10	0.000
2	0.50		0.07			0.16	0.10	0.001
3	0.60		0.05			0.35	0.10	0.002
4	0.70		0.08			0.23	0.10	0.002
5	0.80		0.05			0.35	0.10	0.002
6	0.90		0.10			0.45	0.10	0.005
7	1.00		0.08			0.32	0.10	0.003
8	1.10		0.06			0.23	0.10	0.001
9	1.20		0.06			0.10	0.10	0.001
10	1.30		0.04			0.05	0.10	0.000
11	1.40		0.04			0.08	0.10	0.000
12	1.50		0.06			0.18	0.10	0.001
13	1.60		0.06			0.16	0.10	0.001
14	1.70		0.06			0.11	0.12	0.001
Right Bank	1.84		0.00			0.00	-0.85	0.000
								0.019

Notes:
1.) Water elevation at transducer 250 982m based on BM elevation 253.44m (nail by tree) (1250 hrs)
2.) New permanent benchmark established elevation 252 364m
3.) Installed conduit below streambed and placed transducer (1330 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Fort Creek
LOCATION: S12
COORDINATES: 6363400N / 462600E

MEASUREMENT DATE: 28 October 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JG
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1700 hrs.
MEASUREMENT END TIME: 1710 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.00			0.00	0.20	0.000
1	0.40		0.21			-0.02	0.25	-0.001
2	0.50		0.17			-0.01	0.10	0.000
3	0.60		0.20			-0.01	0.10	0.000
4	0.70		0.24			0.00	0.10	0.000
5	0.80		0.24			0.04	0.10	0.001
6	0.90		0.24			0.18	0.10	0.004
7	1.00		0.25			0.19	0.10	0.005
8	1.10		0.24			0.19	0.10	0.005
9	1.20		0.23			0.24	0.10	0.006
10	1.30		0.24			0.18	0.10	0.004
11	1.40		0.23			0.08	0.10	0.002
12	1.50		0.23			0.03	0.10	0.001
13	1.60		0.22			0.02	0.10	0.000
14	1.70		0.24			-0.01	0.23	-0.001
Right Bank	2.06		0.00			0.00	-0.85	0.000
								0.025

Notes: 1) Water elevation not surveyed
2) Water backed up to the station by ice at riffle downstream

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

STREAM NAME: Fort Creek
LOCATION: S12
COORDINATES: 6363400N / 462600E

MEASUREMENT DATE: 03 December 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JE
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1400 hrs.
MEASUREMENT END TIME: 1430 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00	0.23	0.00			0.00	0.10	0.000
1	0.20	0.20	0.07			-0.01	0.20	0.000
2	0.40	0.19	0.08			0.06	0.20	0.001
3	0.60	0.17	0.10			0.04	0.20	0.001
4	0.80	0.18	0.05			0.13	0.20	0.001
5	1.00	0.14	0.08			0.04	0.20	0.001
6	1.20	0.14	0.10			-0.05	0.23	-0.001
Right Bank	1.45	0.22	0.00			0.00	-0.60	0.000
								0.002

Notes 1) Water elevation 251 074m, top of ice elevation 251.146m (1421 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

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

MEASUREMENT DATE: 16 Jan 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 1200 hrs.
MEASUREMENT END TIME: 1257 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes:
1) Water elevation 278.270m (1235 hrs)
2.) Ice thickness 0.51m
3.) Augered hole, not able to install new transducer
4) No flow measurements taken

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7030
DISCHARGE DATA

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

MEASUREMENT DATE: 20 April 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1410 hrs.
MEASUREMENT END TIME: 1430 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank								0.000
1								0.000
2								0.000
3								0.000
4								0.000
5								0.000
6								0.000
7								0.000
Right Bank								0.000
								0.000

Notes: 1) No flow
2) Informed that work will be carried out inside the pond and transducer will be installed when work is completed

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

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

MEASUREMENT DATE: 11 May 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: NS
COMPUTATIONS BY: RS

MEASUREMENT START TIME:
MEASUREMENT END TIME:

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank								0.000
1								0.000
2								0.000
3								0.000
4								0.000
5								0.000
6								0.000
7								0.000
Right Bank								0.000
								0.000

Notes: 1) Still iced, unable to retrive instruments
2.) No flow
3) Water elevation not surveyed

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

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

MEASUREMENT DATE: 08 July 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 1355 hrs.
MEASUREMENT END TIME: 1430 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
								0.004

Notes:
1.) Slight flow over the weir, photos taken
2) No flow measurements taken as the flow was too shallow to measure at downstream of weir
3.) Water elevation 278 972m (1406 hrs)
4.) Trickling flow unmeasurable; flow estimate based on 0 07m head from photo

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

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

MEASUREMENT DATE: 12 September 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: NS
COMPUTATIONS BY: RS

MEASUREMENT START TIME:
MEASUREMENT END TIME:

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

0.006

Notes
1) Slight flow over the weir, photos taken
2.) No flow measurements taken as the flow was too shallow to measure at downstream of weir
3) Water elevation 278 975m (1347 hrs)
4.) Trickling flow unmeasurable; flow estimate based on 0.08m head from photo

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

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

MEASUREMENT DATE: 27 October 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: JG
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 1626 hrs
MEASUREMENT END TIME:

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank								0.000
1								0.000
2								0.000
3								0.000
4								0.000
5								0.000
6								0.000
7								0.000
Right Bank								0.000
								0.000

Notes. 1.) Water elevation 278 828m
2.) No flow

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

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

MEASUREMENT DATE: 06 December 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JE
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1026 hrs
MEASUREMENT END TIME: 1040 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank								0.000
1								0.000
2								0.000
3								0.000
4								0.000
5								0.000
6								0.000
7								0.000
Right Bank								0.000
								0.000

Notes:
1.) No flow over the weir - the outlet channel was dry
2) Water elevation 278 173m, top of ice elevation 278 451m (1033 hrs)
3) Elevation of V-Notch 278 902m
4) Ice thickness 0 19m

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7030
DISCHARGE DATA

STREAM NAME: Ells River
LOCATION: S14
COORDINATES: 6349466N / 457310E

MEASUREMENT DATE: 15 March 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1410 hrs.
MEASUREMENT END TIME: 1430 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00	0.65	0.00			0.000	0.8	0.000
1	1.60	0.65	0.00			0.000	2.15	0.000
2	4.30	0.77	0.33			0.400	3.25	0.395
3	8.10	0.84	0.00			0.000	3.6	0.000
4	11.50	0.74	0.22			0.430	3.125	0.272
5	14.35	0.65	0.22			0.510	2.9	0.299
6	17.30	0.63	0.15			0.500	2.775	0.191
7	19.90	0.66	0.06			0.150	1.85	0.015
Right Bank	21.00	0.66	0.00			0.000	-9.95	0.000
								1.173

Notes
1) Discharge measurement carried out at the old WSC station
2) Water elevation not surveyed

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Ells River
LOCATION: S14
COORDINATES: 6349466N / 457310E

MEASUREMENT DATE: 13 May 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/AC/NS
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1425 hrs.
MEASUREMENT END TIME: 1450 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.20		0.00			0.000	0.50	0.000
1	1.00		0.40			0.440	1.15	0.202
2	2.50		0.65			0.690	1.50	0.673
3	4.00		0.69			0.800	1.50	0.828
4	5.50		0.70			1.080	1.50	1.134
5	7.00		1.08	1.27	0.96	1.115	1.50	1.806
6	8.50		1.06	1.37	1.05	1.210	1.50	1.924
7	10.00		1.10	1.33	1.04	1.185	1.50	1.955
8	11.50		1.10	1.34	0.94	1.140	1.50	1.881
9	13.00		1.00	1.29	1.00	1.145	1.50	1.718
10	14.50		0.85	1.17	0.96	1.065	1.50	1.358
11	16.00		0.85	1.21	0.93	1.070	1.50	1.364
12	17.50		0.82	1.22	0.96	1.090	1.50	1.341
13	19.00		0.79	1.05	0.82	0.935	1.50	1.108
14	20.50		0.64			0.650	1.50	0.624
Right Bank	22.00		0.00			0.000	-10.25	0.000
								17.916

Notes:
1.) Water elevation at transducer 97.666m based on TBM elevation 100 000 m (nail in tree) (1420 hrs)
2) Top of pin elevation 98.386m
3.) Estimated springmelt 2001 high water mark 98 422m

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Ells River
LOCATION: S14
COORDINATES: 6349466N / 457310E

MEASUREMENT DATE: 11 June 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/ME
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1800 hrs.
MEASUREMENT END TIME: 1900 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes:
1.) Water elevation at transducer 97 403m based on TBM elevation 100.000m (nail in tree) (1811hrs)
2.) Installed a new BM - T-Bar (Top of T-Bar elevation 100.199m)
3) Erected the tower and installed the thermistor string
4.) No flow measurement taken as river was not wadeable

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Ells River
LOCATION: S14
COORDINATES: 6349466N / 457310E

MEASUREMENT DATE: 21 June 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/TC
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1000 hrs.
MEASUREMENT END TIME: 1200 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.65		0.00			0.000	0.50	0.000
1	1.00		0.17			0.140	0.68	0.016
2	2.00		0.33			0.290	1.00	0.096
3	3.00		0.41			0.330	1.00	0.135
4	4.00		0.39			0.400	1.00	0.156
5	5.00		0.44			0.430	1.00	0.189
6	6.00		0.57			0.540	1.00	0.308
7	7.00		0.75			0.690	1.00	0.518
8	8.00		0.80	0.85	0.70	0.775	1.00	0.620
9	9.00		0.74			0.710	1.00	0.525
10	10.00		0.75			0.600	1.00	0.450
11	11.00		0.74			0.680	1.00	0.503
12	12.00		0.75			0.770	1.00	0.578
13	13.00		0.69			0.690	1.00	0.476
14	14.00		0.63			0.810	1.00	0.510
15	15.00		0.58			0.760	1.00	0.441
16	16.00		0.52			0.820	1.00	0.426
17	17.00		0.49			0.750	1.00	0.368
18	18.00		0.50			0.620	1.00	0.310
19	19.00		0.49			0.560	1.00	0.274
20	20.00		0.42			0.450	1.00	0.189
21	21.00		0.28			0.210	0.70	0.041
Right Bank	21.40		0.00			0.000	-10.50	0.000
								7.129

Notes 1) Water elevation at transducer 97 375m based on BM elevation 100 199m (Top of T-Bar) (1109hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Ells River
LOCATION: S14
COORDINATES: 6349466N / 457310E

MEASUREMENT DATE: 9 August 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 0915 hrs.
MEASUREMENT END TIME: 1020 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.70		0.00			0.000	1.00	0.000
1	2.00		0.50			0.510	1.65	0.421
2	4.00		0.53			0.870	2.00	0.922
3	6.00		0.93	1.09	0.70	0.895	2.00	1.665
4	8.00		0.95	1.35	1.03	1.190	2.00	2.261
5	10.00		0.96	1.32	0.85	1.085	2.00	2.083
6	12.00		0.94	1.29	0.90	1.095	2.00	2.059
7	14.00		0.84	1.15	0.88	1.015	2.00	1.705
8	16.00		0.75			1.000	2.00	1.500
9	18.00		0.74			0.930	2.00	1.376
10	20.00		0.68			0.680	1.50	0.694
11	21.00		0.52			0.460	0.85	0.203
Right Bank	21.70		0.00			0.000	-10.50	0.000
								14.889

Notes: 1.) Water elevation at transducer 97.581m based on BM elevation 100.199m (Top of T-Bar) (0925 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Ells River
LOCATION: S14
COORDINATES: 6349466N / 457310E

MEASUREMENT DATE: 15 September 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/NS
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1040 hrs.
MEASUREMENT END TIME: 1115 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.40		0.00			0.000	0.50	0.000
1	1.00		0.26			0.180	0.80	0.037
2	2.00		0.42			0.310	1.00	0.130
3	3.00		0.48			0.370	1.00	0.178
4	4.00		0.45			0.480	1.00	0.216
5	5.00		0.51			0.500	1.00	0.255
6	6.00		0.63			0.600	1.00	0.378
7	7.00		0.83	0.88	0.50	0.690	1.00	0.573
8	8.00		0.85	0.98	0.75	0.865	1.00	0.735
9	9.00		0.82	0.91	0.65	0.780	1.00	0.640
10	10.00		0.85	0.97	0.66	0.815	1.00	0.693
11	11.00		0.85	0.92	0.59	0.755	1.00	0.642
12	12.00		0.82	0.98	0.69	0.835	1.00	0.685
13	13.00		0.74			0.680	1.00	0.503
14	14.00		0.70			0.710	1.00	0.497
15	15.00		0.65			0.940	1.00	0.611
16	16.00		0.59			0.840	1.00	0.496
17	17.00		0.56			0.730	1.00	0.409
18	18.00		0.57			0.660	1.00	0.376
19	19.00		0.54			0.570	1.00	0.308
20	20.00		0.50			0.580	1.00	0.290
21	21.00		0.35			0.380	0.65	0.086
22	21.30		0.22			0.080	0.20	0.004
Right Bank	21.40		0.00			0.000	-10.65	0.000
								8.741

Notes 1) Water elevation at transducer 97 433m based on BM elevation 100 199m (Top of T-Bar) (1045hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Ells River
LOCATION: S14
COORDINATES: 6349466N / 457310E

MEASUREMENT DATE: 31 October 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: JG
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 1050 hrs.
MEASUREMENT END TIME:

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes
1) Water elevation at transducer 97.314m based on BM elevation 100.199m
2) No flow measurements taken

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7030
DISCHARGE DATA

STREAM NAME: Tar River
LOCATION: S15
COORDINATES: 6356983N / 454453E

MEASUREMENT DATE: 14 March 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1410 hrs.
MEASUREMENT END TIME: 1430 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00	34.00	0.00			0.000	0.63	0.000
1	1.26	34.00	14.00			-0.010	1.55	-0.200
2	3.10	33.00	20.00			-0.010	1.72	-0.316
3	4.70	34.00	24.00			0.000	1.53	0.000
4	6.15	33.00	22.00			-0.010	1.70	-0.344
5	8.10	33.00	11.00			-0.020	1.75	-0.354
6	9.65	30.00	15.00			-0.010	1.40	-0.193
7	10.90	32.00	16.00			0.000	1.38	0.000
8	12.40	31.00	26.00			0.000	1.63	0.000
9	14.15	34.00	29.00			0.000	1.38	0.000
10	15.15	37.00	10.00			0.000	0.83	0.000
Right Bank	15.80	37.00	0.00			0.000	-7.58	0.000
								0.000

Notes: 1) Stream frozen to bottom

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Tar River
LOCATION: S15
COORDINATES: 6356983N / 454453E

MEASUREMENT DATE: 9 May 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/NS
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1510 hrs.
MEASUREMENT END TIME: 1531 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	5.80		0.00			0.000	3.25	0.000
1	6.50		0.30			0.390	0.60	0.070
2	7.00		0.55			0.640	0.50	0.176
3	7.50		0.70			0.810	0.50	0.284
4	8.00		0.81			0.680	0.50	0.275
5	8.50		0.82			1.090	0.50	0.447
6	9.00		0.92			1.110	0.50	0.511
7	9.50		1.04			1.090	0.50	0.567
8	10.00		0.97			1.230	0.50	0.597
9	10.50		0.97			0.600	0.50	0.291
10	11.00		0.89			0.990	0.50	0.441
11	11.50		1.05			1.100	0.50	0.578
12	12.00		0.85			0.900	0.50	0.383
13	12.50		0.76			0.360	0.50	0.137
Right Bank	13.00		0.00			0.000	-6.25	0.000
								4.754

Notes 1.) Water elevation 98.060m based on TBM elevation 100.000m (nail in tree) (1245 hrs)
2.) Top of pin elevation 98.249m

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Tar River
LOCATION: S15
COORDINATES: 6356983N / 454453E

MEASUREMENT DATE: 11 June 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/ME
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1600 hrs.
MEASUREMENT END TIME: 1720 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	2.00		0.00			0.000	1.25	0.000
1	2.50		0.15			0.200	0.50	0.015
2	3.00		0.38			0.210	0.50	0.040
3	3.50		0.51			0.220	0.50	0.056
4	4.00		0.60			0.370	0.50	0.111
5	4.50		0.63			0.460	0.50	0.145
6	5.00		0.70			0.550	0.50	0.193
7	5.50		0.78	0.48	0.38	0.430	0.50	0.168
8	6.00		0.81	0.31	0.33	0.320	0.50	0.130
9	6.50		0.80	0.22	0.23	0.225	0.50	0.090
10	7.00		0.85	0.32	0.32	0.320	0.75	0.204
11	8.00		0.34			0.410	0.85	0.118
Right Bank	8.70		0.00			0.000	-4.00	0.000
								1.269

Notes.
1.) Water elevation 97.663m based on TBM elevation 100 000m (nail in tree) (1700 hrs)
2.) Installed a new BM elevation 100 59m top of T-Bar
3) Installed thermistor string

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Tar River
LOCATION: S15
COORDINATES: 6356983N / 454453E

MEASUREMENT DATE: 8 July 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1600 hrs.
MEASUREMENT END TIME: 1710 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.95		0.00			0.000	0.75	0.000
1	1.50		0.21			0.130	0.53	0.014
2	2.00		0.37			0.250	0.50	0.046
3	2.50		0.45			0.340	0.50	0.077
4	3.00		0.50			0.380	0.50	0.095
5	3.50		0.57			0.360	0.50	0.103
6	4.00		0.54			0.310	0.50	0.084
7	4.50		0.55			0.260	0.50	0.072
8	5.00		0.63			0.130	0.50	0.041
9	5.50		0.65			0.150	0.50	0.049
10	6.00		0.72			0.180	0.50	0.065
11	6.50		0.26			0.270	0.50	0.035
12	7.00		0.20			0.270	0.45	0.024
Right Bank	7.40		0.00			0.000	-3.50	0.000
								0.704

Notes. 1) Water elevation 97 546m based on TBM elevation 100 590m (top of T-bar) (1707 hrs)
2) Installed conductivity probe

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Tar River
LOCATION: S15
COORDINATES: 6356983N / 454453E

MEASUREMENT DATE: 6 August 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1640 hrs.
MEASUREMENT END TIME: 1700 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	2.05		0.00			0.000	1.25	0.000
1	2.50		0.21			0.140	0.48	0.014
2	3.00		0.40			0.170	0.50	0.034
3	3.50		0.54			0.280	0.50	0.076
4	4.00		0.62			0.390	0.50	0.121
5	4.50		0.70			0.330	0.50	0.116
6	5.00		0.74			0.360	0.50	0.133
7	5.50		0.82	0.34	0.31	0.325	0.50	0.133
8	6.00		0.76			0.400	0.50	0.152
9	6.50		0.75			0.350	0.50	0.131
10	7.00		0.75			0.230	0.50	0.086
11	7.50		0.84	0.31	0.28	0.295	0.50	0.124
12	8.00		0.72			0.220	0.45	0.071
Right Bank	8.40		0.00			0.000	-4.00	0.000
								1.191

Notes: 1.) Water elevation 97.627m based on TBM elevation 100.590m (top of T-bar) (1700 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Tar River
LOCATION: S15
COORDINATES: 6356983N / 454453E

MEASUREMENT DATE: 11 September 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/NS
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1450 hrs.
MEASUREMENT END TIME: 1600 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	2.90		0.00			0.000	1.50	0.000
1	3.00		0.47			0.050	0.30	0.007
2	3.50		0.76			0.110	0.50	0.042
3	4.00		0.75			0.150	0.50	0.056
4	4.50		0.60			0.120	0.50	0.036
5	5.00		0.56			0.160	0.50	0.045
6	5.50		0.43			0.200	0.50	0.043
7	6.00		0.33			0.190	0.50	0.031
8	6.50		0.25			0.180	0.50	0.023
9	7.00		0.18			0.140	0.50	0.013
10	7.50		0.16			0.140	0.50	0.011
11	8.00		0.13			0.170	0.50	0.011
12	8.50		0.14			0.140	0.50	0.010
13	9.00		0.05			0.090	0.50	0.002
Right Bank	9.50		0.00			0.000	-4.50	0.000
								0.330

Notes 1) Water elevation 97.490m based on TBM elevation 100.590m (top of T-bar) (1450 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Tar River
LOCATION: S15
COORDINATES: 6356983N / 454453E

MEASUREMENT DATE: 30 October 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JG
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1240 hrs.
MEASUREMENT END TIME: 1310 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.40	0.08	0.12			0.020	0.43	0.001
1	0.85	0.10	0.13			0.050	0.60	0.004
2	1.60	0.12	0.10			0.060	0.73	0.004
3	2.30	0.12	0.20			0.090	0.88	0.014
4	3.35	0.12	0.09			0.030	1.03	0.003
5	4.36	0.12	0.19			0.040	0.98	0.007
6	5.30	0.13	0.21			0.020	1.22	0.005
Right Bank	6.80	0.00	0.00			0.000	-2.65	0.000
								0.037

Notes
1) Water level 97.433m based on TBM elevation 100 590m (top of T-bar) (1240 hrs)
2) Applied 0 92 factor for under-ice flow

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

STREAM NAME: Tar River
LOCATION: S15
COORDINATES: 6356983N / 454453E

MEASUREMENT DATE: 07 December 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JE
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 0943 hrs.
MEASUREMENT END TIME: 0950 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.90	0.34	0.00			0.000	0.88	0.000
1	1.75	0.33	0.14			0.080	0.85	0.009
2	2.60	0.28	0.33			0.110	0.90	0.030
3	3.55	0.28	0.23			0.130	0.95	0.026
4	4.50	0.31	0.30			0.070	0.88	0.017
5	5.30	0.34	0.31			0.070	0.80	0.016
Right Bank	6.10	0.34	0.00			0.000	-2.65	0.000
								0.098

Notes:
1.) Water elevation 97.493m based on TBM elevation 100 590m (top of T-bar) (0956 hrs)
2.) Applied 0.92 factor for under-ice flow
3.) Top of ice elevation 97.564m

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Calumet River
LOCATION: S16
COORDINATES: 6361693N / 458152E

MEASUREMENT DATE: 12 May 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/NS
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1200 hrs.
MEASUREMENT END TIME: 1214 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.30		0.00			0.000	0.25	0.000
1	0.50		0.72	-0.02	-0.03	-0.025	0.30	-0.005
2	0.90		0.98	0.08	0.10	0.090	0.40	0.035
3	1.30		0.99	0.24	0.22	0.230	0.40	0.091
4	1.70		1.02	0.44	0.25	0.345	0.40	0.141
5	2.10		1.03	0.50	0.22	0.360	0.40	0.148
6	2.50		0.98	0.48	0.28	0.380	0.40	0.149
7	2.90		0.94	0.58	0.45	0.515	0.40	0.194
8	3.30		0.90	0.45	0.34	0.395	0.40	0.142
9	3.70		0.75	0.45	0.02	0.235	0.40	0.071
10	4.10		0.76	0.15	0.07	0.110	0.40	0.033
11	4.50		0.69			0.100	0.35	0.024
Right Bank	4.80		0.00			0.000	-2.25	0.000
								1.023

Notes
1) Water elevation at transducer 98.732m based on TBM elevation 100 000m (nail in tree) (1150 hrs)
2) Top of staff gauge 99.213m
3) Staff gauge reading 0 457m (zero at top of gauge)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Calumet River
LOCATION: S16
COORDINATES: 6361693N / 458152E

MEASUREMENT DATE: 11 June 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/ME
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 0900 hrs.
MEASUREMENT END TIME: 1230 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.10		0.00			0.000	0.25	0.000
1	0.50		0.31			0.020	0.45	0.003
2	1.00		0.40			0.050	0.50	0.010
3	1.50		0.58			0.080	0.50	0.023
4	2.00		0.62			0.090	0.50	0.028
5	2.50		0.74			0.070	0.50	0.026
6	3.00		0.64			0.150	0.50	0.048
7	3.50		0.70			0.180	0.50	0.063
8	4.00		0.72			0.170	0.50	0.061
9	4.50		0.60			0.210	0.50	0.063
10	5.00		0.50			0.250	0.50	0.063
11	5.50		0.44			0.320	0.50	0.070
12	6.00		0.60			0.260	0.50	0.078
Right Bank	6.50		0.00			0.000	-3.00	0.000
								0.536

Notes:
1.) Water elevation at transducer 98.540m based on TBM elevation 100 000 m (nail in tree) (1116 hrs)
2) Installed new BM elevation 100 618m top of T-bar
3) Installed air temp probe/raingauges/water temp probe
4) Transducer was moved after survey - it was working after rewiring the transducer probe

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Calumet River
LOCATION: S16
COORDINATES: 6361693N / 458152E

MEASUREMENT DATE: 10 July 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JE
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1300 hrs.
MEASUREMENT END TIME: 1350 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.10		0.00			0.000	0.20	0.000
1	0.40		0.18			0.210	0.25	0.009
2	0.60		0.18			0.180	0.20	0.006
3	0.80		0.16			0.210	0.20	0.007
4	1.00		0.18			0.240	0.20	0.009
5	1.20		0.20			0.270	0.20	0.011
6	1.40		0.24			0.280	0.20	0.013
7	1.60		0.24			0.280	0.20	0.013
8	1.80		0.24			0.260	0.20	0.012
9	2.00		0.24			0.220	0.20	0.011
10	2.20		0.12			0.200	0.20	0.005
11	2.40		0.23			0.210	0.20	0.010
12	2.60		0.14			0.210	0.20	0.006
13	2.80		0.21			0.220	0.20	0.009
14	3.00		0.20			0.300	0.20	0.012
15	3.20		0.08			0.290	0.20	0.005
16	3.40		0.08			0.340	0.20	0.005
17	3.60		0.08			0.290	0.20	0.005
18	3.80		0.06			0.290	0.20	0.003
19	4.00		0.08			0.220	0.20	0.004
20	4.20		0.06			0.100	0.23	0.001
Right Bank	4.45		0.00			0.000	-2.10	0.000
								0.157

Notes: 1.) Water elevation at transducer 98 435m based on TBM elevation 100 618m (top of T-bar) (1335 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Calumet River
LOCATION: S16
COORDINATES: 6361693N / 458152E

MEASUREMENT DATE: 9 August 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1230 hrs.
MEASUREMENT END TIME: 1245 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	-0.50		0.00			0.000	0.00	0.000
1	0.00		0.20			0.020	0.50	0.002
2	0.50		0.18			0.010	0.50	0.001
3	1.00		0.23			0.040	0.50	0.005
4	1.50		0.38			0.030	0.50	0.006
5	2.00		0.40			0.110	0.50	0.022
6	2.50		0.44			0.140	0.50	0.031
7	3.00		0.48			0.160	0.50	0.038
8	3.50		0.56			0.170	0.50	0.048
9	4.00		0.59			0.160	0.50	0.047
10	4.50		0.48			0.220	0.50	0.053
11	5.00		0.41			0.200	0.50	0.041
12	5.50		0.34			0.220	0.50	0.037
13	6.00		0.32			0.230	0.45	0.033
Right Bank	6.40		0.00			0.000	-3.00	0.000
								0.364

Notes. 1) Water elevation at transducer 98.523m based on TBM elevation 100.000m (nail in tree) (1230 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Calumet River
LOCATION: S16
COORDINATES: 6361693N / 458152E

MEASUREMENT DATE: 15 September 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/NS
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1550 hrs.
MEASUREMENT END TIME: 1559 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00		0.00			0.000	0.10	0.000
1	0.20		0.07			0.020	0.20	0.000
2	0.40		0.15			0.020	0.20	0.001
3	0.60		0.16			0.470	0.20	0.015
4	0.80		0.18			0.050	-0.25	-0.002
5	0.10		0.15			-0.040	0.20	-0.001
6	1.20		0.17			0.070	0.65	0.008
7	1.40		0.17			0.440	0.20	0.015
8	1.60		0.20			0.240	0.20	0.010
9	1.80		0.24			0.170	0.20	0.008
10	2.00		0.24			0.080	0.20	0.004
11	2.20		0.23			0.170	0.20	0.008
12	2.40		0.24			0.200	0.20	0.010
13	2.60		0.20			0.160	0.20	0.006
14	2.80		0.16			0.130	0.20	0.004
15	3.00		0.08			0.090	0.20	0.001
16	3.20		0.07			0.100	0.20	0.001
17	3.40		0.00			0.000	0.19	0.000
18	3.57		0.00			0.000	0.10	0.000
19	3.60		0.04			0.100	0.07	0.000
20	3.70		0.08			0.010	0.20	0.000
21	4.00		0.00			0.000	0.20	0.000
22	4.10		0.00			0.000	0.10	0.000
23	4.20		0.04			-0.080	0.10	0.000
24	4.30		0.00			0.000	0.10	0.000
25	4.40		0.00			0.000	0.09	0.000
26	4.47		0.08			0.000	0.10	0.000
Right Bank	4.60		0.00			0.000	-2.24	0.000
								0.088

Notes 1) Water elevation at transducer 98 415m based on TBM elevation 100 623m (T-bar) (1605 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Calumet River
LOCATION: S16
COORDINATES: 6361693N / 458152E

MEASUREMENT DATE: 31 October 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JG
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1442 hrs.
MEASUREMENT END TIME: 1450 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00	0.00	0.00			0.000	0.35	0.000
1	0.70	0.08	0.05			0.070	0.50	0.002
2	1.00	0.09	0.07			0.070	0.30	0.001
3	1.30	0.10	0.07			0.070	0.25	0.001
4	1.50	0.10	0.14			0.070	0.25	0.002
5	1.80	0.10	0.20			0.010	0.30	0.001
6	2.10	0.10	0.07			0.050	0.30	0.001
7	2.40	0.10	0.06			0.080	0.35	0.002
8	2.80	0.10	0.06			0.060	0.35	0.001
9	3.10	0.10	0.04			0.080	0.35	0.001
10	3.50	0.08	0.02			0.040	0.55	0.000
Right Bank	4.20	0.00	0.00			0.000	-1.75	0.000
								0.012

Notes: 1.) Water elevation at transducer 98 391m based on TBM elevation 100 623m (T-bar) (1442 hrs)
2) Applied 0.92 factor for ice cover

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7030
DISCHARGE DATA

STREAM NAME: Tar River Upland
LOCATION: S17
COORDINATES: 6357804N / 444486E

MEASUREMENT DATE: 12 May 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/NS
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 1730 hrs.
MEASUREMENT END TIME: 1735 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.50		0.00			0.000	0.30	0.000
1	0.60		0.24			0.300	0.10	0.007
2	0.70		0.36			0.550	0.10	0.020
3	0.80		0.36			0.600	0.10	0.022
4	0.90		0.40			0.540	0.10	0.022
5	1.00		0.36			0.620	0.10	0.022
6	1.10		0.36			0.300	0.10	0.011
7	1.20		0.12			0.560	0.10	0.007
8	1.30		0.20			0.100	0.10	0.002
9	1.40		0.14			0.070	0.16	0.002
Right Bank	1.61		0.00			0.000	-0.70	0.000
								0.114

Notes: 1.) Water elevation at transducer 98 604m based on TBM elevation 100 000m (nail in tree) (1726 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7030
DISCHARGE DATA

STREAM NAME: Tar River Upland
LOCATION: S17
COORDINATES: 6357804N / 444486E

MEASUREMENT DATE: 12 May 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/NS
COMPUTATIONS BY: NS

MEASUREMENT START TIME: 1445 hrs.
MEASUREMENT END TIME: 1455 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.80		0.00			0.000	0.50	0.000
1	1.00		0.09			0.000	0.20	0.000
2	1.20		0.08			0.010	0.20	0.000
3	1.40		0.14			0.080	0.20	0.002
4	1.60		0.20			0.160	0.20	0.006
5	1.80		0.26			0.100	0.20	0.005
6	2.00		0.34			0.060	0.20	0.004
7	2.20		0.42			0.250	0.20	0.021
8	2.40		0.46			0.260	0.20	0.024
9	2.60		0.56			0.240	0.20	0.027
10	2.80		0.60			0.230	0.20	0.028
11	3.00		0.64			0.230	0.20	0.029
12	3.20		0.60			0.220	0.15	0.020
Right Bank	3.30		0.00			0.000	-1.60	0.000
								0.167

Notes:
1.) Water elevation at transducer 97.334m based on TBM elevation 100.000m (nail in tree)
2) Top of staff gauge at 97.739m
3) Staff gauge reading 0.594m

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Tar River Upland
LOCATION: S17
COORDINATES: 6357804N / 444486E

MEASUREMENT DATE: 11 June 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/ME
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1500 hrs.
MEASUREMENT END TIME: 1540 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.00			0.000	0.10	0.000
1	0.20		0.07			-0.030	0.20	0.000
2	0.40		0.10			-0.010	0.20	0.000
3	0.60		0.12			0.010	0.20	0.000
4	0.80		0.12			0.030	0.20	0.001
5	1.00		0.14			0.100	0.20	0.003
6	1.20		0.20			0.230	0.20	0.009
7	1.40		0.19			0.260	0.20	0.010
8	1.60		0.15			0.070	0.20	0.002
9	1.80		0.09			0.010	0.20	0.000
10	2.00		0.07			-0.020	0.13	0.000
Right Bank	2.05		0.00			0.000	-1.00	0.000
								0.024

Notes:
1) Water elevation at transducer 98 423m based on TBM elevation 100.000m (nail in tree) (1525 hrs)
2) Top of staff gauge elevation 99.196m
3.) Staff gauge reading 0 229m
4.) Thermistor string installed

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Tar River Upland
LOCATION: S17
COORDINATES: 6357804N / 444486E

MEASUREMENT DATE: 9 Aug 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1048 hrs.
MEASUREMENT END TIME: 1100 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.00			0.000	0.15	0.000
1	0.30		0.06			-0.030	0.20	0.000
2	0.40		0.05			-0.020	0.10	0.000
3	0.50		0.09			0.030	0.10	0.000
4	0.60		0.10			0.050	0.10	0.001
5	0.70		0.08			0.000	0.10	0.000
6	0.80		0.09			-0.010	0.10	0.000
7	0.90		0.02			0.000	0.15	0.000
Right Bank	1.10		0.00			0.000	-0.45	0.000
								0.000

Notes: 1) Water elevation at transducer 98.326m based on TBM elevation 100.000m (nail in tree) (1058 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Tar River Upland
LOCATION: S17
COORDINATES: 6357804N / 444486E

MEASUREMENT DATE: 15 September 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/NS
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1720 hrs.
MEASUREMENT END TIME: 1727 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00		0.00			0.000	0.05	0.000
1	0.10		0.04			0.000	0.08	0.000
2	0.15		0.04			0.000	0.05	0.000
3	0.20		0.06			0.000	0.05	0.000
4	0.25		0.07			-0.010	0.05	0.000
5	0.30		0.06			-0.010	0.05	0.000
6	0.35		0.07			-0.020	0.05	0.000
7	0.40		0.10			-0.010	0.05	0.000
8	0.45		0.10			-0.010	0.05	0.000
9	0.50		0.10			-0.010	0.05	0.000
10	0.55		0.10			0.010	0.05	0.000
11	0.60		0.13			0.060	0.05	0.000
12	0.65		0.13			0.040	0.05	0.000
13	0.70		0.14			0.040	0.05	0.000
14	0.75		0.13			0.010	0.05	0.000
15	0.80		0.14			0.010	0.05	0.000
16	0.85		0.14			0.020	0.05	0.000
17	0.90		0.14			0.000	0.05	0.000
18	0.95		0.14			0.000	0.05	0.000
19	1.00		0.12			0.000	0.05	0.000
20	1.05		0.04			0.000	0.05	0.000
21	1.10		0.04			0.000	0.05	0.000
22	1.15		0.06			0.000	0.26	0.000
Right Bank	1.61		0.00			0.000	-0.58	0.000
								0.0010

Notes: 1.) Water elevation at transducer 97.471m based on TBM elevation 99.963m (T-Bar) (1720 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Tar River Upland
LOCATION: S17
COORDINATES: 6357804N / 444486E

MEASUREMENT DATE: 31 October 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: JG
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 1245 hrs.
MEASUREMENT END TIME:

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank								0.000
1								0.000
2								0.000
3								0.000
4								0.000
5								0.000
6								0.000
7								0.000
Right Bank								0.000
								0.000

Notes: 1) No flow - stagnant water
2.) Water elevation 97 507m based on BM elevation 100.000m (nail in tree)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Calumet River Upland
LOCATION: S18
COORDINATES: 6367135N / 452701E

MEASUREMENT DATE: 12 May 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/NS
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1445 hrs.
MEASUREMENT END TIME: 1455 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.80		0.00			0.000	0.50	0.000
1	1.00		0.09			0.000	0.20	0.000
2	1.20		0.08			0.010	0.20	0.000
3	1.40		0.14			0.080	0.20	0.002
4	1.60		0.20			0.160	0.20	0.006
5	1.80		0.26			0.100	0.20	0.005
6	2.00		0.34			0.060	0.20	0.004
7	2.20		0.42			0.250	0.20	0.021
8	2.40		0.46			0.260	0.20	0.024
9	2.60		0.56			0.240	0.20	0.027
10	2.80		0.60			0.230	0.20	0.028
11	3.00		0.64			0.230	0.20	0.029
12	3.20		0.60			0.220	0.15	0.020
Right Bank	3.30		0.00			0.000	-1.60	0.000
								0.167

Notes
1) Water elevation at transducer 97 334m based on TBM elevation 100.000m (nail in tree)
2) Top of staff gauge elevation 97 739m
3) Staff gauge reading 0 594m

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Calumet River Upland
LOCATION: S18
COORDINATES: 6367135N / 452701E

MEASUREMENT DATE: 11 June 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/ME
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1330 hrs.
MEASUREMENT END TIME: 1415 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.40		0.00			0.000	0.30	0.000
1	0.60		0.48			0.010	0.20	0.001
2	0.80		0.50			-0.020	0.20	-0.002
3	1.00		0.54			0.030	0.20	0.003
4	1.20		0.56			0.210	0.20	0.024
5	1.40		0.48			0.170	0.20	0.016
6	1.60		0.34			0.210	0.20	0.014
7	1.80		0.32			0.150	0.20	0.010
8	2.00		0.38			0.070	0.20	0.005
9	2.20		0.42			0.220	0.20	0.018
10	2.40		0.50			0.310	0.20	0.031
11	2.60		0.50			0.570	0.20	0.057
12	2.80		0.40			0.660	0.20	0.053
Right Bank	3.00		0.00			0.000	-1.40	0.000
								0.231

Notes:
1) Water elevation at transducer 97 424m based on TBM elevation 100 000m (nail in tree) (1400 hrs)
2.) Not able to auger for the post as the ground was still frozen
3) Calumet Lake 57° 25.418'/111° 46 143' no place to land by chopper - have to hike to the lake shore if need to install staff gauge

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Calumet River Upland
LOCATION: S18
COORDINATES: 6367135N / 452701E

MEASUREMENT DATE: 10 July 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JE
COMPUTATIONS BY: RS

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

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes:
1) Water elevation 97.589m (1448 hrs)
2) Top of staff gauge to water level 0 085m (1428 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Calumet River Upland
LOCATION: S18
COORDINATES: 6367135N / 452701E

MEASUREMENT DATE: 09 August 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 1130 hrs.
MEASUREMENT END TIME: 1150 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes:
1) Water elevation 98 256m based on BM elevation 100 00m (1140 hrs)
2) Area flooded by beaver dam downstream
3) No flow measurments taken - water level too high

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Calumet River Upland
LOCATION: S18
COORDINATES: 6367135N / 452701E

MEASUREMENT DATE: 31 October 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: JG
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 1600 hrs.
MEASUREMENT END TIME:

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes
1) Lost transducer and temperature probe
2.) Top of T-bar at least 1 5m below ice surface
3) Area flooded due to beaver dam
4) No flow measurements taken and water elevation not surveyed

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Tar River Lowland
LOCATION: S19
COORDINATES: 6352849N / 457329E

MEASUREMENT DATE: 9 May 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/NS
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1852 hrs.
MEASUREMENT END TIME: 1900 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.40		0.10			0.000	0.25	0.000
1	0.50		0.10			0.030	0.10	0.000
2	0.60		0.16			0.460	0.10	0.007
3	0.70		0.17			0.600	0.10	0.010
4	0.80		0.16			0.640	0.10	0.010
5	0.90		0.10			0.320	0.10	0.003
Right Bank	1.00		0.10			0.000	-0.45	0.000
								0.031

Notes: 1.) Top of pin elevation 99.409m based on TBM elevation 100.000m (nail in tree)
2) Water elevation at gauge 99.390m

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Tar River Lowland
LOCATION: S19
COORDINATES: 6352849N / 457329E

MEASUREMENT DATE: 13 June 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/ME
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1520 hrs.
MEASUREMENT END TIME: 1650 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.00			0.000	0.05	0.000
1	0.10		0.22			0.140	0.10	0.003
2	0.20		0.22			0.280	0.10	0.006
3	0.30		0.26			0.250	0.10	0.007
4	0.40		0.26			0.300	0.10	0.008
5	0.50		0.30			0.290	0.10	0.009
6	0.60		0.30			0.310	0.10	0.009
7	0.70		0.26			0.280	0.10	0.007
8	0.80		0.24			0.280	0.10	0.007
9	0.90		0.22			0.230	0.10	0.005
10	1.00		0.14			0.250	0.10	0.004
11	1.10		0.16			0.210	0.10	0.003
12	1.20		0.08			0.100	0.08	0.001
Right Bank	1.26		0.00			0.000	-0.60	0.000
								0.068

Notes
1.) TBM elevation 100 000m (nail in tree - stump)
2.) Water elevation 99 432m (1602 hrs)
3.) Water elevation 99 424m (1650 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Tar River Lowland
LOCATION: S19
COORDINATES: 6352849N / 457329E

MEASUREMENT DATE: 21 June 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/TC
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1230 hrs.
MEASUREMENT END TIME: 1330 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.10		0.00			0.000	0.10	0.000
1	0.20		0.15			0.250	0.10	0.004
2	0.30		0.16			0.250	0.10	0.004
3	0.40		0.15			0.230	0.10	0.003
4	0.50		0.16			0.170	0.10	0.003
5	0.60		0.18			0.190	0.10	0.003
6	0.70		0.18			0.190	0.10	0.003
7	0.80		0.16			0.150	0.10	0.002
8	0.90		0.12			0.060	0.10	0.001
9	1.00		0.06			0.000	0.12	0.000
Right Bank	1.14		0.00			0.000	-0.50	0.000
								0.024

Notes:
1) TBM elevation 100 000m (nail in tree - stump)
2) Water elevation 99.369m (1308 hrs)
3) Water temperature 13.3 degree C. (1310 hrs)
4) Post augered and erected

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Tar River Lowland
LOCATION: S19
COORDINATES: 6352849N / 457329E

MEASUREMENT DATE: 4 July 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: TC/PM
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1700 hrs.
MEASUREMENT END TIME: 1830 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.09		0.00			0.000	0.08	0.000
1	0.15		0.20			0.280	0.06	0.003
2	0.20		0.20			0.270	0.05	0.003
3	0.25		0.21			0.260	0.05	0.003
4	0.30		0.21			0.250	0.05	0.003
5	0.35		0.21			0.240	0.05	0.003
6	0.40		0.20			0.230	0.05	0.002
7	0.45		0.21			0.210	0.05	0.002
8	0.50		0.21			0.210	0.05	0.002
9	0.55		0.21			0.190	0.05	0.002
10	0.60		0.21			0.180	0.05	0.002
11	0.65		0.20			0.150	0.05	0.002
12	0.70		0.20			0.130	0.05	0.001
13	0.75		0.19			0.120	0.05	0.001
14	0.80		0.15			0.110	0.05	0.001
15	0.85		0.07			0.120	0.05	0.000
16	0.90		0.07			0.070	0.05	0.000
17	0.95		0.06			0.040	0.05	0.000
18	1.00		0.05			0.030	0.09	0.000
Right Bank	1.13		0.00			0.000	-0.50	0.000
								0.030

Notes: 1) TBM elevation 100.000m (nail in tree - stump)
2) Water elevation 99.442m (1830 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Tar River Lowland
LOCATION: S19
COORDINATES: 6352849N / 457329E

MEASUREMENT DATE: 8 July 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1730 hrs.
MEASUREMENT END TIME: 1800 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.10		0.00			0.000	0.10	0.000
1	0.20		0.11			0.080	0.10	0.001
2	0.30		0.09			0.070	0.10	0.001
3	0.40		0.12			0.320	0.10	0.004
4	0.50		0.10			0.520	0.10	0.005
5	0.60		0.07			0.530	0.10	0.004
6	0.70		0.08			0.670	0.10	0.005
7	0.80		0.05			0.360	0.08	0.001
Right Bank	0.86		0.00			0.000	-0.40	0.000
								0.021

Notes: 1) TBM elevation 100.000m (nail in tree - stump)
2) Water elevation 99.386m (1741 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Tar River Lowland
LOCATION: S19
COORDINATES: 6352849N / 457329E

MEASUREMENT DATE: 6 August 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1715 hrs.
MEASUREMENT END TIME: 1740 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.00			0.000	0.05	0.000
1	0.10		0.13			0.140	0.10	0.002
2	0.20		0.11			0.140	0.10	0.002
3	0.30		0.13			0.160	0.10	0.002
4	0.40		0.15			0.150	0.10	0.002
5	0.50		0.15			0.180	0.10	0.003
6	0.60		0.16			0.190	0.10	0.003
7	0.70		0.15			0.190	0.10	0.003
8	0.80		0.14			0.170	0.10	0.002
9	0.90		0.12			0.150	0.10	0.002
10	1.00		0.13			0.140	0.10	0.002
11	1.10		0.13			0.110	0.10	0.001
12	1.20		0.10			0.090	0.10	0.001
13	1.30		0.08			0.070	0.10	0.001
14	1.40		0.09			0.040	0.10	0.000
15	1.50		0.08			0.020	0.08	0.000
Right Bank	1.56		0.00			0.000	-0.75	0.000
								0.026

Notes:
1) TBM elevation 100 000m (nail in tree - stump)
2) Water elevation 99 482m (1735 hrs)
3) Wooden debris blocking the channel - cleared at 1740 hrs

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Tar River Lowland
LOCATION: S19
COORDINATES: 6352849N / 457329E

MEASUREMENT DATE: 11 September 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/NS
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1010 hrs.
MEASUREMENT END TIME: 1020 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.30		0.00			0.000	0.20	0.000
1	0.40		0.04			-0.010	0.10	0.000
2	0.50		0.07			-0.030	0.10	0.000
3	0.60		0.08			0.050	0.10	0.000
4	0.70		0.09			0.080	0.10	0.001
5	0.80		0.09			0.090	0.10	0.001
6	0.90		0.09			0.100	0.10	0.001
7	1.00		0.07			0.080	0.10	0.001
8	1.10		0.06			0.080	0.10	0.000
9	1.20		0.05			0.050	0.10	0.000
10	1.30		0.04			-0.020	0.16	0.000
Right Bank	1.52		0.00			0.000	-0.65	0.000
								0.004

Notes.
1) TBM elevation 100 000m (nail in tree - stump)
2) Water elevation 99 555m (1007 hrs) before clearing weir of debris
3) Wooden debris blocking the channel - cleared at 1020 hrs
4) Water elevatioin 99.367m (1125 hrs) after clearing debris and letting pool drain and stabilize level

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Tar River Lowland
LOCATION: S19
COORDINATES: 6352849N / 457329E

MEASUREMENT DATE: 30 October 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: JG
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1344 hrs.
MEASUREMENT END TIME: 1405 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00		0.00			0.000	0.06	0.000
1	0.12		0.08			0.020	0.10	0.000
2	0.20		0.10			0.110	0.09	0.001
3	0.30		0.08			0.110	0.10	0.001
4	0.40		0.06			0.090	0.10	0.001
5	0.50		0.06			0.000	0.10	0.000
6	0.60		0.06			0.010	0.13	0.000
Right Bank	0.75		0.00			0.000	-0.30	0.000
								0.003

Notes:
1) TBM elevation 100 000m (nail in tree - stump)
2.) Water elevation 99.361m (1344 hrs)
3) Removed sensors for winter

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

STREAM NAME: Tar River Lowland
LOCATION: S19
COORDINATES: 6352849N / 457329E

MEASUREMENT DATE: 07 December 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JE
COMPUTATIONS BY: LL

MEASUREMENT START TIME: 0943 hrs.
MEASUREMENT END TIME: 0950 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.90	0.34	0.00			0.000	0.88	0.000
1	1.75	0.33	0.14			0.080	0.85	0.009
2	2.60	0.28	0.33			0.110	0.90	0.030
3	3.55	0.28	0.23			0.130	0.95	0.026
4	4.50	0.31	0.30			0.070	0.88	0.017
5	5.30	0.34	0.31			0.070	-1.88	-0.037
Right Bank	0.75	0.34	0.00			0.000	-2.65	0.000
								0.044

Notes
1) Water elevation 97 493m based on station reference to top of T-Bar BM (0956 hrs)
2) Top of ice elevation 97 564m

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7030
DISCHARGE DATA

STREAM NAME: Muskeg River Upland
LOCATION: S20
COORDINATES: 6354787N / 492178E

MEASUREMENT DATE: 21 April 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: LL/RS

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

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.00			0.000	0.25	0.000
1	0.50		0.40			0.160	0.5	0.032
2	1.00		0.48			0.190	0.5	0.046
3	1.50		0.46			0.220	0.5	0.051
4	2.00		0.33			0.330	0.5	0.054
5	2.50		0.49			0.250	0.5	0.061
6	3.00		0.50			0.180	0.5	0.045
7	3.50		0.48			0.030	0.5	0.007
8	4.00		0.48			0.050	0.5	0.012
9	4.50		0.46			-0.010	0.5	-0.002
Right Bank	5.00		0.00			0.000	-2.25	0.000
								0.306

Notes. 1) Water elevation 99.994m based on TBM elevation 100 000m (nail in tree)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Muskeg River Upland
LOCATION: S20
COORDINATES: 6354787N / 492178E

MEASUREMENT DATE: 8 May 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/NS
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1200 hrs.
MEASUREMENT END TIME: 1400 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	4.70		0.00			0.000	2.50	0.000
1	5.00		0.22			0.050	0.30	0.003
2	5.30		0.38			0.060	0.30	0.007
3	5.60		0.49			0.080	0.30	0.012
4	5.90		0.60			0.320	0.30	0.058
5	6.20		0.57			0.250	0.30	0.043
6	6.50		0.63			0.280	0.30	0.053
7	6.80		0.64			0.260	0.30	0.050
8	7.10		0.74			0.180	0.30	0.040
9	7.40		0.88			0.270	0.30	0.071
10	7.70		0.92			0.310	0.30	0.086
11	8.00		0.98			0.350	0.30	0.103
12	8.30		0.92			0.370	0.30	0.102
13	8.60		0.94			0.420	0.30	0.118
14	8.90		0.90			0.370	0.30	0.100
15	9.20		0.94			0.370	0.30	0.104
16	9.50		0.93			0.300	0.30	0.084
17	9.80		0.95			0.220	0.30	0.063
18	10.10		0.95			0.150	0.30	0.043
19	10.40		0.94			0.090	0.30	0.025
20	10.70		0.91			0.140	0.30	0.038
21	11.00		0.82			0.050	0.30	0.012
22	11.30		0.69			0.010	0.45	0.003
Right Bank	11.90		0.00			0.000	-5.65	0.000
								1.218

Notes
1) Water elevation at transducer 98 336m based on TBM elevation 100 000m (nail in tree)
2) Top of pin elevation 98 590m
3) Current water elevation at site of April 21 water level measurement 98 342m (1435 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Muskeg River Upland
LOCATION: S20
COORDINATES: 6354787N / 492178E

MEASUREMENT DATE: 10 June 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/ME
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 0830 hrs.
MEASUREMENT END TIME: 1030 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.75		0.00			0.000	0.5	0.000
1	1.00		0.14			0.020	0.625	0.002
2	2.00		0.37			0.070	1	0.026
3	3.00		0.65			0.100	1	0.065
4	4.00		0.57			0.260	1	0.148
5	5.00		0.62			0.300	1	0.186
6	6.00		0.63			0.130	1	0.082
7	7.00		0.70			0.100	0.95	0.067
Right Bank	7.90		0.00			0.000	-3.5	0.000
								0.575

Notes:
1.) Water elevation 98 149m based on BM elevation 100.00m (nail by tree) (1000 hrs)
2) Not able to auger for the post as ground was still frozen
3) Transducer was moved after water elevation survey

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Muskeg River Upland
LOCATION: S20
COORDINATES: 6354787N / 492178E

MEASUREMENT DATE: 8 July 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1000 hrs.
MEASUREMENT END TIME: 1200 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.50		0.00			0.000	0.5	0.000
1	1.00		0.10			0.010	0.5	0.001
2	1.50		0.35			0.050	0.5	0.009
3	2.00		0.33			0.140	0.5	0.023
4	2.50		0.51			0.150	0.5	0.038
5	3.00		0.52			0.150	0.5	0.039
6	3.50		0.60			0.170	0.5	0.051
7	4.00		0.68			0.380	0.5	0.129
8	4.50		0.70			0.330	0.5	0.116
9	5.00		0.70			0.330	0.5	0.116
10	5.50		0.66			0.310	0.5	0.102
11	6.00		0.70			0.260	0.5	0.091
12	6.50		0.72			0.130	0.5	0.047
13	7.00		0.80			0.180	0.5	0.072
14	7.50		0.70			0.160	0.5	0.056
15	8.00		0.54			0.050	0.55	0.015
Right Bank	8.60		0.00			0.000	-4	0.000
								0.904

Notes: 1) Water elevation 98 238m based on BM elevation 100.00m (nail by tree) (1130 hrs)
2) Completed augered post installation

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Muskeg River Upland
LOCATION: S20
COORDINATES: 6354787N / 492178E

MEASUREMENT DATE: 6 August 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 0930 hrs.
MEASUREMENT END TIME: 1023 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.95		0.00			0.000	0.75	0.000
1	1.50		0.15			0.020	0.525	0.002
2	2.00		0.23			0.020	0.5	0.002
3	2.50		0.35			0.030	0.5	0.005
4	3.00		0.46			0.130	0.5	0.030
5	3.50		0.50			0.100	0.5	0.025
6	4.00		0.56			0.190	0.5	0.053
7	4.50		0.54			0.210	0.5	0.057
8	5.00		0.53			0.210	0.5	0.056
9	5.50		0.51			0.200	0.5	0.051
10	6.00		0.56			0.200	0.5	0.056
11	6.50		0.62			0.120	0.5	0.037
12	7.00		0.59			0.130	0.5	0.038
13	7.50		0.54			0.080	0.5	0.022
14	8.00		0.42			0.010	0.4	0.002
Right Bank	8.30		0.00			0.000	-4	0.000
								0.435

Notes: 1.) Water elevation 98 104m based on BM elevation 100 00m (nail by tree) (1015 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Muskeg River Upland
LOCATION: S20
COORDINATES: 6354787N / 492178E

MEASUREMENT DATE: 19 September 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/NF
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 1000 hrs.
MEASUREMENT END TIME: 1045 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes:
Note
1) Water elevation 98 684m (1028 hrs)
2) Beaver Dam was observed downstream of the station (i e. water level at the gauging station was high)
3) Noted a flooded area close to station
4) No flow measurements taken

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Muskeg River Upland
LOCATION: S20
COORDINATES: 6354787N / 492178E

MEASUREMENT DATE: 27 October 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: JG
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 1046 hrs.
MEASUREMENT END TIME: 1030 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes: 1) Instrument area flooded
2) No flow measurements taken

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7030
DISCHARGE DATA

STREAM NAME: Shelley Creek
LOCATION: S21
COORDINATES: 6347933N / 476419E

MEASUREMENT DATE: 15 March 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: LL

MEASUREMENT START TIME: 1410 hrs.
MEASUREMENT END TIME: 1430 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00	0.65	0.00			0.000	0.8	0.000
1	1.60	0.65	0.00			0.000	2.15	0.000
2	4.30	0.77	0.33			0.400	3.25	0.395
3	8.10	0.84	0.00			0.000	3.6	0.000
4	11.50	0.74	0.22			0.430	3.125	0.272
5	14.35	0.65	0.22			0.510	2.9	0.299
6	17.30	0.63	0.15			0.500	2.775	0.191
7	19.90	0.66	0.06			0.150	1.85	0.015
Right Bank	21.00	0.66	0.00			0.000	-9.95	0.000
								1.173

Notes 1) Flow measurement carried out at the old WSC station
2.) Water elevation not surveyed

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Shelley Creek
LOCATION: S21
COORDINATES: 6347933N / 476419E

MEASUREMENT DATE: 14 May 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/NS
COMPUTATIONS BY: NS

MEASUREMENT START TIME: 1525 hrs.
MEASUREMENT END TIME: 1550 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.00			0.000	0.04	0.000
1	0.08		0.55			0.010	0.55	0.003
2	1.10		0.57			0.020	0.66	0.008
3	1.40		0.60			0.010	0.30	0.002
4	1.70		0.66			0.020	0.25	0.003
5	1.90		0.66			0.020	0.20	0.003
6	2.10		0.69			0.020	0.20	0.003
7	2.30		0.70			0.040	0.20	0.006
8	2.50		0.70			0.040	0.20	0.006
9	2.70		0.62			0.020	0.20	0.002
10	2.90		0.60			0.010	0.25	0.002
11	3.20		0.58			0.010	0.35	0.002
12	3.60		0.50			0.010	0.40	0.002
13	4.00		0.48			0.010	0.45	0.002
14	4.50		0.38			0.020	0.50	0.004
15	5.00		0.28			0.010	0.75	0.002
16	6.00		0.25			0.010	1.25	0.003
Right Bank	7.50		0.00			0.000	-3.00	0.000
								0.051

Notes
1.) Water elevation at transducer 99 639m based on TBM elevation 100.000m (nail in tree)
2.) Top of pin elevation 100.062m

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Shelley Creek
LOCATION: S21
COORDINATES: 6347933N / 476419E

MEASUREMENT DATE: 12 June 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/ME
COMPUTATIONS BY: LL/RS

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

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.00			0.000	0.20	0.000
1	0.40		0.18			0.010	0.35	0.001
2	0.70		0.30			0.030	0.25	0.002
3	0.90		0.40			0.030	0.20	0.002
4	1.10		0.48			0.030	0.20	0.003
5	1.30		0.57			0.030	0.20	0.003
6	1.50		0.57			0.020	0.20	0.002
7	1.70		0.60			0.030	0.20	0.004
8	1.90		0.71			0.030	0.20	0.004
9	2.10		0.72			0.040	0.20	0.006
10	2.30		0.78			0.040	0.25	0.008
11	2.60		0.72			0.030	0.25	0.005
12	2.80		0.54			0.020	0.20	0.002
13	3.00		0.54			0.040	0.20	0.004
14	3.20		0.50			0.020	0.20	0.002
15	3.40		0.56			0.020	0.20	0.002
16	3.60		0.50			0.020	0.20	0.002
17	3.80		0.46			0.010	0.20	0.001
18	4.00		0.38			0.020	0.20	0.002
19	4.20		0.35			0.020	0.20	0.001
20	4.40		0.35			0.020	0.20	0.001
21	4.60		0.34			0.020	0.20	0.001
22	4.80		0.30			0.020	0.20	0.001
23	5.00		0.28			0.000	0.35	0.000
Right Bank	5.50		0.30			0.000	-2.50	0.000
								0.061

Notes 1) Water elevation at transducer 99 629m based on TBM elevation 100 000m (nail in tree) (1315 hrs)
2) Installed thermistor string

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Shelley Creek
LOCATION: S21
COORDINATES: 6347933N / 476419E

MEASUREMENT DATE: 10 July 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JE
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1000 hrs.
MEASUREMENT END TIME: 1045 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00		0.00			0 000	0.25	0 000
1	0.50		0 25			0.040	0 50	0.005
2	1 00		0 30			0.030	0.40	0 004
3	1.30		0.44			0.040	0 25	0.004
4	1 50		0 54			0.030	0.20	0.003
5	1.70		0.58			0 040	0 20	0.005
6	1 90		0.64			0 020	0.20	0.003
7	2 10		0.70			0 040	0.20	0 006
8	2.30		0 75			0.040	0.20	0 006
9	2.50		0 75			0.040	0 20	0.006
10	2 70		0 74			0.050	0.20	0.007
11	2 90		0.64			0.030	0 20	0 004
12	3 10		0.56			0.050	0 20	0 006
13	3 30		0.54			0 040	0 20	0 004
14	3.50		0.50			0 030	0 20	0 003
15	3.70		0 50			0 040	0.20	0.004
16	3 90		0 46			0 040	0.20	0.004
17	4 10		0 44			0.040	0 20	0.004
18	4 30		0.40			0.030	0 20	0 002
19	4 50		0.35			0.030	0 20	0 002
20	4 70		0 24			0 030	0 20	0.001
21	4.90		0.32			0 020	0 20	0 001
22	5 10		0 34			0 040	0.20	0 003
23	5 30		0 34			0 030	0.20	0 002
24	5.50		0.27			0.030	0.35	0.003
25	6 00		0.06			0.020	0 50	0.001
26	6 50		0.06			0.020	0.50	0.001
Right Bank	7 00		0.10			0.000	-3.25	0.000
								0.092

Notes
1) Water elevation at transducer 99 623m based on TBM elevation 100 000m (nail in tree) (1040 hrs)
2) Fixed thermistor string, ground still frozen

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Shelley Creek
LOCATION: S21
COORDINATES: 6347933N / 476419E

MEASUREMENT DATE: 9 August 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: NS/RS

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

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.00			0.000	0.10	0.000
1	0.20		0.06			-0.010	0.20	0.000
2	0.40		0.24			0.010	0.20	0.000
3	0.60		0.24			0.020	0.20	0.001
4	0.80		0.30			0.010	0.20	0.001
5	1.00		0.40			0.010	0.20	0.001
6	1.20		0.48			0.010	0.20	0.001
7	1.40		0.52			0.010	0.20	0.001
8	1.60		0.60			0.020	0.20	0.002
9	1.80		0.64			0.010	0.20	0.001
10	2.00		0.52			0.010	0.20	0.001
11	2.20		0.48			0.010	0.20	0.001
12	2.40		0.46			0.020	0.20	0.002
13	2.60		0.38			0.010	0.20	0.001
14	2.80		0.32			0.010	0.20	0.001
15	3.00		0.34			0.020	0.20	0.001
16	3.20		0.30			0.010	0.20	0.001
17	3.40		0.24			0.020	0.20	0.001
18	3.60		0.22			0.020	0.20	0.001
19	3.80		0.16			0.020	0.20	0.001
20	4.00		0.14			0.010	0.20	0.000
21	4.20		0.12			0.020	0.20	0.000
22	4.40		0.12			-0.010	0.40	0.000
Right Bank	5.00		0.00			0.000	-2.20	0.000
								0.018

Notes
1) Water elevation at transducer 99 483m based on TBM elevation 100 000m (nail in tree) (1645 hrs)
2) Erected pipe support in concrete foundation

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Shelley Creek
LOCATION: S21
COORDINATES: 6347933N / 476419E

MEASUREMENT DATE: 20 September 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/NF
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 1346 hrs.
MEASUREMENT END TIME: 1400 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00		0.00			0.000	0.10	0.000
1	0.20		0.12			-0.010	0.20	0.000
2	0.40		0.28			0.000	0.20	0.000
3	0.60		0.26			-0.010	0.20	-0.001
4	0.80		0.32			0.000	0.20	0.000
5	1.00		0.38			0.000	0.20	0.000
6	1.20		0.46			0.000	0.20	0.000
7	1.40		0.56			0.000	1.30	0.000
Right Bank	3.80		0.00			0.000	-0.70	0.000
								0.000

Notes: 1.) Water elevation at transducer 99.447m based on TBM elevation 100 000m (nail in tree) (1355 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Shelley Creek
LOCATION: S21
COORDINATES: 6347933N / 476419E

MEASUREMENT DATE: 26 October 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: JG
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 1543 hrs.
MEASUREMENT END TIME: 1543 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes. 1) Water elevation at transducer 99 322m based on TBM elevation 100.000m (nail in tree)
2) No flow measurements taken

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7030
DISCHARGE DATA

STREAM NAME: Muskeg Creek
LOCATION: S22
COORDINATES: 6348856N / 481036E

MEASUREMENT DATE: 21 April 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1045 hrs.
MEASUREMENT END TIME: 1145 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.00			0.000	0.1	0.000
1	0.20		0.22			0.340	0.2	0.015
2	0.40		0.30			0.490	0.2	0.029
3	0.60		0.33			0.460	0.2	0.030
4	0.80		0.35			0.460	0.2	0.032
5	1.00		0.33			0.510	0.2	0.034
6	1.20		0.30			0.460	0.2	0.028
7	1.40		0.26			0.420	0.2	0.022
8	1.60		0.19			0.220	0.15	0.006
Right Bank	1.70		0.00			0.000	-0.8	0.000
								0.196

Notes.
1.) Flow was measured upstream of the bridge - by old existing upright culvert (might be an old monitoring station)
2.) Flow was confined by ice cover
3) Survey of water elevation underneath bridge of proposed transducer location
4) Water elevation 97.013m based on BM evevation 100 00m (1124 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7030
DISCHARGE DATA

STREAM NAME: Muskeg Creek
LOCATION: S22
COORDINATES: 6348856N / 481036E

MEASUREMENT DATE: 8 May 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/NS
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1640 hrs.
MEASUREMENT END TIME: 1651 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.70		0.00			0.000	0.50	0.000
1	1.00		0.25			0.130	0.30	0.010
2	1.30		0.41			0.470	0.30	0.058
3	1.60		0.42			0.530	0.30	0.067
4	1.90		0.43			0.570	0.30	0.074
5	2.20		0.41			0.580	0.30	0.071
6	2.50		0.42			0.660	0.30	0.083
7	2.80		0.44			0.820	0.30	0.108
8	3.10		0.50			0.840	0.30	0.126
9	3.40		0.54			0.790	0.35	0.149
10	3.80		0.46			0.980	0.35	0.158
11	4.10		0.58			0.800	0.30	0.139
12	4.40		0.66			0.810	0.30	0.160
13	4.70		0.64			1.010	0.30	0.194
14	5.00		0.64			1.150	0.30	0.221
15	5.30		0.66			1.140	0.30	0.226
16	5.60		0.58			1.240	0.80	0.575
17	6.90		0.50			1.290	0.30	0.194
18	6.20		0.36			0.990	-0.20	-0.071
19	6.50		0.22			1.060	0.30	0.070
20	6.80		0.14			0.240	0.35	0.012
Right Bank	7.20		0.00			0.000	-3.40	0.000
								2.623

Notes
1) Water elevation at transducer 96 572m based on TBM elevation 100 000 m (right downstream bridge abutment) (1700 hrs)
2) Top of pin elevation 96 969m
3) Current water elevation at site of April 21 water level measurement 96 803m
4) Water elevation at transducer 96 554m (9 May 01 - 2035 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Muskeg Creek
LOCATION: S22
COORDINATES: 6348856N / 481036E

MEASUREMENT DATE: 12 June 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/ME
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 0900 hrs.
MEASUREMENT END TIME: 1000 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.00			0.000	0.25	0.000
1	0.50		0.40			0.510	0.50	0.102
2	1.00		0.40			0.620	0.50	0.124
3	1.50		0.52			0.620	0.50	0.161
4	2.00		0.50			0.790	0.50	0.198
5	2.50		0.52			0.770	0.50	0.200
6	3.00		0.66			0.810	0.50	0.267
7	3.50		0.64			0.850	0.50	0.272
8	4.00		0.66			1.010	0.50	0.333
9	4.50		0.62			1.000	0.50	0.310
10	5.00		0.50			1.300	0.50	0.325
11	5.50		0.42			1.130	0.50	0.237
12	6.00		0.30			0.100	0.40	0.012
Right Bank	6.30		0.00			0.000	-3.00	0.000
								2.542

Notes. 1) Water elevation at transducer 96 528m based on TBM elevation 100.000m (right downstream bridge abutment) (0930 hrs)
2.) Installed a new BM (T-bar) elevation 99.061m top of T-bar

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Muskeg Creek
LOCATION: S22
COORDINATES: 6348856N / 481036E

MEASUREMENT DATE: 8 July 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 0800 hrs.
MEASUREMENT END TIME: 0845 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	1.00		0.00			0.000	0.75	0.000
1	1.50		0.35			0.270	0.50	0.047
2	2.00		0.36			0.560	0.50	0.101
3	2.50		0.33			0.720	0.50	0.119
4	3.00		0.30			0.780	0.50	0.117
5	3.50		0.34			0.760	0.50	0.129
6	4.00		0.34			0.870	0.50	0.148
7	4.50		0.54			0.830	0.50	0.224
8	5.00		0.56			0.820	0.50	0.230
9	5.50		0.52			1.030	0.50	0.268
10	6.00		0.43			0.920	0.50	0.198
11	6.50		0.28			1.010	0.50	0.141
12	7.00		0.12			0.160	0.45	0.009
Right Bank	7.40		0.00			0.000	-3.50	0.000
								1.730

Notes: 1) Water elevation at transducer 96.413m based on BM (T-bar) elevation 99 061m top of T-bar (0840 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Muskeg Creek
LOCATION: S22
COORDINATES: 6348856N / 481036E

MEASUREMENT DATE: 6 August 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 0830 hrs.
MEASUREMENT END TIME: 0840 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.00			0.000	0.15	0.000
1	0.30		0.10			0.240	0.30	0.007
2	0.60		0.11			0.250	0.30	0.008
3	0.90		0.08			0.090	0.30	0.002
4	1.20		0.04			0.330	0.30	0.004
5	1.50		0.10			0.640	0.30	0.019
6	1.80		0.19			0.770	0.30	0.044
7	2.10		0.22			0.670	0.30	0.044
8	2.40		0.26			0.830	0.30	0.065
9	2.70		0.26			0.940	0.30	0.073
10	3.00		0.28			0.960	0.30	0.081
11	3.30		0.28			0.710	0.30	0.060
12	3.60		0.29			0.840	0.30	0.073
13	3.90		0.18			0.350	0.30	0.019
14	4.20		0.20			-0.100	0.30	-0.006
15	4.50		0.12			0.000	0.38	0.000
Right Bank	4.95		0.00			0.000	-2.25	0.000
								0.493

Notes. 1) Water elevation at transducer 96.112m based on BM (T-bar) elevation 99 061m top of T-bar (0815 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Muskeg Creek
LOCATION: S22
COORDINATES: 6348856N / 481036E

MEASUREMENT DATE: 10 September 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/NS
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1628 hrs.
MEASUREMENT END TIME: 1636 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.00			0.000	0.25	0.000
1	0.50		0.12			0.090	0.50	0.005
2	1.00		0.10			0.150	0.50	0.008
3	1.50		0.08			0.310	0.50	0.012
4	2.00		0.12			0.410	0.50	0.025
5	2.50		0.22			0.370	0.50	0.041
6	3.00		0.28			0.490	0.50	0.069
7	3.50		0.31			0.550	0.50	0.085
8	4.00		0.24			0.590	0.50	0.071
9	4.50		0.10			0.550	0.50	0.028
10	5.00		0.04			0.170	0.50	0.003
Right Bank	5.50		0.00			0.000	-2.50	0.000
								0.346

Notes: 1) Water elevation at transducer 96 173m based on BM (T-bar) elevation 99.061m top of T-bar (1800 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Muskeg Creek
LOCATION: S22
COORDINATES: 6348856N / 481036E

MEASUREMENT DATE: 27 October 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JG
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1250 hrs.
MEASUREMENT END TIME: 1300 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/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		0.07			0.060	0.10	0.000
3	0.40		0.08			0.250	0.15	0.003
4	0.60		0.11			0.530	0.20	0.012
5	0.80		0.12			0.480	0.20	0.012
6	1.00		0.12			0.590	0.20	0.014
7	1.20		0.14			0.550	0.20	0.015
8	1.40		0.15			0.370	0.20	0.011
9	1.60		0.10			0.520	0.20	0.010
10	1.80		0.08			0.420	0.20	0.007
11	2.00		0.04			0.020	0.16	0.000
Right Bank	2.11		0.00			0.000	-1.00	0.000
								0.085

Notes: 1.) Water elevation at transducer 96.035m based on BM (T-bar) elevation 99.061m top of T-bar (1250 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

STREAM NAME: Aurora Boundary Weir
LOCATION: S23
COORDINATES: 6349946N / 470315E

MEASUREMENT DATE: 17 January 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1100 hrs.
MEASUREMENT END TIME: 1215 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes. 1.) No flow measurements taken
2) Water elevation 292 485m (1152 hrs)
3) V-notch weir elevation 292 257m

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

STREAM NAME: Aurora Boundary Weir
LOCATION: S23
COORDINATES: 6349946N / 470315E

MEASUREMENT DATE: 16 February 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 0715 hrs.
MEASUREMENT END TIME: 0845 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank								0.000
1								0.000
2								0.000
3								0.000
4								0.000
5								0.000
6								0.000
7								0.000
Right Bank								0.000
								0.000

Notes
1) No flow over the weir
2.) Water elevation 291 942m (0840 hrs)
3.) V-notch weir elevation 292 257m
4.) Downloaded data

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7030
DISCHARGE DATA

STREAM NAME: Aurora Boundary Weir
LOCATION: S23
COORDINATES: 6349946N / 470315E

MEASUREMENT DATE: 18 March 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 0715 hrs.
MEASUREMENT END TIME: 0845 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00	0.94	0.00			0.000	0.225	0.000
1	0.45	0.94	0.32			-0.020	0.6	-0.004
2	1.20	0.97	0.43			0.010	0.775	0.003
3	2.00	1.00	0.47			0.020	0.8	0.007
4	2.80	1.00	0.47			0.030	0.7	0.009
5	3.40	0.97	0.49			0.030	0.7	0.009
6	4.20	0.93	0.51			0.020	0.7	0.007
7	4.80	0.97	0.38			0.010	0.65	0.002
Right Bank	5.50	1.00	0.00			0.000	-2.4	0.000
								0.034

Notes: 1.) Water elevation not surveyed

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7030
DISCHARGE DATA

STREAM NAME: Aurora Boundary Weir
LOCATION: S23
COORDINATES: 6349946N / 470315E

MEASUREMENT DATE: 20 April 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 0850 hrs.
MEASUREMENT END TIME: 1015 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes 1.) No flow measurements take -creek too deep
2) Water elevation 292.502m based on BM elevation 293.786m (1015 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Aurora Boundary Weir
LOCATION: S23
COORDINATES: 6349946N / 470315E

MEASUREMENT DATE: 15 May 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/CK
COMPUTATIONS BY: LL

MEASUREMENT START TIME: 0800 hrs.
MEASUREMENT END TIME: 1015 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00		0.00			0.000	0.5	0.000
1	1.00		0.36			0.000	0.75	0.000
2	1.50		0.60			0.020	0.5	0.006
3	2.00		0.98	0.01	0.05	0.030	0.5	0.015
4	2.50		1.20	0.03	0.05	0.040	0.5	0.024
5	3.00		1.20	0.02	0.03	0.025	0.5	0.015
6	3.50		1.20	0.03	0.02	0.025	0.5	0.015
7	4.00		1.14	0.01	0.01	0.010	0.5	0.006
8	4.50		1.10	0.01	0.01	0.010	0.5	0.006
9	5.00		1.02	0.00	0.00	0.000	0.75	0.000
10	6.00		0.72			0.000	1.2	0.000
Right Bank	7.40		0.00			0.000	-3	0.000
								0.086

Notes 1.) Water elevation 292.502m (1000 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2320-7050
DISCHARGE DATA

STREAM NAME: Aurora Boundary Weir
LOCATION: S23
COORDINATES: 6349946N / 470315E

MEASUREMENT DATE: 13 June 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/ME
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1030 hrs.
MEASUREMENT END TIME: 1130 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00		0.00			0.00	0.10	0.000
1	0.20		0.52			0.01	0.35	0.002
2	0.70		0.82	0.01	0.01	0.01	0.50	0.004
3	1.20		0.92	0.01	0.01	0.01	0.50	0.005
4	1.70		1.10	0.01	0.01	0.01	0.50	0.006
5	2.20		1.20	0.02	0.01	0.02	0.50	0.009
6	2.70		1.20	0.02	0.01	0.02	0.50	0.009
7	3.20		1.20	0.01	0.02	0.02	0.50	0.009
8	3.70		1.14	0.03	0.01	0.02	0.50	0.011
9	4.20		1.10	0.04	0.03	0.04	0.50	0.019
10	4.70		1.02	0.06	0.02	0.04	0.50	0.020
11	5.20		0.97	0.05	0.02	0.04	0.50	0.017
12	5.70		0.86	0.11	0.05	0.08	0.50	0.034
13	6.20		0.68			0.04	0.50	0.014
14	6.70		0.42			0.04	0.50	0.008
15	7.20		0.32			0.02	0.40	0.003
Right Bank	7.50		0.00			0.00	-3.60	0.000
								0.170

Notes: 1.) Water elevation 292 567m (1104 hrs)
2.) Syncrude built a wooden bridge across the creek

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2320-7050
DISCHARGE DATA

STREAM NAME: Aurora Boundary Weir
LOCATION: S23
COORDINATES: 6349946N / 470315E

MEASUREMENT DATE: 09 July 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/MC
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1310 hrs.
MEASUREMENT END TIME: 1336 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	1.34		0.00			0.00	1.00	0.000
1	2.00		0.21			0.01	0.58	0.001
2	2.50		0.79	0.01	0.01	0.01	0.50	0.004
3	3.00		0.97	0.01	0.03	0.02	0.50	0.010
4	3.50		1.07	0.00	0.00	0.00	0.50	0.000
5	4.00		1.12	0.01	0.00	0.01	0.50	0.003
6	4.50		1.17	0.01	0.02	0.02	0.50	0.009
7	5.00		1.06	-0.01	-0.01	-0.01	0.50	-0.005
8	5.50		1.02	-0.02	-0.02	-0.02	0.50	-0.010
9	6.00		0.92	-0.02	-0.03	-0.03	0.50	-0.012
10	6.50		0.90	-0.02	-0.03	-0.03	0.50	-0.011
11	7.00		0.80	-0.04	-0.05	-0.05	0.50	-0.018
12	7.50		0.61			-0.05	0.50	-0.015
13	8.00		0.37			-0.05	0.50	-0.009
14	8.50		0.17			-0.05	0.35	-0.003
Right Bank	8.70		0.00			0.00	-4.25	0.000
								-0.057

Notes: 1) Water elevation 292.484m (1350 hrs)
2) There is a lot of algae growth in the creek where flow measured

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2320-7050
DISCHARGE DATA

STREAM NAME: Aurora Boundary Weir
LOCATION: S23
COORDINATES: 6349946N / 470315E

MEASUREMENT DATE: 07 August 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 0915 hrs.
MEASUREMENT END TIME: 0950 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes: 1.) Water elevation 292.521m (0950 hrs)
2) No flow measurements taken

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2320-7010
DISCHARGE DATA

STREAM NAME: Aurora Boundary Weir
LOCATION: S23
COORDINATES: 6349946N / 470315E

MEASUREMENT DATE: 04 December 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JE
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 0930 hrs.
MEASUREMENT END TIME: 1530 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes:
1.) Water elevation 292 425m (1435 hrs)
2) Top of ice elevation 292 501m
3) Attached 2" steel post to the shack and installed thermistor string
4) Downloaded data

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2320-7010
DISCHARGE DATA

STREAM NAME: Aurora Boundary Weir
LOCATION: S23
COORDINATES: 6349946N / 470315E

MEASUREMENT DATE: 05 December 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JE
COMPUTATIONS BY: RS

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

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	1.40	0.27	0.00			0.00	0.98	0.000
	1.95	0.27	0.12			-0.06	0.61	-0.004
	2.62	0.24	0.48			-0.02	0.75	-0.007
	3.44	0.23	0.75			-0.01	0.76	-0.005
	4.13	0.21	0.88			0.00	0.75	0.000
	4.94	0.20	1.01			0.00	0.74	0.000
	5.60	0.21	1.01			0.00	0.76	0.000
	6.45	0.23	0.77			-0.01	0.88	-0.006
	7.35	0.25	0.40			-0.02	0.63	-0.005
	7.70	0.25	0.00			0.00	-3.68	0.000
Right Bank								
								0.000

Notes:
1) Water elevation 292.431m (0939 hrs)
2) Top of ice elevation 292.484m
3) Downloaded data

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Athabasca River
LOCATION: S24
COORDINATES: 6372760N / 466313E

MEASUREMENT DATE: 20 June 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/TC
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1030 hrs.
MEASUREMENT END TIME: 1830 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00		0.00			0.000	0.75	0.000
1	1.50		0.41			0.170	2.50	0.174
2	5.00		1.00	0.29	0.24	0.265	16.25	4.306
3	34.00		2.30	0.40	0.17	0.285	36.00	23.598
4	77.00		2.40	0.53	0.54	0.535	44.50	57.138
5	123.00		2.48	0.51	0.49	0.500	42.00	52.080
6	161.00		2.30	0.48	0.45	0.465	42.50	45.454
7	208.00		3.00	0.58	0.41	0.495	47.00	69.795
8	255.00		2.59	0.77	0.74	0.755	47.50	92.884
9	303.00		2.09	0.95	0.73	0.840	45.95	80.670
10	346.90		2.09	0.91	0.71	0.810	55.95	94.718
11	414.90		2.08	0.98	0.81	0.895	70.00	130.312
12	486.90		1.40	0.98	0.66	0.820	63.00	72.324
13	540.90		1.10	0.87	0.66	0.765	49.00	41.234
14	584.90		0.50			0.500	36.00	9.000
15	612.90		0.56			0.050	19.00	0.532
16	622.90		1.10	0.06	0.02	0.040	8.00	0.352
Right Bank	628.90		0.00			0.000	-311.45	0.000
								774.570

Notes
1.) Water elevation 95.649m (1750 hrs)
2.) Installed a T-Bar as new BM elevation 100.251m

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Athabasca River
LOCATION: S24
COORDINATES: 6372760N / 466313E

MEASUREMENT DATE: 04 July 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: TC/PM
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1115 hrs.
MEASUREMENT END TIME: 1300 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00		0.00			0.000	3.64	0.000
1	7.28		0.70			0.140	9.06	0.887
2	18.11		2.72	0.55	0.50	0.525	17.72	25.304
3	42.72		2.92	0.66	0.60	0.630	23.37	42.987
4	64.85		3.08	0.69	0.63	0.660	22.56	45.867
5	87.85		3.33	0.70	0.49	0.595	33.77	66.906
6	132.38		3.10	0.66	0.45	0.555	50.16	86.297
7	188.16		3.61	0.57	0.41	0.490	40.74	72.063
8	213.86		3.65	0.68	0.46	0.570	25.51	53.067
9	239.18		3.32	0.80	0.64	0.720	32.38	77.410
10	278.63		3.00	0.92	0.77	0.845	41.81	105.994
11	322.80		2.99	0.92	0.58	0.750	51.03	114.425
12	380.68		2.71	1.07	0.66	0.865	57.54	134.873
13	437.87		2.37	1.12	0.89	1.005	48.97	116.641
14	478.62		2.37	1.01	0.77	0.890	39.73	83.807
15	517.34		2.00	0.88	0.68	0.780	30.43	47.475
16	539.48		2.07	0.47	0.32	0.395	19.51	15.954
17	556.36		1.40	0.03	0.02	0.025	15.83	0.554
18	571.14		1.20	0.37	0.13	0.250	14.55	4.364
19	585.45		1.14	0.44	0.38	0.410	12.74	5.952
20	596.61		1.38	0.56	0.39	0.475	10.51	6.890
21	606.48		1.74	0.58	0.48	0.530	7.83	7.217
22	612.26		0.75			0.360	3.78	1.021
23	614.04		0.36			0.260	1.56	0.146
Right Bank	615.38		0.00			0.000	-307.02	0.000
								1116.100

Notes 1) Water elevation 96.339m (1052 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Athabasca River
LOCATION: S24
COORDINATES: 6372760N / 466313E

MEASUREMENT DATE: 11 August 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: TC/LL
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1015 hrs.
MEASUREMENT END TIME: 1205 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00		0.00			0.000	11.50	0.000
1	23.00		2.72	0.85	0.71	0.780	16.50	35.006
2	33.00		2.30	1.02	0.72	0.870	11.00	22.011
3	45.00		2.12	1.03	0.87	0.950	15.00	30.210
4	63.00		2.21	1.03	0.85	0.940	16.00	33.238
5	77.00		2.28	1.02	0.97	0.995	13.50	30.626
6	90.00		2.59	0.97	0.82	0.895	13.50	31.294
7	104.00		2.70	0.93	0.86	0.895	16.00	38.664
8	122.00		2.62	0.89	0.74	0.815	20.50	43.774
9	145.00		2.53	0.89	0.76	0.825	24.50	51.138
10	171.00		2.68	0.86	0.74	0.800	21.00	45.024
11	187.00		2.67	0.86	0.74	0.800	18.50	39.516
12	208.00		2.78	0.78	0.59	0.685	20.00	38.086
13	227.00		3.36	0.74	0.68	0.710	18.50	44.134
14	245.00		3.28	0.82	0.69	0.755	23.50	58.195
15	274.00		3.32	0.90	0.85	0.875	32.00	92.960
16	309.00		3.69	1.07	0.76	0.915	32.00	108.043
17	338.00		3.78	1.12	0.93	1.025	29.50	114.298
18	368.00		3.90	1.24	0.93	1.085	40.00	169.260
19	418.00		3.98	1.28	0.87	1.075	42.50	181.836
20	453.00		3.30	1.09	0.86	0.975	31.00	99.743
21	480.00		3.00	1.07	0.88	0.975	25.00	73.125
22	503.00		2.38	0.97	0.85	0.910	19.00	41.150
23	518.00		2.20	0.59	0.40	0.495	15.00	16.335
24	533.00		1.80	0.20	0.22	0.210	18.50	6.993
25	555.00		0.78	0.49	0.38	0.435	22.00	7.465
26	577.00		1.45	0.43	0.40	0.415	20.50	12.336
27	596.00		1.96	0.49	0.47	0.480	16.50	15.523
28	610.00		2.32	0.57	0.55	0.560	13.00	16.890
Right Bank	622.00		0.00		0.00	0.000	-305.00	0.000
								1496.9

Notes 1) Water elevation 96 683m based on BM elevation 100 00m (nail by tree) (0940 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Athabasca River
LOCATION: S24
COORDINATES: 6372760N / 466313E

MEASUREMENT DATE: 31 August 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: TC/NP
COMPUTATIONS BY: NS

MEASUREMENT START TIME: 1015 hrs.
MEASUREMENT END TIME: 1205 hrs.

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0.00		0.00			0.000	4.53	0.000
1	9.06		0.92	0.57	0.62	0.595	10.12	5.542
2	20.25		0.92	0.71	0.61	0.660	12.74	7.737
3	34.54		0.98	0.73	0.65	0.690	11.81	7.984
4	43.86		1.00	0.72	0.59	0.655	15.82	10.365
5	66.19		1.03	0.79	0.56	0.675	23.51	16.342
6	90.87		1.09	0.71	0.57	0.640	24.21	16.890
7	114.61		1.02	0.67	0.60	0.635	21.29	13.792
8	133.46		1.08	0.57	0.47	0.520	17.81	10.002
9	150.23		1.33	0.46	0.37	0.415	17.56	9.693
10	168.59		1.09	0.48	0.42	0.450	17.11	8.394
11	184.46		0.98	0.50	0.35	0.425	18.37	7.650
12	205.32		1.58	0.45	0.27	0.360	21.90	12.455
13	228.25		2.34	0.56	0.42	0.490	19.05	21.840
14	243.42		2.18	0.59	0.51	0.550	15.40	18.469
15	259.06		2.24	0.56	0.45	0.505	18.27	20.668
16	279.96		2.12	0.69	0.54	0.615	25.68	33.476
17	310.41		2.57	0.74	0.66	0.700	24.84	44.682
18	329.63		2.58	0.94	0.74	0.840	24.01	52.039
19	358.44		2.80	1.01	0.80	0.905	32.64	82.706
20	394.91		2.82	1.03	0.69	0.860	26.58	64.452
21	411.59		2.58	0.99	0.87	0.930	39.12	93.867
22	473.15		1.82	0.86	0.73	0.795	54.93	79.481
23	521.45		1.40	0.59	0.43	0.510	34.67	24.754
24	542.49		1.02	0.33	0.32	0.325	35.56	11.787
25	592.56		0.46			0.050	28.61	0.658
26	599.71		0.75			0.030	14.31	0.322
Right Bank	621.18		0.00			0.000	-299.86	0.000
								676.0

Notes 1) Water elevation 95 394m based on BM elevation 100 000 m (0940 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Athabasca River
LOCATION: S24
COORDINATES: 6372760N / 466313E

MEASUREMENT DATE: 3 October 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: TC/LL
COMPUTATIONS BY: NS

MEASUREMENT START TIME: 1023 hrs.
MEASUREMENT END TIME: 1207 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0		0.00			0.000	1.00	0.000
1	2		0.35			0.420	5 00	0 735
2	10		0.36			0.440	7.00	1 109
3	16		0.36			0 460	11.00	1.822
4	32		0.45			0.450	13.00	2.633
5	42		0.53			0 430	12.00	2.735
6	56		0 70			0 430	15 00	4 515
7	72		0.67			0.430	20.00	5.762
8	96		0.38			0.480	23.00	4.195
9	118		0.22			0.290	23 00	1 467
10	142		0.13			0.230	21.00	0 628
11	160		0 13			0.190	15.00	0.371
12	172		0 22			0 030	12.00	0 079
13	184		0 37			0 030	12.00	0.133
14	196		0 61			0 090	10.00	0 549
15	204		0 70			0 140	11.00	1 078
16	218		1 30	0 37	0 31	0 340	14.00	6 188
17	232		1.38	0.50	0 39	0.445	13 00	7.983
18	244		1.55	0.55	0 25	0.400	10 00	6.200
19	252		1.55	0.59	0.34	0.465	9 00	6.487
20	262		1 65	0.45	0.33	0.390	11 00	7.079
21	274		1 42	0 61	0.51	0.560	11.00	8.747
22	284		1 48	0.65	0.39	0.520	13.00	10.005
23	300		1.82	0.67	0 48	0.575	17 00	17.791
24	318		1.82	0 53	0.45	0.490	17.00	15.161
25	334		1.92	0 81	0 56	0.685	18.00	23.674
26	354		2.00	0.73	0.25	0.490	30.00	29.400
27	394		1.97	0.50	0.28	0.390	33.00	25.354
28	420		2.00	0.61	0.47	0.540	21.00	22.680
29	436		1.43	0 42	0.48	0.450	31.00	19 949
30	482		0.83	0.26	0 23	0 245	31.00	6.304
31	498		0 75			0 250	14.00	2 625
32	510		0.66			0 170	10.00	1.122
33	518		0.43			0 160	10.00	0.688
Right Bank	530		0.00			0 000	-259.00	0.000
								245.2

Notes 1) Water elevation not surveyed

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Khahago Creek
LOCATION: S28
COORDINATES: 6342185N / 480489E

MEASUREMENT DATE: 12 June 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/ME
COMPUTATIONS BY: LL/RS

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

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes:
1.) Not able to auger as ground was still frozen
2) Site appears to be inaccessable by quad
3.) Installed thermistor string
4) No flow measurement taken, too deep to wade
5.) Water elevation 99.483m (1215 hrs)

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Khahago Creek
LOCATION: S28
COORDINATES: 6342185N / 480489E

MEASUREMENT DATE: 10 July 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JE
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 0900 hrs.
MEASUREMENT END TIME: 0945 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes:
1.) Water elevation 99 136m based on BM elevation 100.000m (0941 hrs)
2) Erected the post and faced south direction
3) Thermistor string broken/unusable
4) No flow measurements taken

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Khahago Creek
LOCATION: S28
COORDINATES: 6342185N / 480489E

MEASUREMENT DATE: 09 August 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/PM
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 1700 hrs.
MEASUREMENT END TIME: 1715 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes
1.) Forgot to bring new thermistor string
2.) No flow measurements taken and no water elevation surveyed

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Khahago Creek
LOCATION: S28
COORDINATES: 6342185N / 480489E

MEASUREMENT DATE: 17 September 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: NS
COMPUTATIONS BY: NO

MEASUREMENT START TIME:
MEASUREMENT END TIME:

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes: 1.) Site investigation: look at foot access for discharge point

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Khahago Creek
LOCATION: S28 (by Canterra Road)
COORDINATES: 6342185N / 480489E

MEASUREMENT DATE: 19 September 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/NF
COMPUTATIONS BY: LL

MEASUREMENT START TIME: 1145 hrs.
MEASUREMENT END TIME: 1230 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.40		0.00			0.000	0.35	0.000
1	0.70		0.16			0.030	0.30	0.001
2	1.00		0.33			0.050	0.35	0.006
3	1.40		0.30			0.030	0.35	0.003
4	1.70		0.38			0.030	0.30	0.003
5	2.00		0.47			0.010	0.30	0.001
6	2.30		0.48			0.060	0.30	0.009
7	2.60		0.53			0.090	0.30	0.014
8	2.90		0.54			0.040	0.30	0.006
9	3.20		0.58			0.120	0.25	0.017
10	3.40		0.54			0.130	0.25	0.018
11	3.70		0.70			0.090	0.25	0.016
12	3.90		0.74			0.060	0.20	0.009
13	4.10		0.70			0.120	0.15	0.013
14	4.20		0.68			0.120	0.15	0.012
15	4.40		0.50			0.090	0.20	0.009
16	4.60		0.27			0.020	0.20	0.001
Right Bank	4.80		0.00			0.000	-2.30	0.000
								0.139

Notes. 1.) The site was accessed from Canterra Road

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Khahago Creek
LOCATION: S28
COORDINATES: 6342185N / 480489E

MEASUREMENT DATE: 20 September 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/NF
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 1400 hrs.
MEASUREMENT END TIME: 1450 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes: 1.) Water elevation 98 916m based on BM elevation100 000 m (1442 hrs)
2.) No flow measurements taken

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: Khahago Creek
LOCATION: S28 (by Canterra Road)
COORDINATES: 6342185N / 480489E

MEASUREMENT DATE: 25 October 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JG
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1405 hrs.
MEASUREMENT END TIME:

STATION	DISTANCE FROM LEFT BANK	ICE THICKNESS	DEPTH	VELOCITY			WIDTH	DISCHARGE
				0.2 Depth	0.8 Depth	0.6 Depth		
	(m)	(m)	(m)	(m/sec)	(m/sec)	(m/sec)	(m)	(m^3/sec)
Left Bank	0 00						3.00	
1	6.00						5.50	
2	11.00						4.50	
3	15 00						4 50	
4	20 00						4.00	
5	23 00						3.00	
6	26.00						2.40	
7	27 80						1.00	
8 - ice edge	28.00						0.85	
9	29.50		0.82				1.20	
10	30.40		1.32				0 85	
11	31 20		1.99				1.55	
12	33.50		2.27				1.90	
13	35 00		1.98				1.30	
14	36.10		0 83				1.25	
15 - ice edge	37.50						0.75	
16	37.60						0.75	
17	39.00						1.70	
18	41.00						2.50	
19	44.00						3.00	
20	47 00						3.00	
21	50.00						3.00	
22	53.00						3.00	
23	56.00						3.00	
24	59 00						2 50	
25	61 00						2.50	
Right Bank	64 00						-30.50	

Notes 1) The site accessed from the Canterra Road
2) No water elevation measurement from data logger which has been removed for winter

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7010
DISCHARGE DATA

STREAM NAME: Khahago Creek
LOCATION: S28 (by Canterra Road)
COORDINATES: 6342185N / 480489E

MEASUREMENT DATE: 1 November 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JG
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1138 hrs.
MEASUREMENT END TIME: 1200 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.00			0.000	0.15	0.000
1	0.30		0.48			0.090	0.30	0.013
2	0.60		0.50			0.090	0.30	0.014
3	0.90		0.40			0.070	0.30	0.008
4	1.20		0.38			0.060	0.30	0.007
5	1.50		0.46			0.040	0.30	0.006
6	1.80		0.44			0.050	0.30	0.007
7	2.10		0.42			0.020	0.30	0.003
8	2.40		0.37			0.000	0.30	0.000
9	2.70		0.20			0.010	0.30	0.001
10	3.00		0.20			0.030	0.30	0.002
11	3.30		0.14			0.010	0.37	0.001
Right Bank	3.74		0.00			0.000	-1.65	0.000
								0.059

Notes
1) The site accessed from the Canterra Road
2) No water elevation measurement from S4A logger which has been removed for winter

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: McClelland Lake Outlet
LOCATION: L1
COORDINATES: 6371950N / 483430E

MEASUREMENT DATE: 14 May 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/NS
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 0950 hrs.
MEASUREMENT END TIME: 1004 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	-0.20		0.18			0.000	0.30	0.000
1	0.60		0.49			0.010	0.60	0.003
2	1.00		0.48			0.050	0.35	0.008
3	1.30		0.46			0.050	0.30	0.007
4	1.60		0.38			0.080	0.30	0.009
5	1.90		0.44			0.100	0.30	0.013
6	2.20		0.45			0.070	0.35	0.011
7	2.60		0.33			0.090	0.35	0.010
8	2.90		0.39			0.030	0.30	0.004
9	3.20		0.57			0.100	0.30	0.017
10	3.50		0.51			0.080	0.30	0.012
11	3.80		0.38			0.030	0.30	0.003
12	4.10		0.38			0.020	0.30	0.002
13	4.40		0.30			0.030	0.30	0.003
14	4.70		0.26			0.020	0.30	0.002
15	5.00		0.28			0.010	0.40	0.001
16	5.50		0.14			0.010	0.50	0.001
17	6.00		0.20			0.010	0.75	0.002
Right Bank	7.00		0.00			0.000	-3.00	0.000
								0.108

Notes: 1.) Staff gauge reading 0.520m
2.) Water elevation at gauge 295 598m

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: McClelland Lake Outlet
LOCATION: L1
COORDINATES: 6371950N / 483430E

MEASUREMENT DATE: 12 June 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/ME
COMPUTATIONS BY: LL/RS

MEASUREMENT START TIME: 1430 hrs.
MEASUREMENT END TIME: 1455 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.00			0.000	0.30	0.000
1	0.60		0.16			0.000	0.40	0.000
2	0.80		0.26			0.010	0.20	0.001
3	1.00		0.30			0.010	0.20	0.001
4	1.20		0.26			0.030	0.20	0.002
5	1.40		0.30			0.010	0.20	0.001
6	1.60		0.38			0.020	0.20	0.002
7	1.80		0.38			0.020	0.20	0.002
8	2.00		0.42			0.020	0.20	0.002
9	2.20		0.40			0.020	0.20	0.002
10	2.40		0.50			0.020	0.20	0.002
11	2.60		0.52			0.060	0.20	0.006
12	2.80		0.50			0.070	0.20	0.007
13	3.00		0.46			0.020	0.20	0.002
14	3.20		0.44			0.030	0.20	0.003
15	3.40		0.39			0.020	0.20	0.002
16	3.60		0.40			0.020	0.20	0.002
17	3.80		0.36			0.020	0.20	0.001
18	4.00		0.30			0.010	0.35	0.001
19	4.50		0.30			0.040	0.50	0.006
20	5.00		0.15			0.020	0.75	0.002
21	6.00		0.19			0.010	1.00	0.002
22	7.00		0.18			0.010	1.00	0.002
23	8.00		0.10			0.020	1.00	0.002
Right Bank	9.00		0.00			0.000	-4.00	0.000
								0.049

Notes
1) Water elevation 294 587m (1450 hrs)
2) Housing with the logger was submerged in the water - sent for repair immediately

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: McClelland Lake Outlet
LOCATION: L1
COORDINATES: 6371950N / 483430E

MEASUREMENT DATE: 10 July 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: LL/JE
COMPUTATIONS BY: NS/RS

MEASUREMENT START TIME: 1220 hrs.
MEASUREMENT END TIME: 1300 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)
Left Bank	0.00		0.04			0.000	0.25	0.000
1	0.50		0.10			0.030	0.50	0.002
2	1.00		0.16			0.040	0.50	0.003
3	1.50		0.06			0.020	0.50	0.001
4	2.00		0.16			0.050	0.50	0.004
5	2.50		0.22			0.040	0.50	0.004
6	3.00		0.21			0.030	0.50	0.003
7	3.50		0.26			0.040	0.50	0.005
8	4.00		0.30			0.050	0.40	0.006
9	4.30		0.40			0.030	0.25	0.003
10	4.50		0.44			0.040	0.20	0.004
11	4.70		0.44			0.030	0.20	0.003
12	4.90		0.46			0.040	0.20	0.004
13	5.10		0.41			0.050	0.20	0.004
14	5.30		0.38			0.040	0.20	0.003
15	5.50		0.32			0.040	0.20	0.003
16	5.70		0.30			0.000	0.25	0.000
17	6.00		0.22			0.030	0.30	0.002
18	6.30		0.28			0.030	0.50	0.004
19	7.00		0.20			0.020	0.60	0.002
Right Bank	7.50		0.06			0.000	-3.50	0.000
								0.059

Notes. 1.) Water elevation 294 526m (1248 hrs)
2) Reinstalled Lakewood logger and 3 psi transducer

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: McClelland Lake Outlet
LOCATION: L1
COORDINATES: 6371950N / 483430E

MEASUREMENT DATE: 15 September 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: NS
COMPUTATIONS BY: RS

MEASUREMENT START TIME: 1310 hrs.
MEASUREMENT END TIME: 1310 hrs.

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes: 1) Water elevation 294.428m (1310 hrs)
2) No flow measurments taken

PROJECT NAME: RAMP/Climate & Hydrology/Ft. McMurray
PROJECT NO.: 012-2302-7050
DISCHARGE DATA

STREAM NAME: McClelland Lake Outlet
LOCATION: L1
COORDINATES: 6371950N / 483430E

MEASUREMENT DATE: 26 October 2001
METER NUMBER: Marsh-McBirney Flo-Mate 2000

MEASUREMENT BY: JG
COMPUTATIONS BY: NO

MEASUREMENT START TIME: 1353 hrs.
MEASUREMENT END TIME:

STATION	DISTANCE FROM LEFT BANK (m)	ICE THICKNESS (m)	DEPTH (m)	VELOCITY 0.2 Depth (m/sec)	VELOCITY 0.8 Depth (m/sec)	VELOCITY 0.6 Depth (m/sec)	WIDTH (m)	DISCHARGE (m^3/sec)

Notes: 1.) Ice on lake and outlet
2.) No flow measurements taken

APPENDIX VII

STAGE-DISCHARGE RATING CURVES

UPDATED STAGE-DISCHARGE RATING CURVES

Most stage-discharge rating curves were updated in 2001 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 – Iyinimin 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 7DA8	273.720	steel rod on right bank
S8 – Stanley Creek[(b)]	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 – Albian Sands Pond #3	279.590	right weir support adjacent to V-notch
S14 – Ells River[(a)]	100.199	local datum: top of T-bar
S15 – Tar River[(a)]	100.590	local datum: top of T-bar
S16 – Calumet River[(a)]	100.000	local datum: nail in tree
S17 – Upland Tar River[(a)]	99.963	local datum: top of T-bar
S18 – Upland Calumet River[(a)]	100.000	local datum: nail in tree
S19 – Lowland Tar River[(a)]	100.000	local datum: nail in tree
S20 – Upland Muskeg River[(a)]	100.000	local datum: nail in tree
S21 – Shelley Creek[(b)] [(a)]	100.000	local datum: nail in tree
S22 – Muskeg Creek[(a)]	99.061	local datum: top of T-bar
S23 – Aurora Boundary Weir	293.786	top of stilling well bracing marked “X”
S24 – Athabasca River[(a)]	100.000	local datum: top of T-bar
S25 – Susan Lake Outlet[(a)]	100.000	local datum: top of T-bar
L1 – McClelland Lake	295.840	steel rod in PVC housing at treeline to southeast
L2 – Kearl Lake[(b)]	333.410	steel rod in PVC housing at treeline to west
L3 – Isadore’s Lake[(b)]	235.910	nail in tree to south (temporary)

(a) Benchmarks at these sites are scheduled to be tied into a geodetic datum in February 2002.
(b) No rating curves have been derived for these sites (i.e., measure water levels only).

Figure VII-1 Stage-Discharge Rating Curve for Alsands Drain Station (S1)

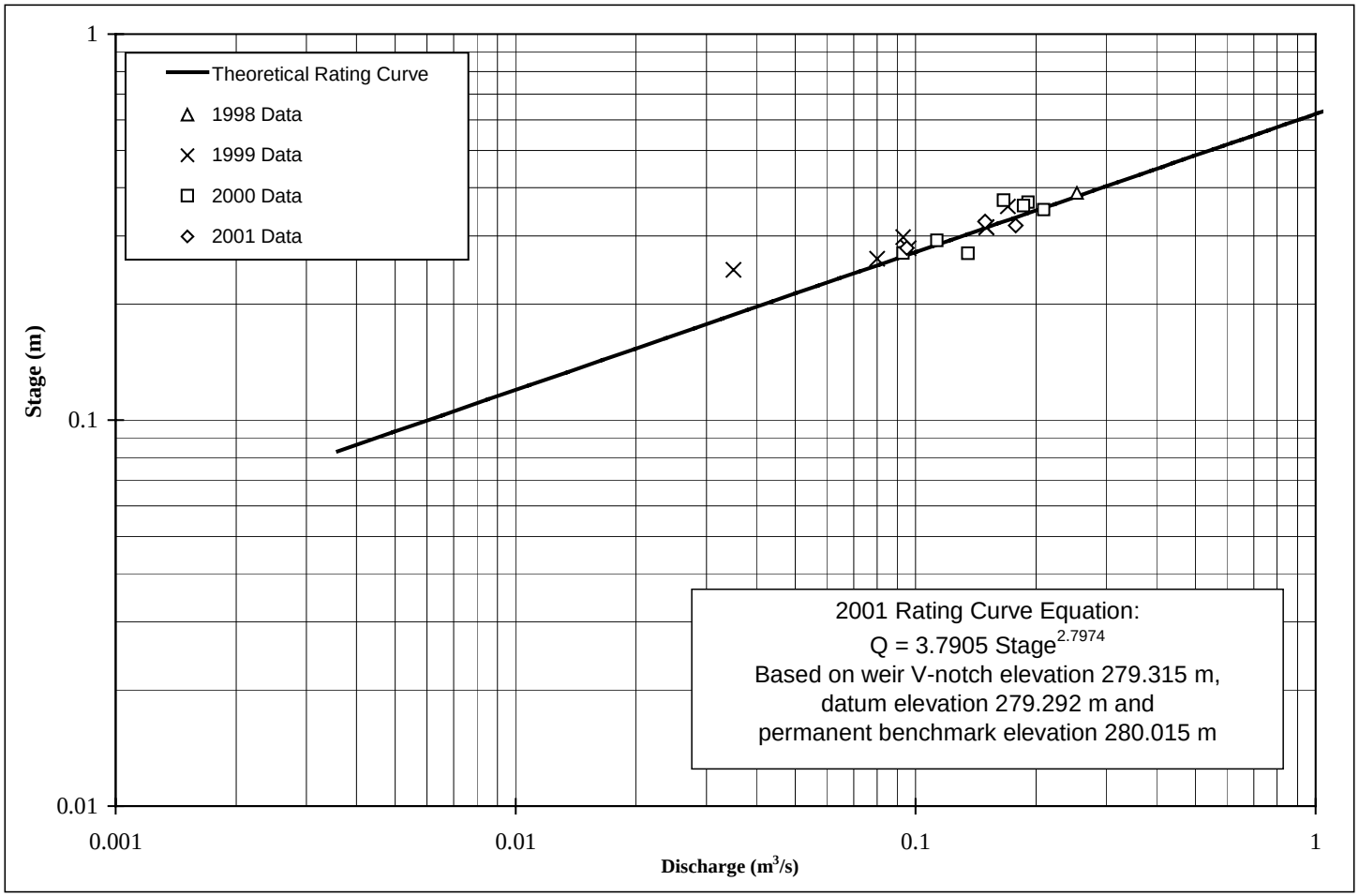


Figure VII-2 Stage-Discharge Rating Curve for Jackpine Creek Station (S2)

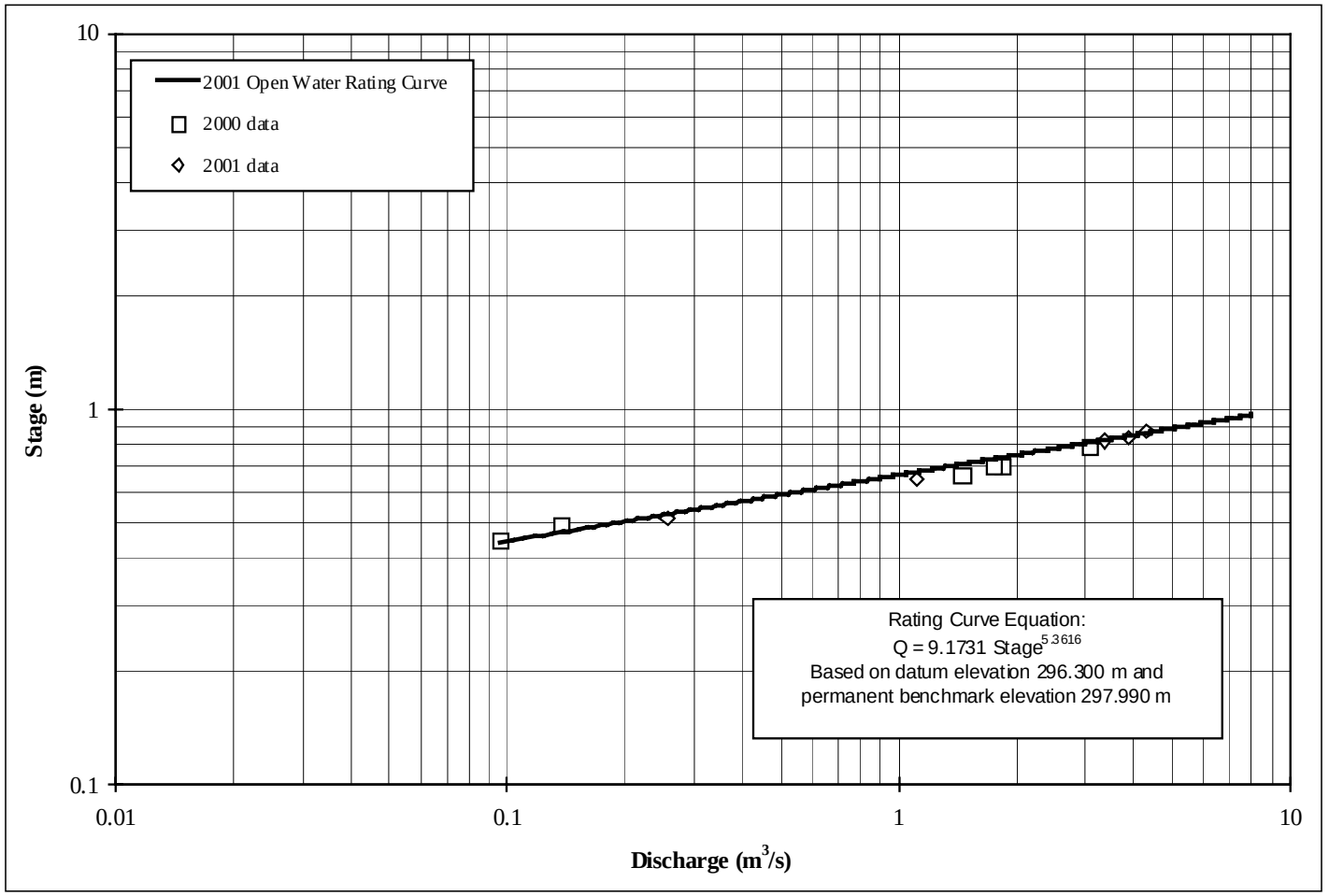


Figure VII-3 Stage-Discharge Rating Curve for Iyinimin Creek Station (S3)

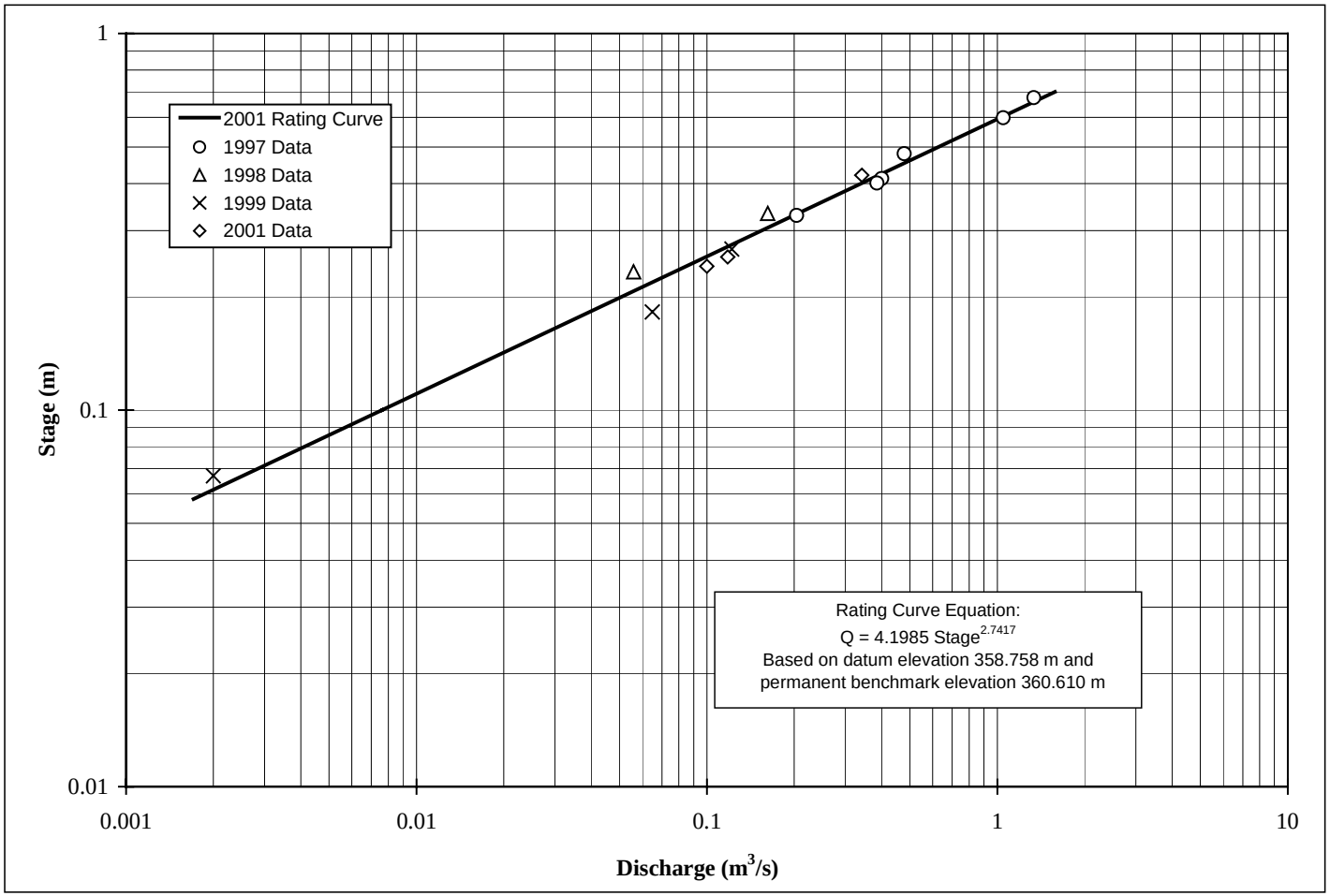


Figure VII-4 Stage-Discharge Rating Curve for Blackfly Creek Station (S4)

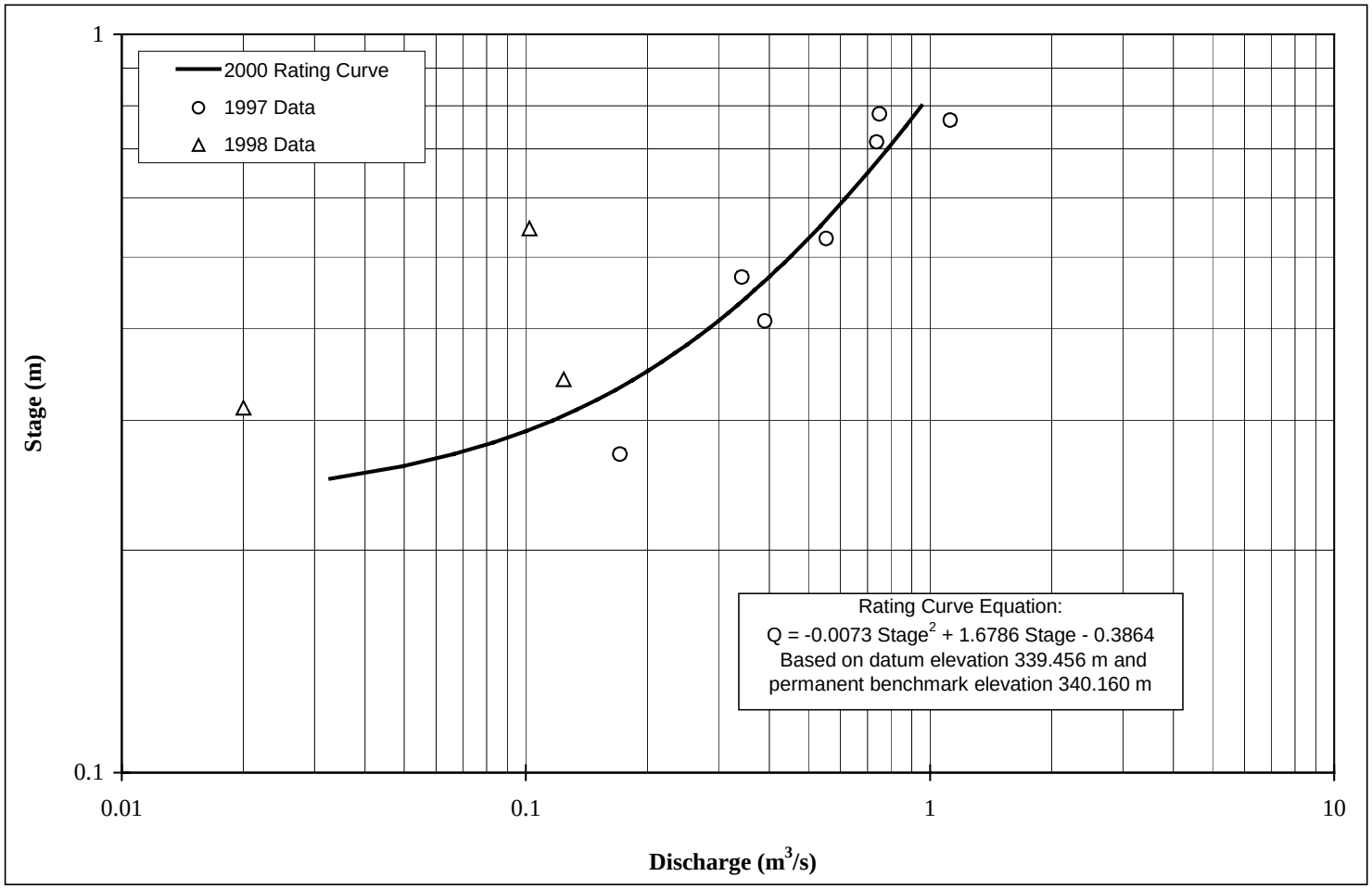


Figure VII-5 Stage-Discharge Rating Curve for Muskeg River Aurora Station (S5A)

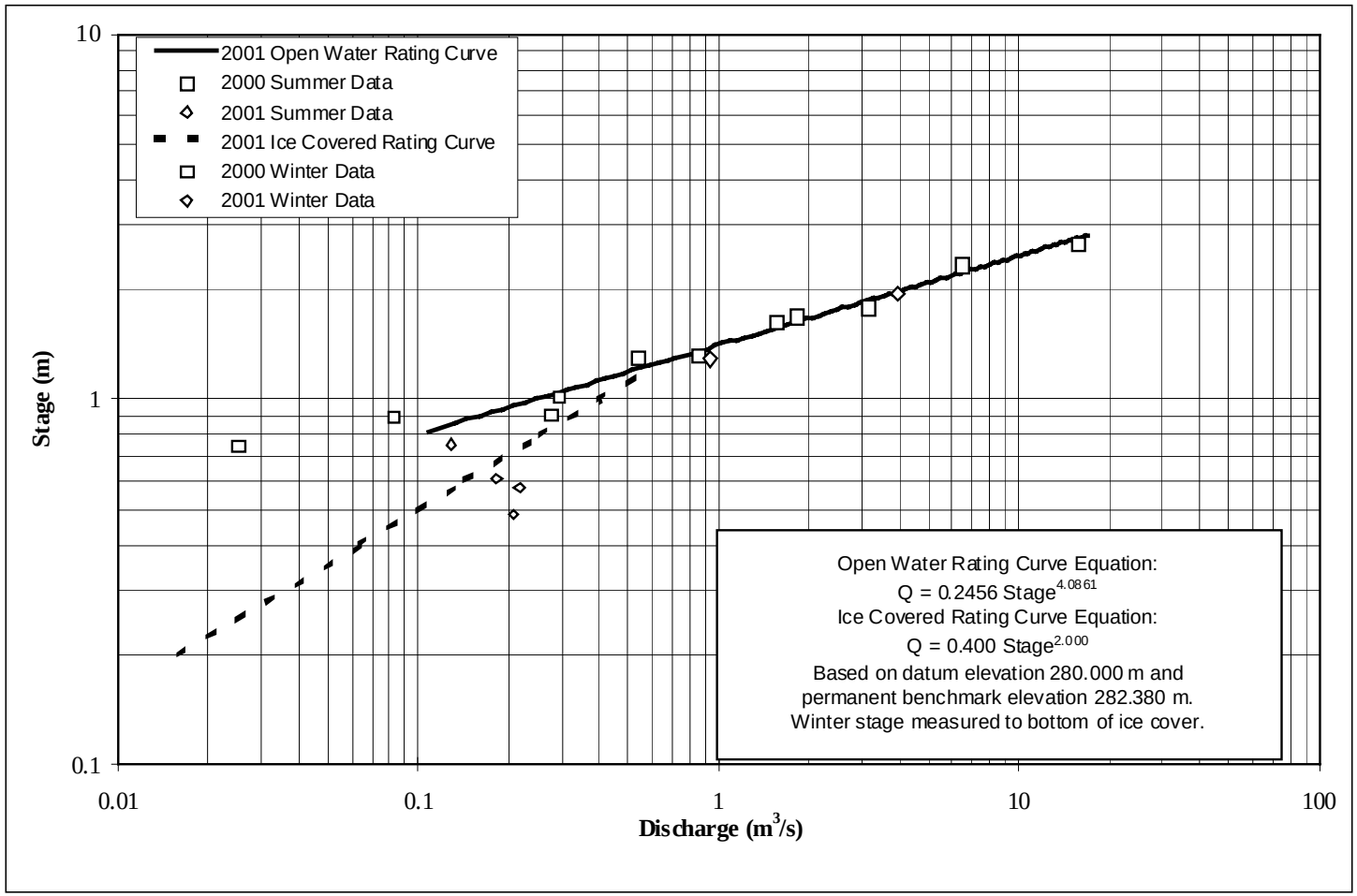


Figure VII-6 Stage-Discharge Rating Curve for Mills Creek Station (S6)

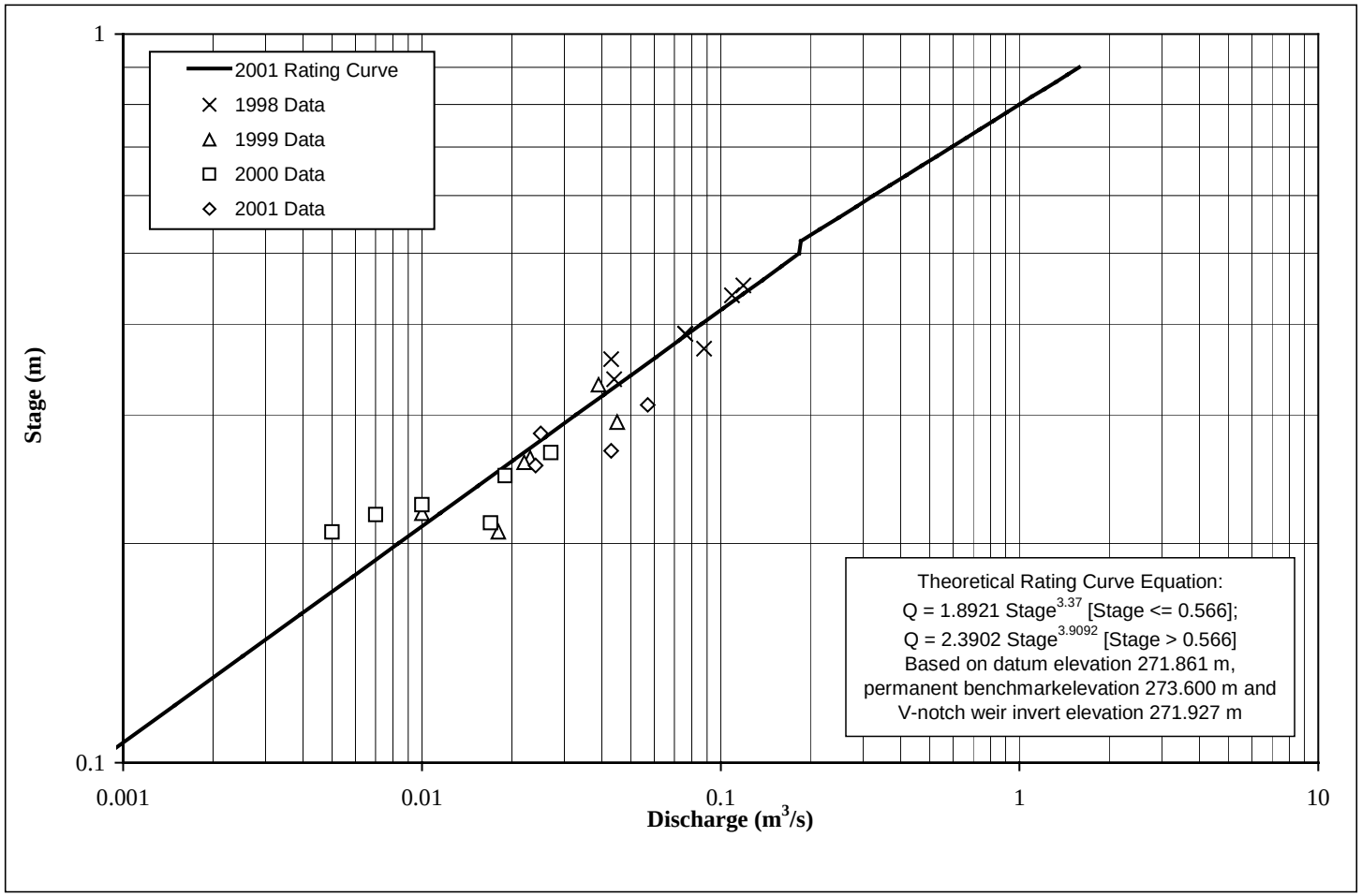


Figure VII-7 Stage-Discharge Rating Curve for Muskeg River 7DA8 Environment Canada Hydometric Station (S7)

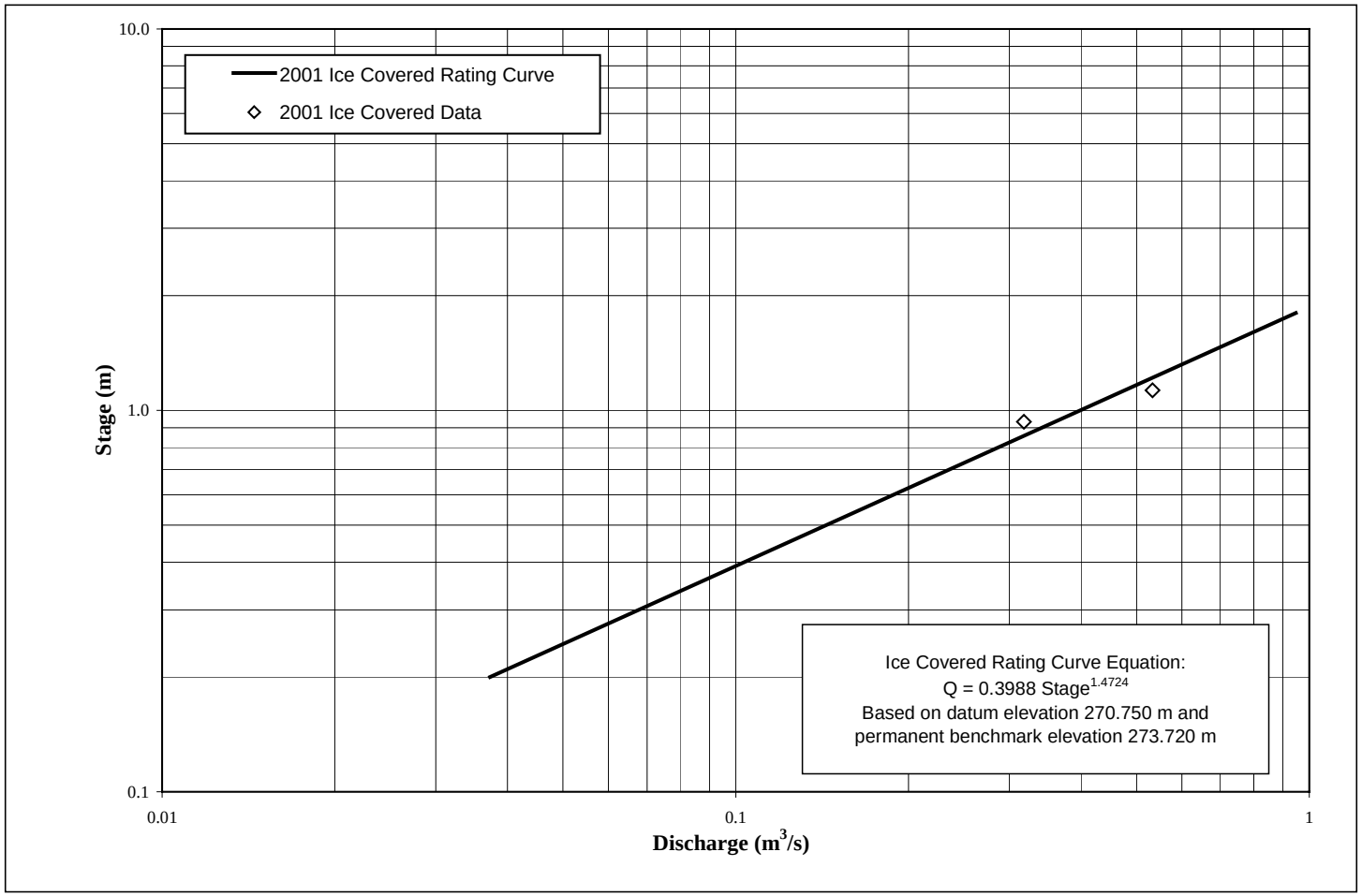


Figure VII-8 Stage-Discharge Rating Curve for Kearl Lake Outlet Station (S9)

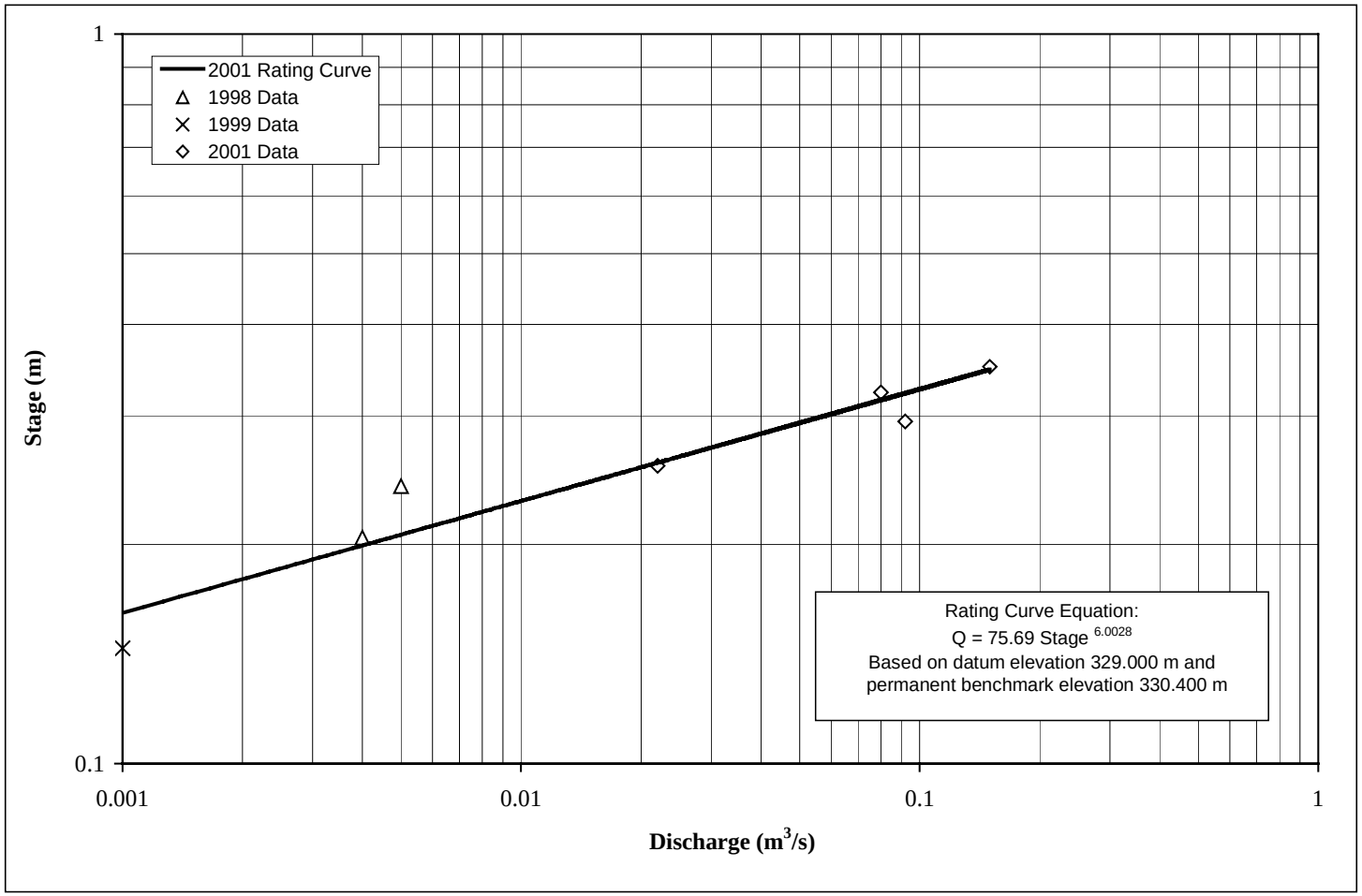


Figure VII-9 Stage-Discharge Rating Curve for Wapasu Creek Station (S10)

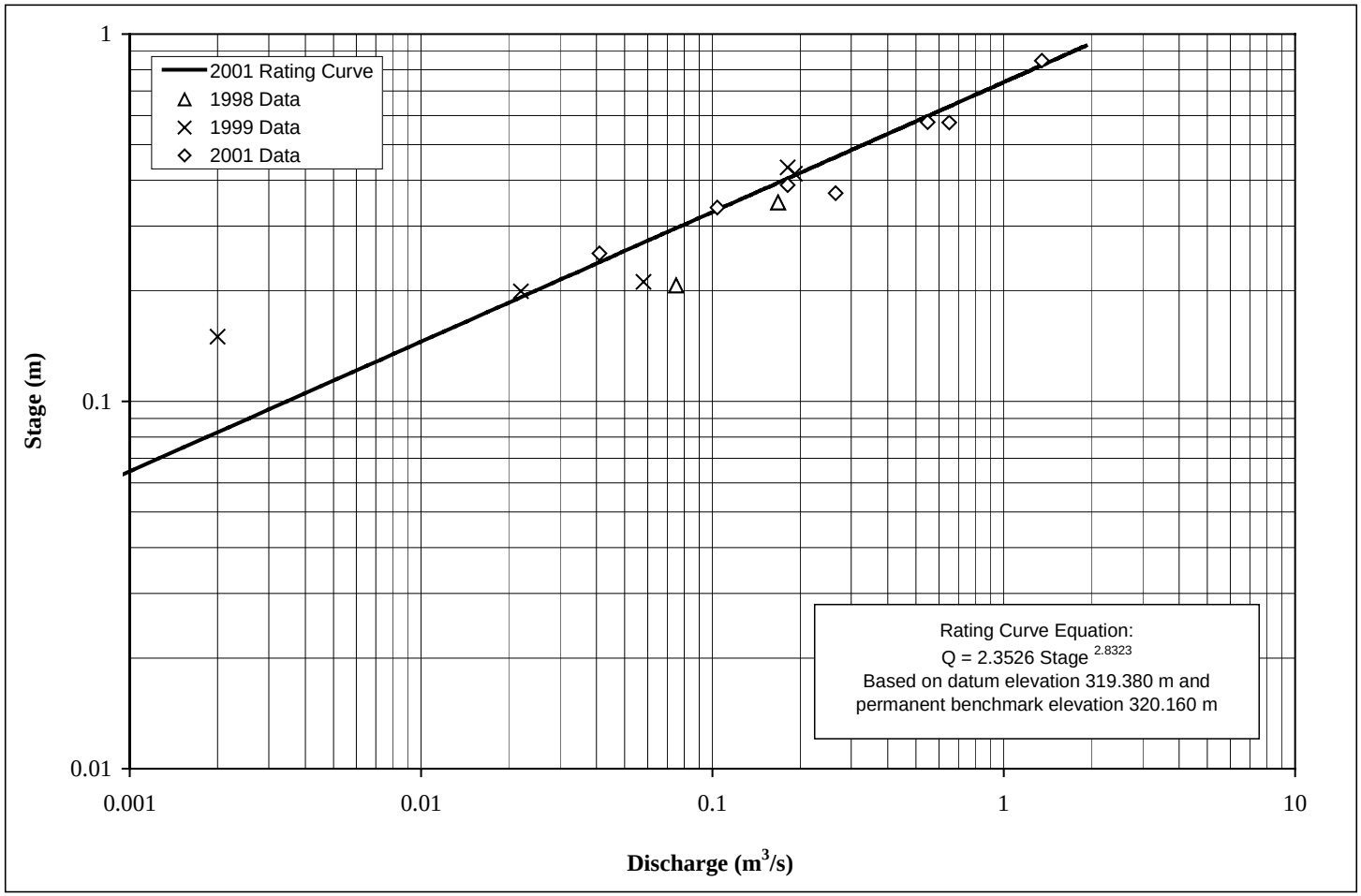


Figure VII-10 Stage-Discharge Rating Curve for Poplar Creek Station (S11)

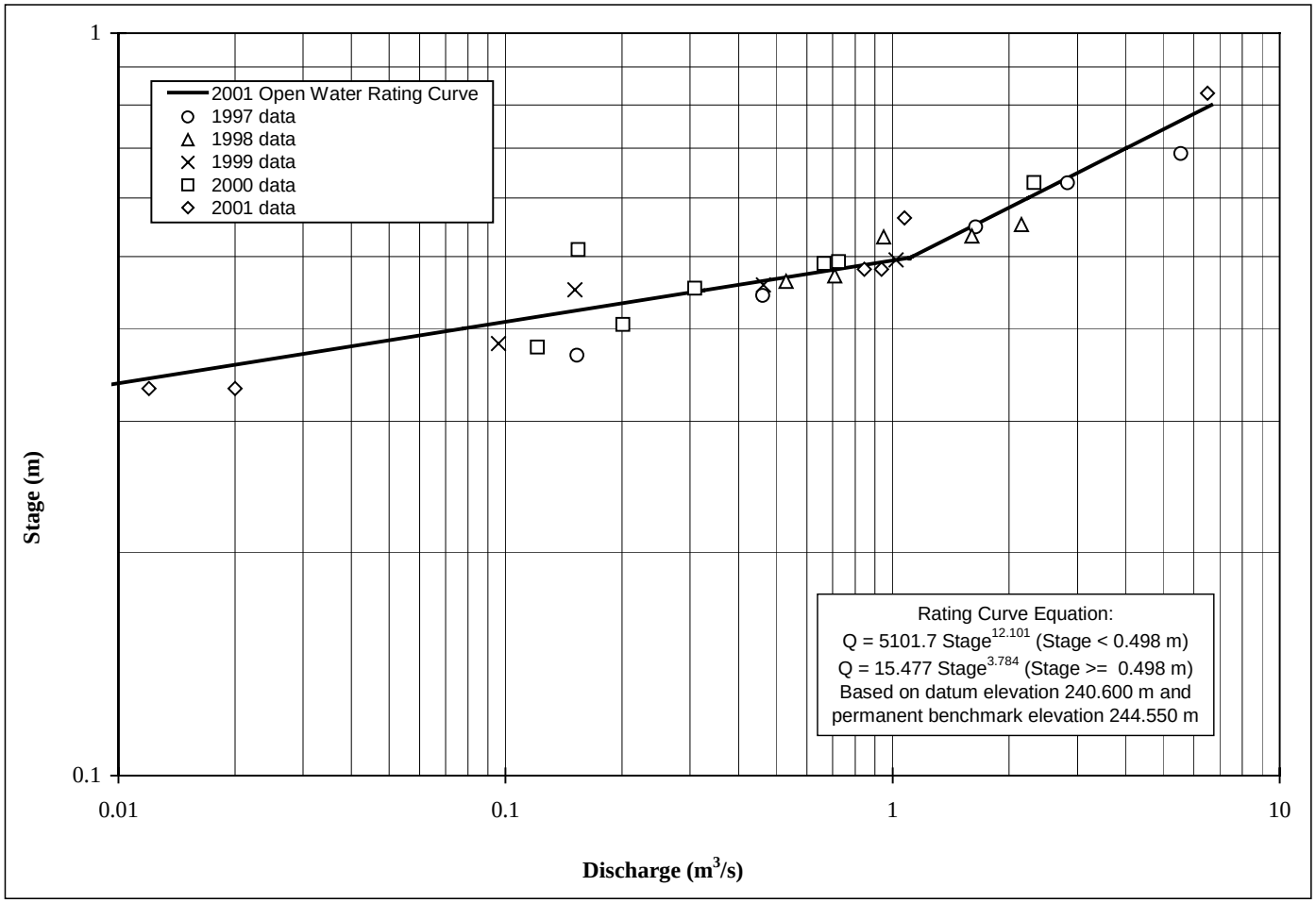


Figure VII-11 Stage-Discharge Rating Curve for Fort Creek Station (S12)

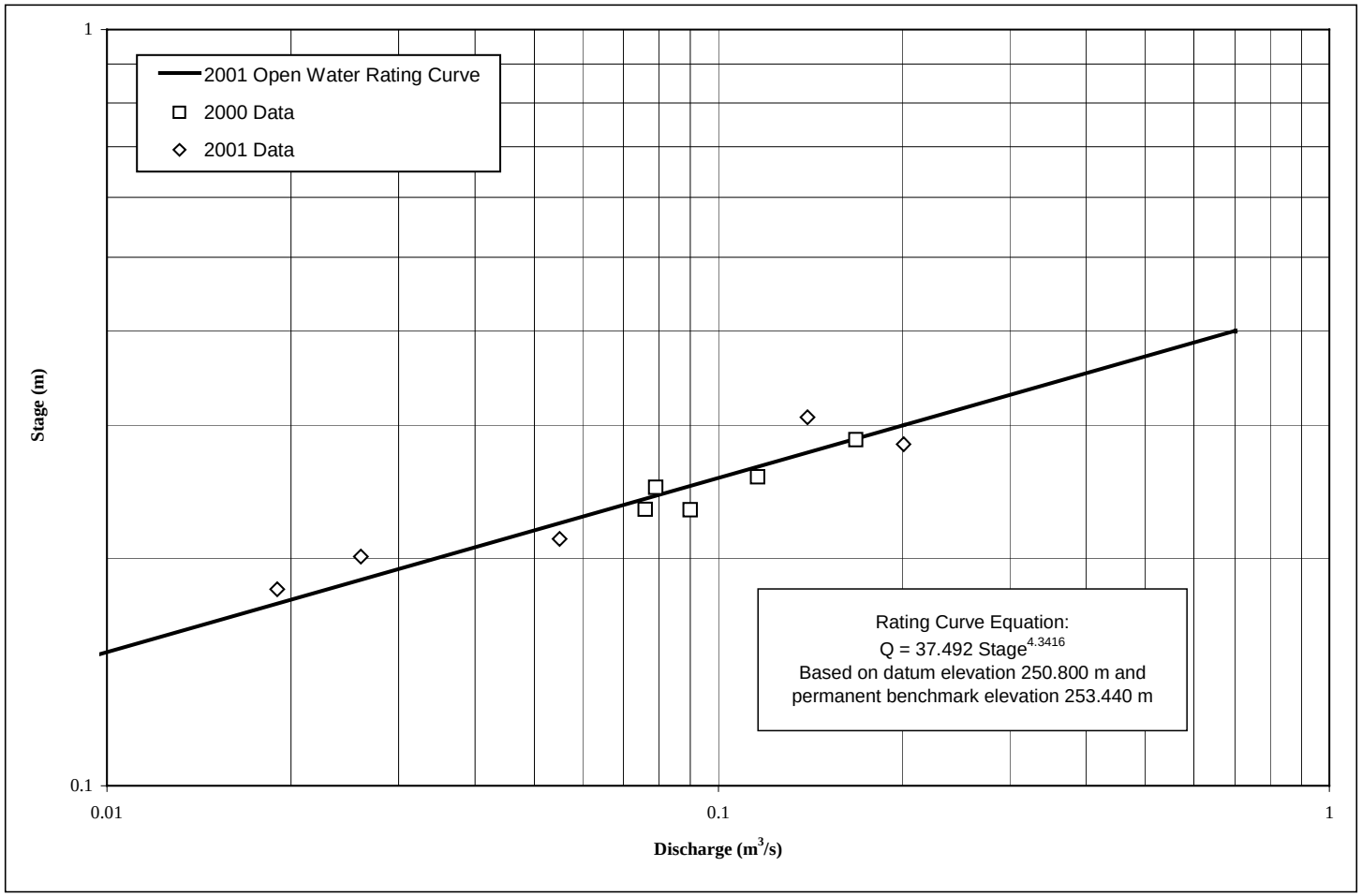


Figure VII-12 Stage-Discharge Rating Curve for Albian Sands Pond #3 Station (S13)

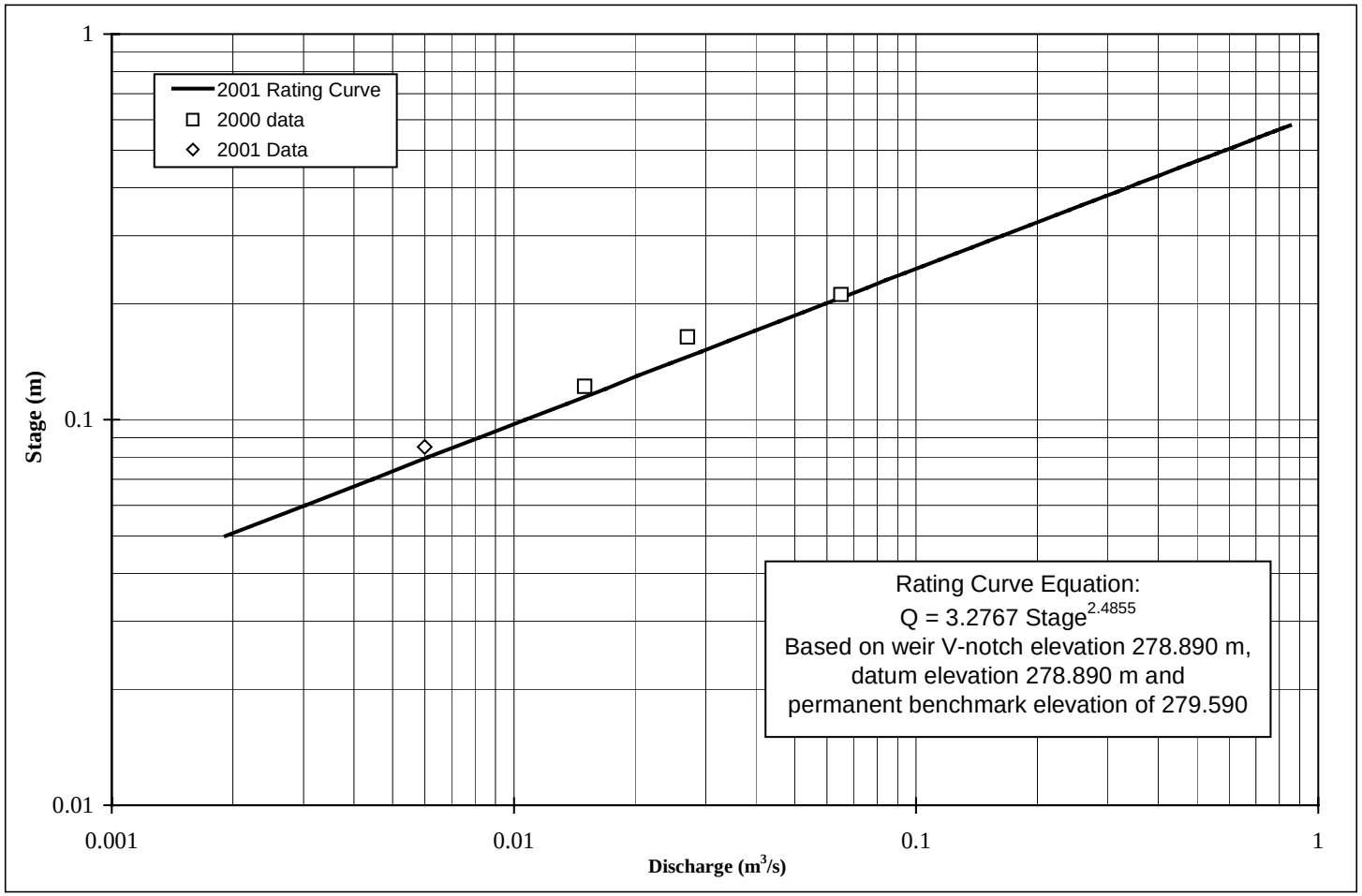


Figure VII-13 Stage-Discharge Rating Curve for Ells River Station (S14)

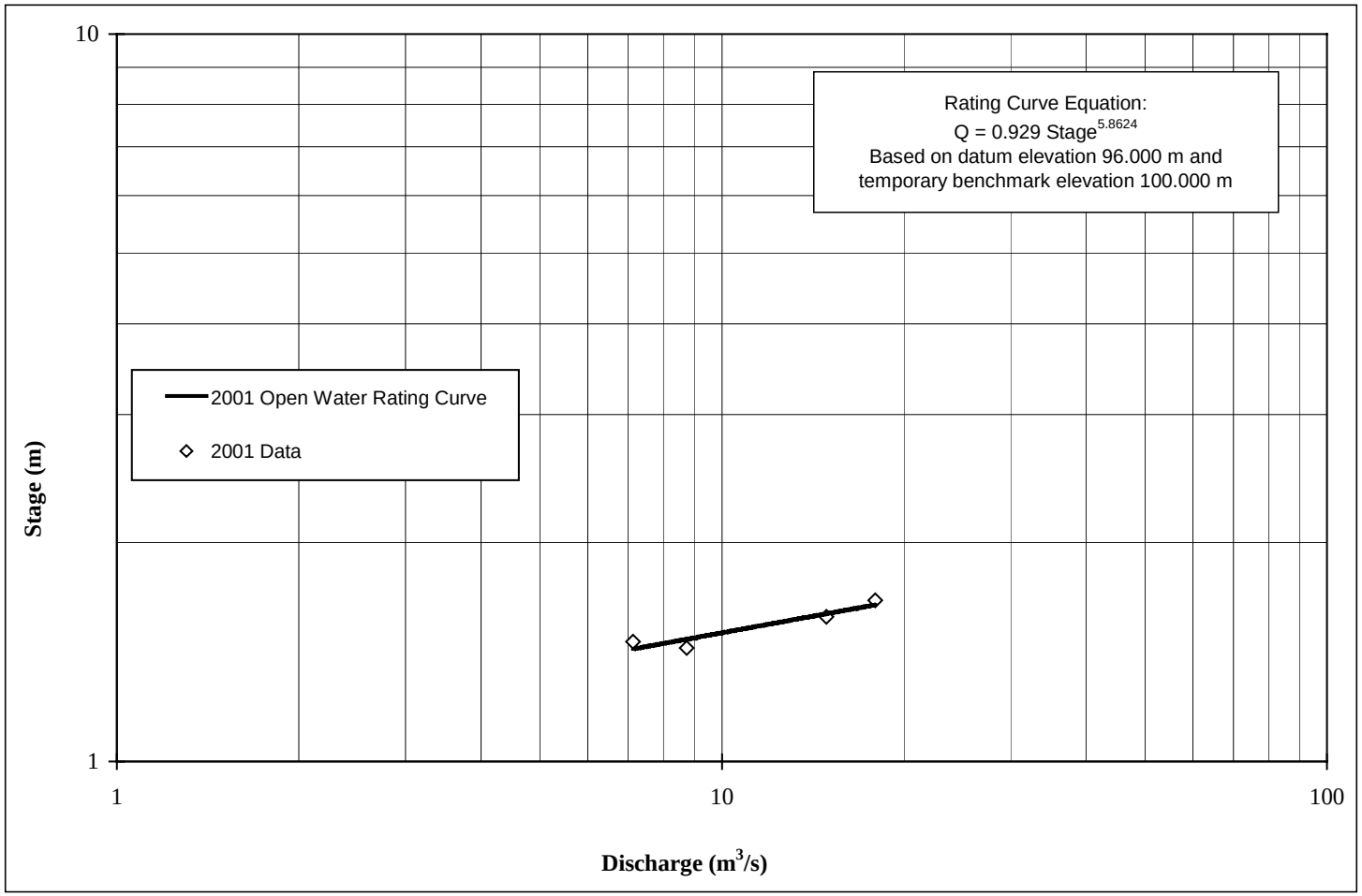


Figure VII-14 Stage-Discharge Rating Curve for Tar River Station (S15)

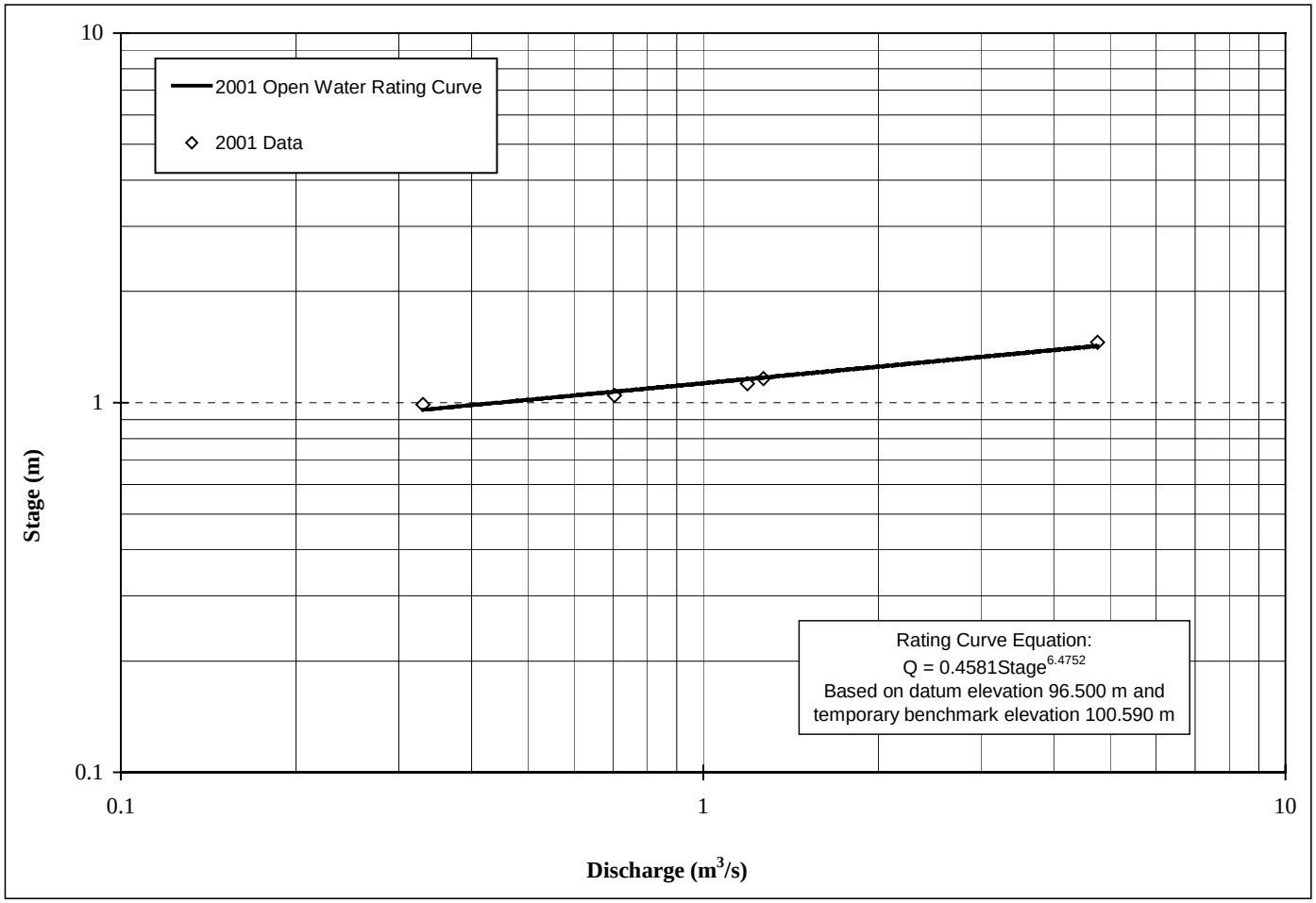


Figure VII-15 Stage-Discharge Rating Curve for Calumet River Station (S16)

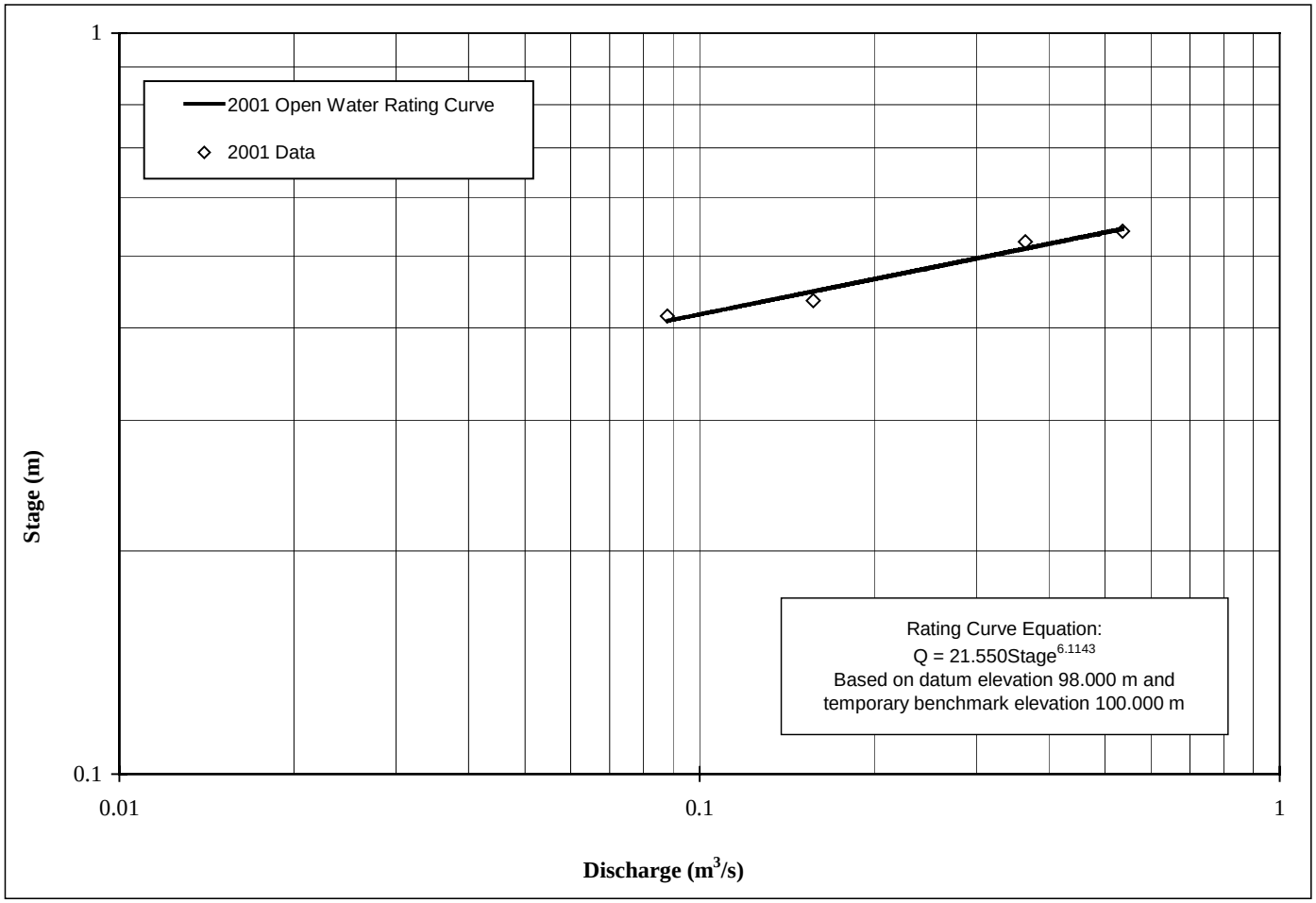


Figure VII-16 Stage-Discharge Rating Curve for Upland Tar River Station (S17)

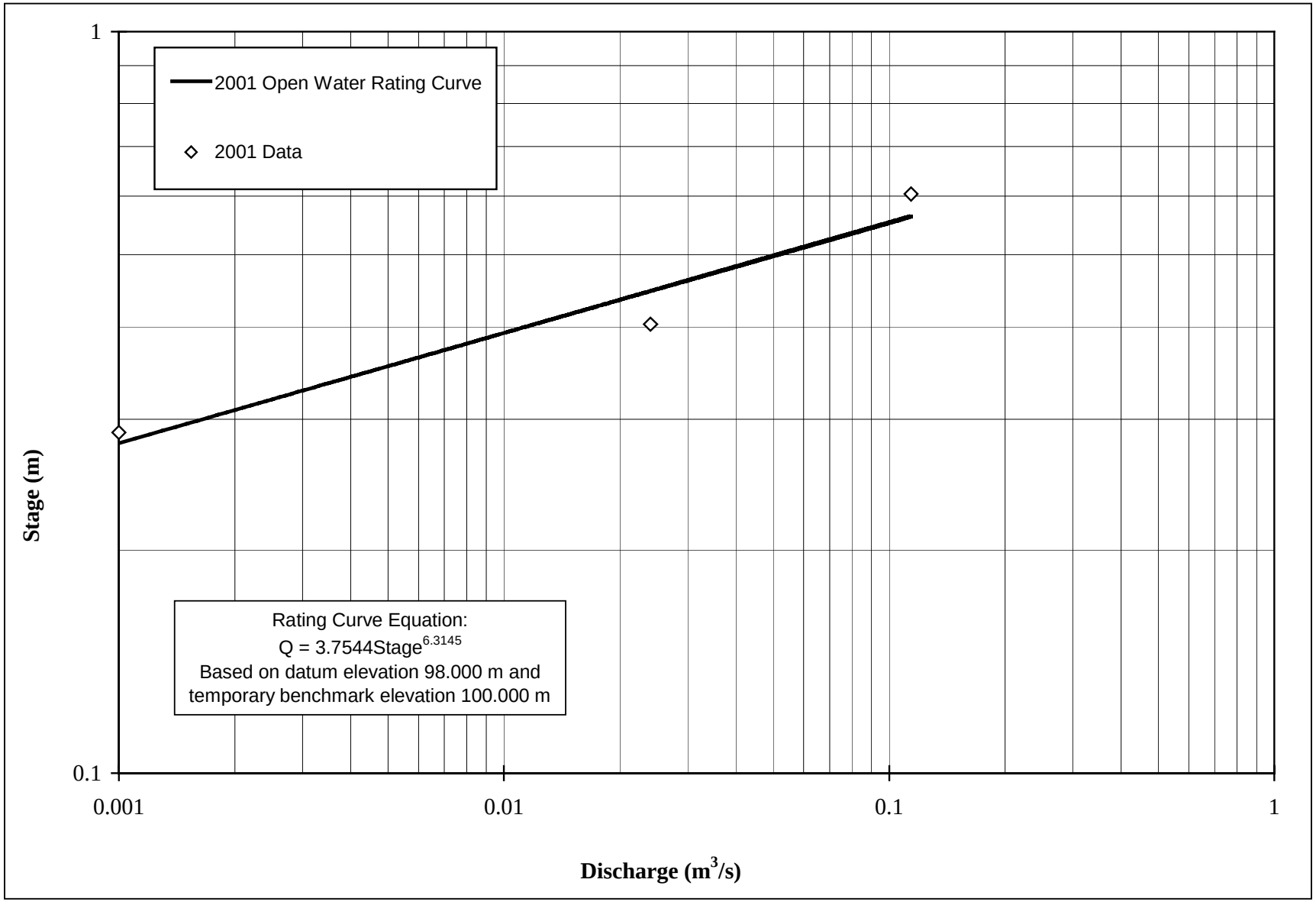


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Figure VII-17 Stage-Discharge Rating Curve for Upland Calumet River Station (S18)

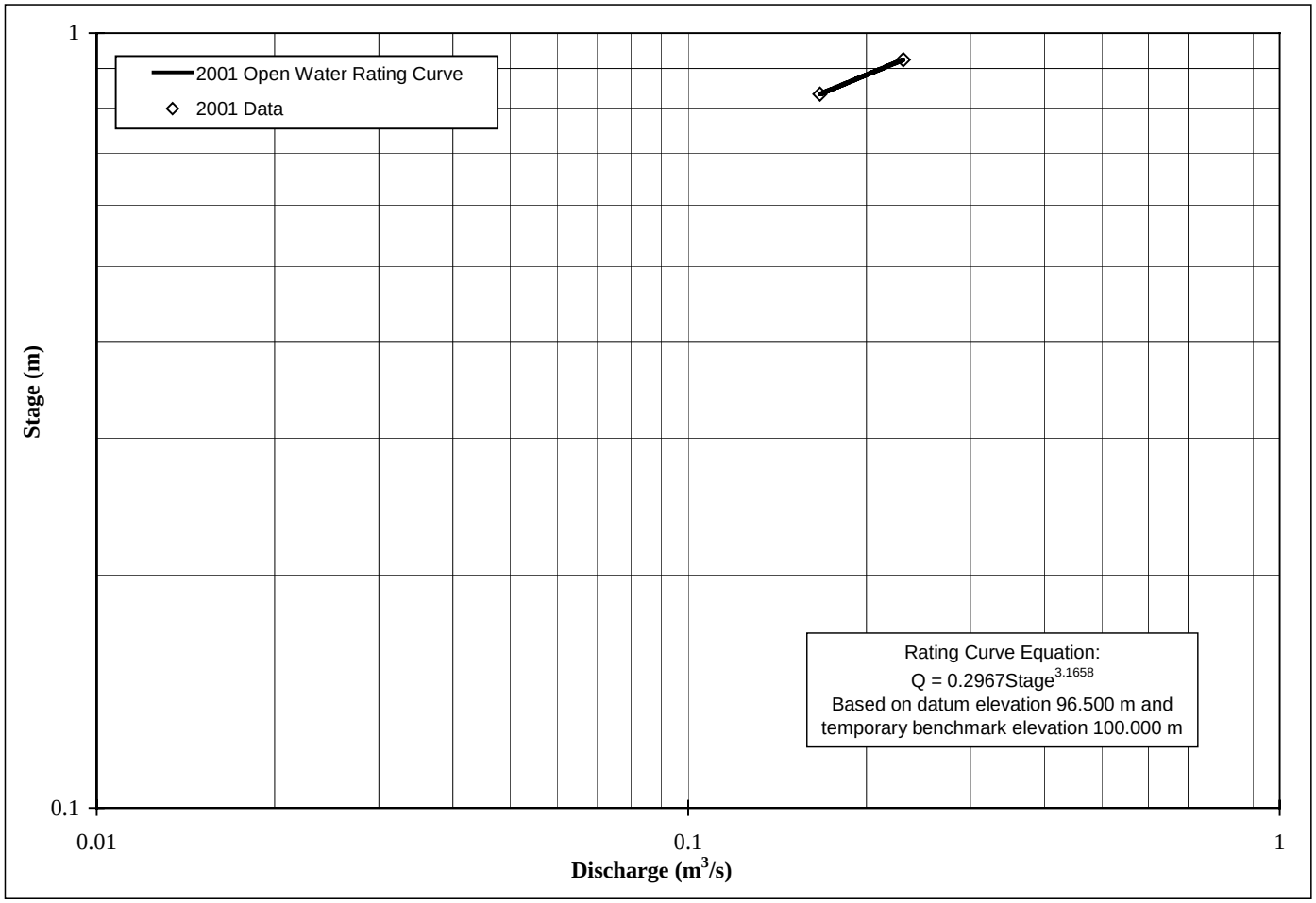


Figure VII-18 Stage-Discharge Rating Curve for Lowland Tar River Station (S19)

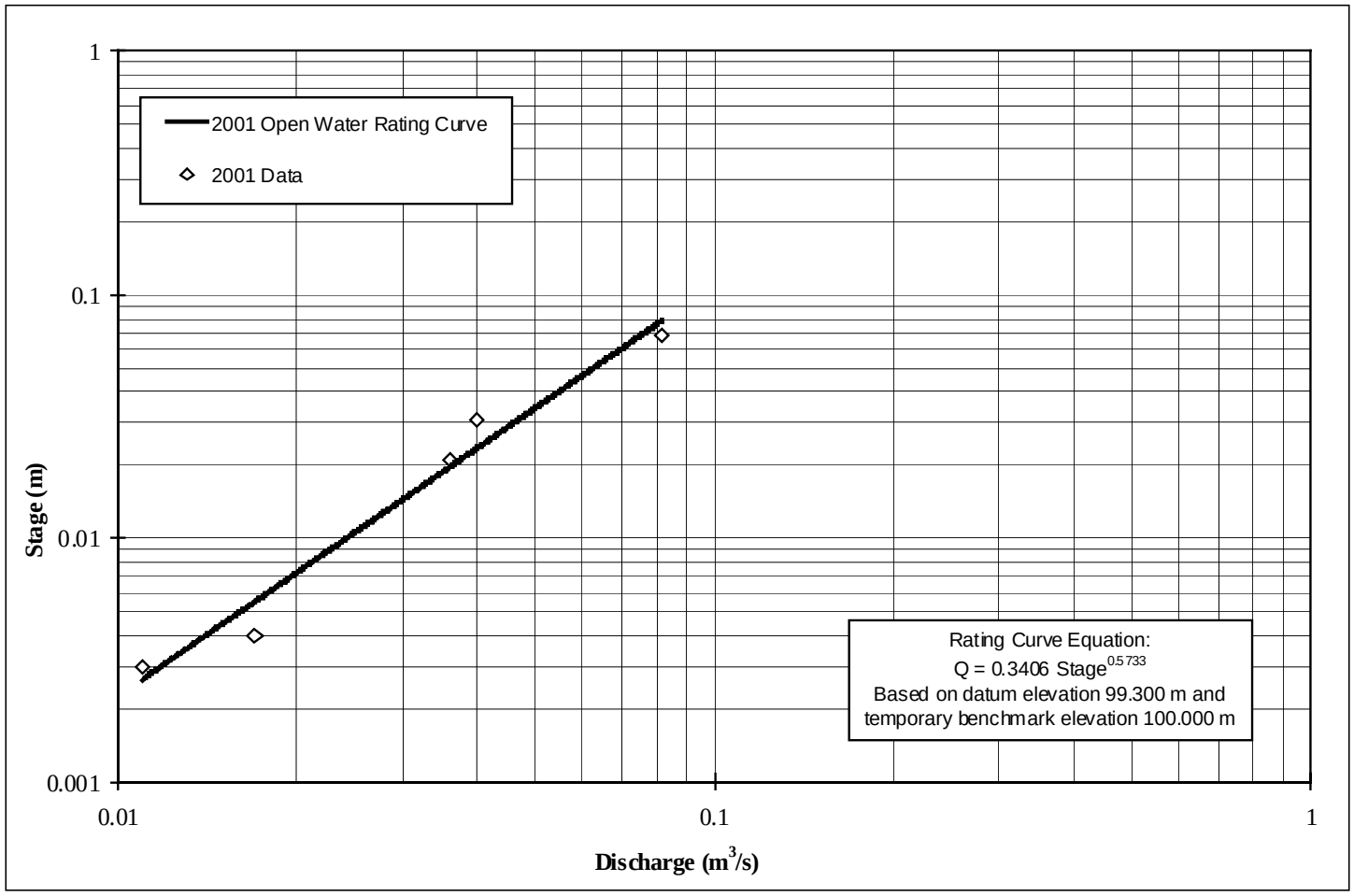


Figure VII-19 Stage-Discharge Rating Curve for Upland Muskeg River Station (S20)

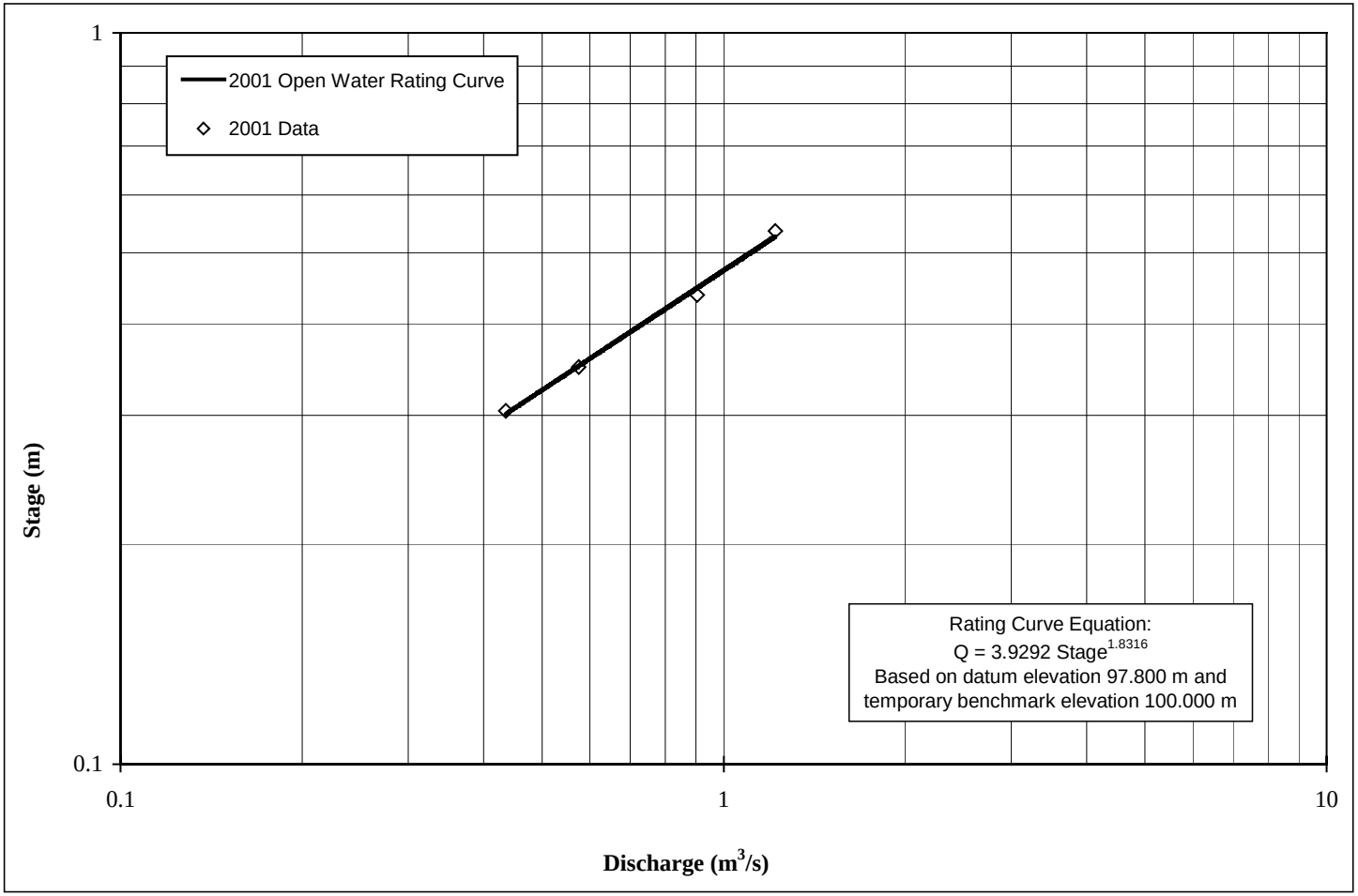


Figure VII-20 Stage-Discharge Rating Curve for Muskeg Creek Station (S22)

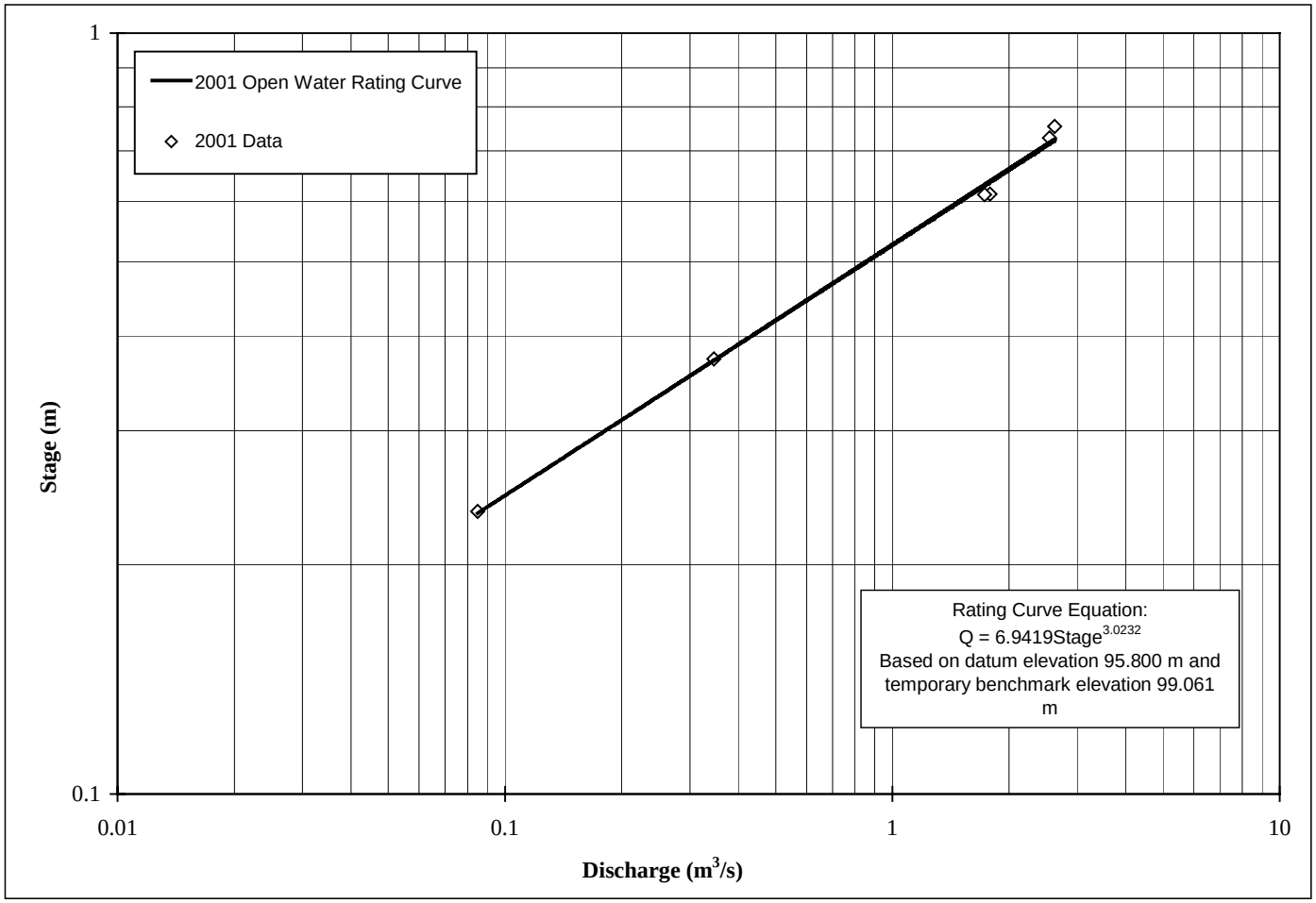


Figure VII-21 Stage-Discharge Rating Curve for Aurora Boundary Weir Station (S23)

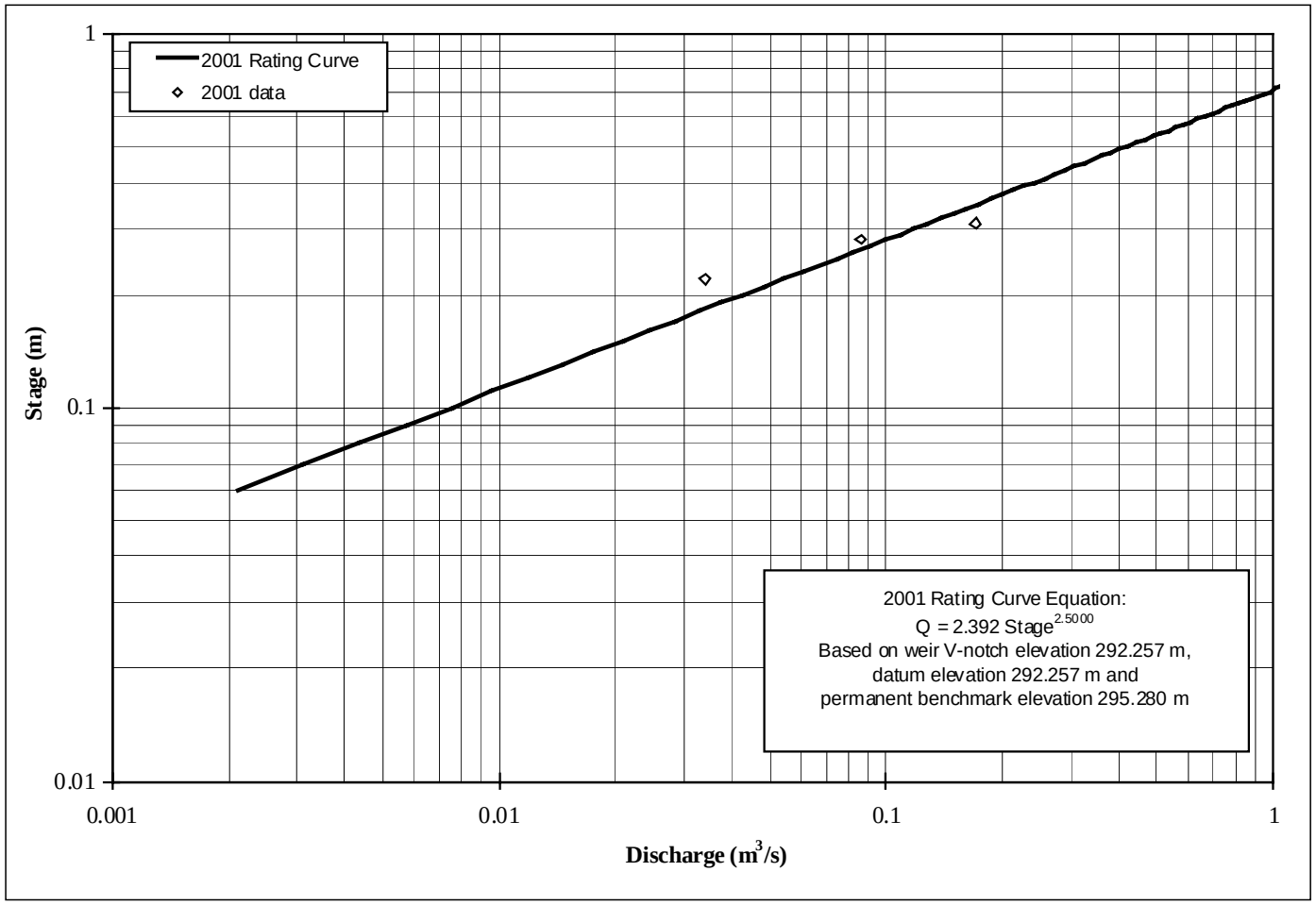


Figure VII-22 Stage-Discharge Rating Curve for Athabasca River Station (S24)

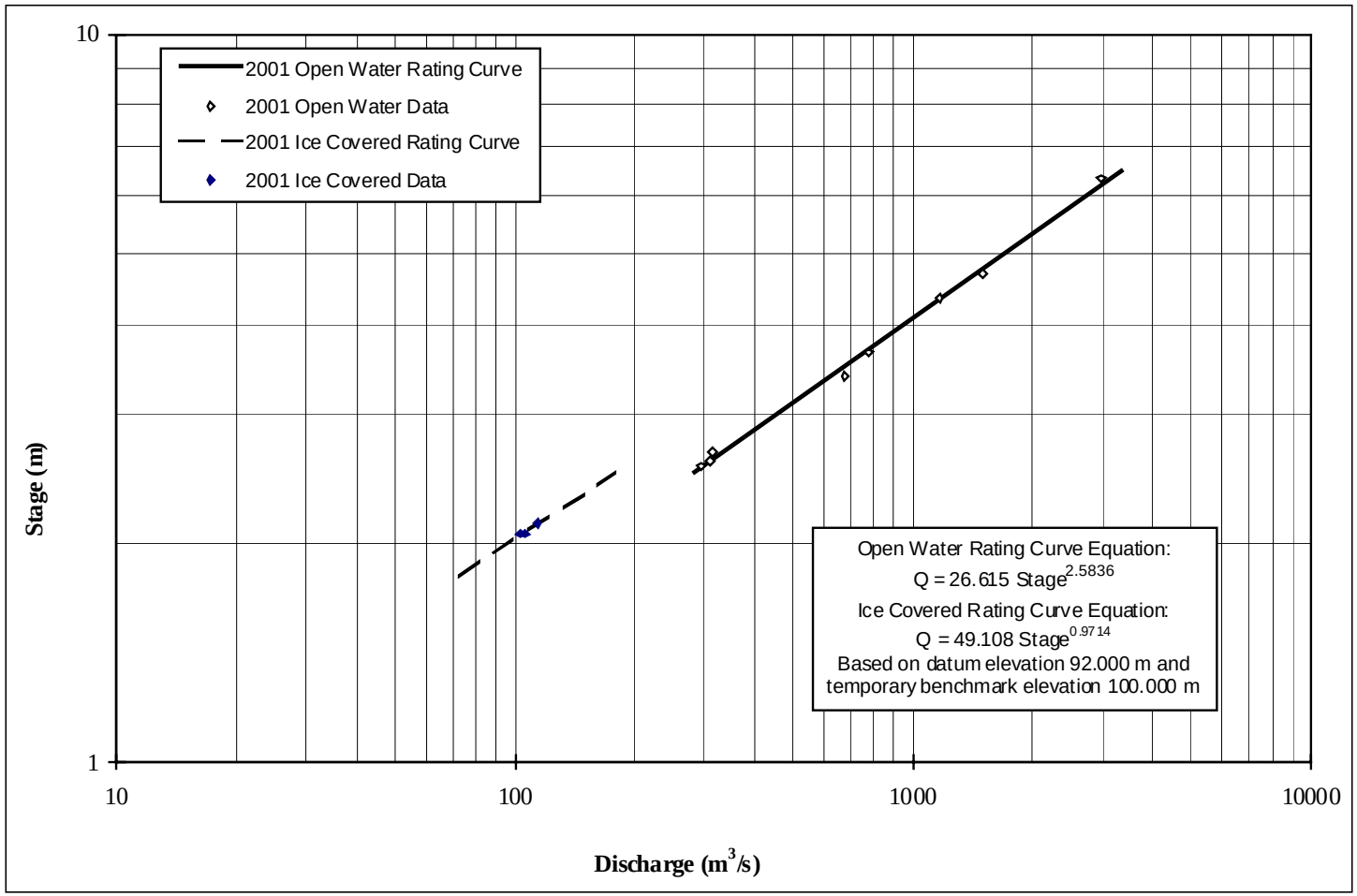


Figure VII-23 Stage-Discharge Rating Curve for Khahago Creek Station (S28)

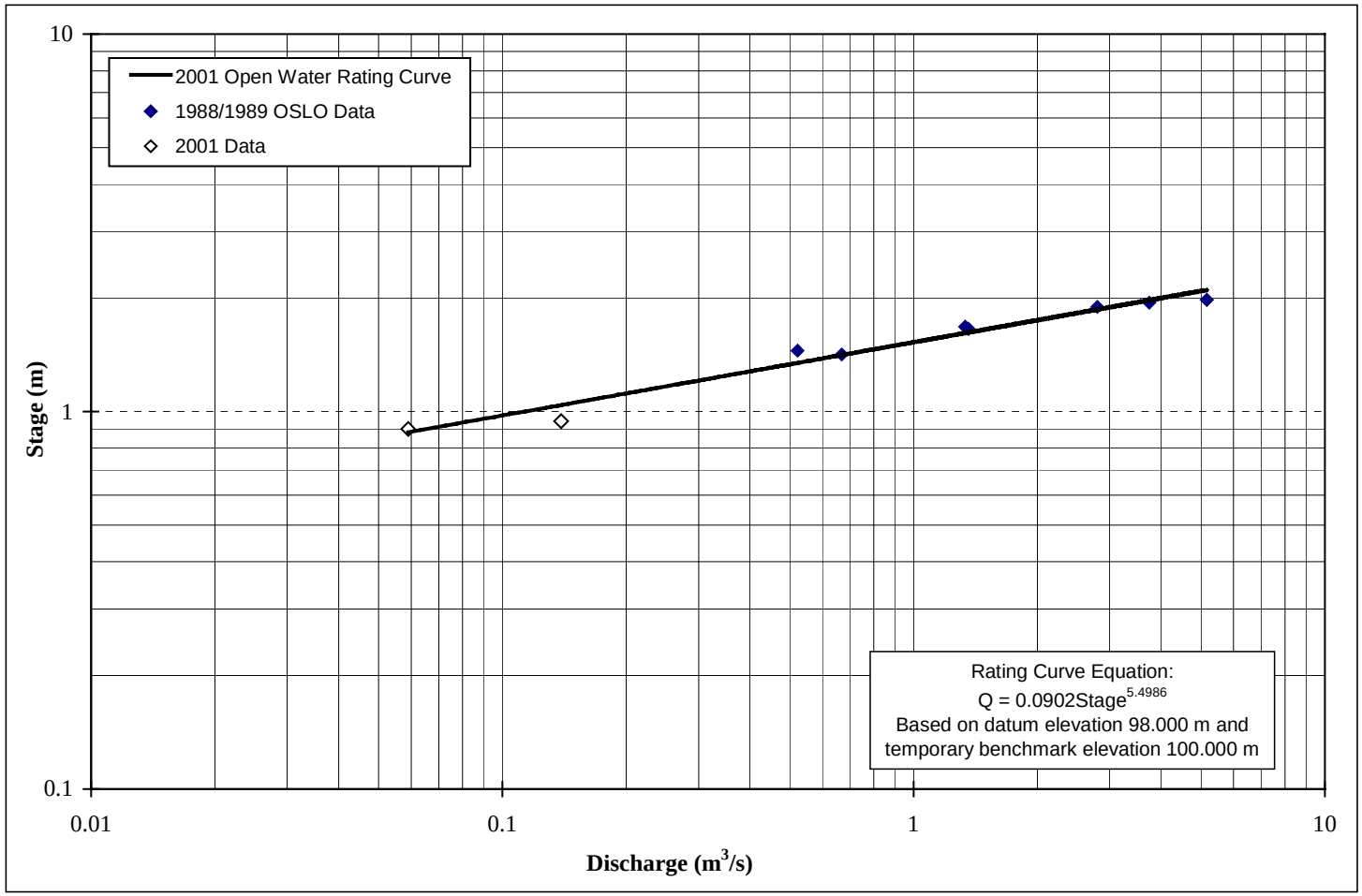
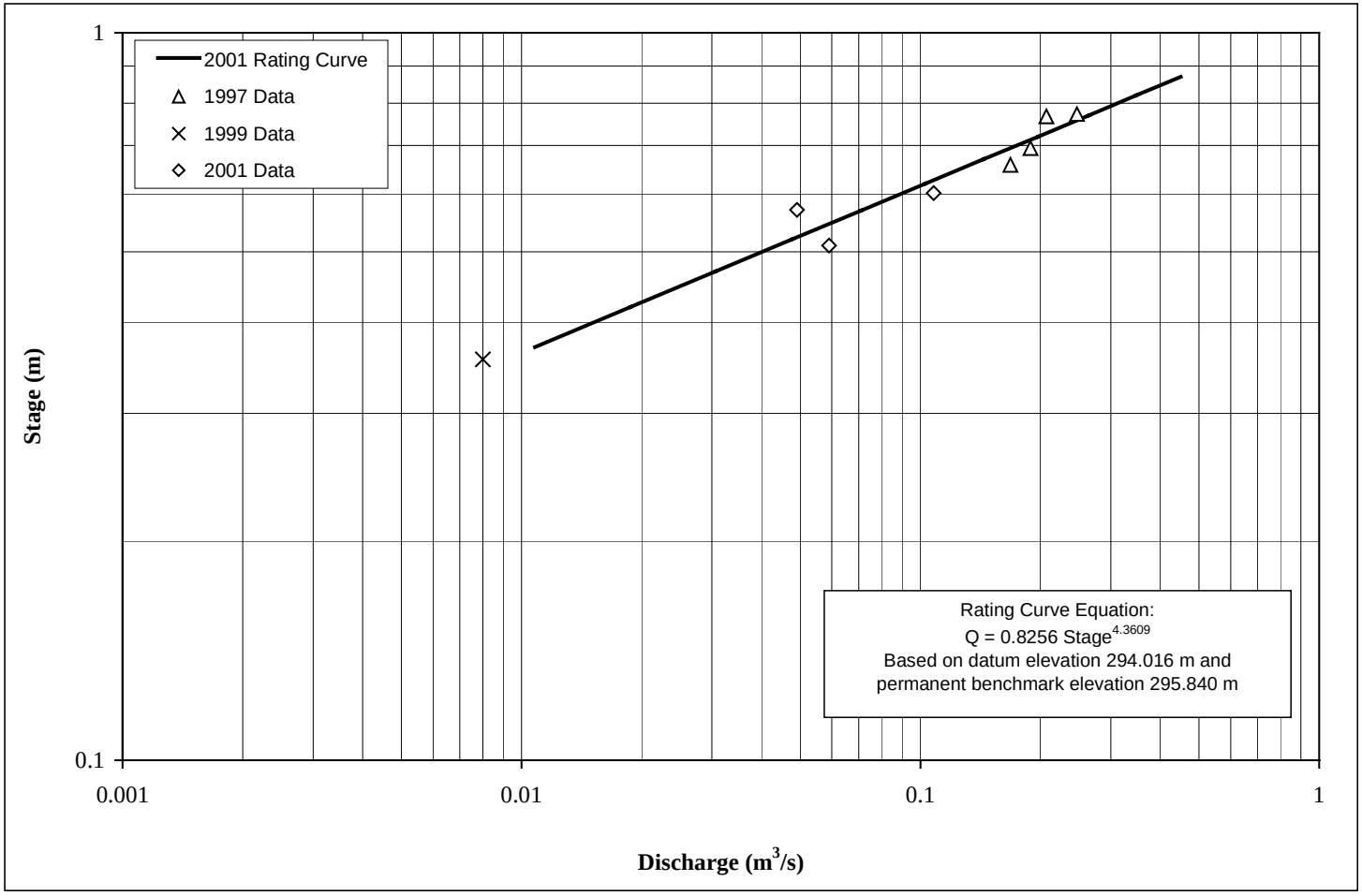


Figure VII-24 Stage-Discharge Rating Curve for McClelland Lake Station (L1)



APPENDIX VIII

2001 RECORDED MEAN DAILY DISCHARGES AND WATER LEVELS AT HYDROMETRIC STATIONS

Table VIII-1 S1 Alsands Drain Mean Daily Discharges (m^3/s), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	0.000	0.000	0.000 X	-	0.162	0.088	0.075	0.023	0.036	0.007	0.009	0.068
2	0.000	0.000	0.000 X	-	0.163	0.103	0.074	0.013	0.056	0.001	0.070	0.005
3	0.000	0.000	0.000 X	0.001 P	0.163	0.142	0.063	0.044	0.001	0.044	0.160	0.013
4	0.000	0.000	0.000 X	0.048	0.163	0.140	0.067	0.042	0.066	0.046	0.131	0.002
5	0.000	0.001	0.000 X	0.095	0.164	0.139	0.072	0.038	0.099	0.024	0.094	0.040
6	0.000	0.000	0.000 X	0.096	0.164	0.101	0.063	0.019	0.034	0.001	0.064	0.035
7	0.000	0.008	0.000 X	0.096	0.141	0.069	0.047	0.000 P	0.048	0.000	0.019	0.006
8	0.000	0.000	0.000 X	0.096	0.121	0.071	0.042	X	0.033	0.000	0.005	0.000
9	0.000	0.007	0.000 X	0.059	0.123	0.071	0.058	X	0.001	0.011	0.020	0.000
10	0.000	0.000	0.000 X	0.028	0.092	0.071	0.022	X	0.057	0.010	0.008	0.003
11	0.000	0.000	0.000 X	0.121	0.063	0.073	0.000	0.001 P	0.034	0.009	0.005	0.000
12	0.000	0.029	0.000 X	0.134	0.091	0.070	0.000	0.001	0.014	0.052	0.005	0.041
13	0.000	0.037	0.000 X	0.154	0.128	0.095	0.000	0.064	0.001	0.128	0.096	0.006
14	0.068	0.056	0.000 X	0.156	0.147	0.137	0.000	0.100	0.024	0.078	0.126	0.027
15	0.082	0.057	0.000 X	0.151	0.127	0.119	0.000	0.041	0.001	0.015	0.018	0.051
16	0.014	0.047	0.000 X	0.153	0.126	0.070	0.000	0.001	0.038	0.001	0.009	0.138
17	0.000	0.000	0.000 X	0.118	0.120	0.071	0.000	0.066	0.001	0.047	0.005	0.183
18	0.000	0.000	0.000 X	0.137	0.105	0.103	0.000	0.100	0.063	0.096	0.004	0.233
19	0.043	0.000	-	0.146	0.090	0.134	0.000	0.065	0.098	0.044	0.036	0.102
20	0.027	0.009	-	0.154	0.091	0.107	0.025	0.001	0.099	0.001	0.006	0.007
21	0.021	0.004	-	0.112	0.088	0.079	0.068	0.039	0.075	0.001	0.103	0.083
22	0.056	0.000	-	0.095	0.084	0.081	0.076	0.065	0.044	0.025	0.076	0.003
23	0.017	0.000 X	-	0.092	0.092	0.073	0.080	0.001	0.099	0.049	0.069	0.000
24	0.000	0.000 X	-	0.091	0.098	0.069	0.046	0.066	0.097	0.054	0.006	0.000
25	0.020	0.000 X	-	0.114	0.094	0.067	0.000	0.099	0.105	0.001	0.005	0.000
26	0.032	0.000 X	-	0.112	0.080	0.065	0.000	0.057	0.151	0.053	0.061	0.000
27	0.030	0.000 X	-	0.132	0.051	0.068	0.000	0.066	0.055	0.093	0.010	0.012
28	0.028	0.000 X	-	0.159	0.061	0.074	0.000	0.077	0.001	0.038	0.051	0.000
29	0.016	-	-	0.158	0.064	0.070	0.000	0.017	0.001	0.020	0.005	0.000
30	0.000	-	-	0.161	0.056	0.069	0.032	0.005	0.001	0.005	0.094	0.000
31	0.000	-	-	-	0.060	-	0.046	0.056	-	0.047	-	0.000
min	**0.000**	**0.000**	**0.000**	**0.001**	**0.051**	**0.065**	**0.000**	**0.000**	**0.001**	**0.000**	**0.004**	**0.000**
mean	**0.015**	**0.009**	**0.000**	**0.113**	**0.107**	**0.090**	**0.029**	**0.042**	**0.048**	**0.033**	**0.047**	**0.033**
max	**0.082**	**0.057**	**0.000**	**0.161**	**0.164**	**0.142**	**0.080**	**0.100**	**0.151**	**0.128**	**0.160**	**0.233**

Notes: P - partial daily average.
X - transducer damaged.

Table VIII-2 S1 Alsands Drain Mean Daily Water Levels (m) Based on Permanent Benchmark el. 280.015 m (geodetic), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	278.891	279.177	278.009 X	-	279.616	279.548	279.538	279.393	279.425	279.351	279.406	279.484
2	278.889	279.158	278.008 X	-	279.617	279.564	279.536	279.337	279.469	279.333	279.482	279.383
3	278.884	279.135	278.008 X	279.333 P	279.617	279.601	279.521	279.495	279.339	279.435	279.615	279.397
4	278.891	279.106	278.008 X	279.443	279.616	279.600	279.527	279.492	279.488	279.448	279.581	279.362
5	278.895	279.191	278.008 X	279.560	279.618	279.599	279.534	279.485	279.563	279.396	279.530	279.422
6	278.880	279.201	278.008 X	279.561	279.617	279.562	279.522	279.402	279.421	279.334	279.484	279.418
7	278.896	279.267	278.008 X	279.560	279.598	279.530	279.490	279.319 P	279.447	279.331	279.413	279.383
8	278.906	279.234	278.008 X	279.561	279.582	279.533	279.464	X	279.418	279.328	279.388	279.242
9	278.910	279.271	278.008 X	279.364	279.583	279.532	279.515	X	279.337	279.361	279.425	279.248
10	278.915	279.219	278.009 X	279.119	279.522	279.533	279.404	X	279.465	279.366	279.403	279.272
11	278.915	279.136	278.008 X	279.582	279.453	279.536	279.316	279.350 P	279.420	279.368	279.387	279.245
12	278.912	279.332	278.008 X	279.592	279.511	279.531	279.310	279.338	279.372	279.460	279.382	279.376
13	278.907	279.413	278.008 X	279.610	279.587	279.557	279.301	279.481	279.337	279.588	279.517	279.362
14	279.223	279.487	278.007 X	279.611	279.603	279.597	279.300	279.565	279.404	279.493	279.566	279.382
15	279.543	279.489	278.008 X	279.607	279.587	279.580	279.296	279.437	279.338	279.383	279.422	279.506
16	279.346	279.450	278.008 X	279.608	279.586	279.532	279.289	279.337	279.425	279.334	279.408	279.596
17	279.229	279.278	278.008 X	279.579	279.582	279.533	279.282	279.485	279.339	279.446	279.386	279.630
18	279.201	279.197	278.008 X	279.596	279.567	279.564	279.286	279.564	279.482	279.561	279.381	279.658
19	279.399	279.156	-	279.603	279.554	279.591	279.292	279.490	279.562	279.448	279.433	279.533 P
20	279.396	279.286	-	279.610	279.555	279.568	279.386	279.341	279.564	279.336	279.392	279.392
21	279.352	279.104	-	279.574	279.551	279.542	279.529	279.425	279.514	279.333	279.528	279.523
22	279.485	278.727	-	279.560	279.547	279.544	279.539	279.491	279.437	279.410	279.505	279.359
23	279.354	278.213 X	-	279.557	279.556	279.535	279.544	279.342	279.564	279.458	279.491	279.287
24	279.235	278.009 X	-	279.556	279.562	279.530	279.453	279.489	279.561	279.474	279.389	279.222
25	279.369	278.009 X	-	279.575	279.558	279.528	279.299	279.562	279.546	279.335	279.385	279.160
26	279.473	278.010 X	-	279.565	279.543	279.526	279.291	279.473	279.608	279.462	279.473	279.130
27	279.469	278.010 X	-	279.590	279.497	279.529	279.285	279.489	279.442	279.557	279.408	279.268
28	279.466	278.010 X	-	279.614	279.520	279.537	279.276	279.528	279.341	279.432	279.458	279.276
29	279.369	-	-	279.613	279.524	279.532	279.284	279.399	279.339	279.397	279.382	279.173
30	279.225	-	-	279.615	279.512	279.531	279.425	279.354	279.333	279.384	279.514	279.110
31	279.203	-	-	-	279.503	-	279.497	279.464	-	279.460	-	279.086
min	**278.880**	**278.009**	**278.007**	**279.119**	**279.453**	**279.526**	**279.276**	**279.319**	**279.333**	**279.328**	**279.381**	**279.086**
mean	**279.162**	**278.974**	**278.008**	**279.547**	**279.561**	**279.551**	**279.400**	**279.442**	**279.444**	**279.415**	**279.453**	**279.347**
max	**279.543**	**279.489**	**278.009**	**279.615**	**279.618**	**279.601**	**279.544**	**279.565**	**279.608**	**279.588**	**279.615**	**279.658**

Notes: P - partial daily average.
X - transducer damaged.

Table VIII-3 S2 Jackpine Creek Mean Daily Discharges (m^3/s), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	1.898	2.663	9.660	0.705	0.621	0.304	-	-
2	-	-	-	-	1.978	2.483	8.209	0.618	0.609	0.289	-	-
3	-	-	-	-	2.067	2.218	6.955	0.601	0.576	0.278	-	-
4	-	-	-	-	1.866	1.967	5.806	0.531	0.532	0.269	-	-
5	-	-	-	-	1.585	1.724	4.899	0.580	0.511	0.260	-	-
6	-	-	-	-	1.842	1.521	4.077	0.880	0.489	0.257	-	-
7	-	-	-	-	2.700	1.375	3.321	0.822	0.481	0.256	-	-
8	-	-	-	-	3.308	1.273	2.755	0.943	0.515	0.253	-	-
9	-	-	-	-	3.946	1.134	2.282	1.062	0.515	0.250	-	-
10	-	-	-	-	4.549	1.325	1.927	1.058	0.496	0.249	-	-
11	-	-	-	-	4.822	2.766	1.776	1.027	0.502	0.257	-	-
12	-	-	-	-	4.663	3.820	1.840	0.970	0.491	0.289	-	-
13	-	-	-	-	4.313	4.755	1.724	0.874	0.488	0.321	-	-
14	-	-	-	-	4.082	6.552	1.484	0.817	0.469	0.318	-	-
15	-	-	-	-	3.718	8.377	1.294	0.833	0.436	0.308	-	-
16	-	-	-	-	3.401	8.788	1.121	0.762	0.411	0.312	-	-
17	-	-	-	-	3.180	8.304	1.044	0.685	0.398	0.315	-	-
18	-	-	-	-	3.043	7.192	0.999	0.603	0.386	0.309	-	-
19	-	-	-	-	2.870	6.580	0.872	0.678	0.389	0.298	-	-
20	-	-	-		2.635	5.953	0.759	1.267	0.471	0.286	-	-
21	-	-	-	-	2.440	5.065	0.671	1.488	0.419	0.275	-	-
22	-	-	-	2.088	2.196	4.115	0.592	1.329	0.401	0.316	-	-
23	-	-	-	1.620	2.081	4.647	0.500	1.233	0.382	0.368	-	-
24	-	-	-	1.146	2.184	5.771	0.431	1.390	0.426	0.414	-	-
25	-	-	-	1.060	2.492	7.166	0.393	1.331	0.359	0.236 P	-	-
26	-	-	-	1.294	2.491	7.697	0.388	1.106	0.353	-	-	-
27	-	-	-	1.259	2.308	7.665	0.389	0.936	0.357	-	-	-
28	-	-	-	1.485	2.042	7.764	0.417	0.848	0.337	-	-	-
29	-	-	-	1.803	1.796	9.887	0.559	0.798	0.322	-	-	-
30	-	-	-	1.827	1.806	10.717	0.831	0.749	0.317	-	-	-
31	-	-	-	-	2.384	-	0.792	0.675	-	-	-	-
min	**-**	**-**	**-**	**1.060**	**1.585**	**1.134**	**0.388**	**0.531**	**0.317**	**0.236**	**-**	**-**
mean	**-**	**-**	**-**	**1.509**	**2.796**	**5.042**	**2.218**	**0.910**	**0.449**	**0.291**	**-**	**-**
max	**-**	**-**	**-**	**2.088**	**4.822**	**10.717**	**9.660**	**1.488**	**0.621**	**0.414**	**-**	**-**

Notes: P - partial daily average.

Table VIII-4 S2 Jackpine Creek Mean Daily Water Levels (m) Based on Permanent Benchmark el. 297.990 m (geodetic), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	297.045	297.094	297.309	296.920	296.905	296.830	-	-
2	-	-	-	-	297.051	297.084	297.279	296.905	296.903	296.825	-	-
3	-	-	-	-	297.057	297.067	297.249	296.901	296.897	296.821	-	-
4	-	-	-	-	297.043	297.050	297.218	296.888	296.888	296.818	-	-
5	-	-	-	-	297.021	297.032	297.189	296.896	296.883	296.815	-	-
6	-	-	-	-	297.040	297.015	297.159	296.946	296.879	296.813	-	-
7	-	-	-	-	297.096	297.002	297.127	296.938	296.877	296.813	-	-
8	-	-	-	-	297.127	296.992	297.099	296.954	296.884	296.812	-	-
9	-	-	-	-	297.154	296.977	297.071	296.969	296.884	296.811	-	-
10	-	-	-	-	297.177	296.995	297.047	296.968	296.880	296.810	-	-
11	-	-	-	-	297.187	297.098	297.036	296.965	296.882	296.813	-	-
12	-	-	-	-	297.181	297.149	297.041	296.958	296.879	296.825	-	-
13	-	-	-	-	297.169	297.184	297.032	296.945	296.879	296.835	-	-
14	-	-	-	-	297.160	297.239	297.012	296.937	296.874	296.834	-	-
15	-	-	-	-	297.145	297.283	296.994	296.939	296.867	296.831	-	-
16	-	-	-	-	297.131	297.292	296.976	296.929	296.860	296.832	-	-
17	-	-	-	-	297.121	297.281	296.967	296.916	296.857	296.833	-	-
18	-	-	-	-	297.114	297.256	296.961	296.902	296.854	296.831	-	-
19	-	-	-	-	297.105	297.240	296.945	296.915	296.854	296.828	-	-
20	-	-	-		297.092	297.222	296.928	296.990	296.874	296.824	-	-
21	-	-	-	297.141 P	297.081	297.195	296.914	297.012	296.862	296.820	-	-
22	-	-	-	297.054	297.066	297.161	296.900	296.997	296.858	296.832	-	-
23	-	-	-	297.022	297.058	297.181	296.881	296.988	296.853	296.847	-	-
24	-	-	-	296.977	297.065	297.217	296.865	297.003	296.864	296.856	-	-
25	-	-	-	296.968	297.084	297.255	296.856	296.998	296.846	296.805 P	-	-
26	-	-	-	296.991	297.084	297.268	296.854	296.974	296.845	-	-	-
27	-	-	-	296.990	297.073	297.267	296.854	296.953	296.846	-	-	-
28	-	-	-	297.011	297.056	297.269	296.862	296.941	296.840	-	-	-
29	-	-	-	297.038	297.038	297.314	296.892	296.934	296.835	-	-	-
30	-	-	-	297.040	297.038	297.329	296.939	296.927	296.834	-	-	-
31	-	-	-	-	297.077	-	296.933	296.915	-	-	-	-
min	**-**	**-**	**-**	**296.968**	**297.021**	**296.977**	**296.854**	**296.888**	**296.834**	**296.805**	**-**	**-**
mean	**-**	**-**	**-**	**297.023**	**297.095**	**297.167**	**297.013**	**296.946**	**296.868**	**296.825**	**-**	**-**
max	**-**	**-**	**-**	**297.141**	**297.187**	**297.329**	**297.309**	**297.012**	**296.905**	**296.856**	**-**	**-**

Notes: P - partial daily average.

Table VIII-5 S3 Iynimin Creek Mean Daily Discharges (m^3/s), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	-	0.291	-	0.135	0.076	-	-
2	-	-	-	-	-	-	0.278	-	0.141	0.076	-	-
3	-	-	-	-	-	-	0.255	-	0.133	0.075	-	-
4	-	-	-	-	-	-	0.221	0.307	0.127	0.073	-	-
5	-	-	-	-	-	-	0.203	0.524	0.121	0.073	-	-
6	-	-	-	-	-	-	0.175	0.547	0.120	0.073	-	-
7	-	-	-	-	-	-	0.150	0.488	0.125	0.074	-	-
8	-	-	-	-	0.410	-	0.129	0.478	0.129	0.072	-	-
9	-	-	-	-	0.431	-	0.109	0.463	0.128	0.073	-	-
10	-	-	-	-	0.418	-	0.096 P	0.430	0.125	0.073	-	-
11	-	-	-	-	0.396	-	-	0.387	0.123	0.078	-	-
12	-	-	-	-	0.393	0.360	-	0.345	0.117	0.097	-	-
13	-	-	-	-	0.399	0.331	-	0.304	0.115	0.110	-	-
14	-	-	-	-	-	0.306	-	0.287	0.113	0.126	-	-
15	-	-	-	-	-	0.280	-	0.269	0.107	0.127	-	-
16	-	-	-	-	-	0.246	-	0.236	0.103	0.122	-	-
17	-	-	-	-	-	0.220	-	0.209	0.098	0.120	-	-
18	-	-	-	-	-	0.199	-	0.184	0.095	0.115	-	-
19	-	-	-	-	-	0.179	-	0.213	0.099	0.108	-	-
20	-	-	-	-	-	0.156	-	0.267	0.104	0.106	-	-
21	-	-	-	-	-	0.134	-	0.303	0.109	0.095	-	-
22	-	-	-	-	-	0.120	-	0.282	0.107	0.093	-	-
23	-	-	-	-	-	0.137	-	0.251	0.103	0.092	-	-
24	-	-	-	-	-	0.151	-	0.228	0.099	0.094	-	-
25	-	-	-	-	-	0.158	-	0.203	0.097	0.081 P	-	-
26	-	-	-	-	-	0.143	-	0.180	0.094	-	-	-
27	-	-	-	-	-	0.128	-	0.163	0.089	-	-	-
28	-	-	-	-	-	0.169	-	0.155	0.083	-	-	-
29	-	-	-	-	-	0.310	-	0.155	0.081	-	-	-
30	-	-	-	-	-	0.309	-	0.152	0.080	-	-	-
31	-	-	-	-	-	-	-	0.143	-	-	-	-
min	**-**	**-**	**-**	**-**	**0.393**	**0.120**	**0.096**	**0.143**	**0.080**	**0.072**	**-**	**-**
mean	**-**	**-**	**-**	**-**	**0.408**	**0.212**	**0.191**	**0.291**	**0.109**	**0.093**	**-**	**-**
max	**-**	**-**	**-**	**-**	**0.431**	**0.360**	**0.291**	**0.547**	**0.141**	**0.127**	**-**	**-**

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

Table VIII-6 S3 Iynimin Creek Mean Daily Water Levels (m) Based on Permanent Benchmark el. 360.610 m (geodetic), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	359.175 B	-	359.136	-	359.043	358.990	-	-
2	-	-	-	-	359.176 B	-	359.130	-	359.048	358.989	-	-
3	-	-	-	-	359.177 B	-	359.118	-	359.042	358.989	-	-
4	-	-	-	-	359.176 B	-	359.100	359.143 P	359.037	358.986	-	-
5	-	-	-	-	359.177 B	-	359.089	359.224	359.033	358.987	-	-
6	-	-	-	-	359.175 B	-	359.072	359.234	359.032	358.986	-	-
7	-	-	-	-	359.176 B	-	359.055	359.214	359.036	358.988	-	-
8	-	-	-	-	359.186	-	359.039	359.211	359.039	358.985	-	-
9	-	-	-	-	359.194	-	359.022	359.205	359.038	358.986	-	-
10	-	-	-	-	359.189	-	359.010 P	359.194	359.035	358.986	-	-
11	-	-	-	-	359.181	-	-	359.177	359.034	358.992	-	-
12	-	-	-	-	359.179	359.171	-	359.160	359.029	359.011	-	-
13	-	-	-	-	359.182	359.154	-	359.142	359.027	359.023	-	-
14	-	-	-	-	-	359.143	-	359.134	359.026	359.037	-	-
15	-	-	-	-	-	359.130	-	359.125	359.021	359.037	-	-
16	-	-	-	-	-	359.113	-	359.108	359.017	359.033	-	-
17	-	-	-	-	-	359.099	-	359.093	359.012	359.031	-	-
18	-	-	-	-	-	359.087	-	359.077	359.010	359.027	-	-
19	-	-	-	-	-	359.074	-	359.094	359.013	359.021	-	-
20	-	-	-	-	-	359.059	-	359.124	359.018	359.019	-	-
21	-	-	-	-	-	359.042	-	359.142	359.022	359.009	-	-
22	-	-	-	-	-	359.032	-	359.132	359.020	359.007	-	-
23	-	-	-	-	-	359.045	-	359.116	359.017	359.006	-	-
24	-	-	-	-	-	359.055	-	359.103	359.013	359.008	-	-
25	-	-	-	359.384 BP	-	359.060	-	359.089	359.011	358.995 P	-	-
26	-	-	-	359.325 B	-	359.050	-	359.075	359.008	-	-	-
27	-	-	-	359.221 B	-	359.038	-	359.063	359.003	-	-	-
28	-	-	-	359.195 B	-	359.066	-	359.058	358.997	-	-	-
29	-	-	-	359.177 B	-	359.144	-	359.058	358.995	-	-	-
30	-	-	-	359.176 B	-	359.144	-	359.056	358.993	-	-	-
31	-	-	-	-	-	-	-	359.049	-	-	-	-
min	**-**	**-**	**-**	**359.176**	**359.175**	**359.032**	**359.010**	**359.049**	**358.993**	**358.985**	**-**	**-**
mean	**-**	**-**	**-**	**359.246**	**359.180**	**359.090**	**359.077**	**359.129**	**359.022**	**359.006**	**-**	**-**
max	**-**	**-**	**-**	**359.384**	**359.194**	**359.171**	**359.136**	**359.234**	**359.048**	**359.037**	**-**	**-**

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

Table VIII-7 S5A Muskeg River Mean Daily Discharges (m^3/s), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	0.231 B	0.136 B	0.149 B	0.285 B	1.424	4.373	3.698	0.712	0.665	0.350	0.333 B	0.238 B
2	0.224 B	0.133 B	0.146 B	0.289 B	1.487	3.995	3.552	0.655	0.631	0.351	0.329 B	0.237 B
3	0.221 B	0.129 B	0.151 B	0.293 B	1.464	3.417	3.321	0.619	0.596	0.347	0.324 B	0.228 B
4	0.214 B	0.124 B	0.153 B	0.316 B	1.442	2.875	2.958	0.612	0.554	0.337	0.322 B	0.220 B
5	0.209 B	0.122 B	0.158 B	0.361 B	1.419	2.399	3.006	0.705	0.530	0.348	0.319 B	0.216 B
6	0.198 B	0.119 B	0.163 B	0.409 B	1.783	2.025	3.061	0.681	0.508	0.353	0.312 B	0.216 B
7	0.195 B	0.114 B	0.168 B	0.431 B	2.695	1.760	2.556	0.679	0.525	0.356	0.303 B	0.212 B
8	0.197 B	0.112 B	0.176 B	0.457 B	2.923	1.564	2.058	0.812	0.547	0.356	0.299 B	0.220 B
9	0.190 B	0.114 B	0.176 B	0.495 B	3.104	1.401	1.643	0.882	0.527	0.358	0.299 B	0.209 B
10	0.182 B	0.113 B	0.185 B	0.623 B	3.377	1.666	1.518	0.956	0.506	0.363	0.294 B	0.203 B
11	0.174 B	0.109 B	0.194 B	0.722 B	3.608	3.183	1.489	1.018	0.504	0.373	0.290 B	0.199 B
12	0.169 B	0.103 B	0.204 B	0.657 B	3.898	3.412	1.293	1.004	0.494	0.405	0.289 B	0.203 B
13	0.168 B	0.084 B	0.203 B	0.675 B	4.014	3.870	1.115	0.998	0.481	0.430	0.287 B	0.203 B
14	0.164 B	0.100 B	0.200 B	0.792 B	4.067	4.484	1.008	1.191	0.462	0.436	0.288 B	0.204 B
15	0.162 B	0.092 B	0.206 B	0.792 B	3.938	4.637	0.965	1.065	0.456	0.434	0.296 B	0.206 B
16	0.166 B	0.095 B	0.214 B	0.749 B	3.696	4.335	0.904	0.935	0.435	0.430	0.293 B	0.203 B
17	0.159 B	0.102 B	0.219 B	0.762 B	3.477	3.874	1.011	0.848	0.413	0.432	0.287 B	0.197 B
18	0.156 B	0.103 B	0.220 B	0.867 B	3.278	3.376	1.184	0.757	0.401	0.427	0.282 B	0.184 B
19	0.155 B	0.104 B	0.227 B	0.936 B	3.050	2.834	1.087	0.790	0.402	0.422	0.276 B	0.182 B
20	0.152 B	0.107 B	0.227 B	0.910 B	2.818	2.295	1.016	1.004	0.439	0.410	0.268 B	0.178 B
21	0.150 B	0.112 B	0.230 B	0.794 B	2.626	1.858	0.928	1.110	0.443	0.394	0.264 B	0.177 B
22	0.145 B	0.117 B	0.234 B	0.871 B	2.386	1.522	0.842	1.063	0.428	0.381	0.262 B	0.175 B
23	0.141 B	0.121 B	0.238 B	1.072	2.180	1.620	0.761	0.955	0.420	0.373	0.259 B	0.172 B
24	0.147 B	0.120 B	0.244 B	0.893	1.982	1.928	0.690	1.137	0.408	0.357	0.253 B	0.170 B
25	0.140 B	0.123 B	0.257 B	0.968	1.860	1.896	0.625	1.232	0.393	0.346	0.244 B	0.168 B
26	0.137 B	0.130 B	0.265 B	0.970	2.056	1.741	0.580	1.043	0.388	0.344	0.247 B	0.166 B
27	0.137 B	0.145 B	0.267 B	0.983	2.453	1.539	0.564	0.916	0.382	0.364 B	0.250 B	0.173 B
28	0.138 B	0.153 B	0.274 B	1.114	2.243	1.756	0.532	0.824	0.370	0.359 B	0.247 B	0.161 B
29	0.134 B	-	0.276 B	1.228	2.003	3.325	0.601	0.827	0.364	0.346 B	0.246 B	0.154 B
30	0.135 B	-	0.273 B	1.327	2.310	3.839	0.773	0.804	0.361	0.340 B	0.243 B	0.155 B
31	0.129 B	-	0.278 B	-	3.915	-	0.784	0.720	-	0.337 B	-	0.154 B
min	**0.129**	**0.084**	**0.146**	**0.285**	**1.419**	**1.401**	**0.532**	**0.612**	**0.361**	**0.337**	**0.243**	**0.154**
mean	**0.168**	**0.116**	**0.212**	**0.735**	**2.677**	**2.760**	**1.488**	**0.889**	**0.468**	**0.376**	**0.283**	**0.193**
max	**0.231**	**0.153**	**0.278**	**1.327**	**4.067**	**4.637**	**3.698**	**1.232**	**0.665**	**0.436**	**0.333**	**0.238**

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

Table VIII-8 S5A Muskeg River Mean Daily Water Levels (m) Based on Permanent Benchmark el. 282.380 m (geodetic), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	281.093 B	281.062 B	281.060 B	281.055 B	281.537	282.023	281.942	281.297	281.276	281.090	281.066 B	281.058 B
2	281.086 B	281.062 B	281.045 B	281.053 B	281.554	281.979	281.923	281.271	281.260	281.091	281.066 B	281.061 B
3	281.085 B	281.058 B	281.048 B	281.051 B	281.548	281.904	281.891	281.254	281.242	281.088	281.063 B	281.051 B
4	281.078 B	281.052 B	281.045 B	281.076 B	281.542	281.825	281.838	281.250	281.220	281.081	281.064 B	281.043 B
5	281.076 B	281.052 B	281.046 B	281.129 B	281.536	281.746	281.846	281.294	281.207	281.089	281.064 B	281.040 B
6	281.061 B	281.048 B	281.050 B	281.183 B	281.621	281.675	281.854	281.284	281.195	281.093	281.059 B	281.045 B
7	281.060 B	281.043 B	281.052 B	281.202 B	281.797	281.619	281.774	281.282	281.204	281.095	281.051 B	281.043 B
8	281.069 B	281.041 B	281.058 B	281.226 B	281.833	281.573	281.682	281.339	281.216	281.095	281.050 B	281.062 B
9	281.060 B	281.051 B	281.051 B	281.261 B	281.860	281.531	281.592	281.367	281.205	281.097	281.053 B	281.048 B
10	281.051 B	281.055 B	281.060 B	281.388 B	281.899	281.589	281.561	281.394	281.193	281.100	281.051 B	281.042 B
11	281.040 B	281.048 B	281.069 B	281.477 B	281.930	281.871	281.554	281.416	281.192	281.108	281.049 B	281.039 B
12	281.036 B	281.040 B	281.079 B	281.408 B	281.967	281.904	281.501	281.411	281.186	281.130	281.052 B	281.051 B
13	281.040 B	280.988 B	281.069 B	281.417 B	281.981	281.963	281.448	281.409	281.179	281.147	281.054 B	281.057 B
14	281.037 B	281.041 BP	281.057 B	281.517 B	281.988	282.036	281.413	281.472	281.167	281.151	281.061 B	281.064 B
15	281.037 B	-	281.060 B	281.510 B	281.972	282.052	281.398	281.432	281.163	281.150	281.076 B	281.071 B
16	281.050 B	281.035 BP	281.065 B	281.464 B	281.942	282.019	281.376	281.387	281.150	281.147	281.076 B	281.071 B
17	281.040 B	281.046 B	281.067 B	281.468 B	281.913	281.964	281.413	281.354	281.136	281.148	281.073 B	281.065 B
18	281.039 B	281.042 B	281.061 B	281.552 B	281.885	281.899	281.469	281.317	281.127	281.145	281.068 B	281.046 B
19	281.042 B	281.038 B	281.064 B	281.602 B	281.852	281.819	281.439	281.330	281.128	281.141	281.065 B	281.047 B
20	281.040 B	281.037 B	281.057 B	281.573 B	281.817	281.727	281.416	281.411	281.153	281.134	281.058 B	281.044 B
21	281.042 B	281.041 B	281.055 B	281.464 B	281.786	281.640	281.385	281.446	281.155	281.123	281.055 B	281.048 B
22	281.037 B	281.044 B	281.053 B	281.403 B	281.744	281.562	281.352	281.431	281.146	281.114	281.057 B	281.049 B
23	281.033 B	281.046 B	281.051 B	281.429	281.706	281.585	281.319	281.394	281.140	281.107	281.056 B	281.048 B
24	281.048 B	281.037 B	281.053 B	281.371	281.667	281.656	281.287	281.454	281.132	281.096	281.052 B	281.050 B
25	281.038 B	281.036 B	281.066 B	281.399	281.641	281.649	281.257	281.484	281.122	281.088	281.042 B	281.052 B
26	281.038 B	281.043 B	281.071 B	281.399	281.681	281.615	281.234	281.425	281.119	281.086	281.050 B	281.052 B
27	281.041 B	281.066 B	281.066 B	281.404	281.756	281.567	281.226	281.380	281.114	281.089 B	281.060 B	281.070 B
28	281.048 B	281.075 B	281.069 B	281.448	281.718	281.615	281.208	281.345	281.106	281.083 B	281.060 B	281.051 B
29	281.046 B	-	281.064 B	281.483	281.671	281.889	281.244	281.346	281.101	281.071 B	281.063 B	281.043 B
30	281.053 B	-	281.052 B	281.511	281.728	281.960	281.324	281.336	281.098	281.067 B	281.062 B	281.048 B
31	281.043 B	-	281.052 B	-	281.967	-	281.328	281.301	-	281.067 B	-	281.053 B
min	**281.033**	**280.988**	**281.045**	**281.051**	**281.536**	**281.531**	**281.208**	**281.250**	**281.098**	**281.067**	**281.042**	**281.039**
mean	**281.051**	**281.045**	**281.059**	**281.375**	**281.783**	**281.774**	**281.485**	**281.367**	**281.164**	**281.107**	**281.059**	**281.052**
max	**281.093**	**281.075**	**281.079**	**281.602**	**281.988**	**282.052**	**281.923**	**281.484**	**281.260**	**281.151**	**281.076**	**281.071**

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

Table VIII-9 S6 Mills Creek Mean Daily Discharges (m^3/s), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	0.020	0.048	-	0.048	0.025	0.018	-	-
2	-	-	-	-	0.020	0.042	-	0.041	0.025	0.018	-	-
3	-	-	-	-	0.020	0.038	-	0.037	0.023	0.018	-	-
4	-	-	-	-	0.020	0.035	-	0.034	0.021	0.018	-	-
5	-	-	-	-	0.022	0.032	-	0.036	0.023	0.018	-	-
6	-	-	-	-	0.031	0.029	-	0.031	0.024	0.018	-	-
7	-	-	-	-	0.030	0.028	-	0.029	0.027	0.018	-	-
8	-	-	-	-	0.028	0.027	-	0.032	0.028	0.018	-	-
9	-	-	-	-	0.028	0.026	0.024 P	0.033	-	0.018	-	-
10	-	-	-	-	0.027	0.038	0.024	0.032	-	0.018	-	-
11	-	-	-	-	0.025	0.058	0.024	0.031	-	0.021	-	-
12	-	-	-	-	0.025	0.048	0.022	0.029	-	0.023	-	-
13	-	-	-	-	0.027	0.042	0.021	0.028	-	0.023	-	-
14	-	-	-	-	0.026	0.024	0.021	0.029	-	0.023	-	-
15	-	-	-	-	0.026	0.024 P	0.021	0.028	-	0.021	-	-
16	-	-	-	-	0.026	-	0.020	0.027	-	0.020	-	-
17	-	-	-	-	0.025	-	0.030	0.025	-	0.021	-	-
18	-	-	-	-	0.026	-	0.031	0.023	-	0.019	-	-
19	-	-	-	-	0.027	-	0.029	0.038	-	0.019	-	-
20	-	-	-	0.019 P	0.028	-	0.026	0.042	-	0.019	-	-
21	-	-	-	0.017	0.028	-	0.028	0.041	-	0.018	-	-
22	-	-	-	0.017	0.029	-	0.028	0.036	-	0.018	-	-
23	-	-	-	0.017	0.031	-	0.024	0.035	0.021	0.017	-	-
24	-	-	-	0.017	0.032	-	0.022	0.041	0.021	0.017	-	-
25	-	-	-	0.018	0.034	-	0.022	0.035	0.021	0.017	-	-
26	-	-	-	0.018	0.043	-	0.024	0.030	0.020	0.017	-	-
27	-	-	-	0.018	0.040	-	0.022	0.028	0.020	0.017	-	-
28	-	-	-	0.019	0.038	-	0.028	0.028	0.019	0.016	-	-
29	-	-	-	0.021	0.035	-	0.082	0.028	0.019	0.015 P	-	-
30	-	-	-	0.020	0.045	-	0.078	0.027	0.019	-	-	-
31	-	-	-	-	0.053	-	0.061	0.026	-	-	-	-
min	**-**	**-**	**-**	**0.017**	**0.020**	**0.024**	**0.020**	**0.023**	**0.019**	**0.015**	**-**	**-**
mean	**-**	**-**	**-**	**0.018**	**0.030**	**0.036**	**0.031**	**0.032**	**0.022**	**0.019**	**-**	**-**
max	**-**	**-**	**-**	**0.021**	**0.053**	**0.058**	**0.082**	**0.048**	**0.028**	**0.023**	**-**	**-**

Notes: P - partial daily average.

Table VIII-10 S6 Mills Creek Mean Daily Water Levels (m) Based on Permanent Benchmark el. 273.600 m (geodetic), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	272.120	272.197	-	272.197	272.140	272.114	-	-
2	-	-	-	-	272.120	272.184	-	272.182	272.137	272.113	-	-
3	-	-	-	-	272.121	272.175	-	272.173	272.130	272.113	-	-
4	-	-	-	-	272.121	272.166	-	272.166	272.124	272.112	-	-
5	-	-	-	-	272.126	272.158	-	272.168	272.130	272.111	-	-
6	-	-	-	-	272.155	272.151	-	272.157	272.135	272.110	-	-
7	-	-	-	-	272.153	272.147	-	272.151	272.145	272.111	-	-
8	-	-	-	-	272.147	272.144	-	272.160	272.157	272.112	-	-
9	-	-	-	-	272.147	272.142	272.134 P	272.161	272.178 X	272.112	-	-
10	-	-	-	-	272.144	272.168	272.134	272.159	272.187 X	272.111	-	-
11	-	-	-	-	272.139	272.217	272.133	272.155	272.190 X	272.124	-	-
12	-	-	-	-	272.137	272.197	272.129	272.150	272.185 X	272.133	-	-
13	-	-	-	-	272.144	272.183 P	272.124	272.148	272.182 X	272.131	-	-
14	-	-	-	-	272.143	-	272.124	272.152	272.177 X	272.130	-	-
15	-	-	-	-	272.142	-	272.123	272.148	272.173 X	272.125	-	-
16	-	-	-	-	272.141	-	272.122	272.143	272.169 X	272.122	-	-
17	-	-	-	-	272.139	-	272.154	272.136	272.166 X	272.122	-	-
18	-	-	-	-	272.142	-	272.156	272.132	272.165 X	272.117	-	-
19	-	-	-	-	272.143	-	272.151	272.171	272.176 X	272.116	-	-
20	-	-	-	272.115 P	272.146	-	272.141	272.185	272.177 X	272.114	-	-
21	-	-	-	272.108	272.148	-	272.146	272.182	272.175 X	272.113	-	-
22	-	-	-	272.107	272.151	-	272.147	272.168	272.170 X	272.111	-	-
23	-	-	-	272.106	272.155	-	272.135	272.166	272.149	272.110	-	-
24	-	-	-	272.106	272.160	-	272.128	272.181	272.123	272.107	-	-
25	-	-	-	272.114	272.163	-	272.127	272.166	272.123	272.107	-	-
26	-	-	-	272.112	272.186	-	272.133	272.154	272.122	272.109	-	-
27	-	-	-	272.113	272.180	-	272.129	272.149	272.121	272.109	-	-
28	-	-	-	272.118	272.174	-	272.139	272.146	272.118	272.105	-	-
29	-	-	-	272.124	272.167	-	272.255	272.146	272.117	272.099P	-	-
30	-	-	-	272.122	272.190	-	272.249	272.144	272.116	-	-	-
31	-	-	-	-	272.208	-	272.221	272.140	-	-	-	-
min	**-**	**-**	**-**	**272.106**	**272.120**	**272.142**	**272.122**	**272.132**	**272.116**	**272.099**	**-**	**-**
mean	**-**	**-**	**-**	**272.113**	**272.150**	**272.172**	**272.149**	**272.159**	**272.152**	**272.115**	**-**	**-**
max	**-**	**-**	**-**	**272.124**	**272.208**	**272.217**	**272.255**	**272.197**	**272.190**	**272.133**	**-**	**-**

Notes: P - partial daily average.

X - water levels affected by downstream obstruction; discharges not derived.

Table VIII-11 S7 Muskeg River 7DA8 Mean Daily Discharges (m^3/s), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	0.759 BE	0.531 BE	0.353 B	0.403 B	7.256	10.697	14.474	3.623	2.675	1.167	0.834 E	0.460 B
2	0.752 BE	0.524 BE	0.338 B	0.396 B	7.604	11.231	14.115	3.270	2.440	1.144	0.788 A	0.456 B
3	0.745 BE	0.517 BE	0.308 B	0.381 B	7.524	10.951	13.414	3.044	2.320	1.106	0.774 E	0.453 B
4	0.737 BE	0.509 BE	0.292 B	0.348 B	7.576	10.230	12.567	2.822	2.188	1.139	0.759 E	0.452 B
5	0.730 BE	0.502 BE	0.320 B	0.396 B	7.231	9.407	11.791	2.746	2.129	1.074	0.745	0.452 B
6	0.723 BE	0.495 BE	0.305 B	0.397 B	7.232	8.583	11.077	3.068	2.067	1.064	0.743	0.451 B
7	0.715 BE	0.487 BE	0.327 B	0.405 B	8.328	7.781	10.496	3.083	1.966	1.053	0.662	0.448 B
8	0.708 BE	0.480 BE	0.335 B	0.418 B	9.611	7.256	9.664	3.211	2.007	1.038	0.610	0.445 B
9	0.700 BE	0.472 BE	0.341 B	0.415 B	10.399	6.803	8.633	3.543	1.975	1.034	0.590	0.449 B
10	0.693 BE	0.465 BE	0.361 B	0.414 B	11.143	6.610	7.767	3.682	1.947	1.025	0.578	0.443 B
11	0.686 BE	0.458 BE	0.380 B	1.115 B	11.585	8.493	7.273	3.709	1.989	1.057	0.586	0.440 B
12	0.678 BE	0.450 BE	0.387 B	2.818 B	11.971	10.836	6.974	3.570	1.907	1.088	0.582	0.437 B
13	0.671 BE	0.443 BE	0.394 B	3.144 B	12.203	11.775	6.596	3.588	1.847	1.244	0.583	0.433 B
14	0.664 BE	0.436 BE	0.401 B	2.861 B	12.210	12.823	6.134	3.487	1.794	1.340	0.713	0.430 B
15	0.656 BE	0.428 BE	0.406 B	3.327 B	12.016	13.938	5.600	3.545	1.706	1.219	0.667	0.425 B
16	0.649 AB	0.421 AB	0.398 B	3.448 B	11.799	14.314	5.119	3.282	1.628	1.188	0.662	0.423 B
17	0.642 BE	0.416 BE	0.359 B	2.985 B	11.429	14.314	4.957	2.975	1.566	1.193	0.653	0.422 B
18	0.634 BE	0.411 BE	0.334 B	3.096 B	11.007	13.942	4.960	2.818	1.504	1.260 A	0.639	0.416 B
19	0.627 BE	0.406 BE	0.324 B	4.319 B	10.732	13.129	4.864	2.721	1.553	1.258	0.644	0.409 B
20	0.620 BE	0.402 BE	0.359 B	4.733 B	10.305	12.289	4.430	3.012	1.579	1.165	0.612	0.403 B
21	0.612 BE	0.397 BE	0.366 B	5.313 B	9.913	11.361	4.050	3.844	1.658	1.118	0.616	0.401 B
22	0.605 BE	0.392 BE	0.361 B	4.662 B	9.471	10.373	3.792	3.996	1.529	1.069	0.679	0.402 B
23	0.598 BE	0.387 BE	0.346 B	4.094 B	9.097	9.839	3.422	3.725	1.527	1.286 B	0.600	0.399 B
24	0.590 BE	0.382 BE	0.345 B	5.244 B	8.973	10.676	3.146	3.893	1.500	1.173 B	0.529	0.398 B
25	0.583 BE	0.377 BE	0.363 B	5.345	8.850	11.448	2.926	4.228	1.509	0.986	0.466	0.396 B
26	0.575 BE	0.372 BE	0.386 B	5.409	8.867	11.891	2.699	4.009	1.461	0.944	0.468 B	0.404 B
27	0.568 BE	0.368 BE	0.399 B	6.030	9.018	11.691	2.479	3.550	1.390	0.985	0.451 B	0.399 B
28	0.561 BE	0.363 BE	0.413 B	6.108	9.089	11.531	2.521	3.262	1.282	1.097	0.451 B	0.399 B
29	0.553 BE	0.358 BE	0.418 B	6.845	8.610	12.552	2.750	2.975	1.246	1.005 A	0.453 B	0.402 B
30	0.546 BE	-	0.419 B	7.085	8.448	13.910	3.250	2.856	1.196	0.880	0.455 B	0.405 B
31	0.539 BE	-	0.413 B	-	9.257	-	3.646	2.739	-	0.881	-	0.403 B
min	**0.539**	**0.358**	**0.292**	**0.348**	**7.231**	**6.610**	**3.422**	**2.721**	**1.196**	**0.880**	**0.451**	**0.396**
mean	**0.649**	**0.436**	**0.363**	**3.065**	**9.637**	**11.022**	**7.920**	**3.351**	**1.770**	**1.106**	**0.620**	**0.424**
max	**0.759**	**0.531**	**0.419**	**7.085**	**12.210**	**14.314**	**14.474**	**4.228**	**2.675**	**1.340**	**0.834**	**0.460**

Notes: P - partial daily average.
B - ice effects.
E - estimated; 16 Apr - 14 Oct data provisional data from Environment Canada.

Table VIII-12 S7 Muskeg River 7DA8 Mean Daily Water Levels (m) Based on Permanent Benchmark el. 273.720 m (geodetic), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	-	-	-	-	-	-	271.961
2	-	-	-	-	-	-	-	-	-	-	271.951 A	271.958
3	-	-	-	-	-	-	-	-	-	-	-	271.963
4	-	-	-	-	-	-	-	-	-	-	-	271.973
5	-	-	-	-	-	-	-	-	-	-	271.953	271.983
6	-	-	-	-	-	-	-	-	-	-	271.952	271.986
7	-	-	-	-	-	-	-	-	-	-	271.946	271.986
8	-	-	-	-	-	-	272.016 A	-	-	-	271.941	271.985
9	-	-	-	-	-	-	-	-	-	-	271.939	271.986
10	-	-	-	-	-	-	-	-	-	-	271.938	271.992
11	-	-	-	-	-	-	-	-	-	-	271.939	272.008
12	-	-	-	-	-	-	-	-	271.684 A	-	271.939	272.017
13	-	-	-	-	-	272.104 A	-	-	-	-	271.938	272.018
14	-	-	-	-	-	-	-	-	-	-	271.950	272.004
15	-	-	-	-	-	-	-	-	-	-	271.946	271.998
16	271.809 AB	271.836 AB	-	-	-	-	-	-	-	-	271.945	271.987
17	-	-	-	-	-	-	-	-	-	-	271.945	271.987
18	-	-	-	-	-	-	-	-	-	-	271.943	271.977
19	-	-	-	-	-	-	-	-	-	-	271.944	272.000
20	-	-	-	-	-	-	-	-	-	-	271.941	271.988
21	-	-	-	-	-	-	-	-	-	-	271.941	271.970
22	-	-	-	-	-	-	-	-	-	-	271.947	271.978
23	-	-	-	-	-	-	-	-	-	-	271.940	271.970
24	-	-	-	271.889 A	-	-	-	-	-	-	271.934	271.972
25	-	-	-	-	-	-	-	-	-	-	271.929	271.976
26	-	-	-	-	-	-	-	-	-	-	271.931	271.976
27	-	-	-	-	-	-	-	-	-	-	271.938	271.976
28	-	-	-	-	-	-	-	-	-	-	271.937	271.978
29	-	-	-	-	-	-	-	-	-	271.602 A	271.941	271.974
30	-	-	-	-	-	-	-	-	-	-	271.943	271.978
31	-	-	-	-	-	-	-	-	-	-	-	271.986
min	**271.809**	**271.836**	**-**	**271.889**	**-**	**272.104**	**272.016**	**-**	**271.684**	**271.602**	**271.929**	**271.958**
mean	**271.809**	**271.836**	**-**	**271.889**	**-**	**272.104**	**272.016**	**-**	**271.684**	**271.602**	**271.942**	**271.984**
max	**271.809**	**271.836**	**-**	**271.889**	**-**	**272.104**	**272.016**	**-**	**271.684**	**271.602**	**271.953**	**272.018**

Notes: P - partial daily average
B - ice effects;
E - estimated; 16 Apr - 14 Oct data provisional data from Environment Canada.

Table VIII-13 S8 Stanley Creek Mean Daily Water Levels (m) Based on Permanent Benchmark el. 292.150 m (geodetic), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	-	-	-	-	289.765	-	-
2	-	-	-	-	-	-	-	-	-	289.762	-	-
3	-	-	-	-	-	-	-	-	-	289.760	-	-
4	-	-	-	-	-	-	-	-	-	289.759	-	-
5	-	-	-	-	-	-	-	-	-	289.762	-	-
6	-	-	-	-	-	-	-	-	-	289.766	-	-
7	-	-	-	-	-	-	-	-	-	289.767	-	-
8	-	-	-	-	-	-	-	-	-	289.768	-	-
9	-	-	-	-	-	-	-	289.779 A	-	289.770	-	-
10	-	-	-	-	-	-	289.800 A	-	-	289.775	-	-
11	-	-	-	-	-	-	-	-	-	289.781	-	-
12	-	-	-	-	-	289.780 A	-	-	-	289.783	-	-
13	-	-	-	-	-	-	-	-	-	289.783	-	-
14	-	-	-	-	-	-	-	-	-	289.781	-	-
15	-	-	-	-	-	-	-	-	-	289.780	-	-
16	-	-	-	-	-	-	-	-	-	289.780	-	-
17	-	-	-	-	-	-	-	-	289.768 P	289.780	-	-
18	-	-	-	-	-	-	-	-	289.767	289.775	-	-
19	-	-	-	-	-	-	-	-	289.771	289.762	-	-
20	-	-	-	-	-	-	-	-	289.772	289.745	-	-
21	-	-	-	-	-	-	-	-	289.774	289.735	-	-
22	-	-	-	-	-	-	-	-	289.774	289.737	-	-
23	-	-	-	-	-	-	-	-	289.774	289.748 P	-	-
24	-	-	-	-	-	-	-	-	289.773	-	-	-
25	-	-	-	289.947 A	-	-	-	-	289.770	-	-	-
26	-	-	-	-	-	-	-	-	289.770	-	-	-
27	-	-	-	-	-	-	-	-	289.770	-	-	-
28	-	-	-	-	-	-	-	-	289.768	-	-	-
29	-	-	-	-	-	-	-	-	289.767	-	-	-
30	-	-	-	-	-	-	-	-	289.768	-	-	-
31	-	-	-	-	-	-	-	-	-	-	-	-
min	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**289.767**	**289.735**	**-**	**-**
mean	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**289.770**	**289.766**	**-**	**-**
max	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**289.774**	**289.783**	**-**	**-**

Notes: P - partial daily average.
A – manual measurement.

Table VIII-14 S9 Kearl Lake Outlet Daily Discharges (m^3/s), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	0.028	0.246	-	0.003	0.002	0.000	-	-
2	-	-	-	-	0.027	0.222	-	0.002	0.002	0.000	-	-
3	-	-	-	-	0.028	0.230	-	0.002	0.002	0.000	-	-
4	-	-	-	-	0.029	0.224	-	0.002	0.001	0.000	-	-
5	-	-	-	-	0.045	0.209	-	0.002	0.001	0.000	-	-
6	-	-	-	-	0.170	0.193	-	0.001	0.001	0.000	-	-
7	-	-	-	-	0.144	0.166	-	0.001	0.002	0.000	-	-
8	-	-	-	-	0.137	0.163	0.039 P	0.001	0.001	0.000	-	-
9	-	-	-	-	0.139	0.155	0.033	0.001	0.001	0.000	-	-
10	-	-	-	-	0.143	0.149 P	0.042	0.001	0.001	0.000	-	-
11	-	-	-	-	0.126	-	0.041	0.001	0.001	0.001	-	-
12	-	-	-	-	0.104	-	0.036	0.001	0.001	0.001	-	-
13	-	-	-	-	0.110	-	0.022	0.001	0.001	0.001	-	-
14	-	-	-	-	0.109	-	0.013	0.001	0.001	0.001	-	-
15	-	-	-	-	0.140	-	0.008	0.001	0.001	0.001	-	-
16	-	-	-	-	0.144	-	0.008	0.001	0.001	0.000	-	-
17	-	-	-	-	0.137	-	0.015	0.001	0.001	0.000	-	-
18	-	-	-	-	0.142	-	0.009	0.001	0.001	0.000	-	-
19	-	-	-	-	0.145	-	0.006	0.002	0.001	0.000	-	-
20	-	-	-	-	0.156	-	0.004	0.002	0.001	0.000	-	-
21	-	-	-	0.017 P	0.149	-	0.004	0.002	0.001	0.000	-	-
22	-	-	-	0.021	0.129	-	0.003	0.002	0.001	0.000	-	-
23	-	-	-	0.019	0.110	-	0.002	0.009	0.001	0.000	-	-
24	-	-	-	0.021	0.111	-	0.002	0.018	0.001	0.000	-	-
25	-	-	-	0.024	0.125	-	0.002	0.008	0.001	0.000	-	-
26	-	-	-	0.023	0.199	-	0.002	0.005	0.001	0.000	-	-
27	-	-	-	0.027	0.159	-	0.002	0.003	0.001	0.000 P	-	-
28	-	-	-	0.031	0.125	-	0.002	0.003	0.001	-	-	-
29	-	-	-	0.031	0.127	-	0.004	0.003	0.001	-	-	-
30	-	-	-	0.029	0.268	-	0.008	0.002	0.001	-	-	-
31	-	-	-	-	0.297	-	0.004	0.002	-	-	-	-
min	**-**	**-**	**-**	**0.017**	**0.027**	**0.149**	**0.002**	**0.001**	**0.001**	**0.000**	**-**	**-**
mean	**-**	**-**	**-**	**0.024**	**0.129**	**0.196**	**0.013**	**0.003**	**0.001**	**0.000**	**-**	**-**
max	**-**	**-**	**-**	**0.031**	**0.297**	**0.246**	**0.042**	**0.018**	**0.002**	**0.001**	**-**	**-**

Notes: P – partial daily average.

Table VIII-15 S9 Kearl Lake Outlet Mean Daily Water Levels (m) Based on Permanent Benchmark el. 330.400 m (geodetic), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	329.269	329.388	-	329.180	329.175	329.137	-	-
2	-	-	-	-	329.269	329.381	-	329.174	329.177	329.134	-	-
3	-	-	-	-	329.270	329.384	-	329.170	329.168	329.133	-	-
4	-	-	-	-	329.272	329.382	-	329.167	329.164	329.131	-	-
5	-	-	-	-	329.291	329.377	-	329.167	329.162	329.130	-	-
6	-	-	-	-	329.363	329.372	-	329.158	329.161	329.130	-	-
7	-	-	-	-	329.355	329.363	-	329.159	329.168	329.131	-	-
8	-	-	-	-	329.352	329.362	329.285 P	329.164	329.164	329.131	-	-
9	-	-	-	-	329.352	329.359	329.277	329.161	329.162	329.130	-	-
10	-	-	-	-	329.354	329.357 P	329.287	329.159	329.160	329.130	-	-
11	-	-	-	-	329.346	-	329.287	329.156	329.158	329.140	-	-
12	-	-	-	-	329.336	-	329.280	329.151	329.158	329.146	-	-
13	-	-	-	-	329.339	-	329.258	329.151	329.157	329.144	-	-
14	-	-	-	-	329.339	-	329.236	329.155	329.155	329.142	-	-
15	-	-	-	-	329.353	-	329.217	329.149	329.154	329.138	-	-
16	-	-	-	-	329.354	-	329.214	329.147	329.151	329.135	-	-
17	-	-	-	-	329.352	-	329.242	329.144	329.150	329.137	-	-
18	-	-	-	-	329.354	-	329.221	329.143	329.150	329.132	-	-
19	-	-	-	-	329.355	-	329.208	329.169	329.157	329.130	-	-
20	-	-	-	-	329.360	-	329.197	329.176	329.157	329.127	-	-
21	-	-	-	329.247 P	329.356	-	329.191	329.178	329.154	329.126	-	-
22	-	-	-	329.257	329.348	-	329.186	329.167	329.150	329.124	-	-
23	-	-	-	329.252	329.339	-	329.177	329.190	329.153	329.124	-	-
24	-	-	-	329.256	329.339	-	329.172	329.250	329.152	329.121	-	-
25	-	-	-	329.264	329.346	-	329.169	329.217	329.150	329.123	-	-
26	-	-	-	329.261	329.374	-	329.170	329.199	329.149	329.125	-	-
27	-	-	-	329.267	329.360	-	329.170	329.191	329.148	329.128 P	-	-
28	-	-	-	329.274	329.346	-	329.166	329.188	329.143	-	-	-
29	-	-	-	329.274	329.346	-	329.195	329.185	329.142	-	-	-
30	-	-	-	329.271	329.389	-	329.219	329.179	329.141	-	-	-
31	-	-	-	-	329.400	-	329.192	329.176	-	-	-	-
min	**-**	**-**	**-**	**329.247**	**329.269**	**329.357**	**329.166**	**329.143**	**329.141**	**329.121**	**-**	**-**
mean	**-**	**-**	**-**	**329.262**	**329.341**	**329.373**	**329.217**	**329.172**	**329.156**	**329.132**	**-**	**-**
max	**-**	**-**	**-**	**329.274**	**329.400**	**329.388**	**329.287**	**329.250**	**329.177**	**329.146**	**-**	**-**

Notes: P - partial daily average.

Table VIII-16 S10 Wapasu Creek Mean Daily Discharges (m^3/s), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	0.449	0.964	0.675	0.177	0.146	0.070	-	-
2	-	-	-	-	0.477	0.900	0.699	0.160	0.151	0.066	-	-
3	-	-	-	-	0.502	0.845	0.689	0.147	0.139	0.064	-	-
4	-	-	-	-	0.514	0.809	0.652	0.137	0.131	0.068	-	-
5	-	-	-	-	0.525	0.723	0.697	0.165	0.122	0.065	-	-
6	-	-	-	-	0.785	0.658	0.630	0.157	0.118	0.063	-	-
7	-	-	-	-	1.035	0.603	0.559	0.154	0.136	0.064	-	-
8	-	-	-	-	1.106	0.558	0.499	0.214	0.136	0.063	-	-
9	-	-	-	-	1.173	0.511	0.427	0.298	0.128	0.062	-	-
10	-	-	-	-	1.293	0.546	0.393	0.281	0.133	0.061	-	-
11	-	-	-	-	1.455	0.724	0.381	0.289	0.158	0.067	-	-
12	-	-	-	-	1.574	0.683	0.414	0.272	0.145	0.085	-	-
13	-	-	-	-	1.589	0.824	0.465	0.248	0.130	0.086	-	-
14	-	-	-	-	1.553	0.686	0.399	0.226	0.123	0.089	-	-
15	-	-	-	-	1.521	0.626	0.298	0.205	0.113	0.086	-	-
16	-	-	-	-	1.591	0.591	0.246	0.190	0.105	0.083	-	-
17	-	-	-	-	1.296	0.598	0.235	0.167	0.097	0.085	-	-
18	-	-	-	-	1.434	0.597	0.222	0.148	0.093	0.078	-	-
19	-	-	-	-	1.284	0.554	0.201	0.170	0.101	0.071	-	-
20	-	-	-	0.148 P	1.148	0.496	0.183	0.199	0.094	0.066	-	-
21	-	-	-	0.224	1.138	0.438	0.168	0.202	0.096	0.062	-	-
22	-	-	-	0.147	0.986	0.417	0.151	0.203	0.091	0.058	-	-
23	-	-	-	0.149	0.928	0.580	0.133	0.221	0.091	0.055	-	-
24	-	-	-	0.131	0.895	0.495	0.112	0.303	0.088	0.050	-	-
25	-	-	-	0.169	0.853	0.447	0.088	0.245	0.087	0.049	-	-
26	-	-	-	0.233	0.884	0.401	0.074	0.209	0.081	0.047	-	-
27	-	-	-	0.242	0.860	0.378	0.083	0.186	0.080	0.049 P	-	-
28	-	-	-	0.306	0.810	0.496	0.079	0.174	0.077	-	-	-
29	-	-	-	0.373	0.890	0.723	0.147	0.176	0.074	-	-	-
30	-	-	-	0.409	0.873	0.675	0.207	0.163	0.072	-	-	-
31	-	-	-	-	1.024	-	0.200	0.152	-	-	-	-
min	**-**	**-**	**-**	**0.131**	**0.449**	**0.378**	**0.074**	**0.137**	**0.072**	**0.047**	**-**	**-**
mean	**-**	**-**	**-**	**0.230**	**1.047**	**0.618**	**0.336**	**0.201**	**0.111**	**0.067**	**-**	**-**
max	**-**	**-**	**-**	**0.409**	**1.591**	**0.964**	**0.699**	**0.303**	**0.158**	**0.089**	**-**	**-**

Notes: P – partial daily average.

Table VIII-17 S10 Wapasu Mean Daily Water Levels (m) Based on Permanent Benchmark el. 320.160 m (geodetic), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	319.937	320.110	320.024	319.781	319.755	319.669	-	-
2	-	-	-	-	319.949	320.092	320.031	319.767	319.759	319.664	-	-
3	-	-	-	-	319.960	320.077	320.028	319.756	319.749	319.660	-	-
4	-	-	-	-	319.964	320.066	320.016	319.747	319.741	319.666	-	-
5	-	-	-	-	319.969	320.039	320.031	319.771	319.731	319.662	-	-
6	-	-	-	-	320.056	320.018	320.008	319.764	319.727	319.658	-	-
7	-	-	-	-	320.128	319.998	319.982	319.762	319.745	319.660	-	-
8	-	-	-	-	320.146	319.982	319.958	319.806	319.746	319.659	-	-
9	-	-	-	-	320.162	319.963	319.927	319.862	319.738	319.656	-	-
10	-	-	-	-	320.189	319.976	319.911	319.852	319.742	319.655	-	-
11	-	-	-	-	320.224	320.040	319.906	319.857	319.765	319.664	-	-
12	-	-	-	-	320.248	320.026	319.921	319.847	319.754	319.689	-	-
13	-	-	-	-	320.251	320.070	319.942	319.832	319.740	319.691	-	-
14	-	-	-	-	320.244	320.027	319.914	319.817	319.732	319.695	-	-
15	-	-	-	-	320.237	320.007	319.862	319.803	319.722	319.691	-	-
16	-	-	-	-	320.250	319.994	319.831	319.791	319.713	319.687	-	-
17	-	-	-	-	320.190	319.997	319.823	319.773	319.704	319.690	-	-
18	-	-	-	-	320.219	319.996	319.814	319.757	319.700	319.680	-	-
19	-	-	-	-	320.187	319.980	319.799	319.774	319.709	319.671	-	-
20	-	-	-	319.756 P	320.156	319.957	319.786	319.798	319.701	319.663	-	-
21	-	-	-	319.801	320.153	319.932	319.774	319.801	319.703	319.656	-	-
22	-	-	-	319.749	320.115	319.923	319.759	319.801	319.697	319.650	-	-
23	-	-	-	319.751	320.100	319.990	319.743	319.813	319.697	319.646	-	-
24	-	-	-	319.740	320.091	319.957	319.721	319.865	319.693	319.637	-	-
25	-	-	-	319.774	320.079	319.936	319.693	319.830	319.692	319.636	-	-
26	-	-	-	319.819	320.088	319.915	319.675	319.805	319.684	319.631	-	-
27	-	-	-	319.828	320.081	319.905	319.687	319.788	319.684	319.634 P	-	-
28	-	-	-	319.866	320.066	319.954	319.682	319.779	319.679	-	-	-
29	-	-	-	319.902	320.089	320.039	319.754	319.781	319.675	-	-	-
30	-	-	-	319.919	320.084	320.023	319.804	319.770	319.672	-	-	-
31	-	-	-	-	320.125	-	319.799	319.760	-	-	-	-
min	**-**	**-**	**-**	**319.740**	**319.937**	**319.905**	**319.675**	**319.747**	**319.672**	**319.631**	**-**	**-**
mean	**-**	**-**	**-**	**319.809**	**320.121**	**320.000**	**319.858**	**319.797**	**319.718**	**319.664**	**-**	**-**
max	**-**	**-**	**-**	**319.919**	**320.251**	**320.110**	**320.031**	**319.865**	**319.765**	**319.695**	**-**	**-**

Notes: P - partial daily average.

Table VIII-18 S11 Poplar Creek Mean Daily Discharges (m^3/s), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	1.884	2.104	1.333	0.954	0.010	0.004	-	-
2	-	-	-	-	1.898	1.918	1.421	0.948	0.012	0.005	-	-
3	-	-	-	-	1.930	1.779	1.348	1.276	0.010	0.005	-	-
4	-	-	-	-	1.816	1.676	1.282	1.305	0.009	0.004	-	-
5	-	-	-	-	1.706	1.561	1.295	1.254	0.009	0.005	-	-
6	-	-	-	-	2.451	1.452	1.261	1.111	0.009	0.004	-	-
7	-	-	-	-	3.425	1.342	1.194	0.968	0.012	0.004	-	-
8	-	-	-	-	4.338	1.279	1.154	0.928	0.011	0.004	-	-
9	-	-	-	-	5.231	1.231	1.009	0.921	0.009	0.004	-	-
10	-	-	-	-	6.844	1.190	0.880	0.965	0.008	0.004	-	-
11	-	-	-	-	6.925	1.253	0.917	0.857	0.007	0.006	-	-
12	-	-	-	-	6.377	1.174	0.962	0.758	0.007	0.008	-	-
13	-	-	-	-	5.722	1.108	0.797	0.754	0.008	0.009	-	-
14	-	-	-	-	5.182	1.135	0.793	0.816	0.009	0.010	-	-
15	-	-	-	-	4.841	1.233	0.849	0.886	0.007	0.010	-	-
16	-	-	-	-	4.484	1.084	0.734	0.804	0.005	0.008	-	-
17	-	-	-	-	4.146	0.976	0.852	0.975	0.005	0.009	-	-
18	-	-	-	-	3.759	0.924	0.922	1.110	0.005	0.008	-	-
19	-	-	-	-	3.395	0.783	0.819	1.178	0.006	0.009	-	-
20	-	-	-	-	3.125	0.680	0.677	1.241	0.008	0.008	-	-
21	-	-	-	-	2.882	0.615	0.668	1.260	0.008	0.006	-	-
22	-	-	-	-	2.575	0.558	1.064	1.191	0.007	0.006	-	-
23	-	-	-	-	2.445	0.762	1.305	1.164	0.007	0.006	-	-
24	-	-	-	1.672 P	2.299	0.789	1.465	1.142	0.007	0.006	-	-
25	-	-	-	1.820	2.250	0.797	1.438	1.121	0.007	0.005	-	-
26	-	-	-	1.727	2.162	0.677	1.373	1.109	0.008	0.006	-	-
27	-	-	-	1.749	2.321	0.594	1.332	0.694	0.006	0.006 P	-	-
28	-	-	-	1.807	2.172	0.995	1.243	0.013	0.005	-	-	-
29	-	-	-	1.979	1.957	1.364	1.284	0.011	0.006	-	-	-
30	-	-	-	1.882	2.040	1.345	1.256	0.010	0.005	-	-	-
31	-	-	-	-	2.213	-	1.149	0.010	-	-	-	-
min	**-**	**-**	**-**	**1.672**	**1.706**	**0.558**	**0.668**	**0.010**	**0.005**	**0.004**	**-**	**-**
mean	**-**	**-**	**-**	**1.805**	**3.381**	**1.146**	**1.099**	**0.895**	**0.008**	**0.006**	**-**	**-**
max	**-**	**-**	**-**	**1.979**	**6.925**	**2.104**	**1.465**	**1.305**	**0.012**	**0.010**	**-**	**-**

Notes: P - partial daily average.

Table VIII-19 S11 Poplar Creek Mean Daily Water Levels (m) Based on Permanent Benchmark el. 245.550 m (geodetic), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1			-	-	241.173	241.190	241.123	241.092	240.938	240.914	-	-
2			-	-	241.174	241.176	241.132	241.092	240.943	240.918	-	-
3			-	-	241.177	241.165	241.125	241.120	240.937	240.916	-	-
4			-	-	241.168	241.156	241.118	241.120	240.933	240.912	-	-
5			-	-	241.158	241.145	241.119	241.115	240.934	240.916	-	-
6			-	-	241.212	241.135	241.115	241.100	240.934	240.916	-	-
7			-	-	241.271	241.124	241.108	241.092	240.941	240.915	-	-
8			-	-	241.314	241.117	241.104	241.091	240.941	240.915	-	-
9			-	-	241.350	241.112	241.094	241.091	240.935	240.916	-	-
10			-	-	241.406	241.108	241.089	241.092	240.930	240.916	-	-
11			-	-	241.409	241.115	241.090	241.087	240.929	240.924	-	-
12			-	-	241.391	241.106	241.092	241.083	240.929	240.933	-	-
13			-	-	241.369	241.099	241.085	241.082	240.930	240.934	-	-
14			-	-	241.349	241.104	241.084	241.086	240.933	240.937	-	-
15			-	-	241.336	241.112	241.087	241.089	240.929	240.938	-	-
16			-	-	241.321	241.098	241.081	241.085	240.921	240.933	-	-
17			-	-	241.306	241.093	241.087	241.093	240.918	240.934	-	-
18			-	-	241.288	241.091	241.091	241.099	240.917	240.932	-	-
19			-	-	241.270	241.084	241.086	241.106	240.923	240.933	-	-
20			-	-	241.255	241.078	241.078	241.113	240.930	240.930	-	-
21			-	-	241.241	241.074	241.077	241.115	240.930	240.925	-	-
22			-	-	241.222	241.070	241.099	241.108	240.928	240.924	-	-
23			-	-	241.214	241.083	241.120	241.105	240.929	240.925	-	-
24			-	241.155 P	241.204	241.084	241.136	241.102	240.927	240.921	-	-
25			-	241.168	241.201	241.085	241.134	241.100	240.928	240.921	-	-
26			-	241.160	241.194	241.078	241.127	241.099	240.930	240.924	-	-
27			-	241.162	241.206	241.073	241.123	241.051	240.923	240.925 P	-	-
28			-	241.167	241.195	241.096	241.113	240.946	240.919	-	-	-
29			-	241.181	241.179	241.126	241.118	240.941	240.921	-	-	-
30			-	241.173	241.185	241.124	241.115	240.936	240.920	-	-	-
31			-	-	241.198	-	241.103	240.936	-	-	-	-
min			**-**	**241.155**	**241.158**	**241.070**	**241.077**	**240.936**	**240.917**	**240.912**	**-**	**-**
mean			**-**	**241.166**	**241.256**	**241.110**	**241.105**	**241.076**	**240.929**	**240.924**	**-**	**-**
max			**-**	**241.181**	**241.409**	**241.190**	**241.136**	**241.120**	**240.943**	**240.938**	**-**	**-**

Notes: P - partial daily average.

Table VIII-20 S12 Fort Creek Mean Daily Discharges (m^3/s), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	0.159	0.112	0.063	0.028	0.029	-	-
2	-	-	-	-	-	0.158	0.096	0.054	0.031	0.029	-	-
3	-	-	-	-	-	0.143	0.087	0.047	0.027	0.028	-	-
4	-	-	-	-	-	0.120	0.078	0.043	0.026	0.024	-	-
5	-	-	-	-	-	0.104	0.084	0.052	0.024	0.026	-	-
6	-	-	-	-	-	0.087	0.076	0.041	0.025	0.025	-	-
7	-	-	-	-	-	0.077	0.068	0.038	0.028	0.025	-	-
8	-	-	-	-	-	0.071	0.064	0.052	0.028	0.025	-	-
9	-	-	-	-	-	0.127	0.053	0.049	0.027	0.025	-	-
10	-	-	-	-	-	0.081	0.063	0.042	0.025	0.026	-	-
11	-	-	-	-	0.192 P	0.116	0.067	0.040	0.027	0.038	-	-
12	-	-	-	-	0.432	0.151	0.071	0.033	0.023	0.037	-	-
13	-	-	-	-	0.116	0.194	0.055	0.056	0.025	0.030	-	-
14	-	-	-	-	0.112	0.133	0.052	0.057	0.038	0.026	-	-
15	-	-	-	-	0.099	0.117	0.051	0.044	0.027	0.025	-	-
16	-	-	-	-	0.090	0.117	0.046	0.038	0.026	0.027	-	-
17	-	-	-	-	0.082	0.106	0.058	0.032	0.032	0.029	-	-
18	-	-	-	-	0.087	0.092	0.055	0.030	0.024	0.024	-	-
19	-	-	-	-	0.084	0.084	0.056	0.048	0.027	0.026	-	-
20	-	-	-	-	0.077	0.073	0.051	0.054	0.031	0.024	-	-
21	-	-	-	-	0.071	0.066	0.042	0.046	0.029	0.032	-	-
22	-	-	-	-	0.065	0.060	0.037	0.040	0.031	0.037	-	-
23	-	-	-	-	0.066	0.079	0.033	0.040	0.049	0.047 B	-	-
24	-	-	-	-	0.057	0.086	0.031	0.050	0.025	0.114 B	-	-
25	-	-	-	-	0.046	0.078	0.031	0.040	0.017	0.018 B	-	-
26	-	-	-	-	0.059	0.070	0.031	0.040	0.019	0.017 B	-	-
27	-	-	-	-	0.059	0.065	0.030	0.033	0.025	0.018 B	-	-
28	-	-	-	-	0.060	0.093	0.031	0.031	0.027	0.136 BP	-	-
29	-	-	-	-	0.060	0.161	0.085	0.031	0.027	-	-	-
30	-	-	-	-	0.092	0.127	0.082	0.029	0.032	-	-	-
31	-	-	-	-	0.158	-	0.074	0.027	-	-	-	-
min	**-**	**-**	**-**	**-**	**0.046**	**0.060**	**0.030**	**0.027**	**0.017**	**0.024**	**-**	**-**
mean	**-**	**-**	**-**	**-**	**0.103**	**0.106**	**0.060**	**0.043**	**0.028**	**0.028**	**-**	**-**
max	**-**	**-**	**-**	**-**	**0.432**	**0.194**	**0.112**	**0.063**	**0.049**	**0.038**	**-**	**-**

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

Table VIII-21 S12 Fort Creek Mean Daily Water Levels (m) Based on Permanent Benchmark el. 253.440 m (geodetic), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	251.084	251.062	251.029	250.990	250.993	-	-
2	-	-	-	-	-	251.084	251.053	251.021	250.994	250.991	-	-
3	-	-	-	-	-	251.077	251.048	251.014	250.990	250.990	-	-
4	-	-	-	-	-	251.066	251.041	251.011	250.987	250.984	-	-
5	-	-	-	-	-	251.057	251.045	251.019	250.984	250.987	-	-
6	-	-	-	-	-	251.047	251.040	251.008	250.985	250.986	-	-
7	-	-	-	-	-	251.040	251.034	251.005	250.991	250.986	-	-
8	-	-	-	-	-	251.036	251.030	251.019	250.991	250.986	-	-
9	-	-	-	-	-	251.066	251.021	251.017	250.989	250.985	-	-
10	-	-	-	-	-	251.043	251.030	251.009	250.985	250.986	-	-
11	-	-	-	-	251.097 P	251.064	251.033	251.006	250.989	251.003	-	-
12	-	-	-	-	251.134	251.081	251.035	250.998	250.982	251.003	-	-
13	-	-	-	-	251.063	251.096	251.022	251.022	250.986	250.993	-	-
14	-	-	-	-	251.062	251.071	251.020	251.024	251.004	250.988	-	-
15	-	-	-	-	251.055	251.064	251.019	251.011	250.988	250.985	-	-
16	-	-	-	-	251.049	251.065	251.014	251.004	250.986	250.988	-	-
17	-	-	-	-	251.043	251.059	251.025	250.997	250.996	250.992	-	-
18	-	-	-	-	251.048	251.051	251.022	250.993	250.983	250.984	-	-
19	-	-	-	-	251.045	251.045	251.023	251.014	250.989	250.987	-	-
20	-	-	-	-	251.040	251.037	251.019	251.021	250.994	250.984	-	-
21	-	-	-	-	251.036	251.032	251.009	251.014	250.991	250.997	-	-
22	-	-	-	-	251.032	251.027	251.003	251.007	250.994	251.003	-	-
23	-	-	-	-	251.032	251.041	250.998	251.006	251.015	251.010 B	-	-
24	-	-	-	-	251.024	251.046	250.995	251.018	250.985	251.047 B	-	-
25	-	-	-	-	251.014	251.041	250.995	251.006	250.971	250.972 B	-	-
26	-	-	-	-	251.026	251.036	250.995	251.006	250.973	250.970 B	-	-
27	-	-	-	-	251.026	251.031	250.994	250.998	250.985	250.971 B	-	-
28	-	-	-	-	251.027	251.049	250.993	250.996	250.990	251.059 BP	-	-
29	-	-	-	-	251.027	251.085	251.046	250.995	250.989	-	-	-
30	-	-	-	-	251.047	251.070	251.044	250.992	250.997	-	-	-
31	-	-	-	-	251.084	-	251.038	250.990	-	-	-	-
min	**-**	**-**	**-**	**-**	**251.014**	**251.027**	**250.993**	**250.990**	**250.971**	**250.970**	**-**	**-**
mean	**-**	**-**	**-**	**-**	**251.048**	**251.056**	**251.024**	**251.009**	**250.989**	**250.993**	**-**	**-**
max	**-**	**-**	**-**	**-**	**251.134**	**251.096**	**251.062**	**251.029**	**251.015**	**251.059**	**-**	**-**

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

Table VIII-22 S13 Albian Sands Polishing Pond #3 Mean Daily Discharges (m^3/s), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	0.004	-	-	-	-	0.000	0.056	0.015	0.004	0.000	0.000	0.000
2	0.003	-	-	-	-	0.000	0.065	0.030	0.003	0.000	0.000	0.000
3	0.002	-	-	-	-	0.000	0.076	0.032	0.003	0.000	0.000	0.000
4	0.002	-	-	-	-	0.000	0.088	0.036	0.001	0.000	0.000	0.000
5	0.001	-	-	-	-	0.000	0.097	0.043	0.002	0.000	0.000	0.000
6	0.001	-	-	-	-	0.000	0.060	0.031	0.004	0.000	0.000	0.000
7	0.001	-	-	-	-	0.000	0.045	0.010	0.003	0.000	0.000	0.000
8	0.000	-	-	-	-	0.000	0.039	0.008	0.002	0.000	0.000	0.000
9	0.000	-	-	-	-	0.000	0.029	0.012	0.002	0.000	0.000	0.000
10	0.000	-	-	-	-	0.000	0.025	0.008	0.004	0.000	0.000	0.000
11	0.000	-	-	-	-	0.000	0.034	0.004	0.005	0.000	0.000	0.000 P
12	0.000	-	-	-	-	0.000	0.057	0.005	0.005	0.000	0.000	-
13	0.000	-	-	-	-	0.000	0.077	0.029	0.005	0.000	0.000	-
14	0.000	-	-	-	-	0.000	0.092	0.028	0.003	0.000	0.000	-
15	0.000	-	-	-	-	0.000	0.105	0.008	0.001	0.000	0.000	-
16	0.000 P	-	-	-	-	0.000	0.083	0.001	0.001	0.000	0.000	-
17	-	-	-	-	-	0.000	0.095	0.005	0.001	0.000	0.000	-
18	-	-	-	-	-	0.000	0.112	0.007	0.001	0.000	0.000	-
19	-	-	-	-	-	0.000	0.077	0.008	0.001	0.000	0.000	-
20	-	-	-	-	-	0.000	0.052	0.009	0.002	0.000	0.000	-
21	-	-	-	-	-	0.000	0.028	0.004	0.002	0.000	0.000	-
22	-	-	-	-	-	0.000	0.038	0.004	0.002	0.000	0.000	-
23	-	-	-	-	0.000 P	0.000	0.026	0.007	0.003	0.000	0.000	-
24	-	-	-	-	0.000	0.000	0.006	0.031	0.002	0.000	0.000	-
25	-	-	-	-	0.000	0.021	0.002	0.021	0.001	0.000	0.000	-
26	-	-	-	-	0.000	0.161	0.003	0.005	0.001	0.000	0.000	-
27	-	-	-	-	0.000	0.138	0.006	0.001	0.000	0.000	0.000	-
28	-	-	-	-	0.000	0.127	0.004	0.005	0.000	0.000	0.000	-
29	-	-	-	-	0.000	0.069	0.011	0.003	0.000	0.000	0.000	-
30	-	-	-	-	0.000	0.061	0.018	0.002	0.000	0.000	0.000	-
31	-	-	-	-	0.000	-	0.021	0.005	-	0.000	-	-
min	**0.000**	**-**	**-**	**-**	**0.000**	**0.000**	**0.002**	**0.001**	**0.000**	**0.000**	**0.000**	**0.000**
mean	**0.001**	**-**	**-**	**-**	**0.000**	**0.019**	**0.049**	**0.013**	**0.002**	**0.000**	**0.000**	**0.000**
max	**0.004**	**-**	**-**	**-**	**0.000**	**0.161**	**0.112**	**0.043**	**0.005**	**0.000**	**0.000**	**0.000**

Notes: P - partial daily average.

Table VIII-23 S13 Albian Sands Polishing Pond #3 Mean Daily Water Levels (m) Based on benchmark el. 279.590 m (geodetic), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	278.956	-	-	-	-	277.835	279.084	279.003	278.958	278.886	278.809	278.423
2	278.947	-	-	-	-	277.834	279.097	279.041	278.947	278.880	278.803	278.412
3	278.941	-	-	-	-	277.834	279.110	279.046	278.946	278.877	278.807	278.391
4	278.939	-	-	-	-	277.834	279.123	279.052	278.934	278.847	278.812	278.379
5	278.934	-	-	-	-	277.834	279.133	279.065	278.938	278.841	278.823	278.377
6	278.927	-	-	-	-	277.834	279.088	279.044	278.956	278.840	278.865	278.390
7	278.919	-	-	-	-	277.834	279.068	278.983	278.953	278.844	278.882	278.408
8	278.919	-	-	-	-	277.834	279.058	278.979	278.944	278.849	278.866	278.389
9	278.914	-	-	-	-	277.834	279.039	278.994	278.942	278.849	278.830	278.391
10	278.910	-	-	-	-	278.004	279.030	278.977	278.953	278.846	278.813	278.390
11	278.903	-	-	-	-	278.243	279.049	278.955	278.965	278.848	278.875	278.389 P
12	278.895	-	-	-	-	278.229	279.086	278.962	278.966	278.853	278.882	-
13	278.891	-	-	-	-	278.205	279.110	279.037	278.963	278.858	278.842	-
14	278.888	-	-	-	-	278.184	279.128	279.036	278.952	278.851	278.806	-
15	278.882	-	-	-	-	278.160	279.140	278.972	278.926	278.842	278.834	-
16	278.887 P	-	-	-	-	278.137	279.116	278.926	278.926	278.842	278.787	-
17	-	-	-	-	-	278.118	279.128	278.963	278.924	278.851	278.730	-
18	-	-	-	-	-	278.101	279.147	278.972	278.924	278.860	278.688	-
19	-	-	-	-	-	278.087	279.110	278.978	278.929	278.844	278.655	-
20	-	-	-	-	-	278.077	279.078	278.983	278.942	278.835	278.627	-
21	-	-	-	-	-	278.076	279.036	278.960	278.940	278.836	278.606	-
22	-	-	-	-	-	278.095	279.057	278.960	278.944	278.840	278.592	-
23	-	-	-	-	277.833 P	278.146	279.030	278.974	278.947	278.839	278.582	-
24	-	-	-	-	277.834	278.192	278.968	279.042	278.940	278.835	278.559	-
25	-	-	-	-	277.834	278.659	278.945	279.019	278.928	278.833	278.527	-
26	-	-	-	-	277.834	279.187	278.948	278.961	278.920	278.828	278.502	-
27	-	-	-	-	277.834	279.169	278.970	278.931	278.918	278.838	278.488	-
28	-	-	-	-	277.834	279.160	278.958	278.964	278.911	278.832	278.476	-
29	-	-	-	-	277.833	279.102	278.990	278.948	278.901	278.812	278.460	-
30	-	-	-	-	277.835	279.091	279.013	278.945	278.895	278.811	278.442	-
31	-	-	-	-	277.837	-	279.021	278.962	-	278.812	-	-
min	**278.882**	**-**	**-**	**-**	277.833	277.834	**278.945**	**278.926**	**278.895**	**278.811**	**278.442**	**278.377**
mean	**278.916**	**-**	**-**	**-**	277.834	278.245	**279.059**	**278.988**	**278.937**	**278.842**	**278.706**	**278.391**
max	**278.956**	**-**	**-**	**-**	277.837	279.187	**279.147**	**279.065**	**278.966**	**278.880**	**278.882**	**278.412**

Notes: P - partial daily average.

Table VIII-24 S14 Ells River Mean Daily Discharges (m^3/s), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	14.102	9.244	17.331	14.040	7.976	-	-
2	-	-	-	-	-	13.950	9.180	16.510	13.816	7.810	-	-
3	-	-	-	-	-	13.527	9.797	15.168	13.259	7.691	-	-
4	-	-	-	-	-	13.054	9.993	14.302	12.880	7.492	-	-
5	-	-	-	-	-	12.738	9.835	14.159	12.412	7.408	-	-
6	-	-	-	-	-	12.476	9.512	15.362	11.941	7.253	-	-
7	-	-	-	-	-	11.892	9.656	15.924	11.915	7.101	-	-
8	-	-	-	-	-	11.741	9.425	14.771	11.485	7.032	-	-
9	-	-	-	-	-	11.569	9.019	13.942	11.284	6.983	-	-
10	-	-	-	-	-	11.811	8.937	13.716	11.226	6.923	-	-
11	-	-	-	-	-	12.755	8.837	13.383	11.068	7.014	-	-
12	-	-	-	-	-	13.495	8.754	12.940	10.956	7.012	-	-
13	-	-	-	-	20.178 P	13.662	8.823	12.915	10.801	7.006	-	-
14	-	-	-	-	18.928	13.171	8.975	12.861	10.698	7.099	-	-
15	-	-	-	-	19.070	12.773	9.054	13.112	9.783	7.022	-	-
16	-	-	-	-	18.268	12.437	9.024	13.450	9.451	6.924	-	-
17	-	-	-	-	17.896	11.972	9.410	12.966	9.514	6.855	-	-
18	-	-	-	-	17.670	11.556	9.607	12.682	9.661	6.675	-	-
19	-	-	-	-	17.457	11.157	10.173	12.989	9.528	6.576	-	-
20	-	-	-	-	17.105	10.833	10.399	13.544	9.503	6.472	-	-
21	-	-	-	-	16.712	9.436	10.860	14.988	9.451	6.199	-	-
22	-	-	-	-	16.150	8.485	11.301	17.281	9.329	6.075	-	-
23	-	-	-	-	16.145	8.553	10.992	18.471	9.120	5.733 P	-	-
24	-	-	-	-	15.566	8.470	10.756	18.657	8.973	-	-	-
25	-	-	-	-	15.468	8.759	10.512	17.754	9.420	-	-	-
26	-	-	-	-	15.573	8.741	10.373	17.233	8.893	-	-	-
27	-	-	-	-	15.277	8.469	10.167	16.595	8.696	-	-	-
28	-	-	-	-	14.658	8.658	10.073	15.883	8.444	-	-	-
29	-	-	-	-	14.361	8.902	10.819	15.431	8.257	-	-	-
30	-	-	-	-	14.368	8.917	11.493	14.835	8.167	-	-	-
31	-	-	-	-	14.357	-	15.386	14.316	-	-	-	-
min	-	-	-	-	14.357	8.469	8.754	12.682	8.167	5.733	-	-
mean	-	-	-	-	16.590	11.269	10.012	14.951	10.466	6.971	-	-
max	-	-	-	-	20.178	14.102	15.386	18.657	14.040	7.976	-	-

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

Table VIII-25 S14 Ells River Mean Daily Water Levels (m) Based on Temporary Benchmark el. 100.199 m, 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	97.590	97.480	97.647	97.589	97.443	-	-
2	-	-	-	-	-	97.587	97.478	97.633	97.584	97.438	-	-
3	-	-	-	-	-	97.578	97.494	97.610	97.573	97.434	-	-
4	-	-	-	-	-	97.568	97.499	97.594	97.565	97.428	-	-
5	-	-	-	-	-	97.562	97.495	97.591	97.554	97.425	-	-
6	-	-	-	-	-	97.556	97.487	97.613	97.546	97.420	-	-
7	-	-	-	-	-	97.544	97.491	97.623	97.545	97.415	-	-
8	-	-	-	-	-	97.540	97.485	97.603	97.535	97.412	-	-
9	-	-	-	-	-	97.536	97.473	97.587	97.530	97.411	-	-
10	-	-	-	-	-	97.542	97.471	97.583	97.528	97.409	-	-
11	-	-	-	-	-	97.563	97.468	97.576	97.526	97.412	-	-
12	-	-	-	-	-	97.578	97.466	97.567	97.523	97.412	-	-
13	-	-	-	-	97.690 P	97.581	97.468	97.566	97.518	97.411	-	-
14	-	-	-	-	97.672	97.571	97.472	97.565	97.515	97.415	-	-
15	-	-	-	-	97.674	97.563	97.474	97.570	97.493	97.412	-	-
16	-	-	-	-	97.662	97.556	97.474	97.577	97.489	97.409	-	-
17	-	-	-	-	97.656	97.545	97.484	97.567	97.487	97.406	-	-
18	-	-	-	-	97.652	97.537	97.489	97.561	97.491	97.400	-	-
19	-	-	-	-	97.649	97.527	97.504	97.568	97.487	97.396	-	-
20	-	-	-	-	97.643	97.519	97.509	97.579	97.487	97.392	-	-
21	-	-	-	-	97.637	97.484	97.521	97.606	97.485	97.382	-	-
22	-	-	-	-	97.627	97.458	97.531	97.646	97.482	97.377	-	-
23	-	-	-	-	97.627	97.460	97.524	97.665	97.476	97.491	-	-
24	-	-	-	-	97.617	97.458	97.518	97.668	97.472	97.569 B	-	-
25	-	-	-	-	97.615	97.466	97.512	97.653	97.484	97.623 B	-	-
26	-	-	-	-	97.617	97.466	97.509	97.645	97.470	97.612 B	-	-
27	-	-	-	-	97.612	97.458	97.504	97.634	97.464	97.592 B	-	-
28	-	-	-	-	97.600	97.463	97.501	97.623	97.457	97.501 B	-	-
29	-	-	-	-	97.594	97.470	97.520	97.614	97.452	97.442 B	-	-
30	-	-	-	-	97.595	97.470	97.535	97.603	97.449	97.447 B	-	-
31	-	-	-	-	97.595	-	97.613	97.594	-	97.412 BP	-	-
min	**-**	**-**	**-**	**-**	**97.594**	**97.458**	**97.466**	**97.561**	**97.449**	**97.377**	**-**	**-**
mean	**-**	**-**	**-**	**-**	**97.633**	**97.527**	**97.498**	**97.604**	**97.509**	**97.443**	**-**	**-**
max	**-**	**-**	**-**	**-**	**97.690**	**97.590**	**97.613**	**97.668**	**97.589**	**97.623**	**-**	**-**

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

Table VIII-26 S15 Tar River Mean Daily Discharges (m^3/s), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	1.099	1.236	2.873	0.513	0.387	-	-
2	-	-	-	-	-	0.829	1.303	1.917	0.512	0.373	-	-
3	-	-	-	-	-	0.712	1.323	3.139	0.460	0.371	-	-
4	-	-	-	-	-	0.622	0.957	1.567	0.439	0.367	-	-
5	-	-	-	-	-	0.559	0.856	1.246	0.426	0.363	-	-
6	-	-	-	-	-	0.508	0.772	1.124	0.399	0.355	-	-
7	-	-	-	-	-	0.454	0.699	0.968	0.419	0.353	-	-
8	-	-	-	-	-	0.466	0.603	0.857	0.440	0.365	-	-
9	-	-	-	-	9.189 P	0.526	0.552	0.745	0.439	0.369	-	-
10	-	-	-	-	6.370	0.581	0.531	0.694	0.432	0.344	-	-
11	-	-	-	-	3.972	1.022	0.522	0.642	0.429	0.373	-	-
12	-	-	-	-	3.102	1.434	0.548	0.571	0.473	0.379	-	-
13	-	-	-	-	2.384	1.040	0.580	0.572	0.483	0.415	-	-
14	-	-	-	-	2.169	0.854	0.537	2.705	0.509	0.423	-	-
15	-	-	-	-	2.126	0.730	0.538	1.657	0.488	0.420	-	-
16	-	-	-	-	1.554	0.645	0.560	1.221	0.460	0.397	-	-
17	-	-	-	-	1.320	0.600	0.569	0.949	0.441	0.405	-	-
18	-	-	-	-	1.310	0.551	0.816	0.767	0.428	0.381	-	-
19	-	-	-	-	1.220	0.499	0.858	0.756	0.451	0.347	-	-
20	-	-	-	-	0.957	0.461	1.063	0.956	0.472	0.362	-	-
21	-	-	-	-	0.805	0.436	1.100	1.318	0.469	0.383	-	-
22	-	-	-	-	0.721	0.439	0.965	1.174	0.451	0.389	-	-
23	-	-	-	-	0.714	0.500	0.794	1.034	0.437	0.328	-	-
24	-	-	-	-	0.678	0.597	0.677	1.087	0.440	0.311	-	-
25	-	-	-	-	0.664	0.643	0.592	1.033	0.432	0.322	-	-
26	-	-	-	-	0.631	0.605	0.544	0.882	0.428	0.332	-	-
27	-	-	-	-	0.599	0.528	0.596	0.756	0.421	0.338 P	-	-
28	-	-	-	-	0.562	0.578	0.534	0.679	0.390	-	-	-
29	-	-	-	-	0.562	1.300	1.188	0.626	0.400	-	-	-
30	-	-	-	-	0.586	1.658	4.763	0.577	0.393	-	-	-
31	-	-	-	-	1.008	-	4.716	0.533	-	-	-	-
min	**-**	**-**	**-**	**-**	**0.562**	**0.436**	**0.522**	**0.533**	**0.390**	**0.311**	**-**	**-**
mean	**-**	**-**	**-**	**-**	**1.878**	**0.716**	**1.029**	**1.149**	**0.446**	**0.369**	**-**	**-**
max	**-**	**-**	**-**	**-**	**9.189**	**1.658**	**4.763**	**3.139**	**0.513**	**0.423**	**-**	**-**

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

Table VIII-27 S15 Tar River Mean Daily Water Levels (m) Based on Temporary Benchmark el. 100.590 m, 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	97.641	97.665	97.825	97.517	97.472	-	-
2	-	-	-	-	-	97.591	97.672	97.746	97.517	97.468	-	-
3	-	-	-	-	-	97.566	97.676	97.807	97.500	97.467	-	-
4	-	-	-	-	-	97.542	97.620	97.707	97.492	97.466	-	-
5	-	-	-	-	-	97.524	97.601	97.666	97.487	97.463	-	-
6	-	-	-	-	-	97.509	97.583	97.647	97.478	97.460	-	-
7	-	-	-	-	-	97.493	97.566	97.621	97.485	97.459	-	-
8	-	-	-	-	-	97.493	97.542	97.601	97.493	97.464	-	-
9	-	-	-	-	98.084 P	97.513	97.528	97.577	97.492	97.466	-	-
10	-	-	-	-	97.993	97.533	97.522	97.565	97.490	97.456	-	-
11	-	-	-	-	97.889	97.623	97.519	97.552	97.490	97.468	-	-
12	-	-	-	-	97.838	97.691	97.525	97.533	97.504	97.471	-	-
13	-	-	-	-	97.788	97.634	97.535	97.533	97.507	97.484	-	-
14	-	-	-	-	97.764	97.600	97.524	97.812	97.515	97.488	-	-
15	-	-	-	-	97.766	97.574	97.523	97.718	97.508	97.486	-	-
16	-	-	-	-	97.704	97.553	97.530	97.662	97.500	97.478	-	-
17	-	-	-	-	97.672	97.541	97.533	97.617	97.493	97.481	-	-
18	-	-	-	-	97.672	97.528	97.591	97.582	97.488	97.472	-	-
19	-	-	-	-	97.658	97.512	97.600	97.580	97.497	97.458	-	-
20	-	-	-	-	97.618	97.500	97.635	97.617	97.504	97.464	-	-
21	-	-	-	-	97.588	97.491	97.644	97.676	97.504	97.471	-	-
22	-	-	-	-	97.568	97.492	97.621	97.656	97.497	97.473	-	-
23	-	-	-	-	97.566	97.513	97.587	97.633	97.491	97.450	-	-
24	-	-	-	-	97.558	97.541	97.560	97.641	97.492	97.442	-	-
25	-	-	-	-	97.551	97.553	97.538	97.633	97.489	97.447	-	-
26	-	-	-	-	97.548	97.543	97.526	97.605	97.488	97.451	-	-
27	-	-	-	-	97.538	97.522	97.540	97.579	97.486	97.453 B	-	-
28	-	-	-	-	97.528	97.535	97.521	97.562	97.474	97.447 B	-	-
29	-	-	-	-	97.525	97.660	97.644	97.548	97.478	97.443 B	-	-
30	-	-	-	-	97.537	97.719	97.925	97.535	97.476	97.429 BP	-	-
31	-	-	-	-	97.606	-	97.931	97.522	-	-	-	-
min	**-**	**-**	**-**	**-**	**97.525**	**97.491**	**97.519**	**97.522**	**97.474**	**97.429**	**-**	**-**
mean	**-**	**-**	**-**	**-**	**97.677**	**97.558**	**97.598**	**97.631**	**97.494**	**97.463**	**-**	**-**
max	**-**	**-**	**-**	**-**	**98.084**	**97.719**	**97.931**	**97.825**	**97.517**	**97.488**	**-**	**-**

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

Table VIII-28 S16 Calumet River Mean Daily Discharges (m^3/s), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	-	0.323	1.872	0.120	0.067	-	-
2	-	-	-	-	-	-	0.270	1.842	0.122	0.064	-	-
3	-	-	-	-	-	-	0.231	1.520	0.108	0.064	-	-
4	-	-	-	-	-	-	0.207	1.192	0.102	0.060	-	-
5	-	-	-	-	-	-	0.244	0.978	0.097	0.059	-	-
6	-	-	-	-	-	-	0.207	0.672	0.095	0.057	-	-
7	-	-	-	-	-	-	0.184	0.521	0.098	0.057	-	-
8	-	-	-	-	-	-	0.169	0.430	0.092	0.056	-	-
9	-	-	-	-	-	-	0.147	0.363	0.095	0.053	-	-
10	-	-	-	-	-	-	0.149	0.332	0.113	0.051	-	-
11	-	-	-	-	-	0.477 P	0.156	0.288	0.128	0.062	-	-
12	-	-	-	-	1.165 A	0.387	0.151	0.239	0.197	0.073	-	-
13	-	-	-	-	-	0.354	0.128	0.294	0.159	0.073	-	-
14	-	-	-	-	-	0.295	0.119	0.306	0.122	0.073	-	-
15	-	-	-	-	-	0.240	0.126	0.255	0.111	0.067	-	-
16	-	-	-	-	-	0.208	0.127	0.229	0.109	0.064	-	-
17	-	-	-	-	-	0.181	0.162	0.197	0.099	0.068	-	-
18	-	-	-	-	-	0.180	0.151	0.176	0.096	0.062	-	-
19	-	-	-	-	-	0.169	0.147	0.276	0.110	0.059	-	-
20	-	-	-	-	-	0.150	0.134	0.260	0.102	0.058	-	-
21	-	-	-	-	-	0.135	0.127	0.272	0.099	0.060	-	-
22	-	-	-	-	-	0.127	0.119	0.244	0.094	0.051	-	-
23	-	-	-	-	-	0.224	0.110	0.237	0.091	0.052	-	-
24	-	-	-	-	-	0.249	0.101	0.233	0.086	0.045	-	-
25	-	-	-	-	-	0.260	0.093	0.193	0.083	0.044	-	-
26	-	-	-	-	-	0.238	0.093	0.168	0.080	0.043	-	-
27	-	-	-	-	-	0.192	0.091	0.159	0.077	0.045	-	-
28	-	-	-	-	-	0.288	0.086	0.153	0.073	0.043	-	-
29	-	-	-	-	-	0.392	0.437	0.144	0.073	0.044	-	-
30	-	-	-	-	-	0.361	0.565 P	0.131	0.072	0.041	-	-
31	-	-	-	-	-	-	0.597 P	0.123	-	0.038 P	-	-
min	**-**	**-**	**-**	**-**	**-**	**0.127**	**0.086**	**0.123**	**0.072**	**0.038**	**-**	**-**
mean	**-**	**-**	**-**	**-**	**-**	**0.255**	**0.192**	**0.461**	**0.103**	**0.057**	**-**	**-**
max	**-**	**-**	**-**	**-**	**-**	**0.477**	**0.597**	**1.872**	**0.197**	**0.073**	**-**	**-**

Notes: P - partial daily average.
B - ice effects.
A - manual measurement.

Table VIII-29 S16 Calumet River Mean Daily Water Levels (m) Based on Temporary Benchmark el. 100.000 m, 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	-	98.503	98.669	98.428	98.389	-	-
2	-	-	-	-	-	-	98.488	98.669	98.429	98.386	-	-
3	-	-	-	-	-	-	98.476	98.648	98.421	98.386	-	-
4	-	-	-	-	-	-	98.468	98.623	98.417	98.382	-	-
5	-	-	-	-	-	-	98.481	98.603	98.413	98.381	-	-
6	-	-	-	-	-	-	98.468	98.567	98.412	98.379	-	-
7	-	-	-	-	-	-	98.459	98.544	98.414	98.379	-	-
8	-	-	-	-	-	-	98.453	98.527	98.410	98.377	-	-
9	-	-	-	-	-	-	98.442	98.513	98.412	98.374	-	-
10	-	-	-	-	-	98.654 P	98.443	98.505	98.423	98.372	-	-
11	-	-	-	-	-	98.587	98.446	98.493	98.433	98.384	-	-
12	-	-	-	-	98.732 A	98.518	98.444	98.479	98.463	98.394	-	-
13	-	-	-	-	-	98.511	98.432	98.495	98.448	98.394	-	-
14	-	-	-	-	-	98.496	98.427	98.499	98.429	98.394	-	-
15	-	-	-	-	-	98.479	98.431	98.484	98.422	98.388	-	-
16	-	-	-	-	-	98.468	98.432	98.475	98.421	98.386	-	-
17	-	-	-	-	-	98.457	98.449	98.464	98.415	98.390	-	-
18	-	-	-	-	-	98.457	98.444	98.456	98.412	98.384	-	-
19	-	-	-	-	-	98.452	98.442	98.487	98.422	98.380	-	-
20	-	-	-	-	-	98.444	98.436	98.485	98.417	98.380	-	-
21	-	-	-	-	-	98.436	98.432	98.489	98.414	98.382	-	-
22	-	-	-	-	-	98.432	98.427	98.480	98.411	98.372	-	-
23	-	-	-	-	-	98.472	98.422	98.478	98.409	98.373	-	-
24	-	-	-	-	-	98.482	98.416	98.477	98.405	98.364	-	-
25	-	-	-	-	-	98.485	98.410	98.462	98.403	98.364	-	-
26	-	-	-	-	-	98.479	98.410	98.452	98.400	98.361	-	-
27	-	-	-	-	-	98.462	98.409	98.448	98.398	98.364	-	-
28	-	-	-	-	-	98.489	98.405	98.445	98.394	98.362	-	-
29	-	-	-	-	-	98.519	98.525	98.440	98.395	98.363	-	-
30	-	-	-	-	-	98.512	98.551	98.434	98.394	98.359	-	-
31	-	-	-	-	-	-	98.555	98.429	-	98.354 P	-	-
min	**-**	**-**	**-**	**-**	**-**	**98.432**	**98.405**	**98.429**	**98.394**	**98.354**	**-**	**-**
mean	**-**	**-**	**-**	**-**	**-**	**98.539**	**98.452**	**98.507**	**98.416**	**98.377**	**-**	**-**
max	**-**	**-**	**-**	**-**	**-**	**98.655**	**98.555**	**98.669**	**98.463**	**98.394**	**-**	**-**

Notes: P - partial daily average.
B - ice effects.
A - manual measurement.

Table VIII-30 S17 Upland Tar River Mean Daily Discharges (m^3/s), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	0.014	0.005	0.009	0.002	0.003	-	-
2	-	-	-	-	-	0.038	0.005	0.008	0.003	0.003	-	-
3	-	-	-	-	-	0.027	0.065	0.003	0.002	0.003	-	-
4	-	-	-	-	-	0.057	0.005	0.002	0.002	0.003	-	-
5	-	-	-	-	-	0.047	0.003	0.002	0.002	0.003	-	-
6	-	-	-	-	-	0.006	0.002	0.002	0.002	0.003	-	-
7	-	-	-	-	-	0.004	0.002	0.002	0.002	0.004	-	-
8	-	-	-	-	-	0.003	0.002	0.002	0.002	0.004	-	-
9	-	-	-	-	-	0.003	0.002	0.002	0.003	0.004	-	-
10	-	-	-	-	-	0.004	0.002	0.002	0.003	0.003	-	-
11	-	-	-	-	-	0.013	0.002	0.002	0.003	0.004	-	-
12	-	-	-	-	0.097 P	0.006	0.002	0.002	0.003	0.004	-	-
13	-	-	-	-	0.044	0.005	0.002	0.002	0.002	0.004	-	-
14	-	-	-	-	0.064	0.005	0.002	0.003	0.002	0.004	-	-
15	-	-	-	-	0.066	0.005	0.002	0.002	0.003	0.004	-	-
16	-	-	-	-	0.016	0.003	0.002	0.002	0.002	0.004	-	-
17	-	-	-	-	0.014	0.003	0.002	0.002	0.003	0.004	-	-
18	-	-	-	-	0.007	0.002	0.002	0.002	0.003	0.003	-	-
19	-	-	-	-	0.009	0.002	0.003	0.003	0.004	0.004	-	-
20	-	-	-	-	0.008	0.002	0.021	0.003	0.003	0.003	-	-
21	-	-	-	-	0.005	0.002	0.009	0.003	0.003	0.003	-	-
22	-	-	-	-	0.005	0.003	0.006	0.003	0.003	0.003	-	-
23	-	-	-	-	0.007	0.005	0.003	0.003	0.003	0.004	-	-
24	-	-	-	-	0.009	0.006	0.002	0.003	0.004	0.004	-	-
25	-	-	-	-	0.014	0.005	0.002	0.002	0.004	0.003	-	-
26	-	-	-	-	0.006	0.004	0.002	0.003	0.003	0.003	-	-
27	-	-	-	-	0.004	0.003	0.002	0.002	0.004	0.004	-	-
28	-	-	-	-	0.003	0.008	0.002	0.002	0.003	0.004	-	-
29	-	-	-	-	0.003	0.018	0.024	0.002	0.004	0.006	-	-
30	-	-	-	-	0.004	0.009	0.040	0.002	0.003	0.004	-	-
31	-	-	-	-	0.034	-	0.015	0.002	-	0.004 P	-	-
min	**-**	**-**	**-**	**-**	**0.003**	**0.002**	**0.002**	**0.002**	**0.002**	**0.003**	**-**	**-**
mean	**-**	**-**	**-**	**-**	**0.021**	**0.010**	**0.008**	**0.003**	**0.003**	**0.004**	**-**	**-**
max	**-**	**-**	**-**	**-**	**0.097**	**0.057**	**0.065**	**0.009**	**0.004**	**0.006**	**-**	**-**

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

Table VIII-31 S17 Upland Tar River Mean Daily Water Levels (m) Based on Permanent Benchmark el. 99.963 m (geodetic), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	98.410	98.350	98.381	98.308	98.321	-	-
2	-	-	-	-	-	98.469	98.346	98.377	98.319	98.326	-	-
3	-	-	-	-	-	98.449	98.395	98.319	98.314	98.327	-	-
4	-	-	-	-	-	98.395	98.343	98.307	98.308	98.322	-	-
5	-	-	-	-	-	98.469	98.330	98.312	98.310	98.327	-	-
6	-	-	-	-	-	98.357	98.309	98.300	98.308	98.331	-	-
7	-	-	-	-	-	98.341	98.304	98.297	98.311	98.333	-	-
8	-	-	-	-	-	98.324	98.294	98.295	98.311	98.334	-	-
9	-	-	-	-	-	98.317	98.292	98.293	98.316	98.333	-	-
10	-	-	-	-	-	98.328	98.302	98.294	98.320	98.330	-	-
11	-	-	-	-	-	98.405	98.305	98.294	98.316	98.343	-	-
12	-	-	-	-	98.554 P	98.358	98.297	98.294	98.321	98.342	-	-
13	-	-	-	-	98.493	98.347	98.297	98.305	98.313	98.338	-	-
14	-	-	-	-	98.509	98.354	98.302	98.319	98.313	98.335	-	-
15	-	-	-	-	98.507	98.349	98.298	98.307	98.324	98.332	-	-
16	-	-	-	-	98.418	98.324	98.296	98.309	98.312	98.338	-	-
17	-	-	-	-	98.408	98.317	98.312	98.299	98.319	98.336	-	-
18	-	-	-	-	98.367	98.308	98.300	98.297	98.315	98.331	-	-
19	-	-	-	-	98.386	98.303	98.314	98.322	98.340	98.333	-	-
20	-	-	-	-	98.376	98.312	98.418	98.323	98.326	98.331	-	-
21	-	-	-	-	98.353	98.294	98.386	98.322	98.329	98.328	-	-
22	-	-	-	-	98.353	98.316	98.356	98.314	98.325	98.328	-	-
23	-	-	-	-	98.365	98.350	98.322	98.314	98.328	98.331	-	-
24	-	-	-	-	98.372	98.360	98.305	98.318	98.331	98.333	-	-
25	-	-	-	-	98.398	98.351	98.306	98.311	98.332	98.331	-	-
26	-	-	-	-	98.359	98.334	98.304	98.316	98.328	98.331	-	-
27	-	-	-	-	98.338	98.319	98.302	98.308	98.332	98.332	-	-
28	-	-	-	-	98.331	98.366	98.298	98.310	98.327	98.335	-	-
29	-	-	-	-	98.327	98.429	98.413	98.306	98.335	98.356	-	-
30	-	-	-	-	98.334	98.382	98.485	98.305	98.330	98.340	-	-
31	-	-	-	-	98.468	-	98.417	98.305	-	98.337 P	-	-
min	**-**	**-**	**-**	**-**	**98.327**	**98.294**	**98.292**	**98.293**	**98.308**	**98.321**	**-**	**-**
mean	**-**	**-**	**-**	**-**	**98.401**	**98.358**	**98.332**	**98.312**	**98.321**	**98.333**	**-**	**-**
max	**-**	**-**	**-**	**-**	**98.554**	**98.469**	**98.485**	**98.381**	**98.340**	**98.356**	**-**	**-**

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

Table VIII-32 S18 Upland Calumet River Mean Daily Discharges (m^3/s), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	0.197	-	-	-	-	-	-
2	-	-	-	-	-	0.167	-	-	-	-	-	-
3	-	-	-	-	-	0.158	-	-	-	-	-	-
4	-	-	-	-	-	0.140	-	-	-	-	-	-
5	-	-	-	-	-	0.133	-	-	-	-	-	-
6	-	-	-	-	-	0.148	-	-	-	-	-	-
7	-	-	-	-	-	0.161	-	-	-	-	-	-
8	-	-	-	-	-	0.170	-	-	-	-	-	-
9	-	-	-	-	-	0.166	-	-	-	-	-	-
10	-	-	-	-	-	0.158	-	-	-	-	-	-
11	-	-	-	-	-	0.233	-	-	-	-	-	-
12	-	-	-	-	0.173 P	0.302	-	-	-	-	-	-
13	-	-	-	-	0.178	0.244	-	-	-	-	-	-
14	-	-	-	-	0.264	0.221	-	-	-	-	-	-
15	-	-	-	-	0.187	0.214	-	-	-	-	-	-
16	-	-	-	-	0.211	0.201	-	-	-	-	-	-
17	-	-	-	-	0.153	0.154	-	-	-	-	-	-
18	-	-	-	-	0.126	0.137	-	-	-	-	-	-
19	-	-	-	-	0.133	0.132	-	-	-	-	-	-
20	-	-	-	-	0.167	0.122	-	-	-	-	-	-
21	-	-	-	-	0.135	0.161	-	-	-	-	-	-
22	-	-	-	-	0.115	0.168	-	-	-	-	-	-
23	-	-	-	-	0.109	0.146	-	-	-	-	-	-
24	-	-	-	-	0.112	0.153	-	-	-	-	-	-
25	-	-	-	-	0.109	0.146	-	-	-	-	-	-
26	-	-	-	-	0.109	0.145	-	-	-	-	-	-
27	-	-	-	-	0.114	0.170	-	-	-	-	-	-
28	-	-	-	-	0.114	0.200	-	-	-	-	-	-
29	-	-	-	-	0.094	-	-	-	-	-	-	-
30	-	-	-	-	0.133	-	-	-	-	-	-	-
31	-	-	-	-	0.164	-	-	-	-	-	-	-
min	**-**	**-**	**-**	**-**	**0.094**	**0.122**	**-**	**-**	**-**	**-**	**-**	**-**
mean	**-**	**-**	**-**	**-**	**0.145**	**0.173**	**-**	**-**	**-**	**-**	**-**	**-**
max	**-**	**-**	**-**	**-**	**0.264**	**0.302**	**-**	**-**	**-**	**-**	**-**	**-**

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

Table VIII-33 S18 Upland Calumet River Mean Daily Water Levels (m) Based on Temporary Benchmark el. 100.000 m, 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	97.378	97.590	98.300	98.465	98.550	-	-
2	-	-	-	-	-	97.333	97.667	98.259	98.470	98.550	-	-
3	-	-	-	-	-	97.319	97.680	98.264	98.472	98.550	-	-
4	-	-	-	-	-	97.288	97.673	98.284	98.475	98.550	-	-
5	-	-	-	-	-	97.276	97.707	98.285	98.477	98.541	-	-
6	-	-	-	-	-	97.303	97.731	98.279	98.481	98.542	-	-
7	-	-	-	-	-	97.325	97.746	98.271	98.492	98.542	-	-
8	-	-	-	-	-	97.339	97.773	98.267	98.494	98.545	-	-
9	-	-	-	-	-	97.332	97.811	98.271	98.498	98.548	-	-
10	-	-	-	-	-	97.320	97.835	98.282	98.497	98.549	-	-
11	-	-	-	-	-	97.421	97.888	98.302	98.502	98.550	-	-
12	-	-	-	-	97.344 P	97.505	97.909	98.317	98.507	98.550	-	-
13	-	-	-	-	97.350	97.439	97.929	98.332	98.511	98.550	-	-
14	-	-	-	-	97.455	97.412	97.938	98.349	98.513	98.550	-	-
15	-	-	-	-	97.353	97.401	97.962	98.377	98.517	98.550	-	-
16	-	-	-	-	97.393	97.384	97.980	98.393	98.520	98.550	-	-
17	-	-	-	-	97.310	97.312	98.008	98.396	98.519	98.550	-	-
18	-	-	-	-	97.263	97.284	98.037	98.403	98.522	98.550	-	-
19	-	-	-	-	97.276	97.275	98.056	98.423	98.531	98.548	-	-
20	-	-	-	-	97.333	97.255	98.077	98.435	98.528	98.550	-	-
21	-	-	-	-	97.279	97.324	98.093	98.433	98.531	98.550	-	-
22	-	-	-	-	97.242	97.335	98.134	98.429	98.534	98.550	-	-
23	-	-	-	-	97.227	97.299	98.159	98.434	98.536	98.550	-	-
24	-	-	-	-	97.234	97.310	98.169	98.441	98.537	98.550	-	-
25	-	-	-	-	97.225	97.300	98.187	98.438	98.538	98.550	-	-
26	-	-	-	-	97.223	97.298	98.202	98.440	98.541	98.550	-	-
27	-	-	-	-	97.226	97.338	98.215	98.444	98.543	98.550	-	-
28	-	-	-	-	97.236	97.382	98.231	98.448	98.546	98.550	-	-
29	-	-	-	-	97.194	97.512	98.295	98.454	98.549	98.550	-	-
30	-	-	-	-	97.273	97.530	98.471	98.459	98.549	98.550 P	-	-
31	-	-	-	-	97.309	-	98.383	98.462	-	-	-	-
min	**-**	**-**	**-**	**-**	**97.194**	**97.255**	**97.590**	**98.259**	**98.465**	**98.541**	**-**	**-**
mean	**-**	**-**	**-**	**-**	**97.287**	**97.351**	**97.985**	**98.367**	**98.513**	**98.549**	**-**	**-**
max	**-**	**-**	**-**	**-**	**97.455**	**97.530**	**98.471**	**98.462**	**98.549**	**98.550**	**-**	**-**

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

Table VIII-34 S19 Lowland Tar River Mean Daily Discharges (m^3/s), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	0.030 A	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	0.026 A	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	0.021 A	-	-	-	-	-
9	-	-	-	-	0.031 A	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	0.004 A	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	0.068 A	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	0.024 A	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-
24	-	-	-	-	-	-	-	-	-	-	-	-
25	-	-	-	-	-	-	-	-	-	-	-	-
26	-	-	-	-	-	-	-	-	-	-	-	-
27	-	-	-	-	-	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-	-	-	0.003 A	-	-
31	-	-	-	-	-	-	-	-	-	-	-	-
min	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
mean	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
max	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Notes: P - partial daily average.
B - ice effects.
A - manual measurement.

Table VIII-35 S19 Lowland Tar River Mean Daily Water Levels (m) Based on Temporary Benchmark el. 100.000 m, 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	99.442 A	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	99.482 A	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	99.386 A	-	-	-	-	-
9	-	-	-	-	99.390 A	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	99.367 A	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	99.424 A	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	99.369 A	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-
24	-	-	-	-	-	-	-	-	-	-	-	-
25	-	-	-	-	-	-	-	-	-	-	-	-
26	-	-	-	-	-	-	-	-	-	-	-	-
27	-	-	-	-	-	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-	-	-	99.361 A	-	-
31	-	-	-	-	-	-	-	-	-	-	-	-
min	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
mean	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
max	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Notes: P - partial daily average.
B - ice effects.
A - manual measurement.

Table VIII-36 S20 Upland Muskeg River Mean Daily Discharges (m^3/s), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	0.815	1.480	0.226	-	-	-	-
2	-	-	-	-	-	0.860	1.545	0.250	-	-	-	-
3	-	-	-	-	-	0.866	1.442	0.244	-	-	-	-
4	-	-	-	-	-	0.834	1.263	0.250	-	-	-	-
5	-	-	-	-	-	0.757	1.190	0.441	-	-	-	-
6	-	-	-	-	-	0.648	1.015	0.368	-	-	-	-
7	-	-	-	-	-	0.585	0.866	0.407	-	-	-	-
8	-	-	-	-	-	0.523	0.736	0.586	-	-	-	-
9	-	-	-	-	1.652 P	0.554	0.584	0.636	-	-	-	-
10	-	-	-	-	1.689	0.604	0.499	0.669	-	-	-	-
11	-	-	-	-	1.620	0.755	0.493	0.647	-	-	-	-
12	-	-	-	-	1.586	0.816	0.544	0.579	-	-	-	-
13	-	-	-	-	1.480	1.005	0.481	0.516	-	-	-	-
14	-	-	-	-	1.342	0.924	0.462	0.480	-	-	-	-
15	-	-	-	-	1.276	0.832	0.434	0.431	-	-	-	-
16	-	-	-	-	1.228	0.755	0.439	0.388	-	-	-	-
17	-	-	-	-	1.122	0.687	0.625	0.334	-	-	-	-
18	-	-	-	-	1.064	0.613	0.699	0.279	-	-	-	-
19	-	-	-	-	1.036	0.556	0.638	0.283	-	-	-	-
20	-	-	-	-	0.970	0.461	0.531	0.285	-	-	-	-
21	-	-	-	-	0.905	0.383	0.444	0.249	-	-	-	-
22	-	-	-	-	0.829	0.332	0.363	0.204	-	-	-	-
23	-	-	-	-	0.766	0.367	0.282	0.207	-	-	-	-
24	-	-	-	-	0.732	0.429	0.234	0.235	-	-	-	-
25	-	-	-	-	0.741	0.486	0.203	0.206	-	-	-	-
26	-	-	-	-	0.761	0.516	0.185	0.189	-	-	-	-
27	-	-	-	-	0.789	0.506	0.166	0.203	-	-	-	-
28	-	-	-	-	0.775	0.606	0.153	0.190	-	-	-	-
29	-	-	-	-	0.746	0.935	0.201	0.266	-	-	-	-
30	-	-	-	-	0.803	1.180	0.239	-	-	-	-	-
31	-	-	-	-	0.817	-	0.214	-	-	-	-	-
min	**-**	**-**	**-**	**-**	**0.732**	**0.332**	**0.153**	**0.189**	**-**	**-**	**-**	**-**
mean	**-**	**-**	**-**	**-**	**1.075**	**0.673**	**0.602**	**0.353**	**-**	**-**	**-**	**-**
max	**-**	**-**	**-**	**-**	**1.689**	**1.180**	**1.545**	**0.669**	**-**	**-**	**-**	**-**

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

Table VIII-37 S20 Upland Muskeg River Mean Daily Water Levels (m) Based on Temporary Benchmark el. 100.000 m, 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	98.224	98.387	98.011	98.096	99.773	-	-
2	-	-	-	-	-	98.236	98.401	98.022	98.119	99.780	-	-
3	-	-	-	-	-	98.238	98.378	98.019	98.184	99.786	-	-
4	-	-	-	-	-	98.229	98.338	98.021	98.293	99.778	-	-
5	-	-	-	-	-	98.207	98.321	98.103	98.347	99.783	-	-
6	-	-	-	-	-	98.174	98.278	98.074	98.381	99.800	-	-
7	-	-	-	-	-	98.154	98.238	98.089	98.400	99.822	-	-
8	-	-	-	-	-	98.133	98.201	98.154	98.401	99.840	-	-
9	-	-	-	-	98.423 P	98.143	98.153	98.170	98.409	99.863	-	-
10	-	-	-	-	98.431	98.159	98.124	98.180	98.425	99.894	-	-
11	-	-	-	-	98.416	98.206	98.122	98.174	98.457	99.926	-	-
12	-	-	-	-	98.409	98.223	98.139	98.152	98.495	99.920	-	-
13	-	-	-	-	98.387	98.275	98.118	98.130	98.519	99.943	-	-
14	-	-	-	-	98.356	98.254	98.111	98.117	98.524	99.943	-	-
15	-	-	-	-	98.341	98.228	98.100	98.099	98.554	99.946	-	-
16	-	-	-	-	98.330	98.206	98.102	98.083	98.581	99.946	-	-
17	-	-	-	-	98.304	98.186	98.166	98.060	98.580	99.958	-	-
18	-	-	-	-	98.290	98.162	98.190	98.036	98.617	99.971	-	-
19	-	-	-	-	98.283	98.144	98.171	98.038	99.066	99.976	-	-
20	-	-	-	-	98.266	98.110	98.135	98.039	99.423	99.975 P	-	-
21	-	-	-	-	98.249	98.080	98.104	98.022	99.479	-	-	-
22	-	-	-	-	98.228	98.059	98.072	97.999	99.524	-	-	-
23	-	-	-	-	98.209	98.074	98.037	98.000	99.568	-	-	-
24	-	-	-	-	98.200	98.098	98.014	98.015	99.593	-	-	-
25	-	-	-	-	98.202	98.119	97.998	98.000	99.630	-	-	-
26	-	-	-	-	98.208	98.130	97.988	97.991	99.674	-	-	-
27	-	-	-	-	98.216	98.127	97.978	97.998	99.715	-	-	-
28	-	-	-	-	98.212	98.159	97.970	97.991	99.721	-	-	-
29	-	-	-	-	98.204	98.257	97.997	98.030	99.735	-	-	-
30	-	-	-	-	98.220	98.318	98.017	98.061	99.754	-	-	-
31	-	-	-	-	98.224	-	98.004	98.072	-	-	-	-
min	**-**	**-**	**-**	**-**	**98.200**	**98.059**	**97.970**	**97.991**	**98.096**	**99.773**	**-**	**-**
mean	**-**	**-**	**-**	**-**	**98.287**	**98.177**	**98.140**	**98.063**	**98.875**	**99.881**	**-**	**-**
max	**-**	**-**	**-**	**-**	**98.431**	**98.318**	**98.401**	**98.180**	**99.754**	**99.976**	**-**	**-**

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

Table VIII-38 S21 Shelley Creek Mean Daily Discharges (m^3/s), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	0.018 A	-	-	-	-
10	-	-	-	-	-	-	0.092 A	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	0.061 A	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	0.051 A	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	0.000 A	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-	-	-
23	-	-	-	-	-	-	-	-	-	-	-	-
24	-	-	-	-	-	-	-	-	-	-	-	-
25	-	-	-	-	-	-	-	-	-	-	-	-
26	-	-	-	-	-	-	-	-	-	0.000 A	-	-
27	-	-	-	-	-	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-	-	-	-	-	-
29	-	-	-	-	-	-	-	-	-	-	-	-
30	-	-	-	-	-	-	-	-	-	-	-	-
31	-	-	-	-	-	-	-	-	-	-	-	-
min	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
mean	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
max	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Notes: P - partial daily average.
B - ice effects.
A - manual measurement.

Table VIII-39 S21 Shelley Creek Mean Daily Water Levels (m) Based on Temporary Benchmark el. 100.000 m, 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	99.656	99.664	99.554	99.500	99.376	-	-
2	-	-	-	-	-	99.653	99.659	99.543	99.492	99.371	-	-
3	-	-	-	-	-	99.647	99.654	99.531	99.480	99.365	-	-
4	-	-	-	-	-	99.642	99.650	99.516	99.466	99.358	-	-
5	-	-	-	-	-	99.637	99.659	99.503	99.457	99.354	-	-
6	-	-	-	-	-	99.631	99.654	99.483	99.459	99.351	-	-
7	-	-	-	-	-	99.623	99.649	99.465	99.468	99.348	-	-
8	-	-	-	-	-	99.614	99.642	99.467	99.494	99.344	-	-
9	-	-	-	-	-	99.611	99.628	99.470	99.500	99.339	-	-
10	-	-	-	-	-	99.637	99.623	99.466	99.499	99.336	-	-
11	-	-	-	-	-	99.655	99.616	99.457	99.501	99.341	-	-
12	-	-	-	-	-	99.654	99.609	99.444	99.498	99.354	-	-
13	-	-	-	-	-	99.653	99.593	99.432	99.491	99.358	-	-
14	-	-	-	-	99.650 P	99.651	99.575	99.422	99.483	99.360	-	-
15	-	-	-	-	99.650	99.650	99.562	99.411	99.473	99.361	-	-
16	-	-	-	-	99.651	99.664	99.542	99.398	99.463	99.361	-	-
17	-	-	-	-	99.651	99.673	99.549	99.384	99.453	99.364	-	-
18	-	-	-	-	99.650	99.678	99.578	99.370	99.443	99.357	-	-
19	-	-	-	-	99.648	99.679	99.580	99.394	99.443	99.348	-	-
20	-	-	-	-	99.646	99.678	99.566	99.439	99.440	99.340	-	-
21	-	-	-	-	99.643	99.674	99.546	99.503	99.436	99.331	-	-
22	-	-	-	-	99.640	99.674	99.526	99.522	99.430	99.324	-	-
23	-	-	-	-	99.638	99.678	99.498	99.525	99.425	99.318	-	-
24	-	-	-	-	99.636	99.677	99.472	99.564	99.419	99.309	-	-
25	-	-	-	-	99.635	99.674	99.450	99.568	99.414	99.301	-	-
26	-	-	-	-	99.645	99.670	99.441	99.558	99.409	99.295 P	-	-
27	-	-	-	-	99.648	99.665	99.441	99.546	99.403	-	-	-
28	-	-	-	-	99.644	99.674	99.445	99.535	99.395	-	-	-
29	-	-	-	-	99.640	99.680	99.490	99.528	99.389	-	-	-
30	-	-	-	-	99.652	99.669	99.543	99.520	99.383	-	-	-
31	-	-	-	-	99.660	-	99.559	99.510	-	-	-	-
min	**-**	**-**	**-**	**-**	**99.635**	**99.611**	**99.441**	**99.370**	**99.383**	**99.295**	**-**	**-**
mean	**-**	**-**	**-**	**-**	**99.646**	**99.657**	**99.570**	**99.485**	**99.454**	**99.345**	**-**	**-**
max	**-**	**-**	**-**	**-**	**99.660**	**99.680**	**99.664**	**99.568**	**99.501**	**99.376**	**-**	**-**

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

Table VIII-40 S22 Muskeg Creek Mean Daily Discharges (m^3/s), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	2.850	3.230	0.176	0.378	0.229	-	-
2	-	-	-	-	-	2.707	3.057	0.153	0.426	0.200	-	-
3	-	-	-	-	-	2.465	2.700	0.129	0.340	0.188	-	-
4	-	-	-	-	-	2.179	2.375	0.171	0.292	0.183	-	-
5	-	-	-	-	-	1.900	2.308	0.232	0.300	0.182	-	-
6	-	-	-	-	-	1.676	2.015	0.231	0.347	0.169	-	-
7	-	-	-	-	-	1.498	1.703	0.259	0.395	0.164	-	-
8	-	-	-	-	-	1.309	1.405	0.402	0.392	0.173	-	-
9	-	-	-	-	-	1.193	1.125	0.511	0.358	0.161	-	-
10	-	-	-	-	-	1.385	0.965	0.603	0.298	0.149	-	-
11	-	-	-	-	-	2.245	0.860	0.573	0.300	0.166	-	-
12	-	-	-	-	-	3.169	0.831	0.517	0.240	0.233	-	-
13	-	-	-	-	-	5.810	0.649	0.490	0.223	0.269	-	-
14	-	-	-	-	-	6.823	0.563	0.473	0.211	0.245	-	-
15	-	-	-	-	-	6.830	0.517	0.419	0.181	0.209	-	-
16	-	-	-	-	3.028 P	6.358	0.447	0.366	0.183	0.189	-	-
17	-	-	-	-	2.859	5.732	0.522	0.287	0.184	0.176	-	-
18	-	-	-	-	2.660	5.067	0.507	0.183	0.196	0.171	-	-
19	-	-	-	-	2.514	4.289	0.427	0.304	0.220	0.147	-	-
20	-	-	-	-	2.413	3.640	0.370	0.479	0.246	0.119	-	-
21	-	-	-	-	2.286	3.061	0.297	0.562	0.238	0.107	-	-
22	-	-	-	-	2.116	2.597	0.228	0.559	0.262	0.098	-	-
23	-	-	-	-	1.962	2.482	0.191	0.676	0.273	0.086	-	-
24	-	-	-	-	1.825	2.365	0.136 P	1.238	0.280	0.073	-	-
25	-	-	-	-	1.760	2.359	-	1.016	0.290	0.064	-	-
26	-	-	-	-	2.099	2.188	-	0.796	0.252	0.062	-	-
27	-	-	-	-	2.147	1.976	-	0.693	0.278	0.068 P	-	-
28	-	-	-	-	1.952	2.200	-	0.618	0.249	-	-	-
29	-	-	-	-	1.737	2.992	0.156 P	0.579	0.214	-	-	-
30	-	-	-	-	2.228	3.215	0.209	0.533	0.213	-	-	-
31	-	-	-	-	2.820	-	0.190	0.465	-	-	-	-
min	**-**	**-**	**-**	**-**	**1.737**	**1.193**	**0.136**	**0.129**	**0.181**	**0.062**	**-**	**-**
mean	**-**	**-**	**-**	**-**	**2.275**	**3.152**	**1.036**	**0.474**	**0.275**	**0.159**	**-**	**-**
max	**-**	**-**	**-**	**-**	**3.028**	**6.830**	**3.230**	**1.238**	**0.426**	**0.269**	**-**	**-**

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

Table VIII-41 S22 Muskeg Creek Mean Daily Water Levels (m) Based on Temporary Benchmark el. 99.061 m, 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	96.545	96.576	96.096	96.182	96.123	-	-
2	-	-	-	-	-	96.532	96.562	96.083	96.197	96.109	-	-
3	-	-	-	-	-	96.510	96.532	96.067	96.169	96.103	-	-
4	-	-	-	-	-	96.481	96.501	96.093	96.151	96.100	-	-
5	-	-	-	-	-	96.451	96.495	96.125	96.153	96.100	-	-
6	-	-	-	-	-	96.425	96.464	96.124	96.171	96.093	-	-
7	-	-	-	-	-	96.402	96.428	96.136	96.187	96.090	-	-
8	-	-	-	-	-	96.376	96.389	96.189	96.187	96.095	-	-
9	-	-	-	-	-	96.358	96.348	96.221	96.175	96.088	-	-
10	-	-	-	-	-	96.383	96.321	96.246	96.152	96.080	-	-
11	-	-	-	-	-	96.488	96.301	96.238	96.154	96.091	-	-
12	-	-	-	-	-	96.567	96.295	96.224	96.128	96.125	-	-
13	-	-	-	-	-	96.742	96.256	96.216	96.120	96.141	-	-
14	-	-	-	-	-	96.794	96.236	96.211	96.115	96.131	-	-
15	-	-	-	-	-	96.795	96.223	96.195	96.099	96.114	-	-
16	-	-	-	-	96.560 P	96.771	96.203	96.178	96.100	96.103	-	-
17	-	-	-	-	96.546	96.738	96.225	96.148	96.101	96.097	-	-
18	-	-	-	-	96.528	96.701	96.221	96.100	96.107	96.094	-	-
19	-	-	-	-	96.515	96.653	96.198	96.150	96.119	96.079	-	-
20	-	-	-	-	96.505	96.608	96.179	96.212	96.131	96.060	-	-
21	-	-	-	-	96.493	96.563	96.153	96.235	96.127	96.052	-	-
22	-	-	-	-	96.475	96.522	96.123	96.234	96.138	96.045	-	-
23	-	-	-	-	96.458	96.512	96.104	96.258	96.143	96.034	-	-
24	-	-	-	-	96.443	96.500	96.072 P	96.365	96.146	96.021	-	-
25	-	-	-	-	96.435	96.500	-	96.329	96.150	96.012	-	-
26	-	-	-	-	96.472	96.483	-	96.288	96.134	96.010	-	-
27	-	-	-	-	96.478	96.460	-	96.267	96.145	96.017 P	-	-
28	-	-	-	-	96.457	96.483	-	96.249	96.132	-	-	-
29	-	-	-	-	96.432	96.557	96.084 P	96.240	96.116	-	-	-
30	-	-	-	-	96.485	96.575	96.114	96.228	96.116	-	-	-
31	-	-	-	-	96.542	-	96.104	96.209	-	-	-	-
min	**-**	**-**	**-**	**-**	**96.432**	**96.358**	**96.072**	**96.067**	**96.099**	**96.010**	**-**	**-**
mean	**-**	**-**	**-**	**-**	**96.489**	**96.549**	**96.285**	**96.199**	**96.141**	**96.082**	**-**	**-**
max	**-**	**-**	**-**	**-**	**96.560**	**96.795**	**96.576**	**96.365**	**96.197**	**96.141**	**-**	**-**

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

Table VIII-42 S23 Aurora Boundary Weir Mean Daily Discharges (m^3/s), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	0.008	0.030	0.025	0.067	0.147	0.145	0.088	0.081	0.066	0.069	0.044	0.029
2	0.020	0.030	0.026	0.076	0.166	0.123	0.084	0.093	0.060	0.078	0.043	0.029
3	0.007	0.026	0.028	0.085	0.162	0.125	0.076	0.095	0.066	0.069	0.041	0.030
4	0.020	0.024	0.035	0.075	0.155	0.123	0.072	0.096	0.063	0.063	0.042	0.037 P
5	0.014	0.022	0.039	0.084	0.132	0.118	0.084	0.096	0.066	0.063	0.041	0.025 P
6	0.039	0.031	0.040	0.075	0.130	0.127	0.076	0.091	0.065	0.079	0.037	0.025
7	0.050	0.033	0.045	0.063	0.128	0.127	0.068	0.087	0.054	0.072	0.034	0.026
8	0.101	0.044	0.041	0.069	0.141	0.132	0.065	0.077	0.054	0.065	0.037	0.025
9	0.038	0.042	0.046	0.086	0.129	0.122	0.065	0.072	0.064	0.061	0.038	0.023
10	0.025	0.035	0.053	0.123	0.137	0.146	0.063	0.072	0.069	0.058	0.036	0.023
11	0.029	0.039	0.060	0.122	0.122	0.145	0.065	0.071	0.070	0.062	0.036	0.036
12	0.049	0.039	0.054	0.135	0.143	0.132	0.063	0.068	0.067	0.061	0.036	0.026
13	0.051	0.039	0.049	0.131	0.144	0.128	0.061	0.068	0.085	0.061	0.036	0.018
14	0.051	0.025	0.047	0.120	0.110	0.131	0.060	0.069	0.091	0.056	0.040	0.023
15	0.051	0.003	0.049	0.103	0.107	0.126	0.060	0.065	0.088	0.061	0.041	0.023
16	0.047	0.028	0.050	0.120	0.085	0.123	0.059	0.065	0.077	0.051	0.040	0.022
17	0.050	0.131	0.050	0.121	0.090	0.114	0.074	0.063	0.085	0.047	0.040	0.022
18	0.050	0.134	0.052	0.125	0.111	0.110	0.072	0.063	0.088	0.046	0.035	0.018
19	0.050	0.144	0.064	0.159	0.100	0.103	0.068	0.083	0.095	0.050	0.034	0.024
20	0.058	0.119	0.106	0.116	0.125	0.096	0.067	0.077	0.089	0.048	0.032	0.016
21	0.070	0.060	0.080	0.131	0.134	0.094	0.083	0.074	0.084	0.050	0.033	0.018
22	0.052	0.061	0.098	0.144	0.137	0.099	0.089	0.070	0.078	0.043	0.032	0.016
23	0.032	0.057	0.096	0.182	0.138	0.116	0.087	0.073	0.075	0.039	0.035	0.016
24	0.033	0.054	0.172	0.175	0.140	0.110	0.088	0.077	0.074	0.037	0.038	0.015
25	0.068	0.081	0.154	0.171	0.138	0.103	0.090	0.069	0.065	0.039	0.044	0.015
26	0.066	0.083	0.166	0.179	0.144	0.095	0.093	0.068	0.067	0.039	0.030	0.015
27	0.057	0.114	0.163	0.163	0.130	0.089	0.089	0.068	0.061	0.037	0.024	0.015
28	0.065	0.085	0.143	0.161	0.127	0.105	0.089	0.070	0.060	0.037	0.028	0.015
29	0.060	-	0.089	0.141	0.137	0.106	0.126	0.069	0.062	0.040	0.032	0.016
30	0.054	-	0.095	0.165	0.152	0.093	0.105	0.067	0.068	0.043 P	0.030	0.015
31	0.033	-	0.064	-	0.158	-	0.074	0.065	-	0.043	-	0.016
min	0.007	0.003	0.026	0.063	0.085	0.089	0.059	0.063	0.054	0.037	0.024	0.015
mean	0.045	0.058	0.075	0.124	0.132	0.116	0.077	0.075	0.072	0.053	0.036	0.022
max	0.101	0.144	0.172	0.182	0.166	0.146	0.126	0.096	0.095	0.079	0.044	0.037

Notes: P – partial daily average.

Table VIII-43 S23 Aurora Boundary Weir Mean Daily Water Levels (m) Based on Permanent Benchmark el. 293.786 m (geodetic), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	292.232	292.502	292.419	292.496	292.584	292.583	292.524	292.515	292.495	292.499	292.460	292.429
2	292.396	292.486	292.420	292.508	292.600	292.562	292.519	292.530	292.485	292.511 P	292.457	292.428
3	292.298	292.420	292.426	292.520	292.597	292.564	292.509	292.532	292.494	292.499	292.454	292.430
4	292.403	292.415	292.441	292.506	292.590	292.562	292.504	292.533	292.490	292.490	292.456	292.464 P
5	292.383	292.411	292.450	292.478	292.568	292.557	292.519	292.533	292.495	292.489	292.453	292.418 P
6	292.450	292.432	292.452	292.506	292.568	292.565	292.508	292.527	292.494	292.513	292.445	292.418
7	292.464	292.471	292.467	292.490	292.566	292.563	292.498	292.523	292.476	292.504	292.440	292.422
8	292.531	292.491	292.454	292.498	292.578	292.571	292.493	292.510	292.477	292.494	292.446	292.418
9	292.446	292.505	292.462	292.518	292.567	292.561	292.494	292.503	292.492	292.488	292.449	292.412
10	292.415	292.449	292.475	292.561	292.575	292.583	292.490	292.504	292.499	292.484	292.444	292.413
11	292.425	292.617	292.486	292.560	292.560	292.583	292.493	292.501	292.500	292.489	292.443	292.510
12	292.468	292.551	292.477	292.572	292.581	292.570	292.491	292.498	292.497	292.487	292.443	292.448
13	292.539	292.742	292.468	292.569	292.582	292.567	292.487	292.497	292.520	292.488	292.444	292.398
14	292.639	292.566	292.465	292.558	292.548	292.570	292.486	292.499	292.528	292.480	292.452	292.413
15	292.685	292.055	292.468	292.540	292.545	292.565	292.486	292.493	292.523	292.487	292.453	292.414
16	292.474	292.186	292.470	292.556	292.519	292.563	292.484	292.494	292.510	292.472	292.451	292.410
17	292.469	292.568	292.470	292.560	292.526	292.553	292.506	292.491	292.521	292.464	292.451	292.410
18	292.470	292.622	292.478	292.563	292.550	292.548	292.504	292.491	292.523	292.463	292.441	292.400
19	292.470	292.596	292.560	292.594	292.537	292.541	292.497	292.517	292.532	292.470	292.439	292.421
20	292.492	292.623	292.665	292.552	292.564	292.533	292.497	292.510	292.525	292.467	292.435	292.393
21	292.498	292.485	292.517	292.570	292.572	292.531	292.517	292.506	292.519	292.470	292.437	292.397
22	292.468	292.488	292.572	292.581	292.576	292.537	292.525	292.500	292.511	292.457	292.436	292.393
23	292.433	292.515	292.594	292.614	292.576	292.555	292.522	292.504	292.507	292.449	292.442	292.390
24	292.436	292.588	292.670	292.608	292.578	292.549	292.523	292.509	292.506	292.446	292.447	292.390
25	292.518	292.585	292.591	292.605	292.577	292.541	292.526	292.498	292.493	292.450	292.460	292.389
26	292.493	292.664	292.601	292.611	292.582	292.532	292.529	292.497	292.496	292.449	292.429	292.388
27	292.481	292.553	292.598	292.597	292.569	292.526	292.525	292.497	292.487	292.446	292.416	292.390
28	292.494	292.520	292.580	292.597	292.566	292.543	292.525	292.500	292.487	292.446	292.427	292.389
29	292.495	-	292.524	292.579	292.576	292.545	292.565	292.499	292.488	292.452	292.435	292.391
30	292.477	-	292.532	292.599	292.589	292.530	292.543	292.496	292.498	292.458	292.432	292.389
31	292.434	-	292.492	-	292.594	-	292.506	292.493	-	292.457	-	292.391
min	292.232	292.055	292.420	292.478	292.519	292.526	292.484	292.491	292.476	292.446	292.416	292.388
mean	292.464	292.504	292.511	292.557	292.569	292.554	292.509	292.506	292.503	292.474	292.443	292.412
max	292.685	292.742	292.670	292.614	292.600	292.583	292.565	292.533	292.532	292.513	292.460	292.510

Notes: P - partial daily average.

Table VIII-44 S24 Athabasca River Mean Daily Discharges (m^3/s), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	-	1190	2626	492	358	287	139
2	-	-	-	-	-	-	1196	2804	476	351	293	139
3	-	-	-	-	-	-	1190	3091	456	351	292	137
4	-	-	-	-	-	-	1175	2829	442	359	282	139
5	-	-	-	-	-	-	1127	2440	436	364	277	138
6	-	-	-	-	-	-	1107	2119	436	378	277	136
7	-	-	-	-	-	-	1093	1848	435	380	272	142
8	-	-	-	-	-	-	1054	1621	429	365	274	148
9	-	-	-	-	-	-	996	1456	432	350	274	148
10	-	-	-	-	-	-	934	1365	441	342	273	148
11	-	-	-	-	-	-	880	1280	430	339	234	148
12	-	-	-	-	-	-	869	1173	413	337	185	149
13	-	-	-	-	-	-	849	1104	402	332	166	146
14	-	-	-	-	-	-	790	1036	393	328	154	142
15	-	-	-	-	-	-	735	952	384	325	149	139
16	-	-	-	-	-	-	726	876	383	322	160	137
17	-	-	-	-	-	-	738	811	378	319	159	135
18	-	-	-	-	-	-	771	757	375	319	160	134
19	-	-	-	-	-	-	816	726	380	316	152	138
20	-	-	-	-	-	-	813	702	380	314	150	146
21	-	-	-	-	-	756 P	804	713	375	310	149	152
22	-	-	-	-	-	779	816	703	370	303	144	153
23	-	-	-	-	-	803	1025	676	365	297	146	151
24	-	-	-	-	-	821	1590	656	363	299	156	149
25	-	-	-	-	-	835	1785	640	366	295	155	147
26	-	-	-	-	-	826	1919	623	371	292	150	145
27	-	-	-	-	-	804	1847	594	375	298	143	145
28	-	-	-	-	-	844	1755	559	376	296	137	144
29	-	-	-	-	-	991	2469	527	376	285	130	141
30	-	-	-	-	-	1127	3122	508	367	279	130	139
31	-	-	-	-	-	-	2966	496	-	279	-	138
min	**-**	**-**	**-**	**-**	**-**	**756**	**726**	**496**	**363**	**279**	**130**	**134**
mean	**-**	**-**	**-**	**-**	**-**	**859**	**1263**	**1236**	**403**	**325**	**197**	**143**
max	**-**	**-**	**-**	**-**	**-**	**1127**	**3122**	**3091**	**492**	**380**	**293**	**153**

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

Table VIII-45 S24 Athabasca River Mean Daily Water Levels (m) Based on Permanent Benchmark el. 100.000 m, 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	-	96.353	97.913	95.093	94.735	94.511	94.555
2	-	-	-	-	-	-	96.362	98.064	95.054	94.714	94.530	94.559
3	-	-	-	-	-	-	96.354	98.299	95.004	94.714	94.528	94.549
4	-	-	-	-	-	-	96.331	98.085	94.967	94.737	94.493	94.559
5	-	-	-	-	-	-	96.262	97.746	94.951	94.752	94.474	94.557
6	-	-	-	-	-	-	96.234	97.442	94.950	94.793	94.477 P	94.546
7	-	-	-	-	-	-	96.212	97.161	94.948	94.798	94.460	94.581
8	-	-	-	-	-	-	96.153	96.906	94.934	94.754	94.466	94.619
9	-	-	-	-	-	-	96.064	96.707	94.941	94.712	94.465	94.622
10	-	-	-	-	-	-	95.964	96.591	94.964	94.687	94.476	94.623
11	-	-	-	-	-	-	95.874	96.477	94.936	94.677	94.565	94.627
12	-	-	-	-	-	-	95.854	96.328	94.889	94.671	94.690	94.632
13	-	-	-	-	-	-	95.820	96.228	94.859	94.656	94.685	94.616
14	-	-	-	-	-	-	95.714	96.126	94.813	94.642	94.621	94.592
15	-	-	-	-	-	-	95.613	95.992	94.809	94.633	94.592	94.578
16	-	-	-	-	-	-	95.595	95.866	94.806	94.623	94.657	94.566
17	-	-	-	-	-	-	95.619	95.753	94.794	94.615	94.650	94.553
18	-	-	-	-	-	-	95.679	95.653	94.784	94.614	94.658	94.553
19	-	-	-	-	-	-	95.761	95.595	94.798	94.605	94.615	94.576
20	-	-	-	-	-	-	95.756	95.550	94.798	94.600	94.603	94.624
21	-	-	-	-	-	95.652 P	95.740	95.570	94.784	94.587	94.600	94.659
22	-	-	-	-	-	95.694	95.761	95.550	94.770	94.562	94.574	94.665
23	-	-	-	-	-	95.739	96.101	95.497	94.755	94.544	94.585	94.656
24	-	-	-	-	-	95.771	96.867	95.457	94.749	94.549	94.646	94.647
25	-	-	-	-	-	95.796	97.093	95.424	94.759	94.536	94.639	94.638
26	-	-	-	-	-	95.779	97.237	95.388	94.772	94.527	94.616	94.629
27	-	-	-	-	-	95.739	97.160	95.326	94.783	94.548	94.573	94.629
28	-	-	-	-	-	95.811	97.059	95.249	94.788	94.542	94.541	94.624
29	-	-	-	-	-	96.054	97.762	95.177	94.787	94.504	94.500	94.608
30	-	-	-	-	-	96.262	98.323	95.131	94.762	94.484	94.498	94.600
31	-	-	-	-	-	-	98.198	95.102	-	94.484	-	94.591
min	**-**	**-**	**-**	**-**	**-**	**95.652**	**95.595**	**95.102**	**94.749**	**94.484**	**94.460**	**94.546**
mean	**-**	**-**	**-**	**-**	**-**	**95.830**	**96.351**	**96.237**	**94.860**	**94.632**	**94.566**	**94.601**
max	**-**	**-**	**-**	**-**	**-**	**96.262**	**98.323**	**98.299**	**95.093**	**94.798**	**94.690**	**94.665**

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

Table VIII-46 S28 Khahago Creek Mean Daily Discharges (m^3/s), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	-	0.287	0.102	0.072	0.064	0.059 A	-
2	-	-	-	-	-	-	0.421	0.103	0.072	0.064	-	-
3	-	-	-	-	-	-	0.426	0.112	0.068	0.063	-	-
4	-	-	-	-	-	-	0.409	0.112	0.066	0.061	-	-
5	-	-	-	-	-	-	0.375	0.115	0.066	0.061	-	-
6	-	-	-	-	-	-	0.325	0.119	0.065	0.060	-	-
7	-	-	-	-	-	-	0.282	0.115	0.063	0.059	-	-
8	-	-	-	-	-	-	0.266	0.127	0.063	0.057	-	-
9	-	-	-	-	-	-	0.234	0.129	0.061	0.056	-	-
10	-	-	-	-	-	-	0.204	0.125	0.059	0.056	-	-
11	-	-	-	-	-	-	0.184	0.120	0.059	0.057	-	-
12	-	-	-	-	-	0.787 P	0.169	0.114	0.061	0.058	-	-
13	-	-	-	-	-	-	0.164	0.109	0.063	0.057	-	-
14	-	-	-	-	0.004 P	-	0.157	0.108	0.062	0.057	-	-
15	-	-	-	-	-	-	0.159	0.102	0.065	0.056	-	-
16	-	-	-	-	-	-	0.156	0.095	0.061	0.057	-	-
17	-	-	-	-	-	0.004 P	0.133	0.092	0.062	0.057	-	-
18	-	-	-	-	-	0.787	0.134	0.088	0.064	0.056	-	-
19	-	-	-	-	-	0.000	0.131	0.090	0.065	0.055	-	-
20	-	-	-	-	-	0.659	0.124	0.097	0.066	0.054	-	-
21	-	-	-	-	-	0.577	0.115	0.102	0.066	0.053	-	-
22	-	-	-	-	-	0.482	0.110	0.098	0.065	0.053	-	-
23	-	-	-	-	-	0.409	0.105	0.099	0.066	0.052	-	-
24	-	-	-	-	-	0.342	0.099	0.097	0.066	0.050	-	-
25	-	-	-	-	-	0.293	0.092	0.094	0.066	0.049 P	-	-
26	-	-	-	-	-	0.295	0.089	0.089	0.066	-	-	-
27	-	-	-	-	-	0.306	0.090	0.083	0.065	-	-	-
28	-	-	-	-	-	0.301	0.088	0.080	0.063	-	-	-
29	-	-	-	-	-	0.276	0.093	0.079	0.064	-	-	-
30	-	-	-	-	-	0.249	0.102	0.077	0.064	-	-	-
31	-	-	-	-	-	-	0.102	0.074	-	-	-	-
min	**-**	**-**	**-**	**-**	**-**	**0.000**	**0.088**	**0.074**	**0.059**	**0.049**	**-**	**-**
mean	**-**	**-**	**-**	**-**	**-**	**0.385**	**0.188**	**0.102**	**0.064**	**0.057**	**-**	**-**
max	**-**	**-**	**-**	**-**	**-**	**0.787**	**0.426**	**0.129**	**0.072**	**0.064**	**-**	**-**

Notes: P - partial daily average.
B - ice effects.
A - manual measurement.

Table VIII-47 S28 Khahago Creek Mean Daily Water Levels (m) Based on Permanent Benchmark el. 100.000m (geodetic), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	-	99.232	99.022	98.961	98.939	-	-
2	-	-	-	-	-	-	99.323	99.025	98.959	98.940	-	-
3	-	-	-	-	-	-	99.326	99.040	98.950	98.937	-	-
4	-	-	-	-	-	-	99.316	99.041	98.946	98.932	-	-
5	-	-	-	-	-	-	99.296	99.044	98.944	98.930	-	-
6	-	-	-	-	-	-	99.263	99.051	98.942	98.928	-	-
7	-	-	-	-	-	-	99.231	99.046	98.937	98.924	-	-
8	-	-	-	-	-	-	99.217	99.064	98.936	98.919	-	-
9	-	-	-	-	-	-	99.189	99.068	98.932	98.917	-	-
10	-	-	-	-	-	-	99.160	99.062	98.925	98.918	-	-
11	-	-	-	-	-	-	99.139	99.053	98.926	98.919	-	-
12	-	-	-	-	-	1.483 P	99.121	99.044	98.931	98.923	-	-
13	-	-	-	-	-	-	99.115	99.036	98.937	98.920	-	-
14	-	-	-	-	0.556 P	-	99.106	99.033	98.934	98.918	-	-
15	-	-	-	-	-	-	99.108	99.023	98.941	98.917	-	-
16	-	-	-	-	-	-	99.105	99.009	98.930	98.919	-	-
17	-	-	-	-	-	0.556 P	99.073	99.003	98.934	98.921	-	-
18	-	-	-	-	-	1.483	99.075	98.996	98.939	98.918	-	-
19	-	-	-	-	-	0.000	99.071	98.999	98.943	98.914	-	-
20	-	-	-	-	-	99.436	99.059	99.014	98.946	98.910	-	-
21	-	-	-	-	-	99.401	99.045	99.022	98.946	98.908	-	-
22	-	-	-	-	-	99.356	99.037	99.016	98.943	98.907	-	-
23	-	-	-	-	-	99.316	99.028	99.016	98.944	98.905	-	-
24	-	-	-	-	-	99.274	99.016	99.013	98.945	98.898	-	-
25	-	-	-	-	-	99.239	99.003	99.008	98.945	98.894 P	-	-
26	-	-	-	-	-	99.241	98.998	98.998	98.945	-	-	-
27	-	-	-	-	-	99.249	98.999	98.986	98.941	-	-	-
28	-	-	-	-	-	99.245	98.995	98.979	98.937	-	-	-
29	-	-	-	-	-	99.225	99.006	98.976	98.940	-	-	-
30	-	-	-	-	-	99.203	99.022	98.971	98.940	-	-	-
31	-	-	-	-	-	-	99.023	98.965	-	-	-	-
min	**-**	**-**	**-**	**-**	**-**	**0.000**	**98.995**	**98.965**	**98.925**	**98.894**	**-**	**-**
mean	**-**	**-**	**-**	**-**	**-**	**73.047**	**99.119**	**99.020**	**98.941**	**98.919**	**-**	**-**
max	**-**	**-**	**-**	**-**	**-**	**99.436**	**99.326**	**99.068**	**98.961**	**98.940**	**-**	**-**

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

Table VIII-48 L1 McClelland Lake Mean Daily Discharges (m^3/s), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	-	-	0.048	0.031	0.013	-	-
2	-	-	-	-	-	-	-	0.047	0.033	0.013	-	-
3	-	-	-	-	-	-	-	0.046	0.032	0.013	-	-
4	-	-	-	-	-	-	-	0.045	0.029	0.011	-	-
5	-	-	-	-	-	-	-	0.038	0.026	0.010	-	-
6	-	-	-	-	-	-	-	0.039	0.028	0.010	-	-
7	-	-	-	-	-	-	-	0.036	0.027	0.010	-	-
8	-	-	-	-	-	-	-	0.033	0.027	0.010	-	-
9	-	-	-	-	-	-	-	0.033	0.026	0.011	-	-
10	-	-	-	-	-	-	0.041 P	0.031	0.027	0.010	-	-
11	-	-	-	-	-	-	0.060	0.032	0.026	0.009	-	-
12	-	-	-	-	-	-	0.043	0.032	0.025	0.011	-	-
13	-	-	-	-	-	-	0.036	0.032	0.023	0.012	-	-
14	-	-	-	-	0.095 P	-	0.040	0.035	0.023	0.012	-	-
15	-	-	-	-	-	-	0.044	0.036	0.018	0.011	-	-
16	-	-	-	-	-	-	0.048	0.035	0.016	0.010	-	-
17	-	-	-	-	-	-	0.049	0.036	0.015	0.011	-	-
18	-	-	-	-	-	-	0.046	0.034	0.014	0.010	-	-
19	-	-	-	-	-	-	0.048	0.040	0.017	0.011	-	-
20	-	-	-	-	-	-	0.050	0.044	0.017	0.011	-	-
21	-	-	-	-	-	-	0.051	0.039	0.016	0.010	-	-
22	-	-	-	-	-	-	0.052	0.036	0.015	0.010	-	-
23	-	-	-	-	-	-	0.051	0.034	0.014	0.010	-	-
24	-	-	-	-	-	-	0.048	0.031	0.013	0.011	-	-
25	-	-	-	-	-	-	0.049	0.033	0.014	0.011	-	-
26	-	-	-	-	-	-	0.047	0.030	0.013	0.010 P	-	-
27	-	-	-	-	-	-	0.044	0.029	0.016	-	-	-
28	-	-	-	-	-	-	0.043	0.031	0.013	-	-	-
29	-	-	-	-	-	-	0.054	0.033	0.013	-	-	-
30	-	-	-	-	-	-	0.053	0.031	0.015	-	-	-
31	-	-	-	-	-	-	0.050	0.029	-	-	-	-
min	**-**	**-**	**-**	**-**	**-**	**-**	**0.036**	**0.029**	**0.013**	**0.009**	**-**	**-**
mean	**-**	**-**	**-**	**-**	**-**	**-**	**0.048**	**0.036**	**0.020**	**0.011**	**-**	**-**
max	**-**	**-**	**-**	**-**	**-**	**-**	**0.060**	**0.048**	**0.033**	**0.013**	**-**	**-**

Notes: P - partial daily average.

Table VIII-49 L1 McClelland Lake Mean Daily Water Levels (m) Based on Permanent Benchmark el. 295.840 m (geodetic), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	-	-	294.536	294.487	294.403	-	-
2	-	-	-	-	-	-	-	294.534	294.494	294.399	-	-
3	-	-	-	-	-	-	-	294.530	294.490	294.402	-	-
4	-	-	-	-	-	-	-	294.529	294.478	294.389	-	-
5	-	-	-	-	-	-	-	294.510	294.470	294.380	-	-
6	-	-	-	-	-	-	-	294.513	294.477	294.380	-	-
7	-	-	-	-	-	-	-	294.504	294.473	294.379	-	-
8	-	-	-	-	-	-	-	294.493	294.473	294.377	-	-
9	-	-	-	-	-	-	-	294.495	294.468	294.385	-	-
10	-	-	-	-	-	-	294.519	294.488	294.471	294.376	-	-
11	-	-	-	-	-	-	294.564	294.489	294.467	294.370	-	-
12	-	-	-	-	-	-	294.522	294.490	294.466	294.386	-	-
13	-	-	-	-	-	-	294.502	294.490	294.457	294.395	-	-
14	-	-	-	-	294.624 P	-	294.516	294.501	294.454	294.397	-	-
15	-	-	-	-	-	-	294.525	294.503	294.431	294.388	-	-
16	-	-	-	-	-	-	294.536	294.500	294.418	294.376	-	-
17	-	-	-	-	-	-	294.540	294.503	294.413	294.385	-	-
18	-	-	-	-	-	-	294.531	294.495	294.409	294.378	-	-
19	-	-	-	-	-	-	294.537	294.516	294.428	294.385	-	-
20	-	-	-	-	-	-	294.541	294.527	294.426	294.384	-	-
21	-	-	-	-	-	-	294.543	294.512	294.423	294.383	-	-
22	-	-	-	-	-	-	294.545	294.505	294.413	294.381	-	-
23	-	-	-	-	-	-	294.543	294.496	294.405	294.382	-	-
24	-	-	-	-	-	-	294.536	294.486	294.402	294.384	-	-
25	-	-	-	-	-	-	294.538	294.494	294.407	294.386	-	-
26	-	-	-	-	-	-	294.535	294.483	294.402	294.379	-	-
27	-	-	-	-	-	-	294.526	294.480	294.420	-	-	-
28	-	-	-	-	-	-	294.524	294.486	294.404	-	-	-
29	-	-	-	-	-	-	294.552	294.494	294.399	-	-	-
30	-	-	-	-	-	-	294.549	294.487	294.417	-	-	-
31	-	-	-	-	-	-	294.542	294.481	-	-	-	-
min	**-**	**-**	**-**	**-**	**-**	**--**	**294.502**	**294.480**	**294.399**	**294.370**	**-**	**-**
mean	**-**	**-**	**-**	**-**	**-**	**-**	**294.535**	**294.502**	**294.440**	**294.385**	**-**	**-**
max	**-**	**-**	**-**	**-**	**-**	**-**	**294.564**	**294.536**	**294.494**	**294.403**	**-**	**-**

Notes: P - partial daily average.

Table VIII-50 L2 Kearl Lake Mean Daily Water Levels (m) Based on Permanent Benchmark el. 333.410 m (geodetic), 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	-	-	-	-	-	-	-	-	332.148	-	-	-
2	-	-	-	-	-	-	-	-	332.154	-	-	-
3	-	-	-	-	-	-	-	-	332.147	-	-	-
4	-	-	-	-	-	-	-	-	332.144	-	-	-
5	-	-	-	-	-	-	-	-	332.144	-	-	-
6	-	-	-	-	-	-	-	332.121 P	332.145	-	-	332.145 P
7	-	-	-	-	-	-	-	332.122	332.150	-	-	332.146
8	-	-	-	-	-	-	332.122 A	332.130	332.149	-	-	332.147
9	-	-	-	-	-	-	-	332.136	332.148	-	-	332.147
10	-	-	-	-	-	332.070 A	-	332.137	332.150	-	-	332.147
11	-	-	-	-	332.040 A	-	-	332.137	332.151	-	-	332.147
12	-	-	-	-	-	-	-	332.137	332.151	-	-	332.146
13	-	-	-	-	-	-	-	332.136	332.149	-	-	332.146
14	-	-	-	-	-	-	-	332.137	332.150	-	-	332.147
15	-	332.049 A	-	-	-	-	-	332.138	332.147	-	-	332.153
16	332.050 A	-	-	-	-	-	-	332.136	332.147	-	-	332.154
17	-	-	-	-	-	-	-	332.137	332.146	-	-	332.154
18	-	-	-	-	-	-	-	-	332.141	-	-	332.153
19	-	-	-	-	-	-	-	-	332.150 P	-	-	332.153
20	-	-	-	-	-	-	-	-	-	-	-	332.153
21	-	-	-	-	-	-	-	-	-	-	-	332.152
22	-	-	-	-	-	-	-	-	-	-	-	332.152
23	-	-	-	-	-	-	-	-	-	-	-	332.152
24	-	-	-	-	-	-	-	-	-	-	-	332.150
25	-	-	-	-	-	-	-	-	-	-	-	332.150
26	-	-	-	-	-	-	-	332.148	-	-	-	332.150
27	-	-	-	-	-	-	-	332.147	-	332.129 A	-	332.150
28	-	-	-	-	-	-	-	332.147	-	-	-	332.150
29	-	-	-	-	-	-	-	332.154	-	-	-	332.149
30	-	-	-	-	-	-	-	332.148	-	-	-	332.149
31	-	-	-	-	-	-	-	332.150	-	-	-	332.149
min	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**332.121**	**332.141**	**-**	**-**	**332.145**
mean	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**332.139**	**332.148**	**-**	**-**	**332.150**
max	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**332.154**	**332.154**	**-**	**-**	**332.154**

Notes: P - partial daily average.
A - manual measurement.

Table VIII-51 L3 Isadore's Lake Mean Daily Water Levels (m) Based on Permanent Benchmark el. 235.910 m, 2001

Date	January	February	March	April	May	June	July	August	September	October	November	December
1	233.799	233.785	233.813	233.878	233.792	233.744	233.806	233.803	233.821	-	-	-
2	233.784	233.783	233.850	233.904	233.781	233.728	233.813	233.796	233.811	-	-	-
3	233.787	233.804	233.846	233.878	233.738	233.755	233.798	233.809	233.815	-	-	-
4	233.795	233.812	233.811	233.857	233.730	233.728	233.779	233.807	233.800	-	-	-
5	233.804	233.812	233.813	233.879	233.763	233.725	233.789	233.805	233.808	-	-	-
6	233.800	233.832	233.817	233.906	233.771	233.738	233.777	233.794	233.831	-	-	-
7	233.797	233.819	233.834	233.888	233.760	233.737	233.806	233.808	233.841	-	-	-
8	233.785	233.845	233.840	233.880	233.761	233.704	233.783	233.806	233.826	-	-	-
9	233.775	233.813	233.847	233.912	233.780	233.713	233.772	233.799	233.827	-	-	-
10	233.769	233.822	233.854	233.925	233.750	233.720	233.776	233.821	233.832	-	-	-
11	233.806	233.817	233.831	233.930	233.749	233.743	233.778	233.820	233.850	-	-	-
12	233.791	233.837	233.841	233.908	233.736	233.772	233.753	233.797	233.840	-	-	-
13	233.783	233.812	233.862	233.921	233.724	233.764	233.749	233.806	233.818	-	-	-
14	233.793	233.832	233.856	233.931	233.742	233.760	233.764	233.801	233.833	-	-	-
15	233.789	233.838	233.852	233.909	233.741	233.757	233.738	233.785	233.831	-	-	-
16	233.797	233.823	233.838	233.895	233.739	233.761	233.748	233.787	233.817	-	-	-
17	233.796	233.807	233.850	233.880	233.737	233.744	233.755	233.779	233.816	-	-	-
18	233.788	233.826	233.864	233.895	233.731	233.728	233.745	233.803	233.833	-	-	-
19	233.803	233.826	233.881	233.917	233.737	233.728	233.743	233.808	233.837	-	-	-
20	233.771	233.824	233.873	233.918	233.747	233.732	233.771	233.787	233.820	-	-	-
21	233.790	233.830	233.882	233.871	233.746	233.729	233.794	233.829	233.838	-	-	-
22	233.779	233.818	233.875	233.861	233.739	233.729	233.782	233.820	233.815	-	-	-
23	233.771	233.844	233.907	233.860	233.753	233.789	233.758	233.822	233.814	-	-	-
24	233.791	233.852	233.879	233.840	233.737	233.792	233.760	233.841	233.838	-	-	-
25	233.777	233.862	233.843	233.852	233.718	233.797	233.759	233.813	233.828	-	-	-
26	233.788	233.828	233.851	233.836	233.737	233.788	233.770	233.828	233.819	-	-	-
27	233.775	233.809	233.842	233.815	233.729	233.788	233.775	233.813	233.822	-	-	-
28	233.763	233.801	233.856	233.815	233.711	233.819	233.767	233.814	233.818	-	-	-
29	233.797	-	233.871	233.783	233.698	233.805	233.822	233.818	233.828	233.821 A	-	-
30	233.827	-	233.865	233.777	233.726	233.807	233.820	233.802	233.820 P	-	-	-
31	233.798	-	233.863	-	233.755	-	233.801	233.812	-	-	-	-
min	233.763	233.783	233.811	233.777	233.698	233.704	233.738	233.779	233.800	-	-	-
mean	233.789	233.822	233.852	233.877	233.744	233.754	233.776	233.808	233.825	-	-	-
max	233.827	233.862	233.907	233.931	233.792	233.819	233.822	233.841	233.850	-	-	-

Notes: P - partial daily average.
A - manual measurement.

APPENDIX IX

PERMITS FOR STATION INSTALLATIONS

IN 2001

This appendix contains the following documentation:

- Alberta Environment Approval 00151738-00-00 and Licence of Occupation LOC 011956 for Jackpine Creek Station (S2);
- Alberta Environment Approval 00151737-00-00 and Licence of Occupation LOC 011955 for Muskeg River 7DA8 Environment Canada Hydometric Station (S7);
- Alberta Environment Approval 00151739-00-00 and Licence of Occupation LOC 011957 for Fort Creek Station (S12);
- Alberta Environment Approval 00153852-00-00 for Ells River Station (S14);
- Alberta Environment Approval 00153918-00-00 for Tar River Station (S15), Calumet River Station (S16) and Calumet River Upland Station (S18);
- Alberta Environment Approval 00153919-00-00 for Tar River Upland Station (S17) and Tar River Lowland Station (S19);
- Alberta Environment Approval 00152942-00-00 for Muskeg River Upland Station (S20), Shelley Creek Station (S21), Muskeg Creek Station (S22) and Khahago Creek Station (S28); and
- Alberta Environment Approval 00152948-00-00 for Athabasca River Station (S24).

Alberta Environment Approval 00151738-00-00 and

Licence of Occupation LOC 011956

for Jackpine Creek Station (S2)

Alberta
ENVIRONMENT

Northeast Boreal Region
Regional Support

Main Floor, Twin Atria
111, 4999 - 98 Avenue
Edmonton, Alberta
T6B 2X3

Telephone 780 427-5296
Fax 780 422-0528

00151738

July 12, 2001

Mr. H. William Hunter
Syncrude Canada Ltd.
Environmental Services
P.O. Bag 4009
Fort McMurray, Alberta
T9H 3L1

Dear Mr. Hunter:

RE: Application under the *Water Act*
Jackpine Creek Monitoring Station

Enclosed is an approval authorizing the construction of the above activity.

The *Water Act* provides a right to appeal this decision. Notice of appeal must be submitted not later than seven (7) days after the receipt of this notice to:

Dr. William A. Tillman, Chair
Environmental Appeal Board
3rd Floor, Peace Hills Trust Tower
10011 – 109 Street
Edmonton, Alberta, T5J 3S8
Telephone: (780) 427-6207
Fax: (780) 427-4693

Also enclosed is the "Certificate of Completion" to be submitted to our office upon completion of the construction.

Please ensure that a copy of this approval is posted and available at the site of the activity.

Under the *Water Act*, the Director will provide a public notice of this decision. The notice will be posted in the Fort McMurray Fish & Wildlife Office and Edmonton Regional office of Alberta Environment.

.../2

12 July 01

In order to reduce the potential of the spread of *Whirling Disease* in fish, we ask that all equipment and machinery that has been used in the United States be washed clean of all mud and dirt before being used again in any activities in or near streams in Alberta.

This approval should not be taken to mean that you have an authority under federal legislation. Please contact:

Habitat Management, Central and Arctic Region
Fisheries and Oceans
501 University Crescent
Winnipeg, Manitoba R3T 2N6
(telephone: 204-984-2505)

relating to the application of federal laws relating to the ***Fisheries Act (Canada)*** and the:

Navigable Waters Protection
Canadian Coast Guard
4253 – 97 Street
Edmonton, Alberta T6B 3B2
(telephone: 780-495-6325)

relating to the ***Navigable Waters Protection Act.***

Please note that you will require an authorization under the *Public Lands Act.*

Please call Dale Adams at (780) 427-7556 if you have any questions.

Sincerely,

Acting Manager, Regional Support
Northeast Boreal Region

enclosure

cc: L. Rhude
T. Sayers

Alberta
ENVIRONMENT

APPROVAL

PURSUANT TO THE PROVISIONS OF THE *WATER ACT*

APPROVAL No. 00151738-00-00

FILE No. 00151738

Syncrude Canada Limited
P.O. Bag 4009
Fort McMurray, Alberta
T9H 3L1

is authorized to construct a water level monitoring station on the bed and bank of Jackpine Creek subject to the attached conditions.

2002 07 11
Expiry Date

Acting Manager, Regional Support,
Northeast Boreal Region

2001 07 12
Dated (Y/M/D)

Approval No. 00151738-00-00
File No. 00151738

CONDITIONS

ACTIVITY

1. This approval is appurtenant to: SW ¼ 16-095-09-W4

2. The approval holder shall undertake the activity in accordance with the plans and/or reports filed in the following Departmental records:

NUMBER	TITLE
00151738-P001	Site Plan
00151738-P002	Typical Details

3. The approval holder shall confine the activity to the work area designated on the plans or to areas as prescribed in the approval.

4. The approval holder shall reclaim any disturbed bed and banks of the water body and areas associated with the activity to the original contours that existed prior to the commencement of the activity.

5. The approval holder shall not deposit any substance that will adversely affect the water body.

6. The approval holder shall prevent siltation and erosion of the water body resulting from the activity.

7. The approval holder shall maintain a continuous flow of water in the water body for the duration of the activity.

8. The approval holder shall not conduct activities in the water body between April 16 and July 15 unless the water body is dry.

12 Sep 01

Approval No. 00151738-00-00
File No. 00151738

CONDITIONS

GENERAL

9. The activity authorized under this approval shall be completed by July 11, 2002.

10. The approval holder shall hold harmless the Minister of Environment or any other agent of the Government of Alberta for damage or damage claims arising out of the activity.

11. The approval holder shall retain a copy of this approval at the site of the activity.

12. On completion, partial completion of the activity, or when requested by the Director, the approval holder shall submit to the Director a certificate of completion which includes:

    (a) a statement that the activity or that part of the activity has been completed in accordance with the approval, and

    (b) any other information required by the Director.

Acting Manager, Regional Support,
Northeast Boreal Region

2001 07 12
Dated (Y/M/D)

Syncrude
Securing Canada's Energy Future

Law Department
Inter-office Correspondence

TO:	Bill Hunter	**REF:**	MD 3065
FROM:	Barry Wolsey	**DATE:**	August 27, 2001

RE: **Monitoring Station - Jackpine Creek**

Attached is a copy of LOC 011956 just received for this station. The conditions seem fairly standard and I trust you will take care of them, including marvelous #3.

Thanks,

Barry

[JF_70]

LOC 011956

(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: Alberta Sustainable Resource Development
Land and Forest Service
Land Administration Division
Petroleum Plaza, South Tower
9915 – 108th Street
Edmonton, Alberta
T5K 2G8
Telephone: (780) 427-3570

"**departmental officer**" means: an employee of the Alberta Sustainable Resource Development, Land and Forest Service, 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 Sustainable Resource Development.

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

Alberta Sustainable Resource Development
Land and Forest Service
Main Floor, Petroleum Plaza, South Tower
9915 – 108th 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, 2nd Floor, Petroleum Plaza, South Tower, 9915 – 108th 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 – 108th 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 Client and Licencing Service, Alberta Sustainable Resource Development, 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) For oil and gas activity on land classified as being in the Green Area of the Province (identified on Schedule "B"), the department may, in addition to any other charges, assess a further charge of 50 cents per acre ($1.24 cents per hectare) on every acre or part acre in this authority to fund the Trapper's Compensation Program.

f) 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.

g) This authorization is granted subject to further amendment by the Minister of Sustainable Resource Development, 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. 154 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.

   Waterways Forest Area
   Fort Mc Murray Office
   (780) 743-7120

3. 062 The holder shall within 30 days provide to the department a written consent from the following occupant(s) who hold prior legal rights:
FMA 9100059
Alberta Pacific Forest Industries Inc.
c/o Ever Green Land Use Consulting
2nd Flr., 410 – 6th Street SW
Calgary, Alberta
T2P 1X2

4. 631 Prior to commencement of construction, the holder shall obtain authority under the *Water Act* from Water Management of Alberta Environment at (780) 427-6451.

5. 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 approval and use for incidental activities such as campsites, borrow pits, temporary access, flare pits, remote sumps, trails and other temporary uses.)

6. 177 Unless otherwise approved by a departmental officer, the holder shall use only existing clearings/trails and not clear any new areas.

7. 185 The holder shall utilize the lands only during frozen or dry ground conditions.

8. 193 The holder shall ensure that surface disturbance is kept to a minimum.

9. 216 Total rollback is required.

10. 250 The holder shall dispose of all debris/waste in a manner directed by a departmental officer.

11. 259 The holder shall strip and pile the topsoil separately from any woody material and subsoil in such a manner that it can be distributed evenly over the disturbed area when operations have been completed.

12. 270 Timber salvage is waived.

13. 275 The holder shall not deposit or push debris, soil or other deleterious materials into or through any watercourse or water body or on the ice of any watercourse/water body.

14. 276 Unless otherwise approved by a departmental officer, the holder shall not conduct any activity within the bed of the following watercourse or water body between the dates indicated.
Watercourse/legal description: Jack Pine Creek
Dates: from April 16 to July 15.

15. The holder shall ensure a continuous flow of water is maintained during all phases of the activity.

16. 285 Reconstruction of the banks, shoreline and approaches on the following watercourses/water bodies is required as directed by a departmental officer:
Watercourse(s): Jack Pine Creek.

17. 298 The holder shall take all precautions and safeguards necessary to prevent soil/surface erosion.

18. 236 The holder shall destroy restricted weeds and control noxious weeds, as defined by the *Weed Control Act*, on the land included under this authority. Contact the departmental officer for further information.

19. 237 Prior to entry on the land, the holder shall steam clean all equipment, including seeders.

20. 218 The holder shall reclaim all disturbed areas immediately after operations.

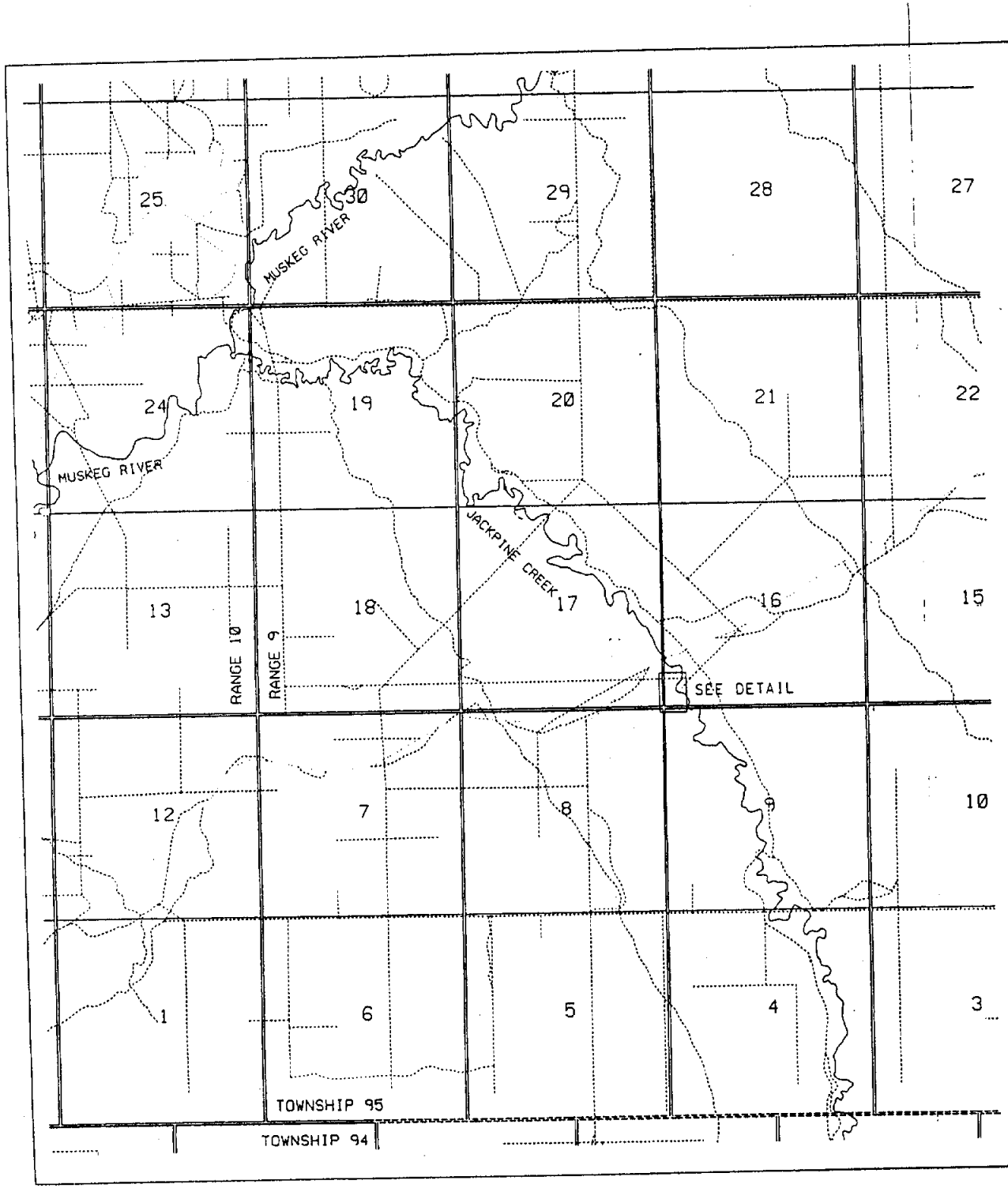
21. 230 Unless otherwise specified by a departmental officer, the holder shall only use seed of suitable native plant species in revegetation. The seed mixture must be approved by a departmental officer. The holder shall provide a certificate of seed analysis for each species to the departmental officer prior to seeding approval.

22. 224 Upon cancellation and abandonment, the holder shall contour the disturbed land to an acceptable land form using subsoil. The holder shall replace topsoil and restore the natural drainage by removing any culverts and fills. In addition, the holder shall, as directed by a departmental officer, take all required measures to minimize the potential for soil erosion and watercourse/water body sedimentation occurring.

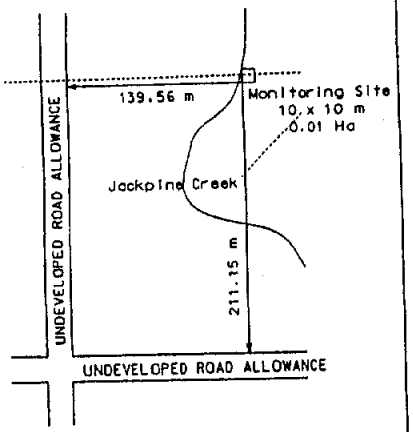
23. Access to this site is by foot traffic only, unless otherwise approved by a departmental officer.

24. 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: 5 years.

All licences, authorizations and approvals issued under the *Alberta Environmental Protection 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, 9021 – 46th Street, Edmonton, Alberta, phone: (780) 495-3701 relating to the *Navigable Waters Protection Act*.



SW1/4 16-95-9-W4M



Plan #: 21385 TL
Version: 2001.08.08
File: LOC011956

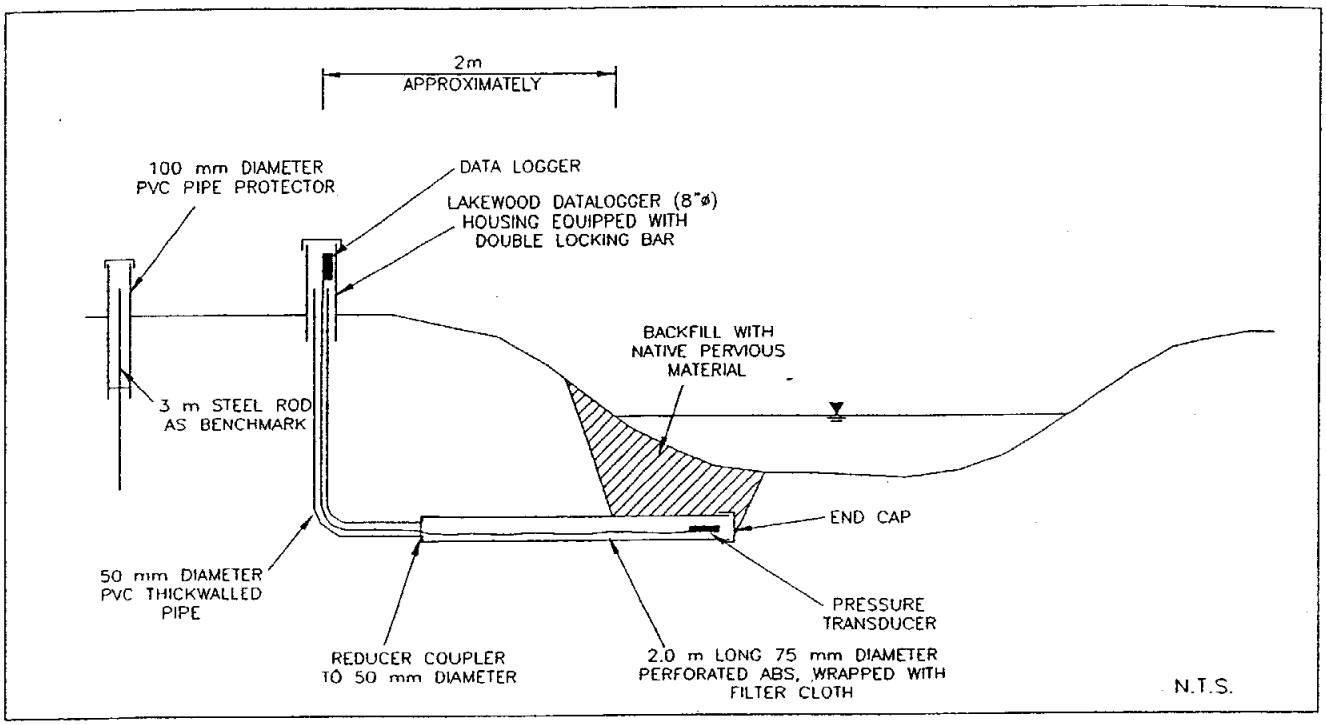
TECHNICAL SERVICES	SKT	

Syncrude
Securing Canada's Energy Future

AURORA
APPLICATION FOR MONITORING SITE
JACKPINE CREEK

APP/DATE Apr 11 2001 | DRAWN BY/DATE Kathy P. | SCALE

SHT. OF REV.



Golder Associates	RAMP

TYPICAL DETAILS OF RIVER/CREEK GAUGING STATION

DRAWN: VS	APPROVED:	DATE: 22 Nov 2000
PROJECT: 002-2309.7050		FIGURE: 2

Revision No.: 01

J:\2000\2300\002-2309\7050\monitor.dwg

SELECTION CRITERIA

(EQUESTED LAND LIST: INCLUDE
TITLE INFORMATION : INCLUDE
(EQUEST 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	

SCHEDULE "B"

REQUESTED ACTIVITY

REQUESTED ACTIVITY: LOC- 011956

REQUESTED LAND

REQUESTED LAND	OWNERSHIP STATUS	TITLE STATUS	ADMINISTERED BY	SURVEY STATUS	-- AREA IN HECTARES --- LAND	TITLE	--- AREA IN ACRES --- LAND	TITLE
4-09-095-16-SW	CROWN	UNTITLED FLW		UNSURVEYED	64.750		160.00	
TOTAL	CROWN	UNTITLED		UNSURVEYED	64.750		160.00	

LAND STATUS INFORMATION (TO QUARTER SECTION ONLY)

LAND IDENTIFIER	OWNERSHIP STATUS	TITLE STATUS	ADMINISTERED BY	SURVEY STATUS	-- AREA IN HECTARES --- LAND	TITLE	--- AREA IN ACRES --- LAND	TITLE
4-09-095-16-SW	CROWN	UNTITLED FLW		UNSURVEYED	64.750		160.00	

GEO-ADMINISTRATIVE AREAS

COAL DEVELOPMENT REGION 4-09-095	NORTHERN FORESTED		CODE: CDR-2
ENVIRONMENT CONS. & RECL. DISTRICT 4-09-095	NO. 4		CODE: ERD-004
FOREST MANAGEMENT UNIT 4-09-095	ATHABASCA FOREST	A7	CODE: FMU-A -07J
FISH & WILDLIFE ADMIN REGION 4-09-095	NORTHEAST REGION	LAC LA BICHE	CODE: FWA-4 -04
FISH AND WILDLIFE DISTRICT	NORTHEAST REGION	FORT MCMURRAY	CODE: FWD-5 -07

GEO-ADMINISTRATIVE AREAS

H AND WILDLIFE DISTRICT 4-09-095	(CONTINUED)		
ERAL LANDS CLASSIFICATION 4-09-095	GREEN		CODE: GLC-G
ZING ZONE 4-09-095	C		CODE: GRZ-C
EGRATED RESOURCE PLAN 4-09-095	FT. MCMURRAY ATHABASCA OIL SANDS		CODE: IRP-F1
LIC LAND DISTRICT 4-09-095	NORTHWEST REGION	SHERWOOD PARK	CODE: PLD-6 -6
GER DISTRICT 4-09-095	NORTHEAST BOREAL	FORT MCMURRAY - WATERWAYS DISTRICT	CODE: RAD-NEB -1C
CIALIZED MUNICIPALITY 4-09-095	REGIONAL MUNICIPALITY OF WOOD BUFFA		CODE: SM -001

ACTIVITIES

CTIVITY	STATUS/TYPE LAND ID	DATE HECTARES	EXPIRY ACRES	CLIENT/INTERIM REMARKS METES AND BOUNDS REMARKS	TOTAL AREA ACRES	 HECTARES
C-720002	APPROVED 0530 INDUSTRIAL/COMMERCIAL SITE 4-09-095	ON 1972-FEB-11 9,323.956	2004-FEB-29 23.040.00	SHELL CANADA LIMITED 1 NO RESTRICTION 710 SPECIFIED IN COMMENTS FIELD	94,101.48	38,081.515
T-870307	APPROVED 0530 INDUSTRIAL/COMMERCIAL SITE 4-09-095-16	ON 1988-FEB-11	2005-FEB-28	ALBERTA ENERGY AND UTILITIES BOAR 1 NO RESTRICTION 710 SPECIFIED IN COMMENTS FIELD	817.01	330.632
A-9100029	ACTIVE/DISPOSED 4-09-095	ON 1991-SEP-01	2011-AUG-31	JOINT VENTURE PARTIES	* 13,870.652.95	5,613,253.675
C- 5729	ACTIVE/DISPOSED 4-09-095-16-SW	ON 1975-MAR-27	9999-999-99	SHELL CANADA LIMITED	10.48	4.241
C- 5975	LOA AMENDMENT 4-09-095-16-SW	ON 1995-AUG-28	9999-999-99	SHELL CANADA LIMITED AND ADJ.THEOR.RD.ALLOW.	130.19	52.685
C- 011731	APP. FOR AMENDMEN 4-09-095-16-SW	ON 2001-JUL-30 0.090	 0.22	SHELL CANADA LIMITED	0.22	0.090
C- 011732	APPLICATION 4-09-095-16-SW	ON 2001-JUL-03		SHELL CANADA LIMITED	4.77	1.930
C- 011956	APPLICATION 4-09-095-16-SW	ON 2001-AUG-08 0.010	 0.02	SYNCRUDE CANADA LTD.	0.02	0.010

ACTIVITIES

ACTIVITY	STATUS/TYPE LAND ID	DATE HECTARES	EXPIRY ACRES	CLIENT/INTERIM REMARKS METES AND BOUNDS REMARKS	TOTAL AREA ACRES	 HECTARES
LOC- 950763	LETTER OF AUTHORI ON 4-09-095-16-03	1995-APR-26	2020-APR-25	SYNCRUDE CANADA LTD.	1.54	0.624
MLL- 900007	ACTIVE/DISPOSED ON 4-09-095-16-SW	1991-JAN-01 1.214	2000-DEC-31 3.00	SHELL CANADA LIMITED	3.00	1.214

*** NOTE: THE FOLLOWING DISCLAIMER ***

---------- 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.

THIS REPORT DOES NOT SHOW CAVEATS, BUILDERS' LIENS, OR OTHER INSTRUMENTS, IF ANY, REGISTERED AT LAND TITLES OFFICE IN RESPECT OF ANY LANDS OR INTERESTS THEREIN. PERSONS ARE ADVISED TO ALSO EXAMINE RECORDS AT LAND TITLES OFFICE TO ASCERTAIN WHETHER OTHER INSTRUMENTS THAT MAY CONCERN THE LANDS OR INTERESTS THEREIN HAVE BEEN REGISTERED.

*** END OF REPORT ***

Alberta Environment Approval 00151737-00-00 and

Licence of Occupation LOC 011955

for Muskeg River 7DA8 Environment Canada Hydometric Station (S7)

Alberta
ENVIRONMENT

Northeast Boreal Region
Regional Support

Main Floor, Twin Atria
111, 4999 - 98 Avenue
Edmonton, Alberta
T6B 2X3

Telephone 780 427-5296
Fax 780 422-0528

00151737

July 12, 2001

Mr. H. William Hunter
Syncrude Canada Ltd.
Environmental Services
P.O. Bag 4009
Fort McMurray, Alberta
T9H 3L1

Dear Mr. Hunter:

RE: Application under the *Water Act*
Muskeg River Monitoring Station

Enclosed is an approval authorizing the construction of the above activity.

The *Water Act* provides a right to appeal this decision. Notice of appeal must be submitted not later than seven (7) days after the receipt of this notice to:

Dr. William A. Tillman, Chair
Environmental Appeal Board
3rd Floor, Peace Hills Trust Tower
10011 – 109 Street
Edmonton, Alberta, T5J 3S8
Telephone: (780) 427-6207
Fax: (780) 427-4693

Also enclosed is the "Certificate of Completion" to be submitted to our office upon completion of the construction.

Please ensure that a copy of this approval is posted and available at the site of the activity.

Under the *Water Act*, the Director will provide a public notice of this decision. The notice will be posted in the Fort McMurray Fish & Wildlife Office and Edmonton Regional office of Alberta Environment.

.../2

12/07/01

In order to reduce the potential of the spread of *Whirling Disease* in fish, we ask that all equipment and machinery that has been used in the United States be washed clean of all mud and dirt before being used again in any activities in or near streams in Alberta.

This approval should not be taken to mean that you have an authority under federal legislation. Please contact:

Habitat Management, Central and Arctic Region
Fisheries and Oceans
501 University Crescent
Winnipeg, Manitoba R3T 2N6
(telephone: 204-984-2505)

relating to the application of federal laws relating to the ***Fisheries Act (Canada)*** and the:

Navigable Waters Protection
Canadian Coast Guard
4253 – 97 Street
Edmonton, Alberta T6B 3B2
(telephone: 780-495-6325)

relating to the ***Navigable Waters Protection Act.***

Please note that you will require an authorization under the *Public Lands Act*.

Please call Dale Adams at (780) 427-7556 if you have any questions.

Sincerely,

Acting Manager, Regional Support
Northeast Boreal Region

enclosure

cc: L. Rhude
T. Sayers

Alberta
ENVIRONMENT

APPROVAL

PURSUANT TO THE PROVISIONS OF THE *WATER ACT*

APPROVAL No. 00151737-00-00

FILE No. 00151737

Syncrude Canada Limited
P.O. Bag 4009
Fort McMurray, Alberta
T9H 3L1

is authorized to construct a water level monitoring station on the bed and bank of the Muskeg River subject to the attached conditions.

2002 07 11
Expiry Date

Acting Manager, Regional Support,
Northeast Boreal Region

2001 07 12
Dated (Y/M/D)

Approval No. 00151737-00-00
File No. 00151737

CONDITIONS

ACTIVITY

1. This approval is appurtenant to: SE ¼ 32-094-10-W4

2. The approval holder shall undertake the activity in accordance with the plans and/or reports filed in the following Departmental records:

NUMBER	TITLE
00151737-P001	Site Plan
00151737-P002	Typical Details

3. The approval holder shall confine the activity to the work area designated on the plans or to areas as prescribed in the approval.

4. The approval holder shall reclaim any disturbed bed and banks of the water body and areas associated with the activity to the original contours that existed prior to the commencement of the activity.

5. The approval holder shall not deposit any substance that will adversely affect the water body.

6. The approval holder shall prevent siltation and erosion of the water body resulting from the activity.

7. The approval holder shall maintain a continuous flow of water in the water body for the duration of the activity.

8. The approval holder shall not conduct activities in the water body between April 16 and July 15 unless the water body is dry.

12 Sep 01

Approval No. 00151737-00-00
File No. 00151737

CONDITIONS

GENERAL

9. The activity authorized under this approval shall be completed by July 11, 2002.

10. The approval holder shall hold harmless the Minister of Environment or any other agent of the Government of Alberta for damage or damage claims arising out of the activity.

11. The approval holder shall retain a copy of this approval at the site of the activity.

12. On completion, partial completion of the activity, or when requested by the Director, the approval holder shall submit to the Director a certificate of completion which includes:

    (a) a statement that the activity or that part of the activity has been completed in accordance with the approval, and

    (b) any other information required by the Director.

Acting Manager, Regional Support,
Northeast Boreal Region

2001 07 12
Dated (Y/M/D)

Syncrude
Securing Canada's Energy Future

LAW DEPARTMENT
INTER-OFFICE CORRESPONDENCE

TO: **Bill Hunter**

FROM: **Barry Wolsey**

REF:

DATE: **2001.10.01**

SUBJECT: **Muskeg River Water Level Monitoring Station**

Attached is a copy of LOC 011955 just received for this station. Again, the conditions seem fairly standard and I trust you will take care of them, even # 3. I don't see anything about the possible native land claim. The trapper involved is Bertha Ganter and I have made the necessary contact with her.

Thanks,
Barry

Barry

LAWRENCE LOW
299-5606

Alberta
SUSTAINABLE RESOURCE DEVELOPMENT

Land and Forest Service
Land Administration Division

Petroleum Plaza - South Tower
3RD Floor, 9915 - 108 Street
Edmonton, Alberta T5K 2G8
Phone: (780) 415-4654
Fax: (780) 427-1185

File No. LOC 011955

September 21, 2001

SEP 25 2001
AIR DEPARTMENT

Syncrude Canada Ltd.
P.O. Bag 4023, M.D. 2800
Ft. McMurray, Alberta
T9H 3H5

Attention: Mr. Barry Wolsey, Law Department

Dear Sir:

RE: LICENCE OF OCCUPATION APPLICATION NO. LOC 011955
SE 32-94-10-W4M (approx. 0.02 acres)
MUSKEG RIVER WATER LEVEL MONITORING STATION
LETTER OF AUTHORITY

Further to your application dated August 1, 2001, this is to advise the department has completed its review.

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 described above 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 the time specified.

These charges are subject to review and amendment when your final plan is received and/or formal lease documents are prepared.

Application Fee	$25.00
First Year's Rent	$50.00
Total	**$100.00**
Amount Paid	$0.00
Balance Owing	**$100.00**

The holder will be invoiced annually for the subsequent annual rental. For the first five years of the term of this authority, unless an amendment is approved during this period, the amount will be $50.00.

If you have any questions or concerns, please contact the undersigned.

Sincerely,

M.G. (Mel) White
Land Use Management Section

cc: North East Boreal
Waterways Forest Area
Ft. McMurray Office
Attention: Terry Sayers

cc: North East Boreal
Alberta Environment
Water Management

cc: International and Intergovernmental Relations
Indian Land Claims
Attention: Steven R. Andres

(CONDITIONS) SCHEDULE A

LOC 011955

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: Alberta Sustainable Resource Development
Public Lands Division
Land Administration Branch
Petroleum Plaza, South Tower
9915 – 108th Street
Edmonton, Alberta
T5K 2G8
Telephone: (780) 427-3570

"**departmental officer**" means: an employee of the Alberta Sustainable Resource Development, Public Lands Division, 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 Sustainable Resource Development.

payments required by this document are to be made payable to "**Minister of Finance**" and may be delivered to the nearest Public Lands office, or mailed to:

Alberta Sustainable Resource Development
Public Lands Division
Main Floor, Petroleum Plaza, South Tower
9915 – 108th 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 Branch, 2nd Floor, Petroleum Plaza, South Tower, 9915 – 108th 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 – 108th 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 Client and Licencing Service, Alberta Sustainable Resource Development, 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) For oil and gas activity on land classified as being in the Green Area of the Province (identified on Schedule "B"), the department may, in addition to any other charges, assess a further charge of 50 cents per acre ($1.24 cents per hectare) on every acre or part acre in this authority to fund the Trapper's Compensation Program.

f) 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.

g) This authorization is granted subject to further amendment by the Minister of Sustainable Resource Development, 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. 154 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.

   Waterways Forest Area
   Ft. McMurray Office
   Phone: (780) 7120

3. 062 The holder shall within 30 days provide to the department a written consent from the following occupant(s) who hold prior legal rights:
   ALPAC Forest Industries Inc.
   c/o Ever Green Land Use Consulting
   400 – 6th St SW
   Calgary AB T2P 1X2
   Attention: Bill Hamilton

4. 631 Prior to commencement of construction, the holder shall obtain authority under the *Water Act* from Alberta Environment at (780) 427-6451.

5. 648 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 approval and use for incidental activities such as campsites, borrow pits, temporary access, flare pits, remote sumps, trails and other temporary uses.)

6. 177 Unless otherwise approved by a departmental officer, the holder shall use only existing clearings/trails and not clear any new areas.

7. 185 The holder shall utilize the lands only during frozen or dry ground conditions.

8. 193 The holder shall ensure that surface disturbance is kept to a minimum.

9. 216 Total rollback is required.

10. 250 The holder shall dispose of all debris/waste in a manner directed by a departmental officer.

11. 259 The holder shall strip and pile the topsoil separately from any woody material and subsoil in such a manner that it can be distributed evenly over the disturbed area when operations have been completed.

12. 270 Timber salvage is waived.

13. 275 The holder shall not deposit or push debris, soil or other deleterious materials into or through any watercourse or water body or on the ice of any watercourse/water body.

14. 276 Unless otherwise approved by a departmental officer, the holder shall not conduct any activity within the bed of the following watercourse or water body between the dates indicated.
Watercourse/legal description: Muskeg River
Dates: from April 16 to July 15.

15. 285 Reconstruction of the banks, shoreline and approaches on the following watercourses/water bodies is required as directed by a departmental officer:
Watercourse(s): Muskeg River.

16. 298 The holder shall take all precautions and safeguards necessary to prevent soil/surface erosion.

17. 236 The holder shall destroy restricted weeds and control noxious weeds, as defined by the *Weed Control Act*, on the land included under this authority. Contact the departmental officer for further information.

18. 237 Prior to entry on the land, the holder shall steam clean all equipment, including seeders.

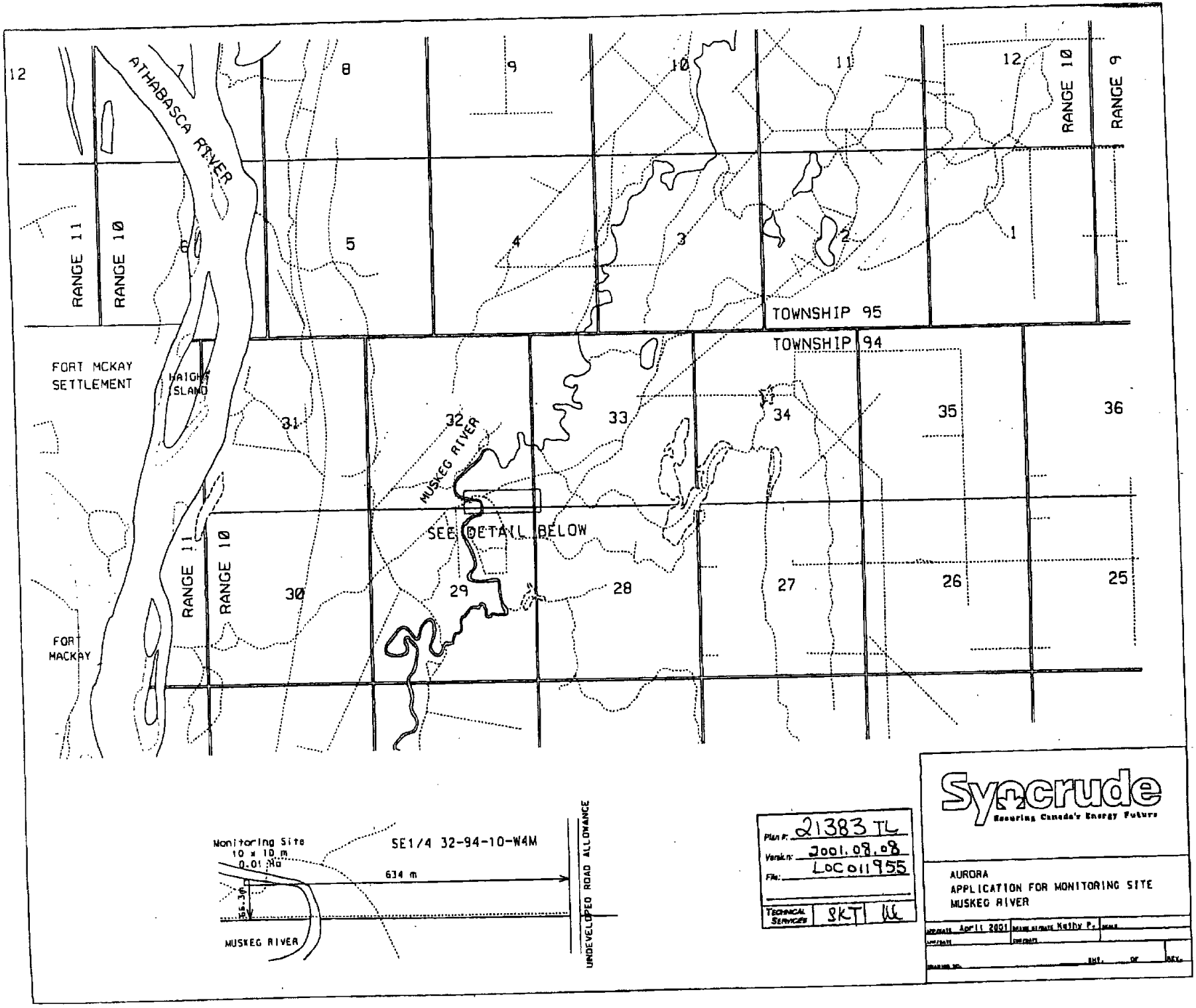
19. 218 The holder shall reclaim all disturbed areas immediately after operations.

20. 230 Unless otherwise specified by a departmental officer, the holder shall only use seed of suitable native plant species in revegetation. The seed mixture must be approved by a departmental officer. The holder shall provide a certificate of seed analysis for each species to the departmental officer prior to seeding approval.

21. 224 Upon cancellation and abandonment, the holder shall contour the disturbed land to an acceptable land form using subsoil. The holder shall replace topsoil and restore the natural drainage by removing any culverts and fills. In addition, the holder shall, as directed by a departmental officer, take all required measures to minimize the potential for soil erosion and watercourse/water body sedimentation occurring.

22. 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 Environmental Protection 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, 9021 – 46th Street, Edmonton, Alberta, phone: (780) 495-3701 relating to the *Navigable Waters Protection Act*.


ATHABASCA RIVER
RANGE 11
RANGE 10
RANGE 9
TOWNSHIP 95
TOWNSHIP 94
FORT MCKAY SETTLEMENT
HAIGH'S ISLAND
MUSKEG RIVER
SEE DETAIL BELOW
FORT MACKAY
Monitoring Site
10 x 10 m
0.01 Ha
SE1/4 32-94-10-W4M
634 m
3.5-3.0
MUSKEG RIVER
UNDEVELOPED ROAD ALLOWANCE
Plan #: 21383 TL
Version: 2001.08.08
File: Loc01955
TECHNICAL SERVICES SKT
Syncrude
Securing Canada's Energy Future
AURORA
APPLICATION FOR MONITORING SITE
MUSKEG RIVER
April 2001
Kathy P.

LAND STATUS AUTOMATED SYSTEM

ENR-LSAS
REPORT DATE: 2001-08-08 TIME: 14:36:18

LAND STANDING REPORT

REQUESTED BY: LSLEI25

LSRC1130
PAGE 1

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	

SCHEDULE "B"

REQUESTED ACTIVITY

REQUESTED ACTIVITY: LOC- 011955

REQUESTED LAND

REQUESTED LAND	OWNERSHIP STATUS	TITLE STATUS	ADMINISTERED BY	SURVEY STATUS	-- AREA IN HECTARES --- LAND	TITLE	--- AREA IN ACRES --- LAND	TITLE	
4-10-094-32-SE	CROWN	UNTITLED FLW		SURVEYED	62.079		153.40		PARTLY WATER
TOTAL	CROWN	UNTITLED		SURVEYED	62.079		153.40		PARTLY WATER

LAND STATUS INFORMATION (TO QUARTER SECTION ONLY)

LAND IDENTIFIER	OWNERSHIP STATUS	TITLE STATUS	ADMINISTERED BY	SURVEY STATUS	-- AREA IN HECTARES --- LAND	TITLE	--- AREA IN ACRES --- LAND	TITLE	
4-10-094-32-SE	CROWN	UNTITLED FLW		SURVEYED	62.079		153.40		PARTLY WATER

GEO-ADMINISTRATIVE AREAS

COAL DEVELOPMENT REGION 4-10-094	NORTHERN FORESTED		CODE: CDR-2
ENVIRONMENT CONS. & RECL. DISTRICT 4-10-094	NO. 4		CODE: ERD-004
FOREST MANAGEMENT UNIT 4-10-094	ATHABASCA FOREST	A7	CODE: FMU-A -07J
FISH & WILDLIFE ADMIN REGION 4-10-094	NORTHEAST REGION	LAC LA BICHE	CODE: FWA-4 -04
FISH AND WILDLIFE DISTRICT	NORTHEAST REGION	FORT MCMURRAY	CODE: FWD-5 -07

LAND STATUS AUTOMATED SYSTEM

R-LSAS LAND STANDING REPORT LSRC1130
PORT DATE: 2001-08-08 TIME: 14:36:18 REQUESTED BY: LSLEI25 PAGE 2

GEO-ADMINISTRATIVE AREAS

SH AND WILDLIFE DISTRICT (CONTINUED)			
4-10-094			
NERAL LANDS CLASSIFICATION	GREEN		CODE: GLC-G
4-10-094			
AZING ZONE	C		CODE: GRZ-C
4-10-094			
TEGRATED RESOURCE PLAN	FT. MCMURRAY ATHABASCA OIL SANDS		CODE: IRP-F1
4-10-094			
BLIC LAND DISTRICT	NORTHWEST REGION	SHERWOOD PARK	CODE: PLD-6 -6
4-10-094			
NGER DISTRICT	NORTHEAST BOREAL	FORT MCMURRAY - WATERWAYS DISTRICT	CODE: RAD-NEB -1C
4-10-094			
ECIALIZED MUNICIPALITY	REGIONAL MUNICIPALITY OF WOOD BUFFA		CODE: SM -001
4-10-094			

ACTIVITIES

CTIVITY / LAND ID	STATUS/TYPE	DATE	EXPIRY	CLIENT/INTERIM REMARKS / METES AND BOUNDS REMARKS	TOTAL AREA ACRES	TOTAL AREA HECTARES
T-870307	APPROVED	ON 1988-FEB-11	2005-FEB-28	ALBERTA ENERGY AND UTILITIES BOAR	817.01	330.632
	0530 INDUSTRIAL/COMMERCIAL SITE		1 NO RESTRICTION	710 SPECIFIED IN COMMENTS FIELD		
	4-10-094-32					
T-990076	APPROVED	ON 1999-JUL-22	2004-JUL-31	INTERNATIONAL AND INTERGOVERNMENT	47,691.03	19,299.874
	0580 OTHER MISCELLANEOUS SITE PROTEC. AREAS		1 NO RESTRICTION	710 SPECIFIED IN COMMENTS FIELD		
				730 WRITTEN AGENCY CONSENTS REQUIR		
	4-10-094-32 256.328 633.40					
- 1043	APPROVED	ON 1976-DEC-06	9999-999-99	ENVIRONMENT, DEPARTMENT OF	0.24	0.097
	0568 METEOROLOGICAL/HYDRO-METEOROLOGICAL SITE			710 SPECIFIED IN COMMENTS FIELD		
	4-10-094-32-01			PT		
	4-10-094-32-02			PT		
- 990180	LETTER OF AUTHORI	ON 2000-JAN-26	9999-999-99	ALBIAN SANDS ENERGY INC.	3.58	1.450
	4-10-094-32-SE					
-9100029	ACTIVE/DISPOSED	ON 1991-SEP-01	2011-AUG-31	JOINT VENTURE PARTIES	* 13,870,652.95	5,613,253.675
	4-10-094-32					
- 5732	LOA AMENDMENT	ON 1999-OCT-15	9999-999-99	SHELL CANADA LIMITED	55.87	22.610
	4-10-094-32-SE					
- 011955	APPLICATION	ON 2001-AUG-08		SYNCRUDE CANADA LTD.	0.02	0.010
	4-10-094-32-SE 0.010 0.02					

LAND STATUS AUTOMATED SYSTEM

LAND STANDING REPORT

LSRC1130

NR-LSAS
EPORT DATE: 2001-08-08 TIME: 14:36:18

REQUESTED BY: LSLEI25 PAGE 3

ACTIVITIES

ACTIVITY	STATUS/TYPE / LAND ID	DATE / HECTARES	EXPIRY / ACRES	CLIENT/INTERIM REMARKS / METES AND BOUNDS REMARKS	TOTAL AREA ACRES	TOTAL AREA HECTARES
TPA- 2006	ACTIVE/DISPOSED 4-10-094-32	ON 1986-AUG-18	2001-JUN-30	GANTER, BERTHA M.	0.00	0.000

*** NOTE: THE FOLLOWING DISCLAIMER ***

---------- 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.

THIS REPORT DOES NOT SHOW CAVEATS, BUILDERS' LIENS, OR OTHER INSTRUMENTS, IF ANY, REGISTERED AT LAND TITLES OFFICE IN RESPECT OF ANY LANDS OR INTERESTS THEREIN. PERSONS ARE ADVISED TO ALSO EXAMINE RECORDS AT LAND TITLES OFFICE TO ASCERTAIN WHETHER OTHER INSTRUMENTS THAT MAY CONCERN THE LANDS OR INTERESTS THEREIN HAVE BEEN REGISTERED.

*** END OF REPORT ***

Alberta Environment Approval 00151739-00-00 and

Licence of Occupation LOC 011957

for Fort Creek Station (S12)

Alberta
ENVIRONMENT

Northeast Boreal Region
Regional Support

Main Floor, Twin Atria
111, 4999 - 98 Avenue
Edmonton, Alberta
T6B 2X3

Telephone 780 427-5296
Fax 780 422-0528

00151739

July 12, 2001

Mr. H. William Hunter
Syncrude Canada Ltd.
Environmental Services
P.O. Bag 4009
Fort McMurray, Alberta
T9H 3L1

Dear Mr. Hunter:

RE: Application under the *Water Act*
Fort Creek Monitoring Station

Enclosed is an approval authorizing the construction of the above activity.

The *Water Act* provides a right to appeal this decision. Notice of appeal must be submitted not later than seven (7) days after the receipt of this notice to:

Dr. William A. Tillman, Chair
Environmental Appeal Board
3rd Floor, Peace Hills Trust Tower
10011 – 109 Street
Edmonton, Alberta, T5J 3S8
Telephone: (780) 427-6207
Fax: (780) 427-4693

Also enclosed is the "Certificate of Completion" to be submitted to our office upon completion of the construction.

Please ensure that a copy of this approval is posted and available at the site of the activity.

Under the *Water Act*, the Director will provide a public notice of this decision. The notice will be posted in the Fort McMurray Fish & Wildlife Office and Edmonton Regional office of Alberta Environment.

.../2

12/7/01

In order to reduce the potential of the spread of *Whirling Disease* in fish, we ask that all equipment and machinery that has been used in the United States be washed clean of all mud and dirt before being used again in any activities in or near streams in Alberta.

This approval should not be taken to mean that you have an authority under federal legislation. Please contact:

Habitat Management, Central and Arctic Region
Fisheries and Oceans
501 University Crescent
Winnipeg, Manitoba R3T 2N6
(telephone: 204-984-2505)

relating to the application of federal laws relating to the ***Fisheries Act (Canada)*** and the:

Navigable Waters Protection
Canadian Coast Guard
4253 – 97 Street
Edmonton, Alberta T6B 3B2
(telephone: 780-495-6325)

relating to the ***Navigable Waters Protection Act.***

Please note that you will require an authorization under the *Public Lands Act*.

Please call Dale Adams at (780) 427-7556 if you have any questions.

Sincerely,

D. McLean

Acting Manager, Regional Support
Northeast Boreal Region

enclosure

cc: L. Rhude
T. Sayers

Alberta
ENVIRONMENT

APPROVAL

PURSUANT TO THE PROVISIONS OF THE *WATER ACT*

APPROVAL No. 00151739-00-00

FILE No. 00151739

Syncrude Canada Limited
P.O. Bag 4009
Fort McMurray, Alberta
T9H 3L1

is authorized to construct a water level monitoring station on the bed and bank of Fort Creek subject to the attached conditions.

2002 07 11
Expiry Date

Acting Manager, Regional Support,
Northeast Boreal Region

2001 07 12
Dated (Y/M/D)

Approval No. 00151739-00-00
File No. 00151739

CONDITIONS

ACTIVITY

1. This approval is appurtenant to: SW ¼ 18-097-10-W4

2. The approval holder shall undertake the activity in accordance with the plans and/or reports filed in the following Departmental records:

NUMBER	TITLE
00151739-P001	Site Plan
00151739-P002	Typical Details

3. The approval holder shall confine the activity to the work area designated on the plans or to areas as prescribed in the approval.

4. The approval holder shall reclaim any disturbed bed and banks of the water body and areas associated with the activity to the original contours that existed prior to the commencement of the activity.

5. The approval holder shall not deposit any substance that will adversely affect the water body.

6. The approval holder shall prevent siltation and erosion of the water body resulting from the activity.

7. The approval holder shall maintain a continuous flow of water in the water body for the duration of the activity.

8. The approval holder shall not conduct activities in the water body between April 16 and July 15 unless the water body is dry.

12 Sep 01

Approval No. 00151739-00-00
File No. 00151739

CONDITIONS

GENERAL

9. The activity authorized under this approval shall be completed by July 11, 2002.

10. The approval holder shall hold harmless the Minister of Environment or any other agent of the Government of Alberta for damage or damage claims arising out of the activity.

11. The approval holder shall retain a copy of this approval at the site of the activity.

12. On completion, partial completion of the activity, or when requested by the Director, the approval holder shall submit to the Director a certificate of completion which includes:

    (a) a statement that the activity or that part of the activity has been completed in accordance with the approval, and

    (b) any other information required by the Director.

Acting Manager, Regional Support,
Northeast Boreal Region

2001 07 12
Dated (Y/M/D)

Syncrude
Securing Canada's Energy Future

Law Department
Inter-office Correspondence

TO:	Bill Hunter	**REF:**	MD 3065
FROM:	Barry Wolsey	**DATE:**	August 27, 2001

RE: **Monitoring Station - Fort Creek**

Attached is a copy of LOC 011957 just received for this station. The conditions seem fairly standard and I trust you will take care of them, including marvelous #3.

As discussed, I will get back to you regarding a time to show Bruce Faichney as soon as I hear from him.

Thanks,

Barry

[Document4]

LOC 011957

(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: Alberta Sustainable Resource Development
Land and Forest Service
Land Administration Division
Petroleum Plaza, South Tower
9915 – 108th Street
Edmonton, Alberta
T5K 2G8
Telephone: (780) 427-3570

"departmental officer" means: an employee of the Alberta Sustainable Resource Development, Land and Forest Service, 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 Sustainable Resource Development.

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

Alberta Sustainable Resource Development
Land and Forest Service
Main Floor, Petroleum Plaza, South Tower
9915 – 108th 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, 2nd Floor, Petroleum Plaza, South Tower, 9915 – 108th 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 – 108th 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 Client and Licencing Service, Alberta Sustainable Resource Development, 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) For oil and gas activity on land classified as being in the Green Area of the Province (identified on Schedule "B"), the department may, in addition to any other charges, assess a further charge of 50 cents per acre ($1.24 cents per hectare) on every acre or part acre in this authority to fund the Trapper's Compensation Program.

f) 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.

g) This authorization is granted subject to further amendment by the Minister of Sustainable Resource Development, 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. 154 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.

   Waterways Forest Area
   Fort Mc Murray Office
   (780) 743-7120

3. 062 The holder shall within 30 days provide to the department a written consent from the following occupant(s) who hold prior legal rights:
FMA 9100059
Alberta Pacific Forest Industries Inc.
c/o Ever Green Land Use Consulting
2nd Flr., 410 – 6th Street SW
Calgary, Alberta
T2P 1X2

4. 631 Prior to commencement of construction, the holder shall obtain authority under the *Water Act* from Water Management of Alberta Environment at (780) 427-6451.

5. 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 approval and use for incidental activities such as campsites, borrow pits, temporary access, flare pits, remote sumps, trails and other temporary uses.)

6. 177 Unless otherwise approved by a departmental officer, the holder shall use only existing clearings/trails and not clear any new areas.

7. 185 The holder shall utilize the lands only during frozen or dry ground conditions.

8. 193 The holder shall ensure that surface disturbance is kept to a minimum.

9. 216 Total rollback is required.

10. 250 The holder shall dispose of all debris/waste in a manner directed by a departmental officer.

11. 259 The holder shall strip and pile the topsoil separately from any woody material and subsoil in such a manner that it can be distributed evenly over the disturbed area when operations have been completed.

12. 270 Timber salvage is waived.

13. 275 The holder shall not deposit or push debris, soil or other deleterious materials into or through any watercourse or water body or on the ice of any watercourse/water body.

14. 276 Unless otherwise approved by a departmental officer, the holder shall not conduct any activity within the bed of the following watercourse or water body between the dates indicated.
Watercourse/legal description:Fort Creek
Dates: from April 16 to July 15.

15. The holder shall ensure a continuous flow of water is maintained during all phases of activity.

16. 285 Reconstruction of the banks, shoreline and approaches on the following watercourses/water bodies is required as directed by a departmental officer:
Watercourse(s): Fort Creek.

17. 298 The holder shall take all precautions and safeguards necessary to prevent soil/surface erosion.

18. 236 The holder shall destroy restricted weeds and control noxious weeds, as defined by the *Weed Control Act*, on the land included under this authority. Contact the departmental officer for further information.

19. 237 Prior to entry on the land, the holder shall steam clean all equipment, including seeders.

20. 218 The holder shall reclaim all disturbed areas immediately after operations.

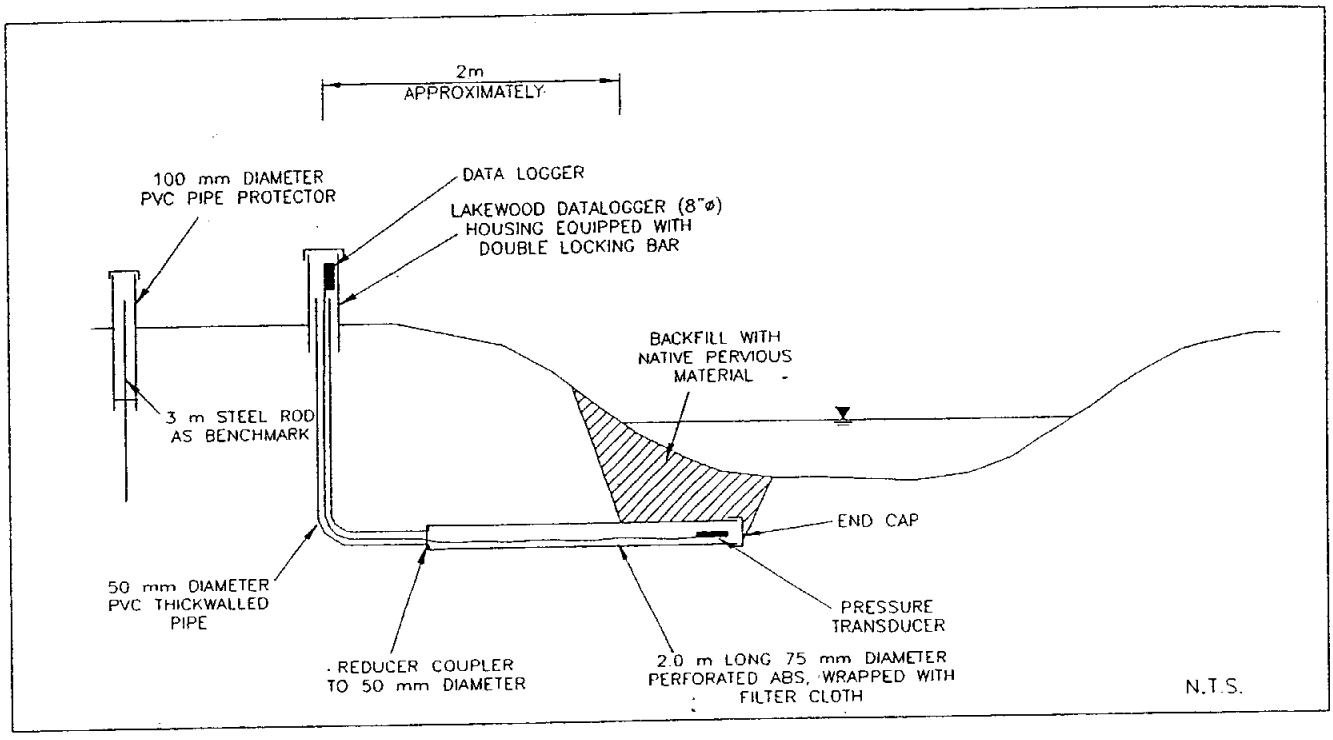
21. 230 Unless otherwise specified by a departmental officer, the holder shall only use seed of suitable native plant species in revegetation. The seed mixture must be approved by a departmental officer. The holder shall provide a certificate of seed analysis for each species to the departmental officer prior to seeding approval.

22. 224 Upon cancellation and abandonment, the holder shall contour the disturbed land to an acceptable land form using subsoil. The holder shall replace topsoil and restore the natural drainage by removing any culverts and fills. In addition, the holder shall, as directed by a departmental officer, take all required measures to minimize the potential for soil erosion and watercourse/water body sedimentation occurring.

23. Access to this site is by foot traffic only, unless otherwise approved by a departmental officer.

24. 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: 5 years.

All licences, authorizations and approvals issued under the *Alberta Environmental Protection 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, 9021 – 46th Street, Edmonton, Alberta, phone: (780) 495-3701 relating to the *Navigable Waters Protection Act*.



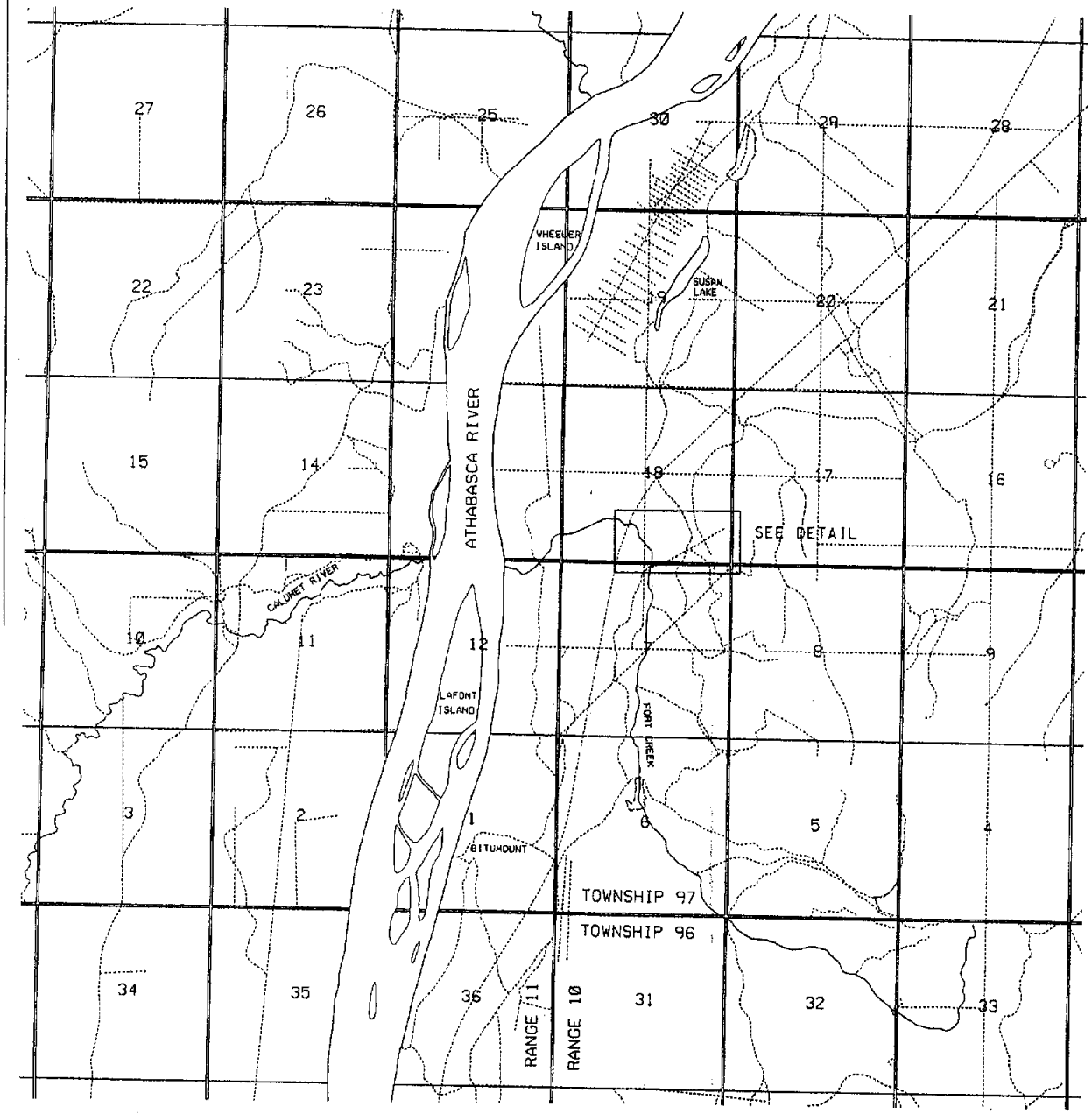
Golder Associates	RAMP

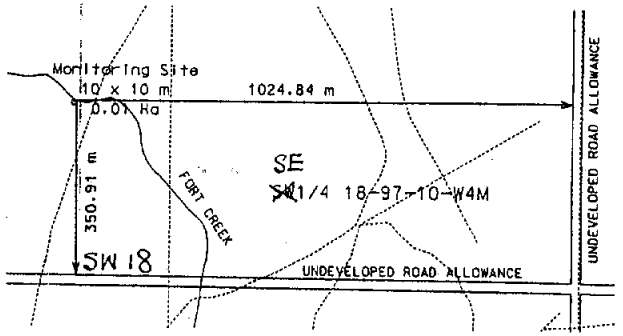
TYPICAL DETAILS OF RIVER/CREEK GAUGING STATION

DRAWN: VS	APPROVED	DATE: 22 Nov 2000
PROJECT: 002-2309.7050		FIGURE: 2

Revision No. 01

J:\2000\2300\002-2309\7050\monitor.dwg





Plan #: 21384TL
Version: 2001.08.08
File: LOC011957
TECHNICAL SERVICES | TEM | WL

Syncrude
Securing Canada's Energy Future

AURORA
APPLICATION FOR WATER
MONITORING SITE - FORT CREEK

APP/DATE April 2001 | DRAWN BY/DATE Kathy P. | SCALE
APP/DATE | CHK/DATE
DRAWING NO. | SHT. OF | REV.

LAND STATUS AUTOMATED SYSTEM

LAND STANDING REPORT

LSRC1130

:NR-LSAS
:EPORT DATE: 2001-08-08 TIME: 14:40:07

REQUESTED BY: LSLEI25 PAGE 1

---------- SELECTION CRITERIA ----------

:EQUESTED LAND LIST: INCLUDE
:ITLE INFORMATION : INCLUDE
:EQUEST 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	

SCHEDULE "B"

---------- REQUESTED ACTIVITY ----------

REQUESTED ACTIVITY: LOC- 011957

---------- REQUESTED LAND ----------

REQUESTED LAND	OWNERSHIP STATUS	TITLE STATUS	ADMINISTERED BY	SURVEY STATUS	-- AREA IN HECTARES --- LAND	TITLE	--- AREA IN ACRES --- LAND	TITLE
4-10-097-18-SW	CROWN	UNTITLED FLW		SURVEYED	64.750		160.00	
TOTAL	CROWN	UNTITLED		SURVEYED	64.750		160.00	

---------- LAND STATUS INFORMATION (TO QUARTER SECTION ONLY) ----------

LAND IDENTIFIER	OWNERSHIP STATUS	TITLE STATUS	ADMINISTERED BY	SURVEY STATUS	-- AREA IN HECTARES --- LAND	TITLE	--- AREA IN ACRES --- LAND	TITLE
4-10-097-18-SW	CROWN	UNTITLED FLW		SURVEYED	64.750		160.00	

---------- GEO-ADMINISTRATIVE AREAS ----------

COAL DEVELOPMENT REGION 4-10-097	NORTHERN FORESTED		CODE: CDR-2
ENVIRONMENT CONS. & RECL. DISTRICT 4-10-097	NO. 4		CODE: ERD-004
FOREST MANAGEMENT UNIT 4-10-097	ATHABASCA FOREST	A7	CODE: FMU-A -07J
FISH & WILDLIFE ADMIN REGION 4-10-097	NORTHEAST REGION	LAC LA BICHE	CODE: FWA-4 -04
FISH AND WILDLIFE DISTRICT	NORTHEAST REGION	FORT MCMURRAY	CODE: FWD-5 -07

GEO-ADMINISTRATIVE AREAS

AND WILDLIFE DISTRICT (CONTINUED)			
4-10-097			
& WILDLIFE REFERRAL LANDS			CODE: FWR-
4-10-097-18			
RAL LANDS CLASSIFICATION	GREEN		CODE: GLC-G
4-10-097			
ING ZONE	C		CODE: GRZ-C
4-10-097			
GRATED RESOURCE PLAN	FT. MCMURRAY ATHABASCA OIL SANDS		CODE: IRP-F1
4-10-097			
IC LAND DISTRICT	NORTHWEST REGION	SHERWOOD PARK	CODE: PLD-6 -6
4-10-097			
ER DISTRICT	NORTHEAST BOREAL	FORT MCMURRAY - WATERWAYS DISTRICT	CODE: RAD-NEB -1C
4-10-097			
IALIZED MUNICIPALITY	REGIONAL MUNICIPALITY OF WOOD BUFFA		CODE: SM -001
4-10-097			

ACTIVITIES

TIVITY	STATUS/TYPE LAND ID	DATE HECTARES	EXPIRY ACRES	CLIENT/INTERIM REMARKS METES AND BOUNDS REMARKS	TOTAL AREA ACRES	 HECTARES
-010002	APPROVED 0530 INDUSTRIAL/COMMERCIAL SITE 4-10-097-18	ON 2001-APR-06 1 NO RESTRICTION 258.999	2004-APR-30 710 SPECIFIED IN COMMENTS FIELD 640.00	TRUENORTH ENERGY CORP	3,891.00	1,574.632
-870307	APPROVED 0530 INDUSTRIAL/COMMERCIAL SITE 4-10-097-18	ON 1988-FEB-11 1 NO RESTRICTION	2005-FEB-28 710 SPECIFIED IN COMMENTS FIELD	ALBERTA ENERGY AND UTILITIES BOAR	817.01	330.632
-9100029	ACTIVE/DISPOSED 4-10-097	ON 1991-SEP-01	2011-AUG-31	JOINT VENTURE PARTIES	* 13,870,652.95	5,613,253.675
- 011957	APPLICATION 4-10-097-18-SW	ON 2001-AUG-08 0.010	 0.02	SYNCRUDE CANADA LTD.	0.02	0.010
- 961526	LOA AMENDMENT 4-10-097-18-SW	ON 1997-MAR-24	2021-DEC-16	NORTHLAND FOREST PRODUCTS LTD.	28.80	11.653
-850171	APPROVED 0322 PROVINCIAL RECREATION AREA POTENTIAL 4-10-097-18-04 4-10-097-18-05	ON 1985-MAR-26 3 NO AGRICULTURAL DISPOS 16.187 16.187	2006-MAR-31 710 SPECIFIED IN COMMENTS FIELD 40.00 40.00	COMMUNITY DEVELOPMENT	4,227.55	1,710.829
-870326	APPROVED 0543 SURFACE MATERIALS POTENTIAL	ON 1987-MAR-01 4 NO SURFACE DISPOSITION	2017-APR-30 620 INDUSTRIAL 710 SPECIFIED IN COMMENTS FIELD 730 WRITTEN AGENCY CONSENTS REQUIR	FORT MCMURRAY OFFICE - LAND AND	10,174.18	4,117.344

ACTIVITIES

ACTIVITY	STATUS/TYPE / LAND ID	DATE / HECTARES	EXPIRY / ACRES	CLIENT/INTERIM REMARKS / METES AND BOUNDS REMARKS	TOTAL AREA ACRES	TOTAL AREA HECTARES
'NT-870326	(CONTINUED)					
	4-10-097-18-03	16.187	40.00			
	4-10-097-18-04	16.187	40.00			
(DS- 780066	ACTIVE/DISPOSED ON 1978-JUL-26		2005-MAY-31	INFRASTRUCTURE, DEPARTMENT OF	0.00	0.000
	4-10-097-18-SW					
FPA- 2137	ACTIVE/DISPOSED ON 1986-AUG-29		2001-JUN-30	FAICHNEY, BRUCE I.	0.00	0.000
	4-10-097-18					

*** NOTE: THE FOLLOWING DISCLAIMER ***

---------- 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.

THIS REPORT DOES NOT SHOW CAVEATS, BUILDERS' LIENS, OR OTHER INSTRUMENTS, IF ANY, REGISTERED AT LAND TITLES OFFICE IN RESPECT OF ANY LANDS OR INTERESTS THEREIN. PERSONS ARE ADVISED TO ALSO EXAMINE RECORDS AT LAND TITLES OFFICE TO ASCERTAIN WHETHER OTHER INSTRUMENTS THAT MAY CONCERN THE LANDS OR INTERESTS THEREIN HAVE BEEN REGISTERED.

*** END OF REPORT ***

Alberta Environment Approval 00153852-00-00

for Ells River Station (S14)

Alberta
ENVIRONMENT

Regional Services
Northeast Boreal Region

Twin Atria
#111, 4999 – 98 Avenue
Edmonton, Alberta T6B 2X3

Telephone: (780) 427-5296
Fax: (780) 422-0528

File: 00153852

September 5, 2001

Mr. Nathan Schmidt
Golder Associates Ltd.
#1000, 940 – 6 Avenue SW
Calgary, Alberta
T2P 3T1

Dear Mr. Schmidt:

**RE: Application under the *Water Act* for an Approval
For the Purpose of Installing a Hydrometric Station in the
Ells River in NW 34-095-11-W4**

Enclosed is the approval authorizing the installation of a hydrometric station in the Ells River in NW 34-095-11-W4.

The *Water Act* provides a right to appeal this decision. Notice of appeal must be submitted not later than 7 days after receipt of this notice to:

Dr. William A. Tillman, Chair
Environmental Appeal Board
3rd Floor, Peace Hills Trust Tower
10011 – 109 Street
Edmonton, Alberta
T5J 3S8

Telephone: (780) 427-6207 Fax: (780) 427-4693

Also enclosed is the "Certificate of Completion" to be submitted upon completion of the activity.

Please ensure that a copy of this approval is available at the site of the activity.

Under the *Water Act,* the Director will provide a public notice of this decision.

In order to reduce the potential of the spread of the Whirling Disease in Fish we ask that all equipment and machinery that has been used in the United States be washed clean of all mud and dirt before being used again in any activities in or near streams in Alberta.

This approval should not be taken to mean that you have an authority under federal legislation. You should contact the

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Fisheries and Oceans
Habitat Management
Whitemud Business Park
4253 – 97 Street
Edmonton, AB T6E 5Y7
Phone: (780) 495-8468
Fax: (780) 495-8606

relating to the application of federal laws relating to the ***Fisheries Act (Canada)*** and the:

Canadian Coast Guard
Navigable Waters Protection
Whitemud Business Park
4253 – 97 Street
Edmonton, AB T6E 5Y7
Phone: (780) 495-6325
Fax: (780) 495-8607

relating to the ***Navigable Waters Protection Act***.

Please notify us should there be a change in the ownership of the land to which this approval is attached.

Please call Tracy Knight at (780) 427-6636 if you have questions.

Sincerely,

Rob George

Patrick Marriott, P.Eng.
Manager, Regional Support, Northeast Boreal Region

Enclosure

cc Larry Rhude - SRD Fisheries Management –Fort McMurray
LFS Field Office - SRD – Fort McMurray

Alberta
ENVIRONMENT

APPROVAL

PURSUANT TO THE PROVISIONS OF THE *WATER ACT*

APPROVAL No. 00153852-00-00

FILE No. 00153852

Canadian Natural Resources Ltd.
#2500, 855 - 2 Street SW
Calgary, Alberta
T2P 3T1

is authorized to construct a hydrometric station on the Ells River in NW 34-095-11-W4 subject to the attached conditions.

2002 09 15
Expiry Date

A/ Rob George
Manager, Regional Support, Northeast Boreal Region

2001 09 05
Dated (Y/M/D)

Approval No. 00153852-00-00
File No. 00153852

CONDITIONS

ACTIVITY

1. This approval is appurtenant to NW 34-095-11-W4.

2. The approval holder shall undertake the activity in accordance with the plans and/or reports filed in the following Departmental records:

NUMBER	TITLE
00153852-P001	Plan Showing Layout of Hydrometric Station S14 Within Theoretical NW 34-95-11-W4
00153852-P002	Typical Hydrometric Station Installation

3. The approval holder shall confine the activity to the work area designated on the plans or to areas as prescribed in the approval.

4. The approval holder shall reclaim any disturbed bed and banks of the water body and areas associated with the activity to the original contours that existed prior to the commencement of the activity.

5. The approval holder shall not deposit any substance that will adversely affect the water body.

6. The approval holder shall prevent siltation and erosion of the water body resulting from the activity.

7. Where applicable, the approval holder shall only release water to a water body when the quality of water is equal to or better than the quality of water in the receiving water body.

8. The approval holder shall maintain a continuous flow of water in the water body for the duration of the activity.

9. The approval holder shall not conduct activities in the water body between September 16 and July 15 unless the water body is dry.

GENERAL

10. The activity authorized under this approval shall be completed by September 15, 2002.

CONDITIONS

11. The approval holder shall hold harmless the Minister of Environment or any other agent of the Government of Alberta for damage or damage claims arising out of the activity.

12. The approval holder shall retain a copy of this approval at the site of the activity.

13. On completion, partial completion of the activity, or when requested by the Director, the approval holder shall submit to the Director a certificate of completion which includes:

    (a) a statement that the activity or that part of the activity has been completed in accordance with the approval, and

    (b) any other information required by the Director.

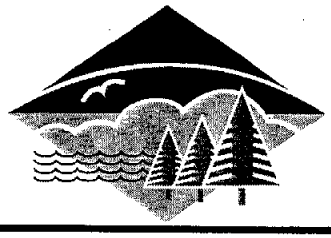
A/ Rob Grenz

Manager, Regional Support, Northeast Boreal Region

2001 09 05

Dated (Y/M/D)

Alberta
ENVIRONMENT



CERTIFICATE OF COMPLETION

PURSUANT TO THE PROVISIONS OF THE *WATER ACT*

APPROVAL No. 00153852-00-00

FILE No. 00153852

Canadian Natural Resources Ltd.
#2500, 855 - 2 Street SW
Calgary, Alberta
T2P 3T1

certifies the activity was completed in accordance with the conditions of Approval No. **00153852-00-00.**

_____
Approval Holder's Signature

_____
Dated (Y/M/D)

Alberta Environment Approval 00153918-00-00

for Tar River Station (S15),

Calumet River Station (S16),

and Calumet River Upland Station (S18)

Alberta
ENVIRONMENT

Regional Services
Northeast Boreal Region

Twin Atria
#111, 4999 – 98 Avenue
Edmonton, Alberta T6B 2X3

Telephone: (780) 427-5296
Fax: (780) 422-0528

File: 00153918

September 25, 2001

Mr. Nathan Schmidt
Golder Associates Ltd.
#1000, 940 – 6 Avenue SW
Calgary, Alberta
T2P 3T1

Dear Mr. Schmidt:

RE: Application under the *Water Act* for an Approval
For the Purpose of Installing Hydrometric Stations in the
Tar River in SW 29-096-11-W4 and the Calumet River in SE 10 & SW 30-097-11-W4

Enclosed is the approval authorizing the installation of hydrometric stations in the Tar River in SW 29-096-11-W4 and the Calumet River in SE 10 & SW 30-097-11-W4.

The *Water Act* provides a right to appeal this decision. Notice of appeal must be submitted not later than 7 days after receipt of this notice to:

Dr. William A. Tillman, Chair
Environmental Appeal Board
3rd Floor, Peace Hills Trust Tower
10011 – 109 Street
Edmonton, Alberta
T5J 3S8

Telephone: (780) 427-6207 Fax: (780) 427-4693

Also enclosed is the "Certificate of Completion" to be submitted upon completion of the activity.

Please ensure that a copy of this approval is available at the site of the activity.

Under the *Water Act,* the Director will provide a public notice of this decision.

In order to reduce the potential of the spread of the Whirling Disease in Fish we ask that all equipment and machinery that has been used in the United States be washed clean of all mud and dirt before being used again in any activities in or near streams in Alberta.

This approval should not be taken to mean that you have an authority under federal legislation. You should contact the

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Fisheries and Oceans
Habitat Management
Whitemud Business Park
4253 – 97 Street
Edmonton, AB T6E 5Y7
Phone: (780) 495-8468
Fax: (780) 495-8606

relating to the application of federal laws relating to the ***Fisheries Act (Canada)*** and the:

Canadian Coast Guard
Navigable Waters Protection
Whitemud Business Park
4253 – 97 Street
Edmonton, AB T6E 5Y7
Phone: (780) 495-6325
Fax: (780) 495-8607

relating to the ***Navigable Waters Protection Act***.

Please notify us should there be a change in the ownership of the land to which this approval is attached.

Please call Tracy Knight at (780) 427-6636 if you have questions.

Sincerely,

Patrick Marriott, P.Eng.
Manager, Regional Support, Northeast Boreal Region

Enclosure

cc Larry Rhude - SRD Fisheries Management –Fort McMurray
LFS Field Office - SRD – Fort McMurray

Alberta
ENVIRONMENT

APPROVAL

PURSUANT TO THE PROVISIONS OF THE *WATER ACT*

APPROVAL No. 00153918-00-00

FILE No. 00153918

Canadian Natural Resources Ltd.
#2500, 855 - 2 Street SW
Calgary, Alberta
T2P 4J8

is authorized to construct hydrometric stations on the Tar River in SW 29-096-11-W4 and on the Calumet River in SE 10 & SW 30-097-11-W4 subject to the attached conditions.

2002 09 24
Expiry Date

Manager, Regional Support, Northeast Boreal Region

2001 09 25
Dated (Y/M/D)

Approval No. 00153918-00-00
File No. 00153918

CONDITIONS

ACTIVITY

1. This approval is appurtenant to

   SW 29-096-11-W4, SE 10 & SW 30-097-11-W4

2. The approval holder shall undertake the activity in accordance with the plans and/or reports filed in the following Departmental records:

NUMBER	TITLE
00153918-P001	Plan Showing Layout of Hydrometric Station S15 Within Theoretical SW 29-096-11-W4
00153918-P002	Plan Showing Layout of Hydrometric Station S16 Within Theoretical SE 10-097-11-W4
00153918-P003	Plan Showing Layout of Hydrometric Station S18 Within Theoretical SW 30-097-11-W4
00153918-P004	Typical Hydrometric Station Installation

3. The approval holder shall confine the activity to the work area designated on the plans or to areas as prescribed in the approval.

4. The approval holder shall reclaim any disturbed bed and banks of the water body and areas associated with the activity to the original contours that existed prior to the commencement of the activity.

5. The approval holder shall not deposit any substance that will adversely affect the water body.

6. The approval holder shall prevent siltation and erosion of the water body resulting from the activity.

7. Where applicable, the approval holder shall only release water to a water body when the quality of water is equal to or better than the quality of water in the receiving water body.

8. The approval holder shall not conduct activities in the water body between April 16 and July 16 unless the water body is dry.

GENERAL

CONDITIONS

9. The activity authorized under this approval shall be completed by September 24, 2002.

10. The approval holder shall hold harmless the Minister of Environment or any other agent of the Government of Alberta for damage or damage claims arising out of the activity.

11. The approval holder shall retain a copy of this approval at the site of the activity.

12. On completion, partial completion of the activity, or when requested by the Director, the approval holder shall submit to the Director a certificate of completion which includes:

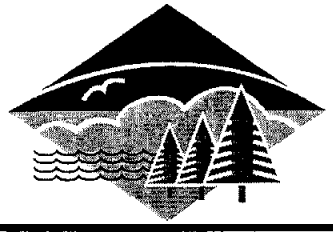
    (a) a statement that the activity or that part of the activity has been completed in accordance with the approval, and

    (b) any other information required by the Director.

Manager, Regional Support, Northeast Boreal Region

2001 09 25
Dated (Y/M/D)

Alberta
ENVIRONMENT



CERTIFICATE OF COMPLETION

PURSUANT TO THE PROVISIONS OF THE *WATER ACT*

APPROVAL No. 00153918-00-00

FILE No. 00153918

Canadian Natural Resources Ltd.
#2500, 855 - 2 Street SW
Calgary, Alberta
T2P 4J8

certifies the activity was completed in accordance with the conditions of Approval No. **00153918-00-00.**

_____
Approval Holder's Signature

_____
Dated (Y/M/D)

Alberta Environment Approval 00153919-00-00

for Tar River Upland Station (S17),

and Tar River Lowland Station (S19)

Alberta
ENVIRONMENT

Regional Services
Northeast Boreal Region

Twin Atria
#111, 4999 – 98 Avenue
Edmonton, Alberta T6B 2X3

Telephone: (780) 427-5296
Fax: (780) 422-0528

File: 00153919

September 25, 2001

Mr. Nathan Schmidt
Golder Associates Ltd.
#1000, 940 – 6 Avenue SW
Calgary, Alberta
T2P 3T1

Dear Mr. Schmidt:

RE: Application under the *Water Act* for an Approval
For the Purpose of Installing Hydrometric Stations in the
Unnamed Creeks in NW 29-096-12-W4 and NW 10-096-11-W4

Enclosed is the approval authorizing the installation of hydrometric stations in the unnamed creeks in NW 29-096-12-W4 and NW 10-096-11-W4.

The *Water Act* provides a right to appeal this decision. Notice of appeal must be submitted not later than 7 days after receipt of this notice to:

Dr. William A. Tillman, Chair
Environmental Appeal Board
3rd Floor, Peace Hills Trust Tower
10011 – 109 Street
Edmonton, Alberta
T5J 3S8

Telephone: (780) 427-6207 Fax: (780) 427-4693

Also enclosed is the "Certificate of Completion" to be submitted upon completion of the activity.

Please ensure that a copy of this approval is available at the site of the activity.

Under the *Water Act,* the Director will provide a public notice of this decision.

In order to reduce the potential of the spread of the Whirling Disease in Fish we ask that all equipment and machinery that has been used in the United States be washed clean of all mud and dirt before being used again in any activities in or near streams in Alberta.

This approval should not be taken to mean that you have an authority under federal legislation. You should contact the

.../2

Fisheries and Oceans
Habitat Management
Whitemud Business Park
4253 – 97 Street
Edmonton, AB T6E 5Y7
Phone: (780) 495-8468
Fax: (780) 495-8606

relating to the application of federal laws relating to the ***Fisheries Act (Canada)*** and the:

Canadian Coast Guard
Navigable Waters Protection
Whitemud Business Park
4253 – 97 Street
Edmonton, AB T6E 5Y7
Phone: (780) 495-6325
Fax: (780) 495-8607

relating to the ***Navigable Waters Protection Act***.

Please notify us should there be a change in the ownership of the land to which this approval is attached.

Please call Tracy Knight at (780) 427-6636 if you have questions.

Sincerely,

Patrick Marriott, P.Eng.
Manager, Regional Support, Northeast Boreal Region

Enclosure

cc Larry Rhude - SRD Fisheries Management –Fort McMurray
LFS Field Office - SRD – Fort McMurray

Alberta
ENVIRONMENT

APPROVAL

PURSUANT TO THE PROVISIONS OF THE *WATER ACT*

APPROVAL No. 00153919-00-00

FILE No. 00153919

Canadian Natural Resources Ltd.
#2500, 855 - 2 Street SW
Calgary, Alberta
T2P 4J8

is authorized to construct hydrometric stations on the unnamed creeks in NW 10-096-11-W4 and NW 29-096-12-W4 subject to the attached conditions.

2002 09 24
Expiry Date

Manager, Regional Support, Northeast Boreal Region

2001 09 25
Dated (Y/M/D)

Approval No. 00153919-00-00
File No. 00153919

CONDITIONS

ACTIVITY

1. This approval is appurtenant to NW 10-096-11-W4 & NW 29-096-12-W4.

2. The approval holder shall undertake the activity in accordance with the plans and/or reports filed in the following Departmental records:

NUMBER	TITLE
00153919-P001	Plan Showing Layout of Hydrometric Station S17 Within Theorectical NW 29-096-12-W4
00153919-P002	Plan Showing Layout of Hydrometric Station S19 Within Theorectical NW 10-096-11-W4
00153919-P003	Typical Hydrometric Station Installation

3. The approval holder shall confine the activity to the work area designated on the plans or to areas as prescribed in the approval.

4. The approval holder shall reclaim any disturbed bed and banks of the water body and areas associated with the activity to the original contours that existed prior to the commencement of the activity.

5. The approval holder shall not deposit any substance that will adversely affect the water body.

6. The approval holder shall prevent siltation and erosion of the water body resulting from the activity.

7. Where applicable, the approval holder shall only release water to a water body when the quality of water is equal to or better than the quality of water in the receiving water body.

8. The approval holder shall not conduct activities in the water body between April 16 and July 16 unless the water body is dry.

GENERAL

9. The activity authorized under this approval shall be completed by September 24, 2002.

CONDITIONS

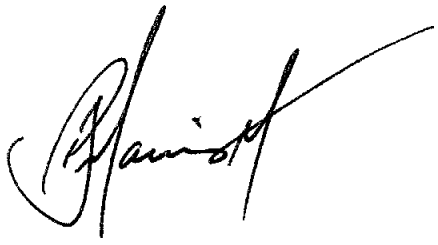
10. The approval holder shall hold harmless the Minister of Environment or any other agent of the Government of Alberta for damage or damage claims arising out of the activity.

11. The approval holder shall retain a copy of this approval at the site of the activity.

12. On completion, partial completion of the activity, or when requested by the Director, the approval holder shall submit to the Director a certificate of completion which includes:

    (a) a statement that the activity or that part of the activity has been completed in accordance with the approval, and

    (b) any other information required by the Director.



Manager, Regional Support, Northeast Boreal Region

2001 09 25
Dated (Y/M/D)

Alberta
ENVIRONMENT

CERTIFICATE OF COMPLETION

PURSUANT TO THE PROVISIONS OF THE *WATER ACT*

APPROVAL No. 00153919-00-00

FILE No. 00153919

Canadian Natural Resources Ltd.
#2500, 855 - 2 Street SW
Calgary, Alberta
T2P 3T1

certifies the activity was completed in accordance with the conditions of Approval No. **00153919-00-00.**

_____
Approval Holder's Signature

_____
Dated (Y/M/D)

Alberta Environment Approval 00152942-00-00

for Muskeg River Upland Station (S20),

Shelley Creek Station (S21),

Muskeg Creek Station (S22),

and Khahago Creek Station (S28).

Alberta
ENVIRONMENT

Northeast Boreal Region
Regional Support

Main Floor, Twin Atria
111, 4999 - 98 Avenue
Edmonton, Alberta
T6B 2X3

Telephone 780 427-5296
Fax 780 422-0528

00152942

August 16, 2001

Mr. Nathan Schmidt
Golder Associates Ltd.
1000, 940 – 6th Avenue SW
Calgary, Alberta
T2P 3T1

Dear Mr. Schmidt:

RE: Application under the *Water Act*
Shell Canada Limited
Proposed Hydrometric Stations

Enclosed is an approval authorizing the construction of the above activity.

The *Water Act* provides a right to appeal this decision. Notice of appeal must be submitted not later than seven (7) days after the receipt of this notice to:

Dr. William A. Tillman, Chair
Environmental Appeal Board
3rd Floor, Peace Hills Trust Tower
10011 – 109 Street
Edmonton, Alberta, T5J 3S8
Telephone: (780) 427-6207
Fax: (780) 427-4693

Also enclosed is the "Certificate of Completion" to be submitted to our office upon completion of the construction.

Please ensure that a copy of this approval is posted and available at the site of the activity.

Under the *Water Act*, the Director will provide a public notice of this decision. The notice will be posted in the Fort McMurray Fish and Wildlife Office and in the Edmonton Regional office of Alberta Environment.

.../2

In order to reduce the potential of the spread of *Whirling Disease* in fish, we ask that all equipment and machinery that has been used in the United States be washed clean of all mud and dirt before being used again in any activities in or near streams in Alberta.

This approval should not be taken to mean that you have an authority under federal legislation. Please contact:

Fisheries and Oceans
Habitat Management
4253 – 97 Street
Edmonton, AB T6E 5Y7
(telephone: 780-495-8468)

relating to the application of federal laws relating to the ***Fisheries Act (Canada)*** and the:

Canadian Coast Guard
Navigable Waters Protection
4253 – 97 Street
Edmonton, AB T6E 5Y7
(telephone: 780-495-6325)

relating to the ***Navigable Waters Protection Act.***

Please note that you may require an authorization under the *Public Lands Act*.

Please call Dale Adams at (780) 427-7556 if you have any questions.

Sincerely,

Patrick Marriott, P.Eng.
Manager, Regional Support
Northeast Boreal Region

enclosure

cc: L. Rhude
T. Sayers

Alberta
ENVIRONMENT

APPROVAL

PURSUANT TO THE PROVISIONS OF THE *WATER ACT*

APPROVAL No. 00152942-00-00

FILE No. 00152942

Shell Canada Limited
400, 4th Avenue SW
Calgary, Alberta
T2P 2H5

is authorized to install hydrometric stations on the bed and banks of the Muskeg River, Muskeg Creek, Khahago Creek and Shelley Creek subject to the attached conditions.

2002 08 15
Expiry Date

Manager, Regional Support, Northeast Boreal Region

2001 08 16
Dated (Y/M/D)

Approval No. 00152942-00-00
File No. 00152942

CONDITIONS

ACTIVITY

1. This approval is appurtenant to:

   SE ¼ 19-096-07-W4
   SE ¼ 36-095-09-W4
   SW ¼ 12-095-09-W4
   NE ¼ 28-095-09-W4

2. The approval holder shall undertake the activity in accordance with the plans and/or reports filed in the following Departmental records:

NUMBER	TITLE
00152942-P001	Site Plan – Muskeg River
00152942-P002	Site Plan – Muskeg Creek
00152942-P003	Site Plan – Khahago Creek
00152942-P004	Site Plan – Shelley Creek
00152942-P005	Typical Installation Details

3. The approval holder shall confine the activity to the work area designated on the plans or to areas as prescribed in the approval.

4. The approval holder shall reclaim any disturbed bed and banks of the water bodies and areas associated with the activity to the original contours that existed prior to the commencement of the activity.

5. The approval holder shall not deposit any substance that will adversely affect the water bodies.

6. The approval holder shall prevent siltation and erosion of all water bodies resulting from the activity.

7. The approval holder shall maintain a continuous flow of water in the water bodies for the duration of the activity.

8. The approval holder shall not conduct activities in the water bodies between April 16 and July 15 unless the water bodies are dry.

CONDITIONS

GENERAL

9. The activity authorized under this approval shall be completed by August 15, 2002.

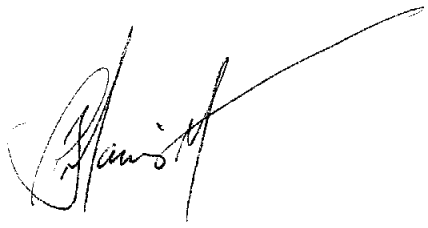
10. The approval holder shall hold harmless the Minister of Environment or any other agent of the Government of Alberta for damage or damage claims arising out of the activity.

11. The approval holder shall retain a copy of this approval at the site of the activity.

12. On completion, partial completion of the activity, or when requested by the Director, the approval holder shall submit to the Director a certificate of completion which includes:

    (a) a statement that the activity or that part of the activity has been completed in accordance with the approval, and

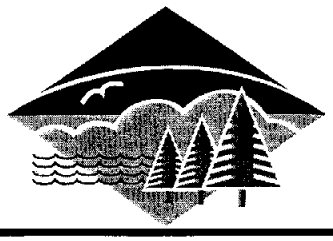
    (b) any other information required by the Director.



Manager, Regional Support, Northeast Boreal Region

2001 08 16
Dated (Y/M/D)

Alberta
ENVIRONMENT



CERTIFICATE OF COMPLETION

PURSUANT TO THE PROVISIONS OF THE *WATER ACT*

APPROVAL No. 00152942-00-00

FILE No. 00152942

Shell Canada Limited
400, 4th Avenue SW
Calgary, Alberta
T2P 2H5

certifies the activity was completed in accordance with the conditions of Approval No. **00152942-00-00.**

_____

Approval Holder's Signature

_____

Dated (Y/M/D)

Alberta Environment Approval 00152948-00-00

for Athabasca River Station (S24)

Alberta
ENVIRONMENT

Northeast Boreal Region
Regional Support

Main Floor, Twin Atria
111, 4999 - 98 Avenue
Edmonton, Alberta
T6B 2X3

Telephone 780 427-5296
Fax 780 422-0528

00152948

August 16, 2001

Mr. Nathan Schmidt
Golder Associates Ltd.
1000, 940 – 6th Avenue SW
Calgary, Alberta
T2P 3T1

Dear Mr. Schmidt:

RE: Application under the *Water Act*
Syncrude Canada Limited
Proposed Hydrometric Station

Enclosed is an approval authorizing the construction of the above activity.

The *Water Act* provides a right to appeal this decision. Notice of appeal must be submitted not later than seven (7) days after the receipt of this notice to:

Dr. William A. Tillman, Chair
Environmental Appeal Board
3rd Floor, Peace Hills Trust Tower
10011 – 109 Street
Edmonton, Alberta, T5J 3S8
Telephone: (780) 427-6207
Fax: (780) 427-4693

Also enclosed is the "Certificate of Completion" to be submitted to our office upon completion of the construction.

Please ensure that a copy of this approval is posted and available at the site of the activity.

Under the *Water Act*, the Director will provide a public notice of this decision. The notice will be posted in the Fort McMurray Fish and Wildlife Office and in the Edmonton Regional office of Alberta Environment.

.../2

In order to reduce the potential of the spread of *Whirling Disease* in fish, we ask that all equipment and machinery that has been used in the United States be washed clean of all mud and dirt before being used again in any activities in or near streams in Alberta.

This approval should not be taken to mean that you have an authority under federal legislation. Please contact:

Fisheries and Oceans
Habitat Management
4253 – 97 Street
Edmonton, AB T6E 5Y7
(telephone: 780-495-8468)

relating to the application of federal laws relating to the ***Fisheries Act (Canada)*** and the:

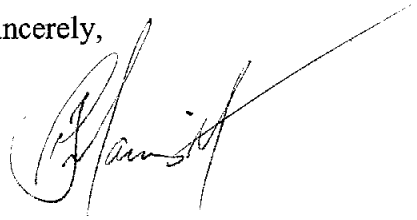
Canadian Coast Guard
Navigable Waters Protection
4253 – 97 Street
Edmonton, AB T6E 5Y7
(telephone: 780-495-6325)

relating to the ***Navigable Waters Protection Act.***

Please note that you may require an authorization under the *Public Lands Act.*

Please call Dale Adams at (780) 427-7556 if you have any questions.

Sincerely,



Patrick Marriott, P.Eng.
Manager, Regional Support
Northeast Boreal Region

enclosure

cc: L. Rhude
T. Sayers

Alberta
ENVIRONMENT

APPROVAL

PURSUANT TO THE PROVISIONS OF THE *WATER ACT*

APPROVAL No. 00152948-00-00

FILE No. 00152948

AUG 2 1 2001

Syncrude Canada Limited
P.O. Box 4009, MD 3065
Fort McMurray, Alberta
T9H 3L1

is authorized to install a hydrometric station on the bed and banks of the Athabasca River subject to the attached conditions.

2002 08 15
Expiry Date

Manager, Regional Support, Northeast Boreal Region

2001 08 16
Dated (Y/M/D)

Approval No. 00152948-00-00
File No. 00152948

CONDITIONS

ACTIVITY

1. This approval is appurtenant to: NE ¼ 09-098-10-W4

2. The approval holder shall undertake the activity in accordance with the plans and/or reports filed in the following Departmental records:

NUMBER	TITLE
00152948-P001	Site Plan – Athabasca River
00152948-P002	Typical Installation Details

3. The approval holder shall confine the activity to the work area designated on the plans or to areas as prescribed in the approval.

4. The approval holder shall reclaim any disturbed bed and banks of the water body and areas associated with the activity to the original contours that existed prior to the commencement of the activity.

5. The approval holder shall not deposit any substance that will adversely affect the water body.

6. The approval holder shall prevent siltation and erosion of the water body resulting from the activity.

7. The approval holder shall maintain a continuous flow of water in the water body for the duration of the activity.

8. The approval holder shall not conduct activities in the water body between September 16 and July 15 unless the water body is dry.

GENERAL

9. The activity authorized under this approval shall be completed by August 15, 2002.

10. The approval holder shall hold harmless the Minister of Environment or any other agent of the Government of Alberta for damage or damage claims arising out of the activity.

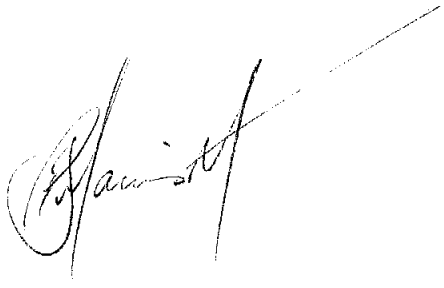
CONDITIONS

11. The approval holder shall retain a copy of this approval at the site of the activity.

12. On completion, partial completion of the activity, or when requested by the Director, the approval holder shall submit to the Director a certificate of completion which includes:

    (a) a statement that the activity or that part of the activity has been completed in accordance with the approval, and

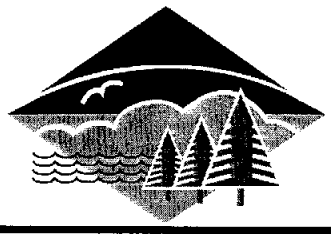
    (b) any other information required by the Director.



Manager, Regional Support, Northeast Boreal Region

2001 08 16
Dated (Y/M/D)

Alberta
ENVIRONMENT



CERTIFICATE OF COMPLETION

PURSUANT TO THE PROVISIONS OF THE *WATER ACT*

APPROVAL No. 00152948-00-00

FILE No. 00152948

Syncrude Canada Limited
P.O. Box 4009, MD 3065
Fort McMurray, Alberta
T9H 3L1

certifies the activity was completed in accordance with the conditions of Approval No. **00152948-00-00.**

_____
Approval Holder's Signature

_____
Dated (Y/M/D)