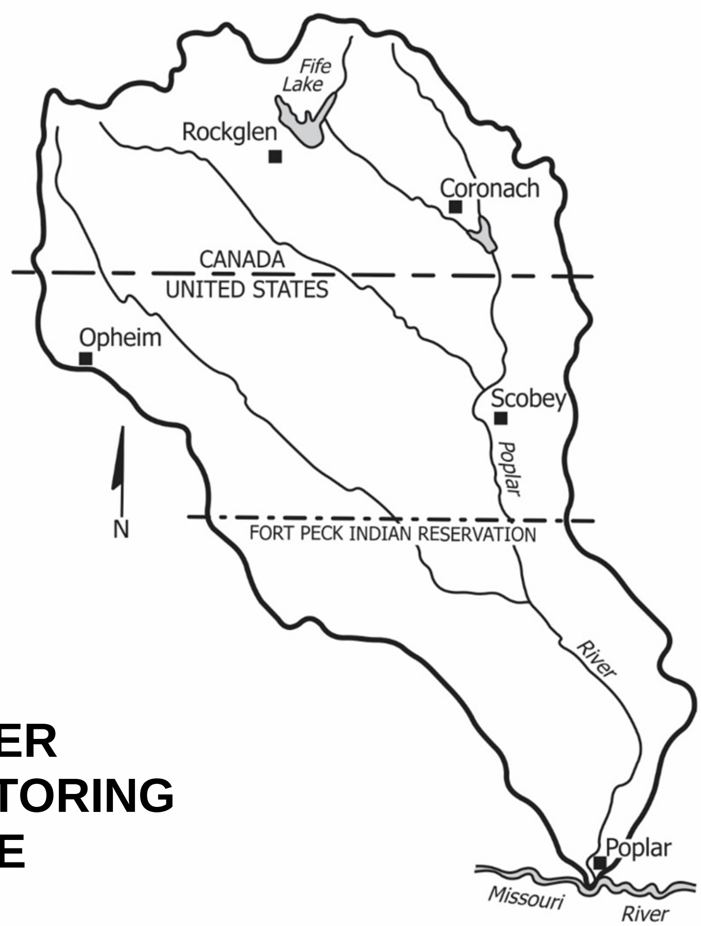
2019 ANNUAL REPORT

to the

GOVERNMENTS OF CANADA, UNITED STATES,

SASKATCHEWAN AND MONTANA



by the

POPLAR RIVER
BILATERAL MONITORING
COMMITTEE

COVERING CALENDAR YEAR 2019

June 2020

Poplar River Bilateral Monitoring Committee

Department of State
Washington, D.C., United States

Global Affairs Canada,
Ottawa, Ontario, Canada

Governor's Office
State of Montana
Helena, Montana, United States

Water Security Agency
Moose Jaw, Saskatchewan, Canada

Ladies and Gentlemen:

Herein is the 38th Annual Report of the Poplar River Bilateral Monitoring Committee. This report discusses the Committee activities of 2019 and presents the Technical Monitoring Schedules for the year 2020.

During 2019, the Poplar River Bilateral Monitoring Committee continued to fulfill the responsibilities assigned by the governments under the Poplar River Cooperative Monitoring Agreement dated September 23, 1980. Through exchange of Diplomatic Notes, the Arrangement was extended in March 1987, July 1992, July 1997, March 2002, April 2007, March 2012, and March 2017. The Monitoring Committee is currently extended to March 2022.

The enclosed report summarizes observed water-quality conditions and compares them to guidelines for specific parameter values that were developed by the International Joint Commission (IJC) under the 1977 Reference from Canada and the United States. After evaluation of the monitoring information for 2019, the Committee finds that the measured conditions meet the recommended objectives.

Based on the March 1 to May 31, 2018 runoff volume of 3,510 dam^3 (2,840 acre-feet) recorded at the Poplar River at International Boundary gauging station, Montana was entitled to an additional release of 370 dam^3 (300 acre-feet) from Cookson Reservoir during the succeeding twelve-month period commencing May 1, 2019. Montana requested this release to be made between May 1 and May 31, 2019. A volume of 483 dam^3 (392 acre-feet), in addition to the minimum flow, was delivered during this period.

During 2019, monitoring continued in accordance with Technical Monitoring Schedules outlined in the 2018 Annual Report of the Poplar River Bilateral Monitoring Committee.

Yours sincerely,

John M.
JOHN KILPATRICK
2020.07.16 08:18:15 -06'00'
John Kilpatrick
Chair, United States Section

Jan Langel
Member, United States Section

Patrick Cherneski
Canadian Section

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Member, Canadian Section

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Poplar River Power Station was operated as base load plant supplying the maximum production except when system constraint and outages dictated otherwise. There was a scheduled maintenance outage for Unit 2 in the spring and Unit 1 in the spring and fall so as not to coincide with system peak demand period that occur over the summer and winter periods.

Between January 1 and December 31, 2019, Poplar River Power Station generated 3,606,659 MW hours. During this time approximately 2,758,000 tonnes of coal and 1,975 m^3 of fuel oil were consumed. The average capacity factors for Unit No. 1 and Unit No. 2 were 53.9% and 76.8% respectively.

Monitoring information collected in both Canada and the United States during 2019 was exchanged in the spring of 2020.

The IJC apportionment recommendation entitles Montana to an on-demand release to be delivered in the East Poplar River during the twelve-month period commencing June 1. Based on the March 1 to May 31, 2018 runoff volume of 3,510 dam^3 (2,840 acre-feet) recorded at the Poplar River at International Boundary gauging station, Montana was entitled to an additional release of 370 dam^3 (300 acre-feet) from Cookson Reservoir during the succeeding twelve-month period commencing May 1, 2019. Montana requested this release to be made between May 1 and May 31, 2019. A volume of 483 dam^3 (392 acre-feet), in addition to the minimum flow, was delivered during this period.

The recorded volume of the Poplar River at International Boundary from March 1 to May 31, 2019 was 28,100 dam^3 (22,781 acre-feet). Based on IJC recommendations and the assumption that the recorded flow is the natural flow, the United States was entitled to a minimum discharge on the East Poplar River of 0.085 cubic metres per second (m^3/s) (3.0 cubic feet per second (ft^3/s) for the period June 1, 2019 to August 31, 2019, and 0.057 m^3/s (2.0 ft^3/s) for the period September 1, 2019 to May 31, 2020.

Daily flows during 2019 met or exceeded the minimum flow recommended by the IJC during the year except, for several periods during June 6-19, August 1-5, August 19-25 and August 9, 11, 30 and 31. According to SaskPower, unintentional periods below minimum flows in 2019 were not caused by operational or maintenance difficulties, and SaskPower worked to minimize these instances to the greatest extent. SaskPower notes that protocols, communication and a new gate control system are expected to reduce the number of days where minimum flows are not met in the future.

The 2019 five-year estimated flow-weighted TDS concentrations were below the long-term objective of 1,000 milligrams per litre (mg/L). The maximum monthly five-year estimated flow-weighted concentration value in 2019 was about 824 mg/L. The 2019 five-year estimated flow-weighted boron concentrations remained well below the long-term objective of 2.5 mg/L.

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1.0 INTRODUCTION

The Poplar River Bilateral Monitoring Committee was authorized for an initial period of five years by the Governments of Canada and the United States under the Poplar River Cooperative Monitoring Arrangement dated September 23, 1980. A copy of the Arrangement is attached to this report as Annex 1. Through exchange of Diplomatic Notes, the Arrangement was extended in March 1987, July 1992, July 1997, March 2002, April 2007, March 2012, and March 2017. The Monitoring Committee is currently extended to March 2022. A more detailed account of the historical background of the Monitoring Arrangement is contained in the 1990 Annual Report of the Poplar River Bilateral Monitoring Committee.

The Committee oversees monitoring programs designed to evaluate the potential for transboundary impacts from SaskPower's (formerly Saskatchewan Power Corporation) coal-fired thermal generating station and ancillary operations near Coronach, Saskatchewan. Monitoring is conducted in Canada and the United States at or near the International Boundary for quantity and quality of surface and ground water and for air quality. Participants from both countries, including Federal, State and Provincial agencies, are involved in monitoring.

The Committee submits an annual report to Governments which summarizes the monitoring results, evaluates apparent trends, and compares the data to objectives or standards recommended by the International Joint Commission (IJC) to Governments, or relevant State, Provincial, or Federal standards. The Committee reports to Governments on a calendar year basis. The Committee is also responsible for drawing to the attention of Governments definitive changes in monitored parameters which may require immediate attention.

A responsibility of the Committee is to review the adequacy of the monitoring programs in both countries and make recommendations to Governments on the Technical Monitoring Schedules. The Schedules are updated annually for new and discontinued programs and for modifications in sampling frequencies, parameter lists, and analytical techniques of ongoing programs. The Technical Monitoring Schedules listed in the annual report (Annex 2) are given for the year 2020. The Committee will continue to review and propose changes to the Technical Monitoring Schedules as information requirements change.

2.0 COMMITTEE ACTIVITIES

2.1 Membership

The Committee is composed of representatives of the Governments of the United States of America and Canada, the State Government of Montana, and the Provincial Government of Saskatchewan. In addition to the representatives of Governments, two ex-officio members serve as local representatives for the State of Montana and Province of Saskatchewan.

During 2019, the members of the Committee included: Ms. Jill Frankforter, U.S. Geological Survey, United States representative and Co-chair; Mr. Mike Renouf, Environment and Climate Change Canada, Canadian representative and Co-chair; Mr. Jan Langel, Montana Department of Natural Resources and Conservation, Montana representative; Mr. Kei Lo, Saskatchewan Water Security Agency, Saskatchewan representative; and Mr. Donald Kirby, Reeve R.M., of Hart Butte, Saskatchewan local ex-officio representative; and Mr. Lee Humbert, Daniels County Commissioner of Scobey, Montana local ex-officio representative.

2.2 Meetings

The Committee met via a conference call on July 9, 2019. Delegated representatives of Governments, with the exception of the ex-officio member from Saskatchewan, participated in the meeting. In addition to Committee members, several technical advisors representing Federal, State, and Provincial agencies also participated. Committee members reviewed the operational status of the Poplar River Power Station and associated coal-mining activities; examined data collected in 2018 including surface-water quality and quantity, ground-water quality and quantity, and air quality; discussed proposed changes in the water-quality sampling program; and established the Technical Monitoring Schedules for the year 2020.

2.3 Review of Water-Quality Objectives

The IJC in its Report to Governments, titled "Water Quality in the Poplar River Basin," recommended that the Committee periodically review the water-quality objectives within the overall Basin context and recommend new and revised objectives as appropriate. In 1991, an action item from the annual Committee meeting set in motion the review and revision of the water-quality objectives.

In 1993, the Committee approved changes in water-quality objectives recommended by the subcommittee that was formed in 1992 to review the objectives. The Committee also discussed the water-quality objectives for 5-year and 3-month flow-weighted concentrations for total dissolved solids and boron. Although the Committee agreed that calculation procedures to determine flow-weighted concentrations are time consuming and probably scientifically questionable, no consensus was reached on alternative objectives or procedures.

In 1997, the Committee agreed to suspend the monitoring and reporting of several parameters. The parameters affected were: dissolved aluminum, un-ionized ammonia, total chromium, dissolved copper, mercury in fish tissues, fecal coliform, and total coliform. The Committee also agreed to other minor revisions for clarification purposes; for example, changing the designation for pH from "natural" to "ambient".

In 1999, the Committee replaced the term "discontinued" with "suspended" in Table 2.1.

In 2001, the Committee suspended the monitoring of dissolved mercury and total copper. This decision was based on data indicating concentrations or levels well below or within the objectives. Current objectives approved by the Committee are listed in Table 2.1.

The Committee also agreed to periodically review all parameters for which monitoring has been suspended.

Another responsibility of the Committee has included an ongoing exchange of data acquired through the monitoring programs. Exchanged data and reports are available for public viewing at the agencies of the participating governments or from Committee members.

2.4 Data Exchange

The Committee is responsible for assuring exchange of data between governments. The exchange of monitoring information was initiated in the first quarter of 1981 and was an expansion of the informal quarterly exchange program initiated between the United States and Canada in 1976. Until 1991, data were exchanged quarterly. At the request of the Committee, the United States and Canada agreed to replace the quarterly exchange of data with an annual exchange effective at the beginning of the 1992 calendar year. Henceforth, data will be exchanged once each year as soon after the end of the calendar year as possible. However, unusual conditions or anomalous data will be reported and exchanged whenever warranted. No unusual conditions occurred during 2019 which warranted special reporting.

2.5 Water-Quality Monitoring Responsibilities

The United States Geological Survey has agreed to take responsibility for maintaining the continuous water-quality monitor installed at the East Poplar station at the International Boundary. The continuous water-quality monitor records daily specific conductance values which are used in the computation of TDS and boron values to monitor water quality in the East Poplar River. In the absence of regular monthly water-quality grab samples, the Committee has agreed to utilize the data collected by the continuous water-quality monitor for its surface-water-quality monitoring program. The USGS has collected few TDS and Boron grab samples in 2019 which were included in the annual report.

Table 2.1 Water-Quality Objectives

Parameter	Original Objective	Recommendation	Current Objective
Boron, total	3.5/2.5[1]	Continue as is	3.5/2.5[1]
TDS[1]	1,500/1,000[1]	Continue as is	1,500/1,000[1]
Aluminum, dissolved	0.1	Suspended*	---
Ammonia, un-ionized	0.02	Suspended*	---
Cadmium, total	0.0012	Continue as is	0.0012
Chromium, total	0.05	Suspended*	---
Copper, dissolved	0.005	Suspended*	---
Copper, total	1	Suspended*	---
Fluoride, dissolved	1.5	Continue as is	1.5
Lead, total	0.03	Continue as is	0.03
Mercury, dissolved	0.0002	Suspended*	---
Mercury, fish (mg/kg)	0.5	Suspended*	---
Nitrate, dissolved (as N)	10	Continue as is	10
Oxygen, dissolved	4.0/5.0[2]	Objective applies only during open water	4.0/5.0[2]
SAR (units)	10	Continue as is	10
Sulfate, dissolved	800	Continue as is	800
Zinc, total	0.03	Continue as is	0.03
Water temperature (C)	30.0[3]	Continue as is	30.0[3]
pH (units)	6.5[4]	Continue as is	6.5[4]
Coliform (no./100 mL)			
Fecal	2,000	Suspended*	---
Total	20,000	Suspended*	---

Units in mg/L except as noted.

1. Five-year average of flow-weighted concentrations (March to October) should be <2.5 boron, <1,000 TDS.
   Three-month average of flow-weighted concentration should be <3.5 boron and <1,500 TDS.
2. 5.0 (minimum April 10 to May 15), 4.0 (minimum remainder of year - Fish Spawning).
3. Natural temperature (April 10 to May 15), <30 degree Celsius (remainder of year).
4. Less than 0.5 pH units above ambient, minimum pH=6.5.

*Suspended after review of historic data found sample concentrations consistently below the objective. The Committee will periodically review status of suspended objectives.

3.0 WATER AND AIR: MONITORING AND INTERPRETATIONS

3.1 Poplar River Power Station Operation

Saskatchewan Power Corporation operates the Poplar River Power Station near the town on Coronach, Saskatchewan. The Poplar River Power Station is comprised of two lignite-burning power generating units designated Unit No. 1 and Unit No. 2. Unit No. 1 is rated as a 315 MW generating unit and Unit No. 2 is rated as a 315 MW generating unit. Both units share a common 122 meter stack.

In 2019 both units were operated as base load units supplying the maximum production except when system constraint and outages dictated otherwise. There was a scheduled maintenance outage for Unit 1 & Unit 2 in the spring and fall so as not to coincide with system peak demand period that occur over the summer and winter periods.

SaskPower has changed the scheduling of Unit 1 and Unit 2 outages. Outages are scheduled approximately every 24 months.

Between January 1 and December 31 2019, Poplar River Power Station generated 3,606,659 MW hours. During this time approximately 2,758,000 tonnes of coal and 1,975 m^3 of fuel oil were consumed. The average capacity factors for Unit No. 1 and Unit No. 2 were 53.9% and 76.8%, respectively.

3.2 Surface Water

3.2.1 Streamflow

Streamflow in the Poplar River basin was well above normal in 2019. The March to October recorded flow of the Poplar River at International Boundary, an indicator of natural flow in the basin, was 31,610 cubic decametres (dam^3) (25,630 acre-feet), which was 301 percent of the 1931-2018 median seasonal flow of 10,495 dam^3 (8,509 acre-feet). A comparison of 2019 monthly mean discharge with the 1931-2018 median monthly mean discharge is shown in Figure 3.1.

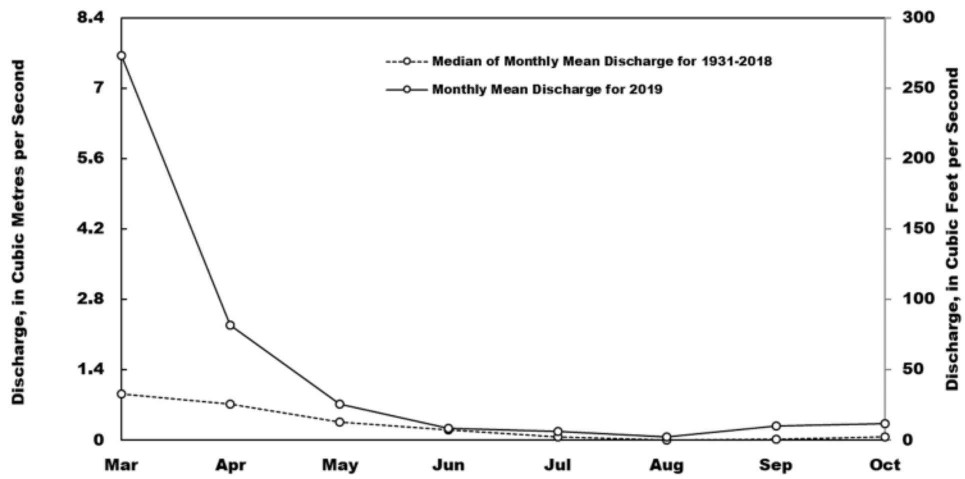


Figure 3.1 Monthly Mean Discharge During 2019 as Compared with the Median Monthly Mean Discharge from 1931-2018 for the Poplar River at International Boundary.

The 2019 recorded flow volume of the East Poplar River at International Boundary was 14,340 dam^3 (11,625 acre-feet). This volume is 471 percent of the median annual flow of 3,040 dam^3 (2,465 acre-feet) for 1976-2018 (since the completion of Morrison Dam).

3.2.2 Apportionment

In 1976 the International Souris-Red Rivers Engineering Board, through its Poplar River Task Force, completed an investigation and made a recommendation to the Governments of Canada and the United States regarding the apportionment of waters of the Poplar River basin. Although the recommendations have not been officially adopted, the Province of Saskatchewan has adhered to the apportionment recommendations. Annex 3 contains the apportionment recommendation.

3.2.3 Minimum Flows

According to the 2018 determination of natural flow of the Poplar River at International Boundary, the minimum entitled flow for the period January 1 to May 31, 2019 was 0.028 m3/s (1.0 ft3/s), determined on the basis of the Poplar River flow volume for March 1 to May 31, 2018.

The recorded volume of the Poplar River at International Boundary from March 1 to May 31, 2019 was 28,100 dam3 (22,781 acre-feet). Based on IJC recommendations and the assumption that the recorded flow is the natural flow, the United States was entitled to a minimum discharge on the East Poplar River of 0.085 cubic metres per second (m^3/s) (3.0 cubic feet per second (ft^3/s) for the period June 1, 2019 to August 31, 2019, and 0.057 m^3/s (2.0 ft^3/s) for the period September 1, 2019 to May 31, 2020. A hydrograph for the East Poplar River at International Boundary and the minimum flow as recommended by the IJC are shown in Figure 3.2.

Daily flows during 2019 met or exceeded the minimum flow recommended by the IJC during the year except for several periods during June 6-19, August 1-5, August 19-25 and August 9,11,30 and 31. According to SaskPower, unintentional periods below minimum flows in 2019 were not caused by operational or maintenance difficulties, and SaskPower worked to minimize these instances to the greatest extent. SaskPower notes that protocols, communication and a new gate control system will reduce the number of days where minimum flows are not met in the future.

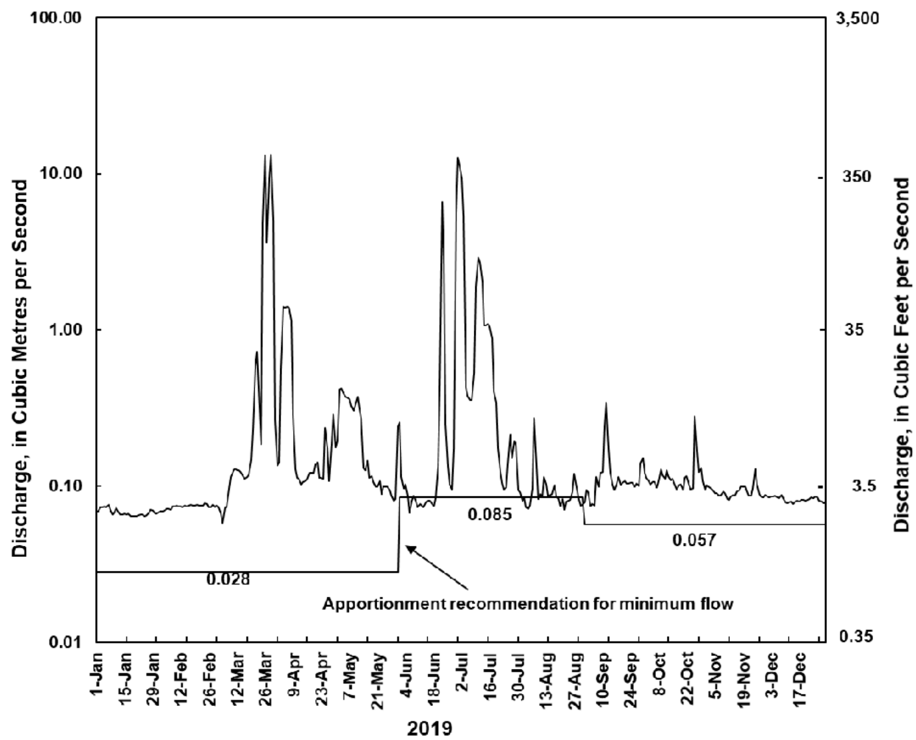


Figure 3.2 Flow Hydrograph of the East Poplar River at International Boundary.

3.2.4 On-Demand Release

Based on the March 1 to May 31, 2018 runoff volume of 3,510 dam^3 (2,840 acre-feet) recorded at the Poplar River at International Boundary gauging station, Montana was entitled to an additional release of 370 dam^3 (300 acre-feet) from Cookson Reservoir during the succeeding twelve-month period commencing May 1, 2019. Montana requested this release to be made between May 1 and May 31, 2019. A volume of 483 dam^3 (392 acre-feet), in addition to the minimum flow, was delivered during this period. A hydrograph showing cumulative volume of the on-demand release request and on-demand release delivery made at the East Poplar River at International Boundary is shown in Figure 3.3.

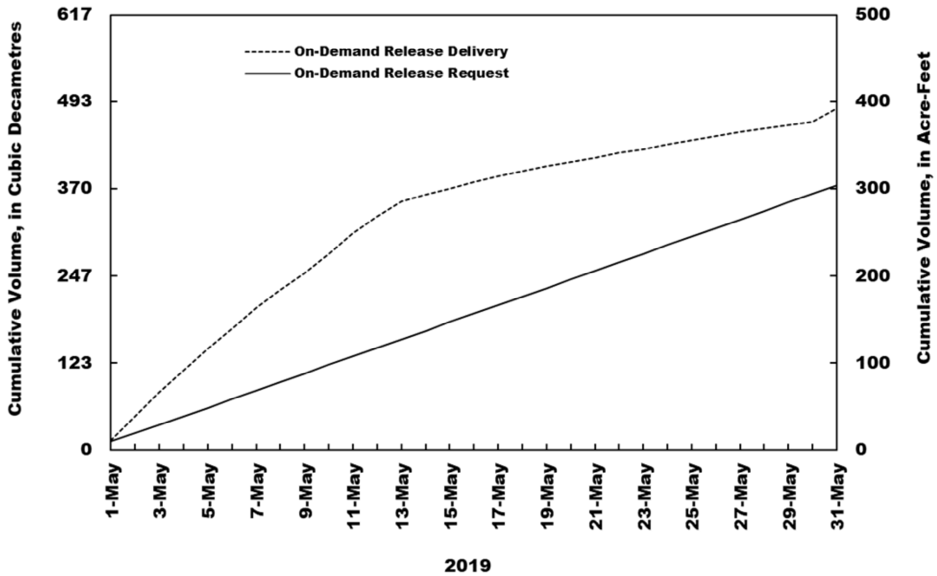


Figure 3.3 Cumulative Volume Hydrograph of On-Demand Release.

3.2.5 Surface-Water Quality

The 1981 report by the IJC to Governments recommended:

For the March to October period, the maximum flow-weighted concentrations should not exceed 3.5 milligrams per litre (mg/L) for boron and 1,500 mg/L for TDS for any three consecutive months in the East Poplar River at the International Boundary. For the March to October period, the long-term average of flow-weighted concentrations should be 2.5 mg/L or less for boron, and 1,000 mg/L or less for TDS in the East Poplar River at the International Boundary.

For the period prior to 1982, the three-month moving flow-weighted concentration (FWC) for boron and total dissolved solids (TDS) was calculated solely from monthly water-quality monitoring results.

Since the beginning of 1982, the USGS has monitored specific conductance daily in the East Poplar River at the International Boundary, making it possible to estimate boron and TDS concentrations using a linear regression relationship with specific conductance. Thus, the three-month FWC for boron and TDS for the period 1982 to 2002 was calculated from the results of monthly monitoring (discrete water-quality samples collected by both Canada and the United States) or from estimated monthly water-quality data based upon daily specific conductance data collected by the USGS during months when a discrete water-quality sample was not available.

In 2003, the Poplar River Bilateral Monitoring Committee decided to suspend much of the water-quality sampling program until it is warranted again. All surface-water-quality sample collection by Environment Canada (now Environment and Climate Change Canada) has been suspended at the East Poplar River International Boundary station. After the monthly discrete sampling program was suspended in 2003, the USGS continued to collect four discrete samples per year until 2010, when due to a lack of funding no samples were obtained. In 2019, the USGS was able to collect two TDS and Boron grab samples.

Since 2003, the Committee has agreed to use the continuous data collected by the specific-conductance monitor as a surrogate for the monthly water-quality sampling program. Hence, the three-month FWC for TDS and boron in 2019 were calculated using the two equations (shown later in text) and the continuous specific-conductance data collected at the East Poplar River at the International Boundary.

The Bilateral Monitoring Committee adopted the approach that, for the purpose of comparison with the proposed IJC long-term objectives, the boron and TDS data are best plotted as a five-year moving FWC which is advanced one month at a time.

Prior to 1988, long-term averages were calculated for a five-year period in which 2.5 years preceded and 2.5 years followed each plotted point. Beginning in 1988, the FWC was calculated from the 5-year period preceding each plotted point. For example, the FWC for December 2019 is calculated from data generated over the period December 2015 to December 2019. The calculations are based on the results of samples collected throughout the year, and are not restricted to only those collected during the months bracketing the period of irrigation (March to October) each year.

3.2.5.1 Total Dissolved Solids

TDS is inversely related to streamflow at the East Poplar River at the International Boundary station. During periods of high runoff such as spring freshet, TDS decreases as the proportion of streamflow contributed by ground water decreases. Conversely, during times of low streamflow (late summer, winter) the contribution of ground water to streamflow is proportionally greater. Because the ground water entering the river has a higher ionic strength than the surface water, the TDS of the stream increases markedly during low-flow conditions. The USGS was able to collect grab samples on December 11, 2019. TDS value of 1,110 mg/L was noted. More grab samples are needed to check the prediction and validity of the model.

The March to October estimated monthly TDS concentrations during 2019 for East Poplar River at the International Boundary are shown in Figure 3.4. The estimated mean monthly TDS concentrations during this period ranged from 756 mg/L (March) to 948 mg/L (October). Estimated daily TDS concentrations during the 2019 calendar year ranged from 634 mg/L (July11) to 1,090 mg/L (April 24).

The three-month moving FWC for TDS for the period of 2000-2019 is presented in Figure 3.5. The short-term TDS objective has not been exceeded during the period of record.

The five-year moving estimated FWC for TDS (Figure 3.6) did not exceed the long-term objective of 1,000 mg/L in 2019. The maximum monthly five-year estimated FWC in 2019 was about 824 mg/L.

The daily TDS values, as estimated by linear regression from the daily specific-conductance readings, for the period January 2000 through December 2019 are shown in Figure 3.7. The figure shows an abrupt drop in estimated TDS corresponding to the snowmelt runoff occurring during the spring of each year.

The relationship between TDS and specific conductance based upon data collected during the March to October period from 1974 to 2009 is as follows:

TDS = (0.6205645 x specific conductance) + 34.843914
(R^2 = 0.89, n = 363)

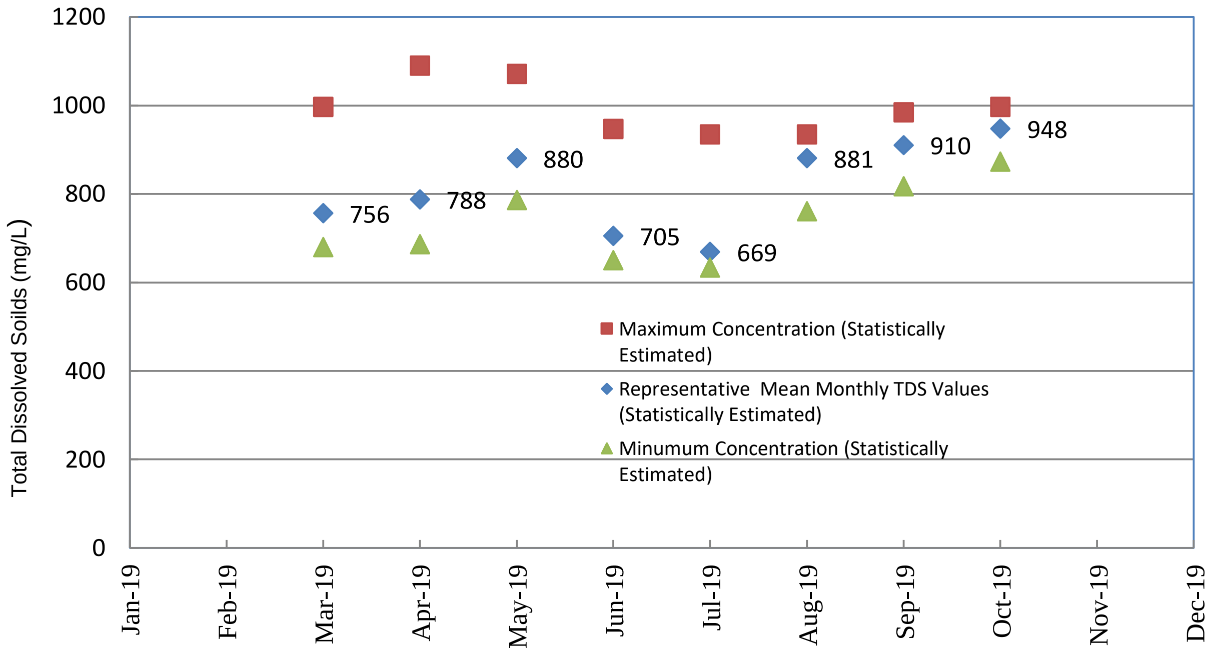


Figure 3.4: Estimated March to October Monthly TDS Concentrations During 2019 for East Poplar River at International Boundary

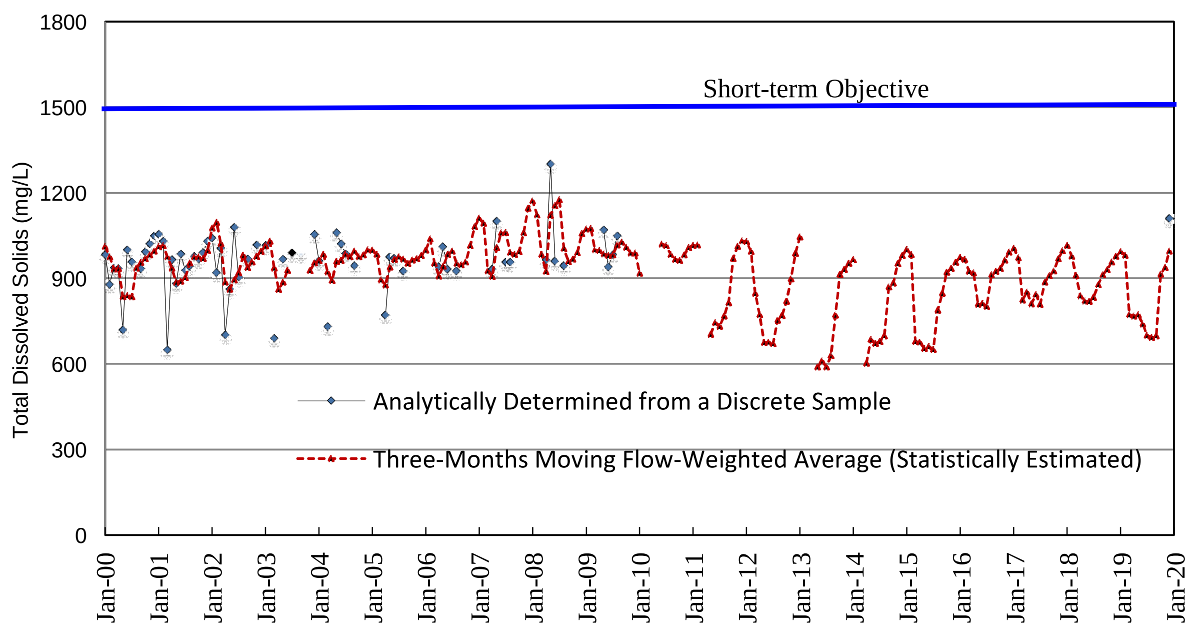


Figure 3.5: Discrete Sample and Three-Month Moving Flow-Weighted Average Estimated TDS Concentrations for East Poplar River at the International Boundary

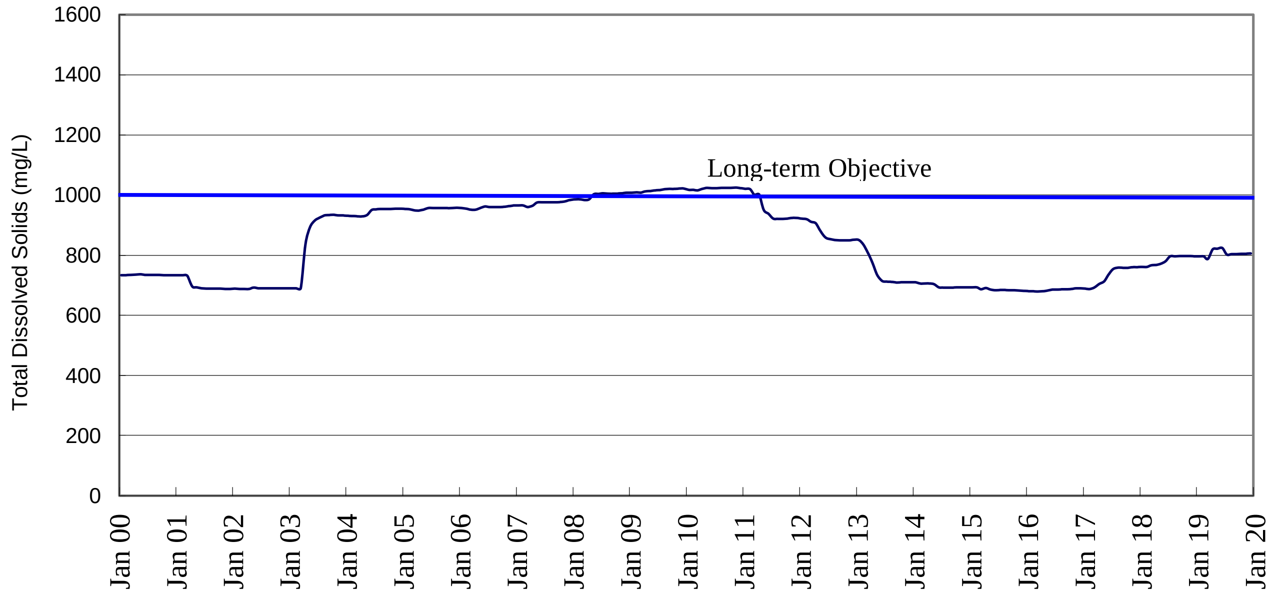


Figure 3.6: Five-Year Moving Flow-Weighted Average Estimated TDS Concentration for East Poplar River at the International Boundary

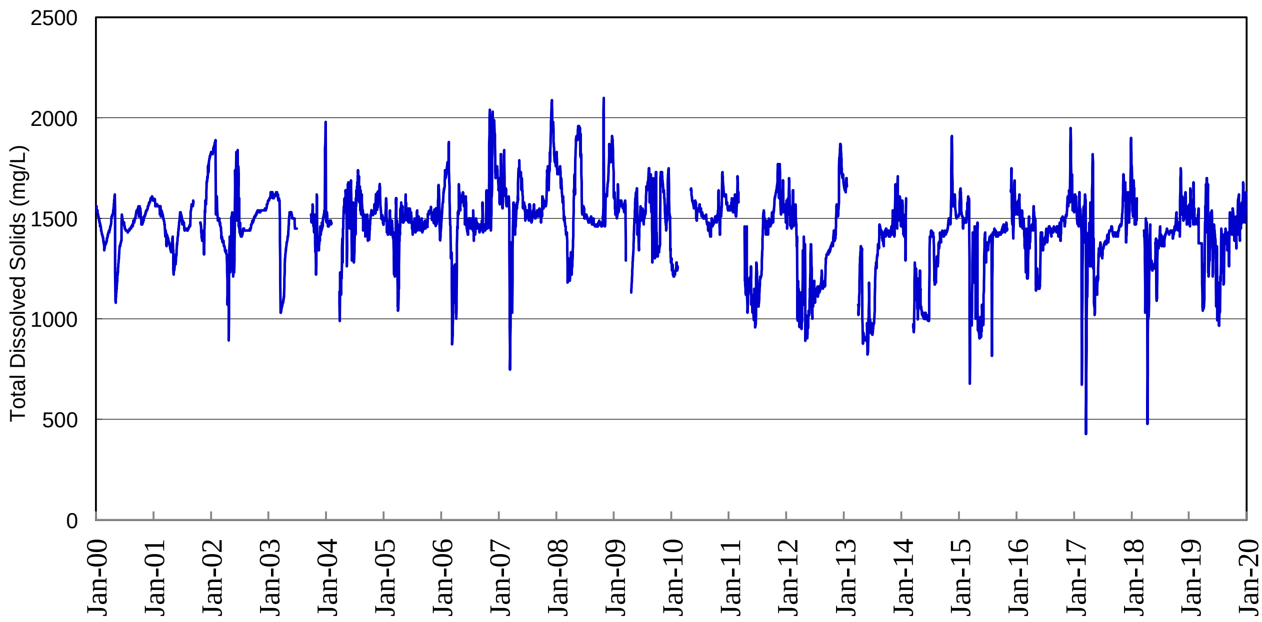


Figure 3.7: Daily TDS Concentration (Statistically Estimated), Calendar Years 2000 to 2020 for East Poplar River at the International Boundary

3.2.5.2 Boron

All the boron concentrations presented below were estimated using the boron equation that was developed from water-quality samples collected during the months of March through October from 1974-2009 and the daily specific conductance data collected by the specific-conductance monitor.

The March to October estimated monthly boron concentrations during 2019 for East Poplar River at the International Boundary are shown in Figure 3.8. The estimated mean-monthly boron concentrations during this period ranged from 1.63 mg/L (March) to 1.86 mg/L (October). Estimated daily boron concentrations during the 2019 calendar year ranged from 1.19 mg/L (July 11) to 2.16 mg/L (April 24).

The USGS collected a Boron sample on December 11, 2019 with a value of 2.02 mg/L and has been incorporated into the annual report. Similar to the TDS, more grab samples are need to compare and check the validity the model.

The 3-month flow-weighted concentration (FWC) for boron for the period of 2001-2019 is shown in Figure 3.9. The short-term objective of 3.5 mg/L has not been exceeded during the period of record.
The 5-year moving FWC for boron (Figure 3.10) remained well below the long-term objective of 2.5 mg/L during 2019.

Boron concentrations are not as well-correlated with specific conductance as TDS. Boron is a relatively minor ion, and does not in itself contribute to a large degree to the total load of dissolved constituents in the water. Accordingly, it appears likely that the standard deviation of dissolved boron (relative to the long-term mean boron concentration) may be greater than that of the major cations (sodium, potassium, and magnesium) and anions (sulphate, bicarbonate, and chloride) around their respective long-term mean concentrations. Therefore, the R^2 (statistical measure of fit) is lower than that of TDS. The general trend shows TDS and Boron being nearly static for 2014-2018 period and then showing a slight increase lately while remaining below their objectives.

The daily boron values, as estimated by linear regression from the daily specific-conductance readings, for the period January 1999 through December 2019 are shown in Figure 3.11.

The relationship between boron and specific conductance based upon March to October data collected from 1974 to 2009 is as follows:

Boron = (0.0013081 x specific conductance) - 0.0677588
(R^2 = 0.66, n = 363)

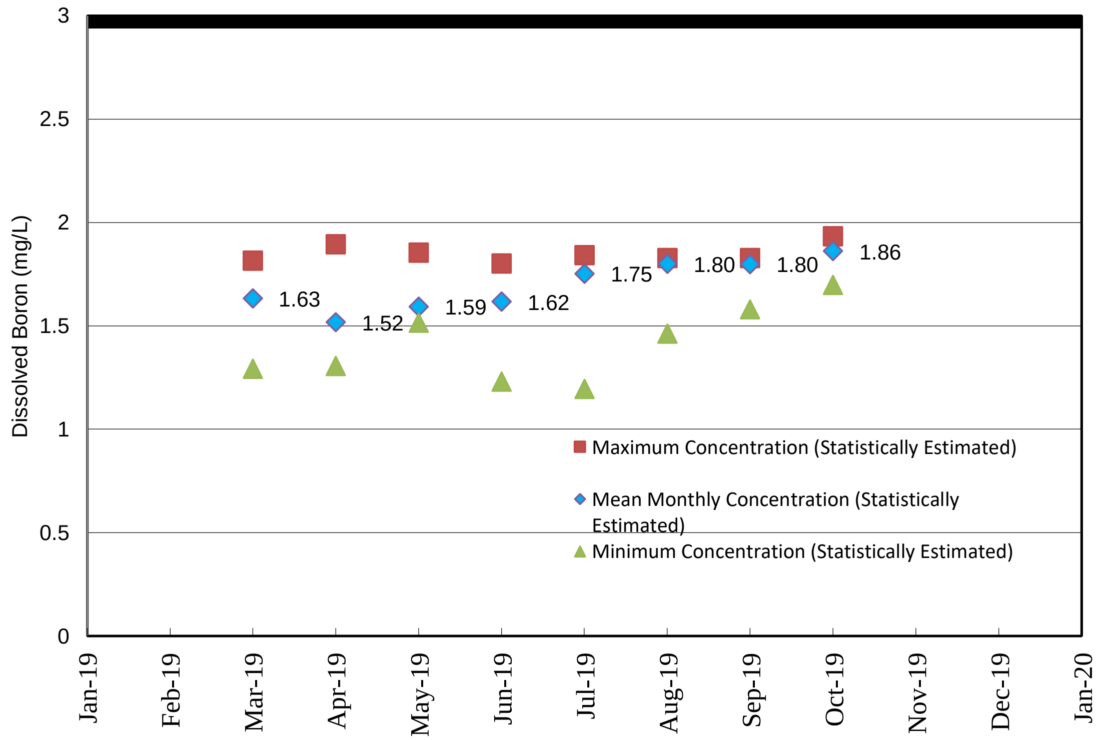


Figure 3.8: Estimated March to October Monthly Boron Concentrations During 2019 for East Poplar River at the International Boundary

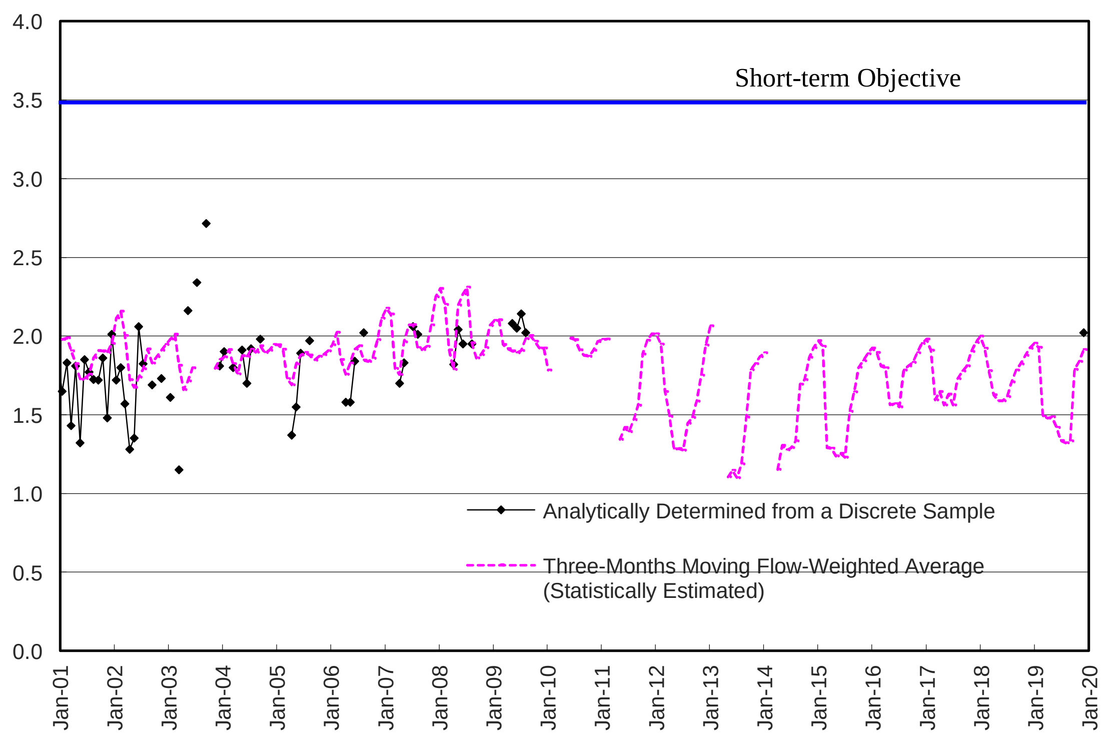


Figure 3.9: Discrete Sample and Three-Month Moving Flow-Weighted Average Estimated Boron Concentrations for East Poplar River at the International Boundary

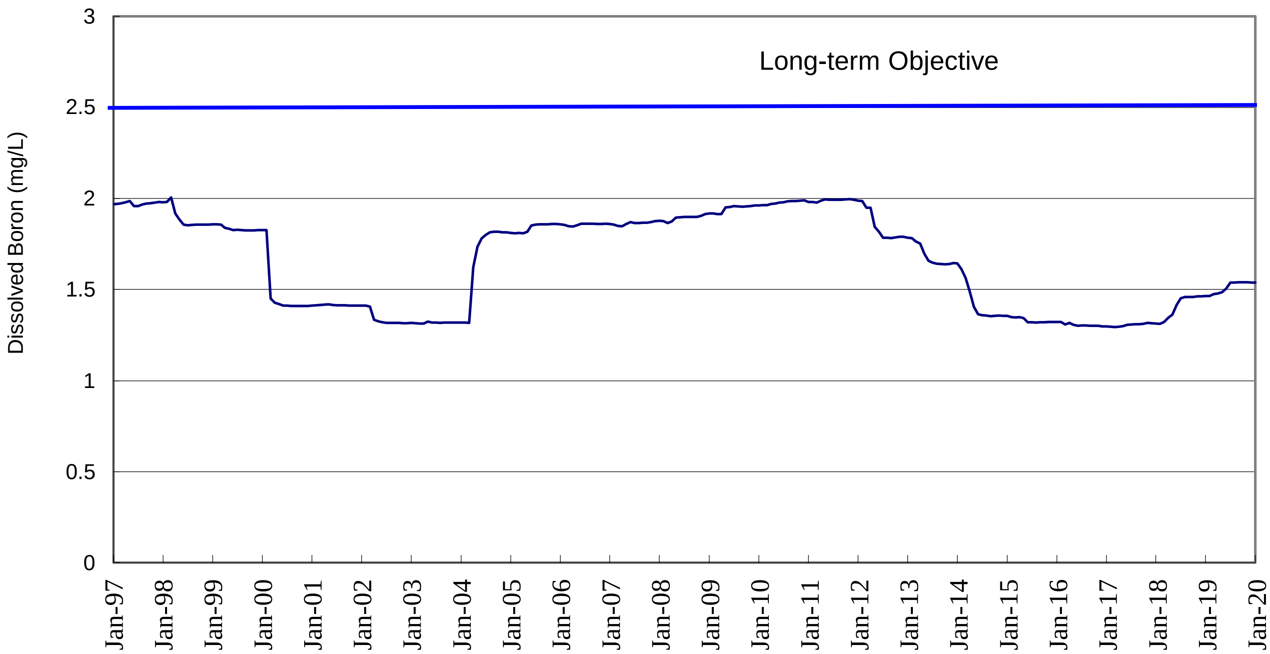


Figure 3.10: Five-Year Moving Flow-Weighted Average Estimated Boron Concentration for East Poplar River at the International Boundary (Statistically Estimated)

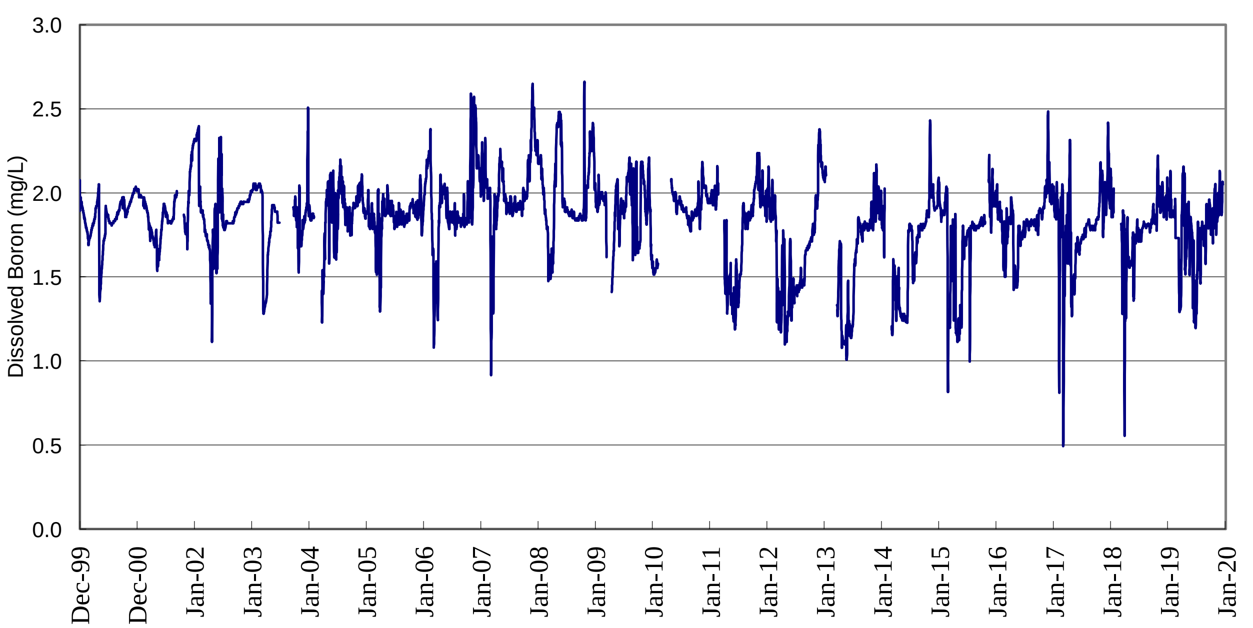


Figure 3.11: Daily Boron Concentration (Statistically Estimated), Calendar Years 1999-2019, for East Poplar River at the International Boundary

3.2.5.3 Other Water-Quality Objectives

Table 3.1 contains the multipurpose water-quality objectives for the East Poplar River at International Boundary, recommended by the International Poplar River Water Quality Board in 1979 to the IJC. Please note that the USGS obtained two grab samples during the 2019 season and they were included in the annual report. The number of samples collected for each parameter and excursions from the recommended objectives are shown as not applicable (N/A) in the table.

For years when samples are obtained, the table shows the number of samples collected for each parameter and the number of times over the course of the year that the objectives were exceeded. Multiple replicate samples collected during the annual quality control exercise are treated as a single sample in the table, but where an objective was exceeded in a replicate sample, this is charged against the single sample noted.

Table 3.1 Recommended Water-Quality Objectives and Excursions, 2019 Sampling Program, East Poplar River at International Boundary (units in mg/L, except as otherwise noted)

Parameter	Objective	No. of Samples		Excursions
		USA	Canada	
Objectives recommended by IJC to Governments				
Boron, dissolved	3.5/2.5 (1)	1	N/A	N/A
Total Dissolved Solids	1,500/1,000 (1)	1	N/A	1
Objectives recommended by Poplar River Bilateral Monitoring Committee to Governments				
Cadmium, total	0.0012	N/A	N/A	N/A
Fluoride, dissolved	1.5	N/A	N/A	N/A
Lead, total	0.03	N/A	N/A	N/A
Nitrate	10.0	N/A	N/A	N/A
Oxygen, dissolved	4.0/5.0 (2)	N/A	N/A	N/A
Sodium adsorption ratio	10.0	N/A	N/A	N/A
Sulphate, dissolved	800.0	N/A	N/A	N/A
Zinc, total	0.03	N/A	N/A	N/A
Water temperature (Celsius)	30.0 (3)	N/A	N/A	N/A
pH (pH units)	6.5 (4)	N/A	N/A	N/A

(1) Three-month average of flow-weighted concentrations should be <3.5 mg/L boron and <1,500 mg/L TDS. Five-year average of flow-weighted concentrations (March to October) should be <2.5 mg/L boron and <1,000 mg/L TDS.
(2) 5.0 (minimum April 10 to May 15), 4.0 (minimum, remainder of the year).
(3) Natural temperature (April 10 to May 15), <30 degrees Celsius (remainder of the year).
(4) Less than 0.5 pH units above natural, minimum pH = 6.5.

N/A – Not applicable

NOTE: Two samples were obtained by the USGS in 2019.

3.3 Groundwater

3.3.1 Operations – Saskatchewan

SaskPower's supplementary groundwater supply system continues to operate, with an annual withdrawal of 1,264 cubic decametres (dam^3) in 2019. The volume withdrawn was lower than 1,377 dam^3 in 2018. Figure 3.12 illustrates the annual withdrawal by the Poplar River Power Station. The average volume withdrawn from 1991 to 2019 was 3,797 dam^3 per year. Prior to 1991, the well network was part of a dewatering network for coal mining operations, which resulted in the high production levels experienced in the early to mid 1980's. With the drought of the late 1980's and early 1990's it was evident that there was a continued need for groundwater to supplement water levels in Cookson Reservoir. As a result, the wells were taken over by SaskPower for use as a supplementary supply.

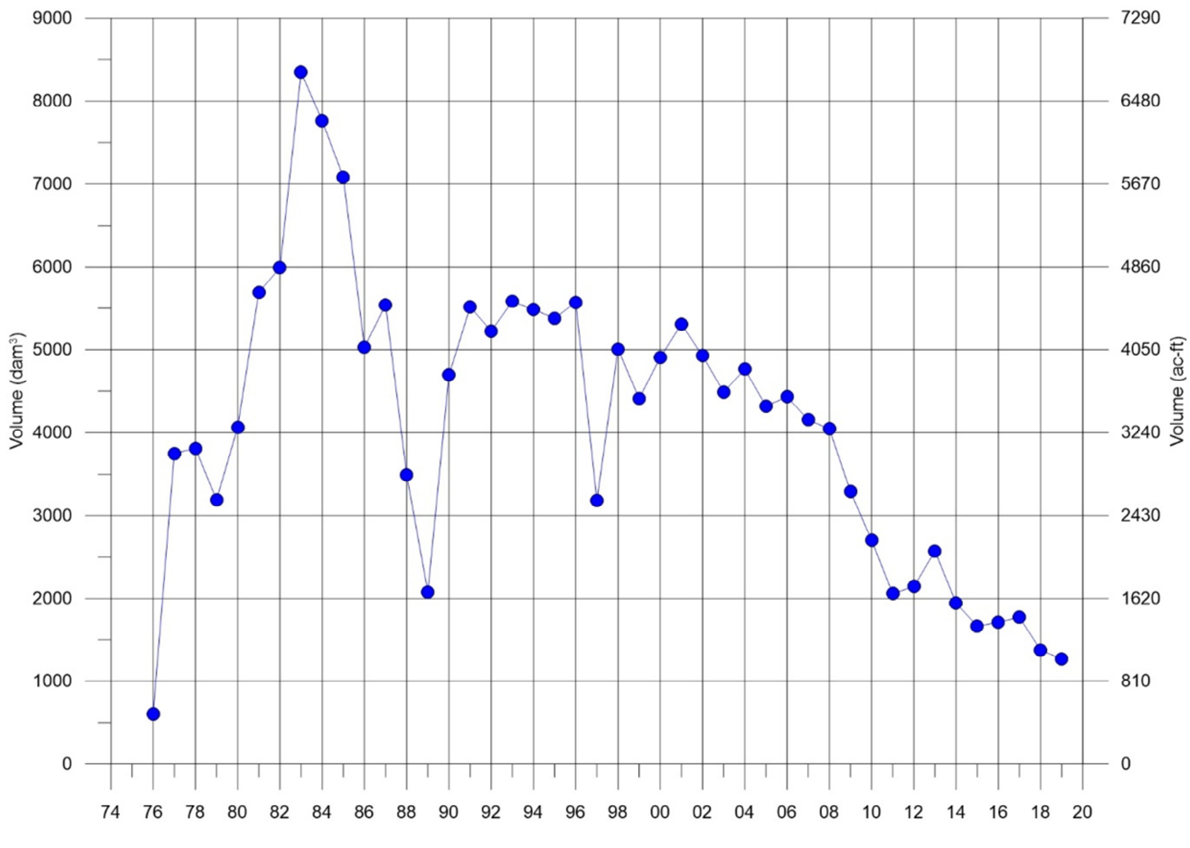


Figure 3.12. Annual Pumping from the Poplar River Power Station Supplementary Supply.

SaskPower has an approval for the supplementary supply project to produce an annual volume of 5,500 dam^3/year. The supplementary supply well network originally consisted of 21 wells with 10 discharge points. However, one production well, PW11A, was converted in 2014 to a farm well to supply groundwater to a local resident and three production wells (38, 48, and 58) were decommissioned in fall 2016. To date, there are 17 production wells in operation as part of the supplementary supply well network.

In addition to the supplementary supply, SaskPower also operates the Soil Salinity Project south of Morrison Dam (Figure 3.13). The impoundment of water behind Morrison Dam caused a 2 to 3 metre rise in groundwater levels. The increase in the groundwater levels raised the salinity of the soil and reduced crop yield. To reduce the groundwater levels south of Morrison Dam, 8 production wells were constructed in 1989 and 1990. Of the 8 production wells, 4 are located on the east side of the East Poplar River and 4 on the west side of the river. Water from the production wells is discharged into the cooling water canal, which is in turn discharged directly to Cookson Reservoir. Withdrawals from the production wells varied from a maximum of 1,100 dam^3 in 1994 to a minimum of 359.86 dam^3 in 2017.

The total water produced from the Soil Salinity Project in 2019 was 455.01 dam^3, which was higher than 2018 of 391.38 dam^3. The 2019 production rate was from two production wells, PW87104 (266.65 dam^3) and well PW87105 (188.36 dam^3), both of which are on the east side of the Poplar River. Production since operation of this network began in 1990 has averaged 656.20 dam^3/yr.

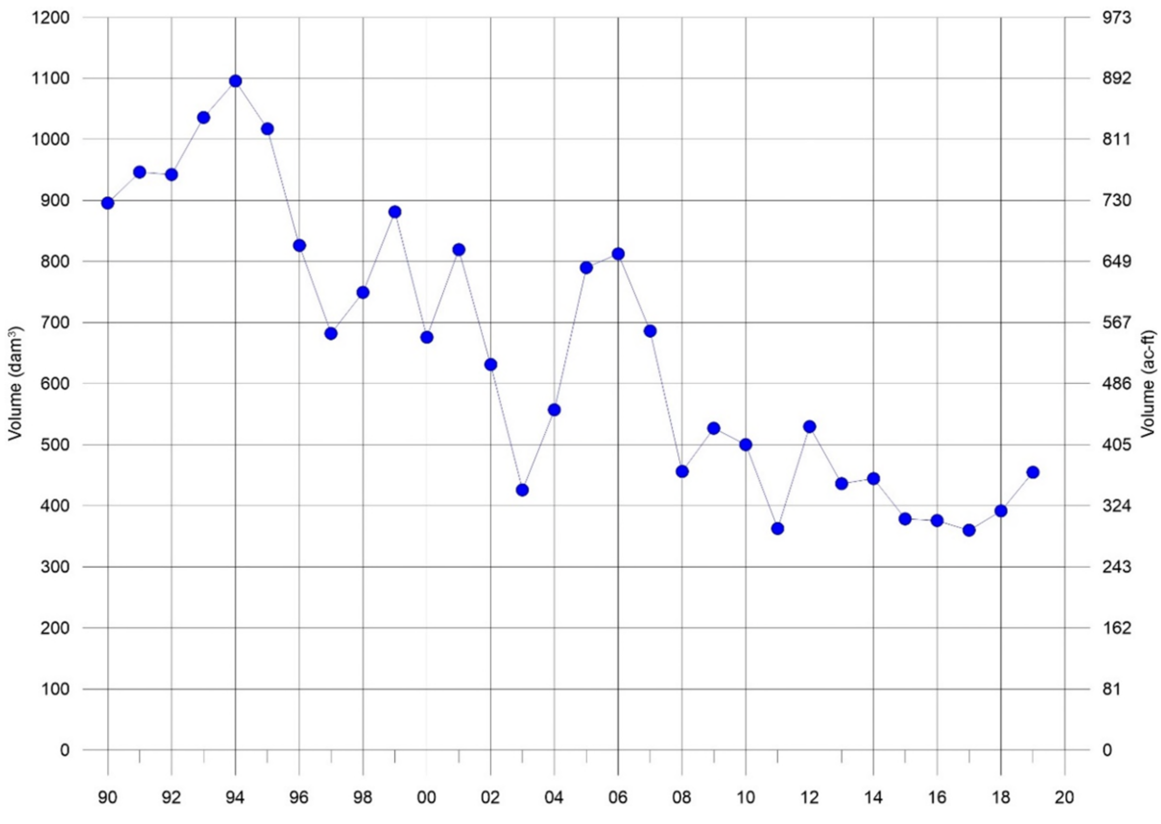


Figure 3.13. Annual Pumping from SaskPower's Soil Salinity Project.

3.3.2 Groundwater Monitoring

Equivalent geologic formations present in Saskatchewan and Montana have different names. A list of the corresponding formation names is provided in Table 3.2.

Table 3.2 Geologic Formation Name Equivalence between Saskatchewan and Montana

System	Series	Group	Lithostratigraphic Units		Hydrogeologic unit	Principal aquifer system
			United States	Canada		
			Montana	Saskatchewan		
Quaternary	Pleistocene		Glacial deposits	Saskatoon Sutherland Empress	Till; Glacial aquifers	Glacial aquifer system
Tertiary	Paleocene	Fort Union Formation[e]	Tongue River Member	Ravenscrag Formation	Upper Fort Union aquifer	Lower Tertiary aquifer system
			Lebo Shale Member	Ravenscrag Formation	Middle Fort Union hydrogeologic unit	
			Ludlow and Tullock Members	Ravenscrag Formation	Lower Fort Union aquifer	
Cretaceous	Upper Cretaceous		Hell Creek Formation (upper part)	Frenchman Formation	Upper Hell Creek hydrogeologic unit	Upper Cretaceous aquifer system
			Hell Creek Formation (lower part)	Frenchman Formation	Lower Hell Creek aquifer	
		Montana Group	Fox Hills Sandstone	Whitemud Formation Eastend Formation	Fox Hills aquifer	
			Bearpaw Shale	Bearpaw Formation	Basal confining unit	

3.3.2.1 Saskatchewan

In 2003, SaskPower reduced its monitoring network from 180 to about 85 piezometers. The Water Security Agency approved this reduction based on modelling studies undertaken by SaskPower.

Figures 3.14 illustrate selected piezometers completed in the Hart Coal Seam near the International Boundary. The hydrograph illustrates that there have been no significant changes in water levels in the Hart Coal Seam near the boundary in the past 30 years.

The goal of the Soil Salinity Project is to lower groundwater levels in the Empress Sands below Morrison Dam to pre-reservoir levels of approximately two to three metres. Groundwater pumping from 1990 to 1995 ranged between 900 and 1,100 dam^3/year and consequently the drawdown objectives were achieved in 1995 and 1996. Despite the decline in well production, with the high reservoir levels and increased precipitation, the drawdown in the Empress Sands is below the two to three metre drawdown objectives.

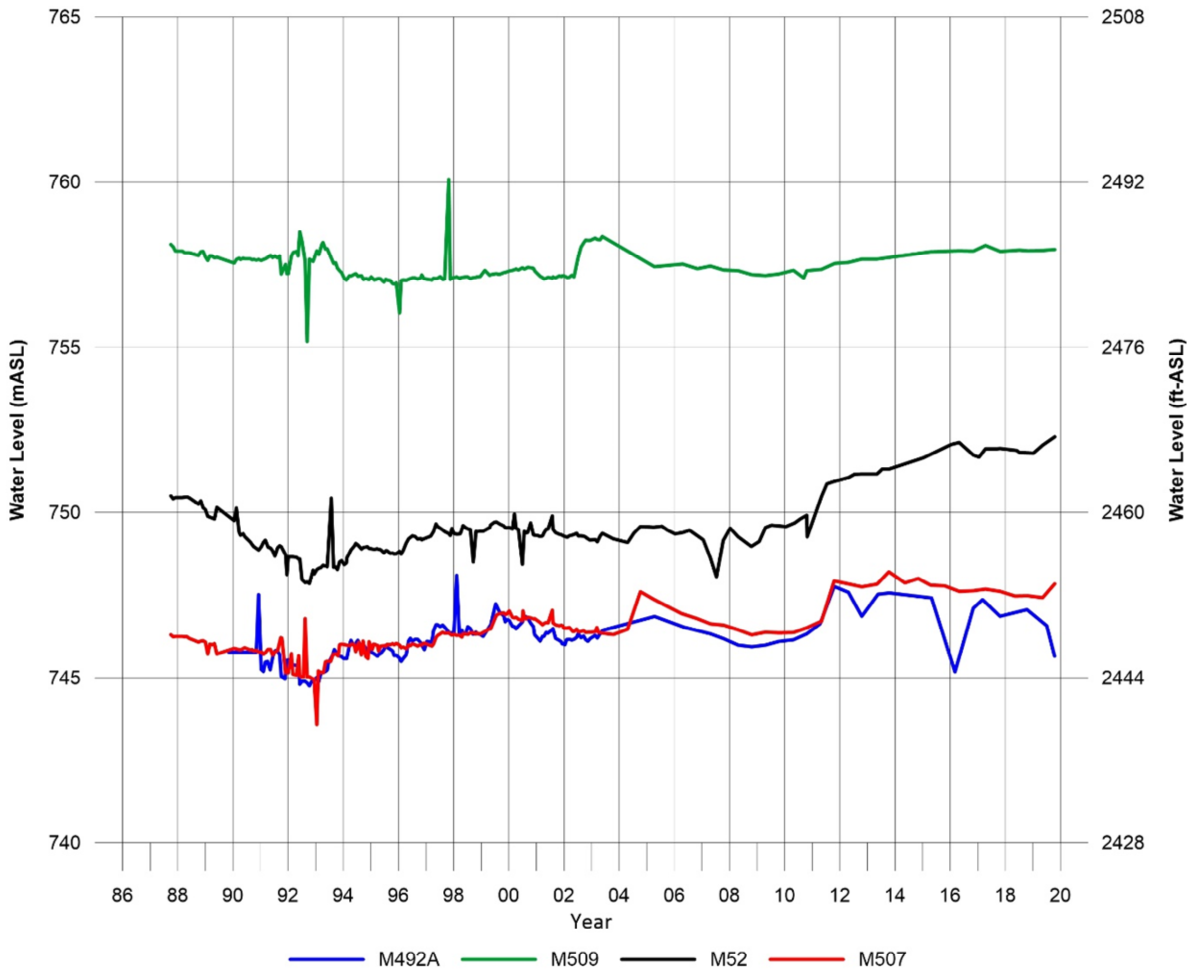


Figure 3.14. Hydrograph of Selected Wells completed in the Hart Coal Seam.

3.3.2.2 Montana

Hydrographs from monitoring wells 6, 7, 9, 13, 17, and 19, completed in the Fort Union Formation and/or the Hart Coal Seam, are shown on Figure 3.15. Offsets noted in the legend for Figure 3.15 have been applied to make the hydrographs more readable. Water-level data used to construct the hydrographs can be accessed through the Montana Ground Water Information Center (GWIC) database at http://mbmggwic.mtech.edu. Well 16, also completed in the Fort Union Formation, was dropped from the monitoring network in 2019 because the well did not yield enough water to collect chemistry samples, and was prone to flooding during spring snowmelt and periods of heavy rain.

Water levels in wells 9, 13, 17, and 19 have changed less than 5 ft (1.5 m) since monitoring began in 1979 (well 9) and 1984 (wells 13, 17, and 19). Since 2011, water levels in these wells show a gradual increase of about 1 to 3 ft. Water levels in wells 6 and 7 show larger changes over the period of record, including several distinct peaks in water levels, of 3 – 7 feet, that are followed by gradual declines over multiple-year periods. The water-level peaks are attributed to groundwater recharge from heavy winter snow accumulation, associated melt, and positive departures from average annual precipitation in 2004, 2011, and 2013 (National Oceanic and Atmospheric Administration's northeast Montana climate division). Since 2014, water levels in all the Fort Union Formation and/or Hart Coal Seam wells have been fairly stable, but show a slight increasing trend through 2019.

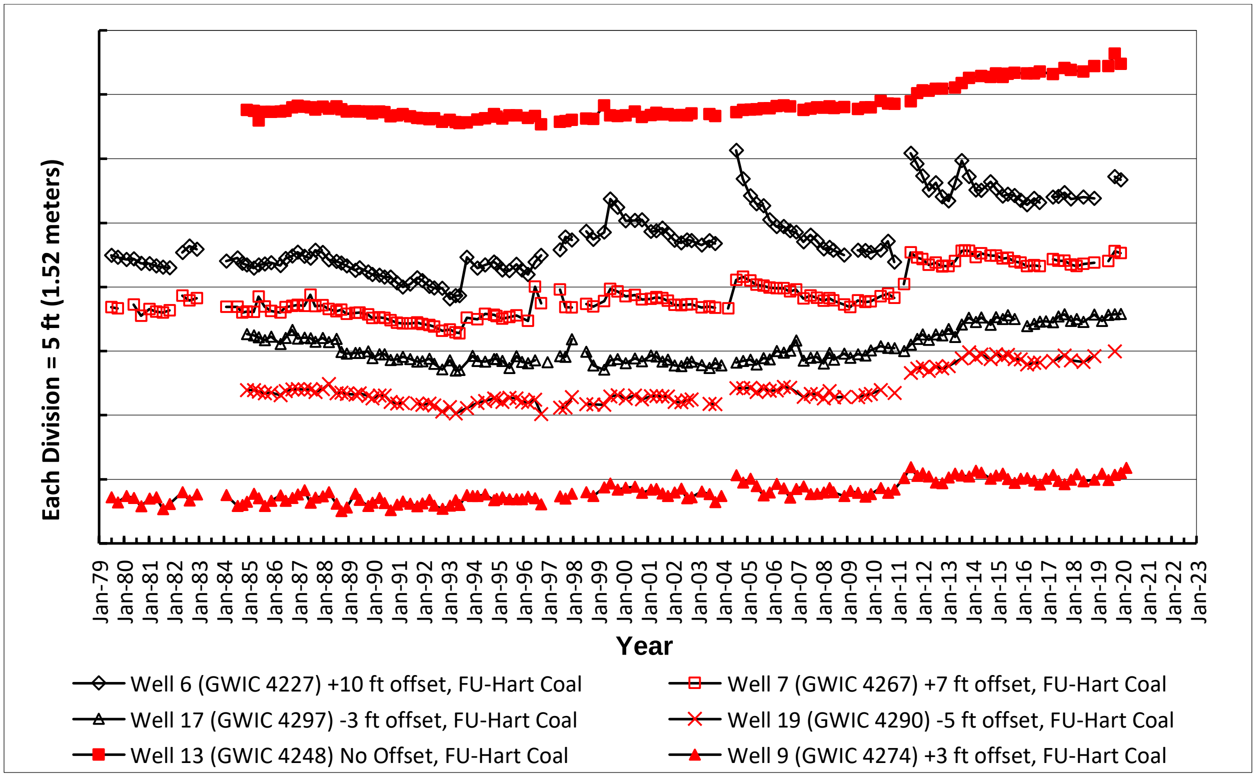


Figure 3.15 Hydrographs of Selected Wells - Fort Union-Hart Coal Aquifer.

Hydrographs for monitoring wells 5, 8, 10, 23, and 24, completed in alluvium or outwash, and for well 11, completed in the Fox Hills-Hell Creek aquifer, are shown on Figure 3.16. Offsets noted in the legend have been applied to make the hydrographs more readable. In general, the hydrographs for wells completed in outwash or alluvium (wells 5, 8, 10, 23, and 24) show responses to major precipitation events and short term climate patters. Heavy snow accumulation and melt in 2004 and 2011 caused upward water-level responses in these wells. In contrast, the hydrograph for well 11, completed in the Fox Hills/Hell Creek artesian aquifer has shown little change over the period of record, with fluctuations of only 1 – 2 feet. Well 5, completed in outwash, is paired with well 6, completed in the Fort Union Formation (fig. 3.15). The hydrographs for these two wells show nearly identical responses that are more dynamic than other wells in the monitoring network. Wells 10 and 24 show similar patterns to well 5, but with lower amplitude water-level changes.

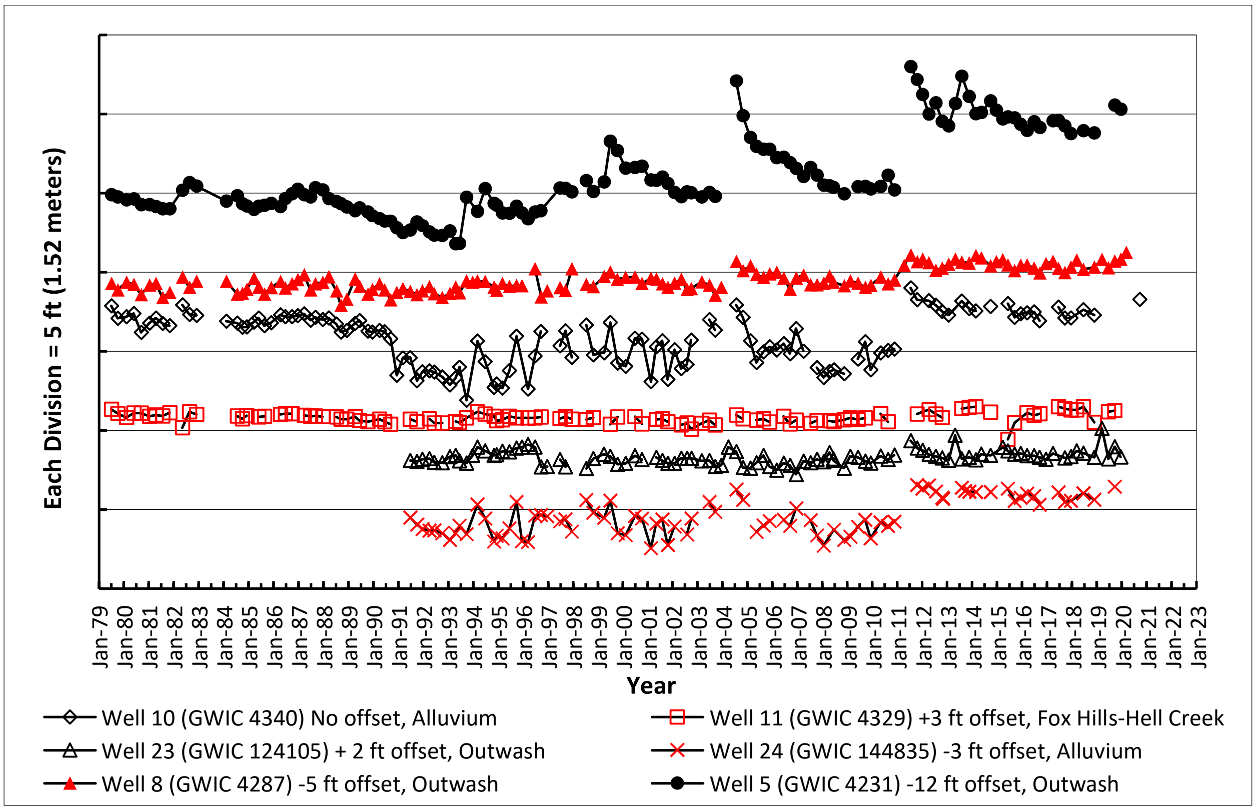


Figure 3.16 Hydrographs of Selected Wells - Alluvium and Fox Hills/Hell Creek Aquifers.

3.3.3 Groundwater Quality

3.3.3.1 Saskatchewan

The water quality from the Supplementary Supply Project discharge points has been consistent with no trends indicated. A summary of the more frequently tested parameters during 2019 is provided in Table 3.3. Result averages for the 1992-2018 periods are also included in this table for comparison.

TABLE 3.3 Water-Quality Statistics for Water Pumped from Supplementary Water Supply Project Wells*

Discharge Pipe Data (Girard Creek "C3")

	2019	1992 to 2018	
	Average	Average	Std. Dev
pH (units)	7.8	8.0	0.3
Conductivity (µs/cm)	897	1248	355
Total Dissolved Solids	695	859	255
Total Suspended Solids	n/a	11	16
Total Boron	0.6	1.1	0.7
Total Sodium	112	164	62
Total Cyanide (µg/L)	1.00	2.03	1.06
Total Iron	0.3	0.3	0.4
Total Manganese	0.0	0.1	0.1
Total Mercury (µg/L)	0.1	0.1	0.04
Calcium	64	66	15
Total Magnesium	38	50	14
Sulfate	218	266	96
Nitrate	0.03	0.14	0.23

All units mg/L unless otherwise noted.

*Sampled at Site "C3" on Girard Creek.

TSS was not available due to Analytical Laboratory issues.

Average results from the common discharge point for the Salinity Control Project for 2019, plus an average of the 1992-2018 results are provided in Table 3.4. Results have remained relatively consistent since 1992.

TABLE 3.4 Water-Quality Statistics for Water Pumped from Salinity Control Project Wells Sampled at the Discharge Pipe*

Salinity Project Water Supply to Cookson Reservoir
Discharge Pipe Analysis

	2019 Average	1992 - 2018 Average
pH (units)	7.8	7.6
Conductivity (µs/cm)	1657	1496
Total Dissolved Solids	1249	1045
Total Boron	1.8	1.6
Total Calcium	107	107
Total Magnesium	58	61
Total Sodium	225	172
Total Potassium	8.2	7.8
Total Arsenic (µg/L)	13.3	12.3
Total Aluminum	0.001	0.043
Total Barium	0.018	0.030
Total Cadmium	0.000	0.009
Total Iron	4.4	4.2
Total Manganese	0.115	0.128
Total Molybdenum	0.002	0.010
Total Strontium	1.813	1.762
Total Vanadium	0.001	0.010
Total Uranium (µg/L)	1.000	0.809
Total Mercury (µg/L)	0.05	0.07
Sulfate	446	352
Total Chloride	7.6	7.1
Nitrate	0.025	0.065

*All concentrations are mg/L unless otherwise noted.

Leachate movement through the ash lagoon liner systems can potentially affect ground-water quality in the vicinity of the ash lagoons. The piezometers listed in the Technical Monitoring Schedules are used to assess leachate movement and calculate seepage rates. Piezometric water level, boron, and chloride are the chosen indicator parameters to assess leachate movement.

The chemistry of water immediately above the liner systems is expected to differ from the surface water of the lagoons. Meaningful information is only available from piezometers installed within Ash Lagoon # 1 where ash had been deposited for many years. Future monitoring of all piezometers completed above the lagoon liner systems will continue to improve the understanding of leachate quality and flow from the ash lagoons.

The piezometric surface measurements for the oxidized till continue to show the presence of a ground-water mound beneath the ash lagoons. The mound extends from the center of the Ash Lagoon # 1 to the southeast side of Ash Lagoon # 2. Isolated ground-water mounds have developed within the area of the oxidized ground-water mound. Piezometers located in the oxidized till suggest limited leachate activity. No seepage activity is evident in the unoxidized till.

The greatest changes in chloride and boron concentrations within the oxidized till have occurred where piezometric levels have changed the most. Although increasing water levels do not automatically suggest that the water affecting the piezometers is leachate, changing piezometric levels do suggest ground-water movement. On the west side of the Polishing Pond, the boron levels have changed only slightly in the oxidized till piezometers C728A and C728D, where the chloride levels have changed more significantly. The chloride level for C728A had decreased from 403 mg/L in 1983 to 63.8 mg/L in 2019. The chloride level for C728D has increased from 185 mg/L in 1983 to 302 mg/L in 2018 and decreased to 124 mg/L in 2019. Although these piezometers are close in proximity and installed at the same level, they are being influenced by different water. Chloride results for C728A suggest initial seepage and it is to be expected that over time the same observation will be seen in C728D.

The piezometric surface of the Empress Sand indicates a regional flow from northwest to southeast below Morrison Dam. As a general observation, Empress piezometers respond to changing reservoir levels. Results for the Empress layer do not indicate seepage activity with the majority of the analyses showing little real change in boron or chloride results.

Piezometer C712B has been monitored for several years. Historically, boron levels were below 1 mg/L. Since that time from 1992 to 2019, boron levels have remained relatively steady around between 12 and 20 mg/L. The boron level in 2019 for piezometer C712B was 9.5 mg/L.

3.3.3.2 Montana

Water quality samples were collected from monitoring wells 7, 9, and 24 in 2019. Well 7 is completed in the Hart Coal Seam within the Tongue River Member of the Fort Union Formation. The Hart Coal Seam at this well is 134 to 143 feet below ground surface (bgs). Well 9 is completed in the Lebo Member of the Fort Union Formation, and is screened in sandstones and shales from 53 – 203 feet bgs, with no coal seams reported. Well 24 is completed in alluvium and is 38-feet deep.
Total dissolved solids (TDS) concentrations from samples collected from these wells are shown in Figure 3.17. Water-chemistry data used to construct the graphs in Figure 3.17 can be accessed through the Montana Ground Water Information Center (GWIC) database at http://mbmggwic.mtech.edu. All of the wells show variations in TDS concentrations of over 100 mg/L. Between 1991 and 2008 TDS concentrations were relatively stable to slightly decreasing. TDS concentrations were noticeably lower in 2009, but since then samples have remained above the anomalously low values observed in 2009. From 2011 through 2019, TDS concentrations have been slightly increasing with the notable exception of well 16. This well is known to be impacted by flooding during spring snow melt, and also does not produce much water when purged. To resolve this problem well 9 was selected to replace well 16. Well 9 was regularly sampled from 1978 through 1992, and once in 2008. The TDS concentration from sampling of this well in 2019 is similar to the 2008 results. Future sampling will be needed to determine if the TDS concentration fluctuate in well 9 like they did between 1978 and 1992.

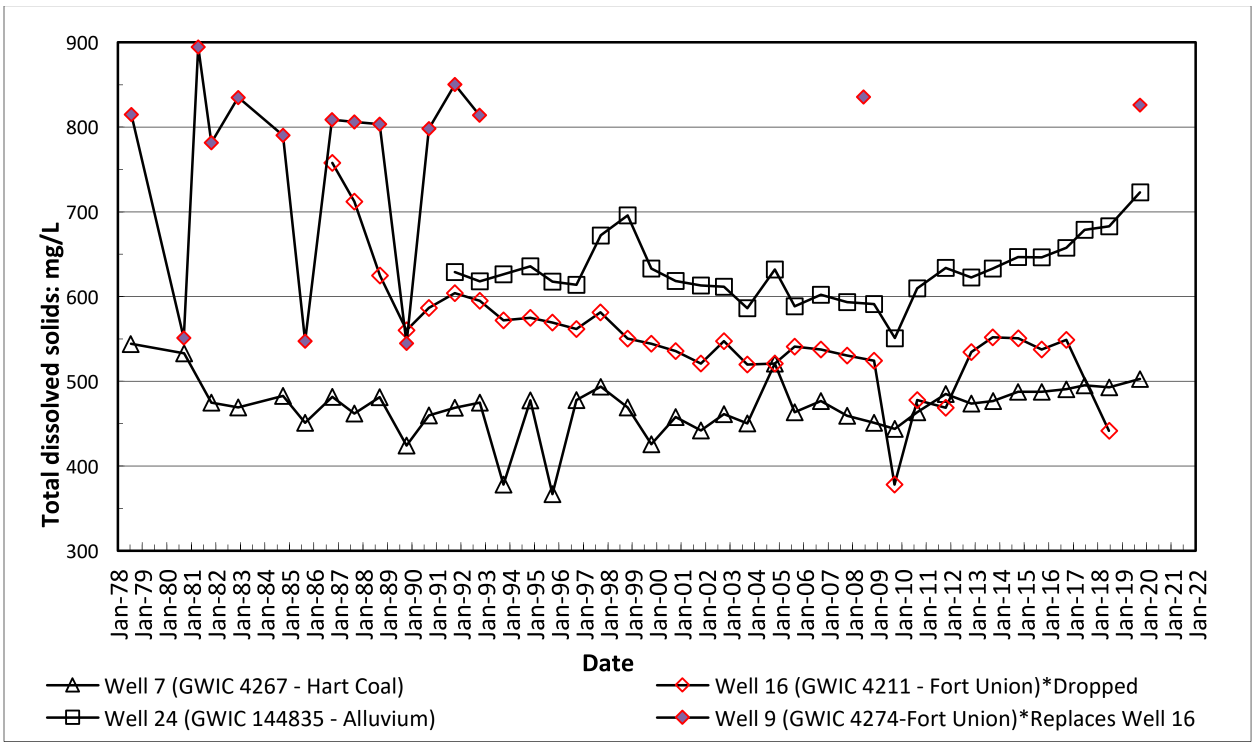


Figure 3.17 Total Dissolved Solids in Samples from Montana Wells.

3.4 Cookson Reservoir

3.4.1 Storage

On January 1, 2019, Cookson Reservoir storage was about 32,534 dam^3 (26,381 acre-feet) or 75 % of the full supply volume. The 2019 maximum, minimum (elevations and volumes) and the associated dates are indicated in Table 3.5.

Spring inflows into the reservoir were well above average, increasing water levels by about 1.574 m, which resulted in a spring peak water level of 753.03 m (2,467.67 ft) on March 29, 2019. After this peak, water levels started to decrease gradually until the middle of the summer. Inflows during the second half of June increased water levels by ~ 0.54 m. This resulted in a second peak water level of 753.21 m (0.21 m above fsl) recorded on June 30th which was also the annual peak water level during 2019. After this peak and for the rest of the year water levels were close to full supply level. On December 31st of 2019, the reservoir was about 752.77 m (2,469.72 ft), or approximately 0.23 m (0.75 ft) below full supply.

Table 3.5 Cookson Reservoir Storage Statistics for 2019

Date	Elevation (m)	Elevation (ft)	Contents (dam^3)	Contents (acre-feet)
Jan-01	751.50	2,465.54	32,534	26,375
June 30 (Maximum)	753.21	2,471.15	45,040	36,514
April 8 (minimum)	751.46	2,465.42	32,2280	26,170
Dec-31	752.77	2,469.72	41,636	33,755
Full Supply Level	753.00	2,470.47	43,410	35,193

The Poplar River Power Station is dependent on water from Cookson Reservoir for cooling. The power plant operation is adversely affected once the reservoir levels drop below 749.0 m (2,457.3 ft). The dead storage level for cooling water used in the generation process is 745.0 m (2,444.2 ft). The 2019 recorded levels and associated operating levels are illustrated in Figure 3.18 along with the 10-year median levels. Likewise, the 2019 storage associated with the operating levels are shown in Figure 3.19 along with the 10-year median levels.

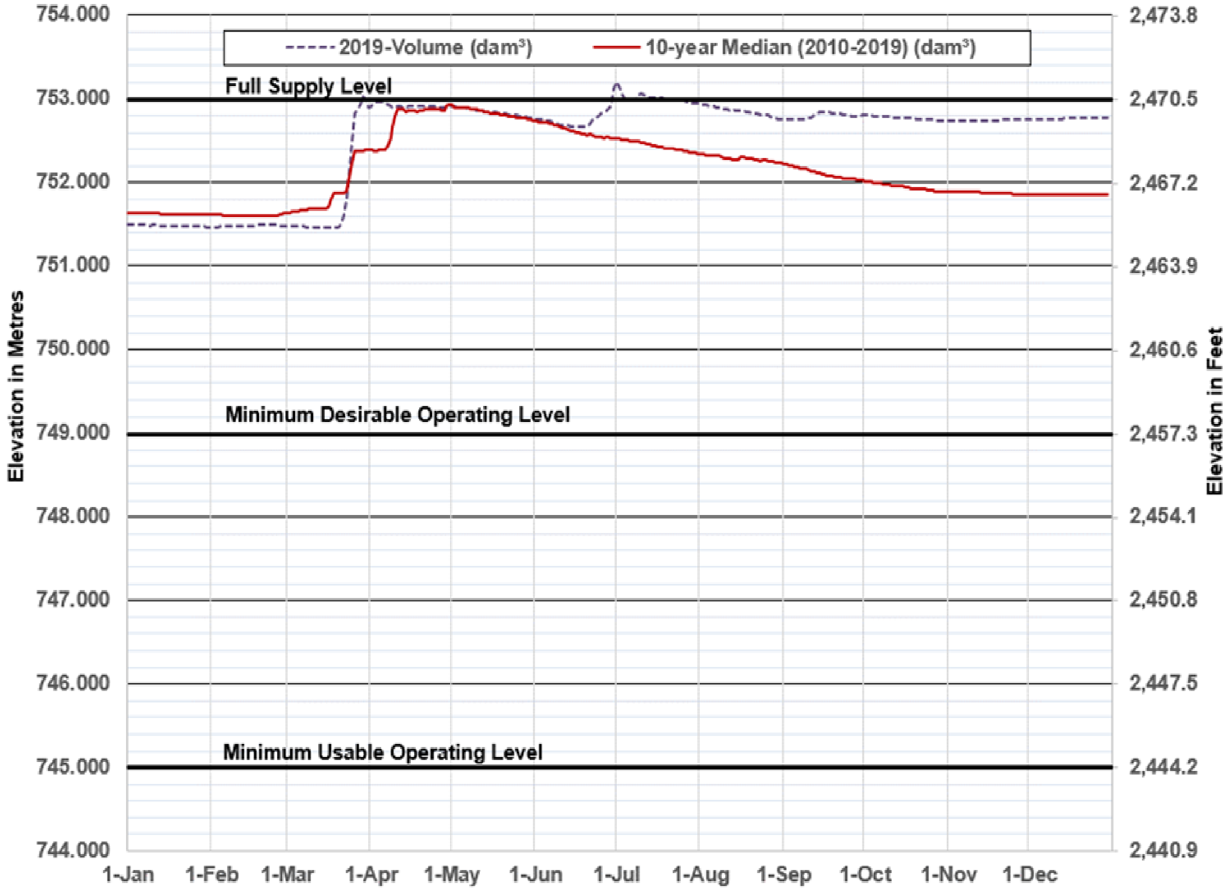


Figure 3.18 Cookson Reservoir Daily Mean Water Levels for 2019 and Median Daily Water Levels, 2010-2019

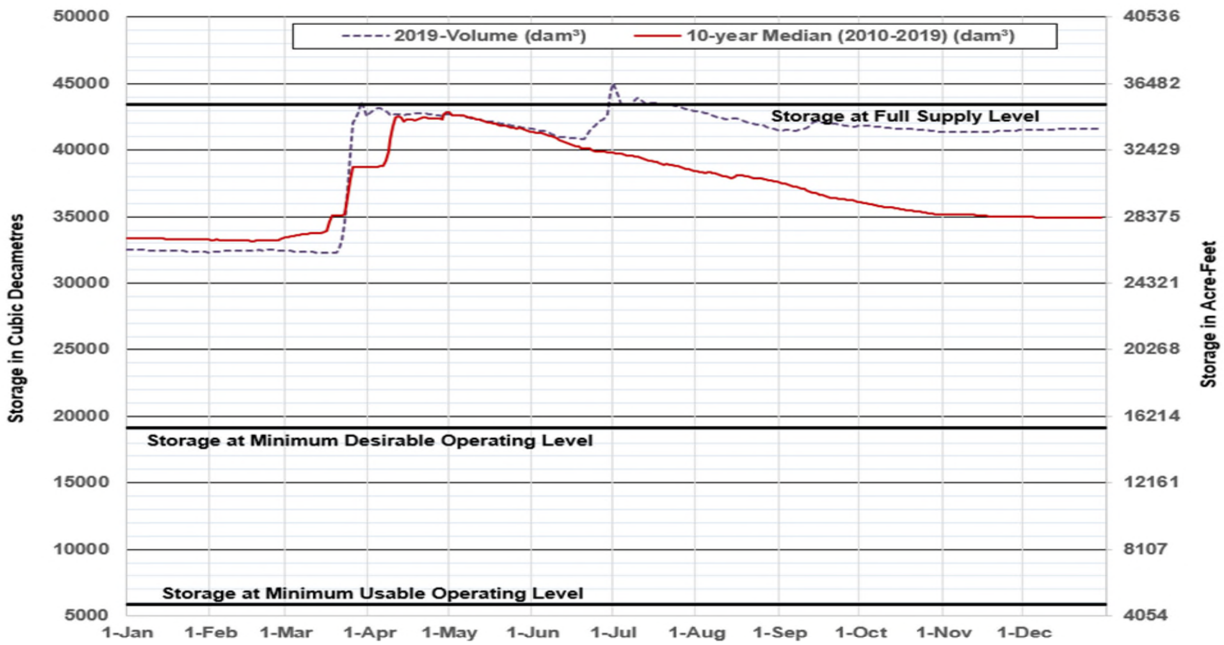


Figure 3.19 Cookson Reservoir Daily Mean Water Storage for 2019 and Median Daily Storage, 2010-2019

3.4.2 Water Quality

One major factor affecting the water quality of Cookson Reservoir is volume. Low reservoir volumes will decrease the water quality while high volumes will improve the water quality. The reservoir volume is controlled by two factors: inflows and losses. Inflows that increase reservoir volumes consist of: spring runoff, precipitation and supplementary water supply. Losses that decrease reservoir volume consist of: evaporation, water uses and apportionment releases.

Figure 3.20 shows the relationship between total dissolved solids (TDS) and the reservoir volume. In 2008, the concentration of total dissolved solids had reached 1,540 mg/L. Significant runoff in 2009 reduced the TDS to 1,160 mg/L. TDS increases throughout the year as the reservoir volume decreases. In 2010 there was a slight decrease in TDS for the runoff period and again increasing as the reservoir level decreased. The spilling that occurred during the 2011 runoff period significantly reduced the total dissolved solids to 391 mg/L (Figure 3.20). The December 2019 TDS of was 719 mg/L which was slightly lower than the 2018 TDS of 907 mg/L. In general, when the reservoir volume decreases TDS increases due to the reciprocal relationship between volume and concentration.

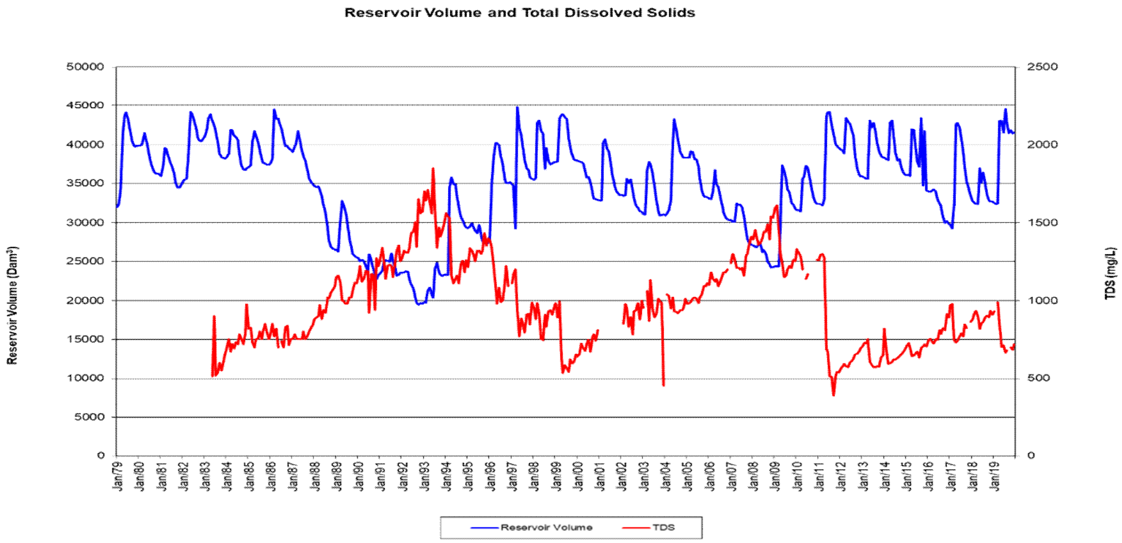


Figure 3.20 Reservoir Volume and Total Dissolved Solids Concentration from 1979-2019 for Cookson Reservoir

3.5 Air Quality

SaskPower's ambient SO_2 monitoring for 2019 recorded no values greater than Saskatchewan Environment's one-hour average standard of 0.17 ppm and the 24-hour average standard of 0.06 ppm. The 2019 geometric mean for the high-volume suspended-particulate sampler was 12.5 µg/m^3 and 2019 was the twenty sixth consecutive year of below-average standard particulate readings. With the approval of PRPS's Industrial Source (Air) Environmental Protection Plan in 2018, a new ambient air monitoring station was installed just south of the plant in 2019.

3.6 Quality Control

3.6.1 Streamflow

On May 28, 2019 Water Survey of Canada, Regina Office and the USGS Billings Field Office made comparison measurements at two USGS Gages – Horse Creek below Horse Creek near the International Boundary and Poplar River at the International Boundary. Both measurements plotted within the stated error of each other.

3.6.2 Water Quality

USGS conducted water quality sampling in 2019 at the East Poplar River at International Boundary**.** The grab samples would provide a means to check the validity of the regression model / equation currently in use by the Committee.

ANNEX 1

POPLAR RIVER

COOPERATIVE MONITORING ARRANGEMENT

CANADA-UNITED STATES

September 23, 1980

POPLAR RIVER COOPERATIVE MONITORING ARRANGEMENT

I. PURPOSE

This Arrangement will provide for the exchange of data collected as described in the attached Technical Monitoring Schedules in water-quality, water quantity and air quality monitoring programs being conducted in Canada and the United States at or near the International Boundary in response to SaskPower development. This Arrangement will also provide for the dissemination of the data in each country and will assure its comparability and assist in its technical interpretation.

The Arrangement will replace and expand upon the quarterly information exchange program instituted between Canada and the United States in 1976.

II. PARTICIPATING GOVERNMENTS

Governments and government agencies participating in the Arrangement are:

Government of Canada: Environment Canada
Government of the Province of Saskatchewan:
Saskatchewan Environment and Resource Management
Government of the United States of America: United States Geological Survey
Government of the State of Montana: Executive Office

III. POPLAR RIVER MONITORING COMMITTEE: TERMS OF REFERENCE

A binational committee called the Poplar River Bilateral Monitoring Committee will be established to carry out responsibilities assigned to it under this Arrangement. The Committee will operate in accordance with the following terms of reference:

A. Membership

The Committee will be composed of four representatives, one from each of the participating Governments. It will be jointly chaired by the Government of Canada and the Government of the United States. There will be a Canadian Section and a United States Section. The participating Governments will notify each other of any changes in membership on the Committee. Co-chairpersons may by mutual agreement invite agency technical experts to participate in the work of the Committee.

The Governor of the State of Montana may also appoint a chief elective official of local government to participate as an ex-officio member of the Committee in its technical deliberations. The Saskatchewan Minister of the Environment may also appoint a similar local representative.

B. Functions of the Committee

The role of the Committee will be to fulfil the purpose of the Arrangement by ensuring the exchange of monitored data in accordance with the attached Technical Monitoring Schedules, and its collation and technical interpretation in reports to Governments on implementation of the Arrangement. In addition, the Committee will review the existing monitoring systems to ensure their adequacy and may recommend to the Canadian and United States Governments any modifications to improve the Technical Monitoring Schedules.

1. Information Exchange

Each Co-chairperson will be responsible for transmitting to his counterpart Co-chairperson on a regular annual basis, the data provided by the cooperative monitoring agencies in accordance with the Technical Monitoring Schedules.

2. Reports

(a) The Committee will prepare a joint Annual Report to the participating governments, and may at any time prepare joint Special Reports.

(b) Annual Reports will

i) summarize the main activities of the Committee in the year under Report and the data which has been exchanged under the Arrangement;

ii) draw to the attention of the participating governments any definitive changes in the monitored parameters, based on collation and technical interpretation of exchanged data (i.e. the utilization of summary, statistical and other appropriate techniques);

iii) draw to the attention of the participating governments any recommendations regarding the adequacy or redundancy of any scheduled monitoring operations and any proposals regarding modifications to the Technical Monitoring Schedules, based on a continuing review of the monitoring programs including analytical methods to ensure their comparability.

(c) Special Reports may, at any time, draw to the attention of participating governments definitive changes in monitored parameters which may require immediate attention.

(d) Preparation of Reports

Reports will be prepared following consultation with all committee members and will be signed by all Committee members. Reports will be separately forwarded by the Committee Co-chairmen to the participating governments. All annual and special reports will be so distributed.

3. Activities of Canadian and United States Sections

The Canadian and United States section will be separately responsible for:

(a) dissemination of information within their respective countries, and the arrangement of any discussion required with local elected officials;

(b) verification that monitoring operations are being carried out in accordance with the Technical Monitoring Schedules by cooperating monitoring agencies;

(c) receipt and collation of monitored data generated by the cooperating monitoring agencies in their respective countries as specified in the Technical Monitoring Schedules;

(d) if necessary, drawing to the attention of the appropriate government in their respective countries any failure to comply with a scheduled monitoring function on the part of any cooperating agency under the jurisdiction of that government, and requesting that appropriate corrective action be taken.

IV. PROVISION OF DATA

In order to ensure that the Committee is able to carry out the terms of this Arrangement, the participating governments will use their best efforts to have cooperating monitoring agencies, in their respective jurisdictions provide on an ongoing basis all scheduled monitored data for which they are responsible.

V. TERMS OF THE ARRANGEMENT

The Arrangement will be effective for an initial term of five years and may be amended by agreement of the participating governments. It will be subject to review at the end of the initial term and will be renewed thereafter for as long as it is required by the participating governments.

ANNEX 2

POPLAR RIVER

COOPERATIVE MONITORING ARRANGEMENT

TECHNICAL MONITORING SCHEDULES

2020

CANADA-UNITED STATES

TABLE OF CONTENTS

PREAMBLE

The Technical Monitoring Schedule lists those water quantity, water-quality and air quality monitoring locations and parameters which form the basis for information exchange and reporting to Governments. The structure of the Committee responsible for ensuring the exchange takes place is described in the Poplar River Cooperative Monitoring Arrangement.

The monitoring locations and parameters listed herein have been reviewed by the Poplar River Bilateral Monitoring Committee and represent the basic technical information needed to identify any definitive changes in water quantity, water quality and air quality at the International Boundary. The Schedule was initially submitted to Governments for approval as an attachment to the 1981 report to Governments. Changes in the sampling locations and parameters may be made by Governments based on the recommendations of the Committee.

Additional information has been or is being collected by agencies on both sides of the International Boundary, primarily for project management or basin-wide baseline data purposes. This additional information is usually available upon request from the collecting agency and forms part of the pool of technical information which may be drawn upon by Governments for specific study purposes. Examples of additional information are water-quantity, water-quality, ground-water and air-quality data collected at points in the Poplar River basin not of direct concern to the Committee. In addition, supplemental information on parameters such as vegetation, soils, fish and waterfowl populations and aquatic vegetation has been collected on either a routine or specific-studies basis by various agencies.

POPLAR RIVER

COOPERATIVE MONITORING ARRANGEMENT

TECHNICAL MONITORING SCHEDULES

2020

CANADA

STREAMFLOW MONITORING

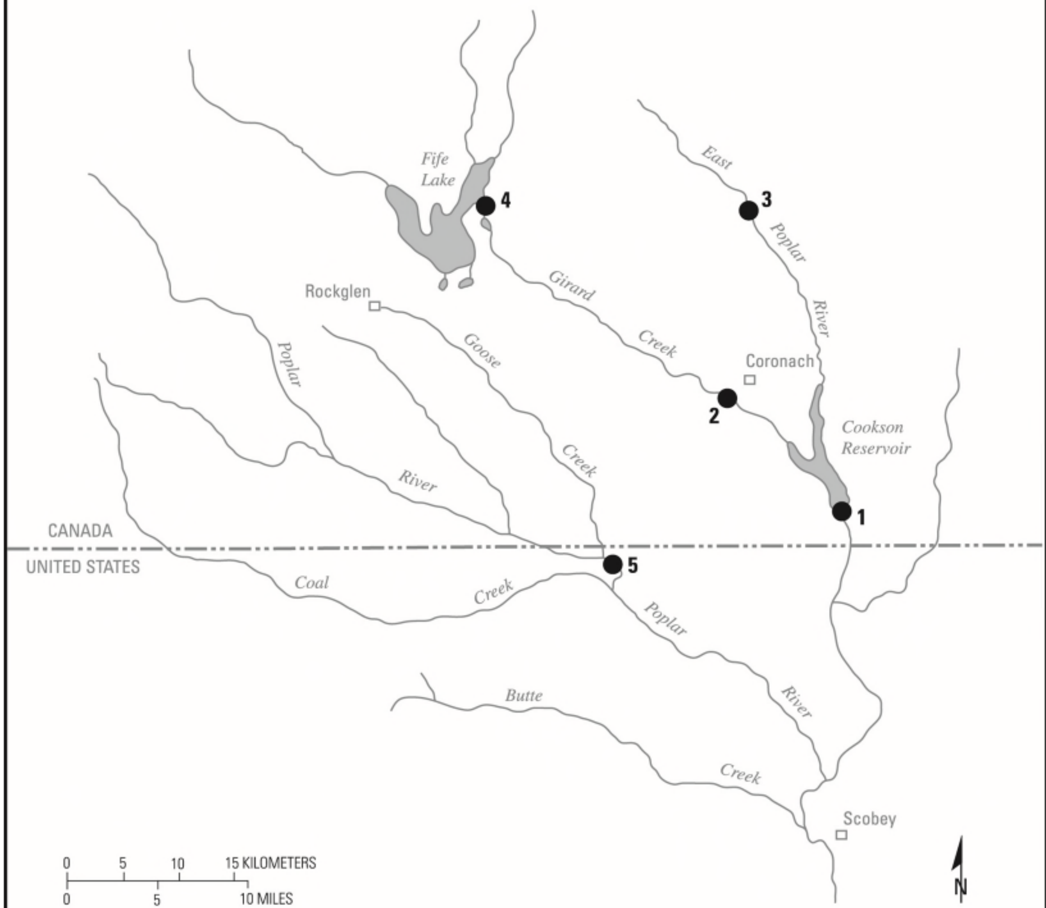
Daily mean discharge or levels and instantaneous monthly extremes as normally published in surface-water-data publications.

Responsible Agencies: Environment Canada, Water Security Agency		
No. on Map	**Station No.**	**Station Name**
1	11AE013**	Cookson Reservoir near Coronach
2	11AE015**	Girard Creek near Coronach Cookson Reservoir
3	11AE014**	East Poplar River above Cookson Reservoir
4		Fife Lake Overflow***
5*	11AE008 (06178000)	Poplar River at International Boundary

* International gauging station.

** Water Security Agency (WSA) took over the monitoring responsibility effective July 1, 1992.

*** Miscellaneous measurements of outflow to be made by WSA during periods of outflow only.



HYDROMETRIC GAUGING STATIONS (CANADA)

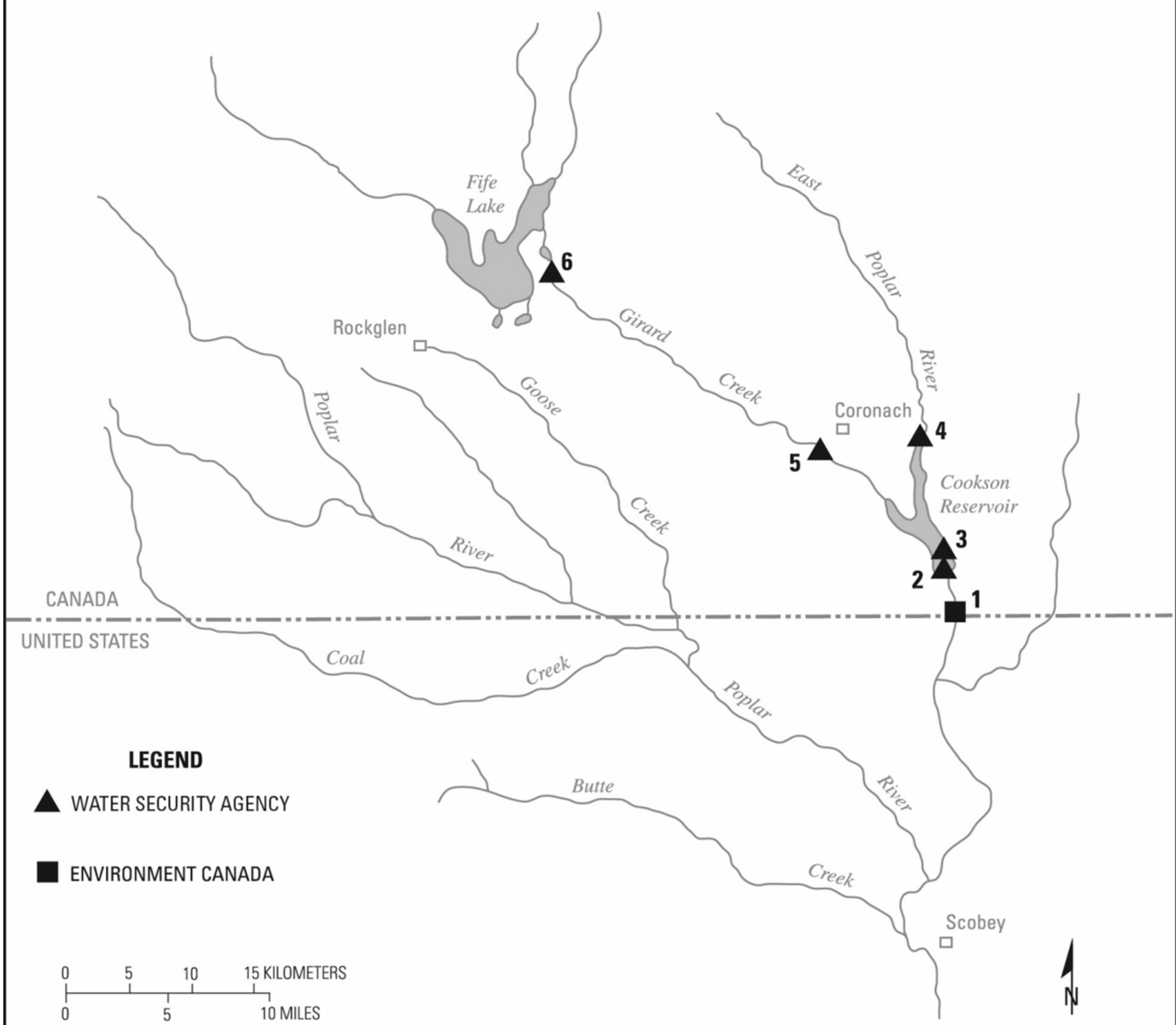
SURFACE-WATER-QUALITY MONITORING

Sampling Locations

Responsible Agency: Environment Canada		
No. on Map	**Station No.**	**Station Name**
1	00SA11AE0008 Suspended	East Poplar River at International Boundary

Responsible Agency: Water Security Agency Data collected by: SaskPower		
No. on Map	**Station No.**	**Station Name**
2	12386 Discontinued	East Poplar River at Culvert immediately below Cookson Reservoir
3	12368	Cookson Reservoir near Dam
4	12377 Discontinued	Upper End of Cookson Reservoir at Highway 36
5	12412 Discontinued	Girard Creek at Coronach, Reservoir Outflow
6	7904	Fife Lake Outflow*

*Sampled only when outflow occurs for a 2-week period, which does not occur every year.



SURFACE-WATER-QUALITY MONITORING STATIONS (CANADA)

PARAMETERS

Responsible Agency: Environment Canada

ENVIRODAT* Code	Parameter	Analytical Method	Sampling Frequency Station No. 1
10151	Alkalinity-phenolphthalein	Potentiometric Titration	SUS
10111	Alkalinity-total	Potentiometric Titration	SUS
13102	Aluminum-dissolved	AA-Direct	SUS
13302	Aluminum-extracted	AA-Direct	SUS
07540	Ammonia-total	Automated Colourimetric	SUS
33108	Arsenic-dissolved	ICAP-hydride	SUS
56001	Barium-total	AA-Direct	SUS
06201	Bicarbonates	Calculated	SUS
05211	Boron-dissolved	ICAP	SUS
96360	Bromoxynil	Gas Chromatography	SUS
48002	Cadmium-total	AA Solvent Extraction	SUS
20113	Calcium	AA-Direct	SUS
06104	Carbon-dissolved organic	Automated IR Detection	SUS
06901	Carbon-particulate	Elemental Analyzer	SUS
06002	Carbon-total organic	Calculated	SUS
06301	Carbonates	Calculated	SUS
17206	Chloride	Automated Colourimetric	SUS
06717	Chlorophyll a	Spectrophotometric	SUS
24003	Chromium-total	AA-Solvent Extraction	SUS
27002	Cobalt-total	AA-Solvent Extraction	SUS
36012	Coliform-fecal	Membrane Filtration	SUS
36002	Coliform-total	Membrane Filtration	SUS
02021	Colour	Comparator	SUS
02041	Conductivity	Wheatstone Bridge	SUS
06610	Cyanide	Automated UV-Colourimetric	SUS
09117	Fluoride-dissolved	Electrometric	SUS
06401	Free Carbon Dioxide	Calculated	SUS
10602	Hardness	Calculated	SUS
17811	Hexachlorobenzene	Gas Chromatography	SUS
08501	Hydroxide	Calculated	SUS
26104	Iron-dissolved	AA-Direct	SUS
82002	Lead-total	AA-Solvent Extraction	SUS
12102	Magnesium	AA-Direct	SUS
25104	Manganese-dissolved	AA-Direct	SUS
07901	N-particulate	Elemental Analyzer	SUS
07651	N-total dissolved	Automated UV Colourimetric	SUS
10401	NFR	Gravimetric	SUS
28002	Nickel-total	AA-Solvent Extraction	SUS
07110	Nitrate/Nitrite	Colourimetric	SUS
07603	Nitrogen-total	Calculated	SUS
10650	Non-Carbonate Hardness	Calculated	SUS
18XXX	Organo Chlorines	Gas Chromatography	SUS
08101	Oxygen-dissolved	Winkler	SUS
15901	P-particulate	Calculated	SUS
15465	P-total dissolved	Automated Colourimetric	SUS
185XX	Phenoxy Herbicides	Gas Chromatography	SUS
15423	Phosphorus-total	Colourimetric (TRAACS)	SUS
19103	Potassium	Flame Emission	SUS
11250	Percent Sodium	Calculated	SUS
011201	SAR	Calculated	SUS
00210	Saturation Index	Calculated	SUS
34108	Selenium-dissolved	ICAP-hydride	SUS
14108	Silica	Automated Colourimetric	SUS
11103	Sodium	Flame Emission	SUS
00211	Stability Index	Calculated	SUS
16306	Sulphate	Automated Colourimetric	SUS
00201	TDS	Calculated	SUS
02061	Temperature	Digital Thermometer	SUS
02073	Turbidity	Nephelometry	SUS
23002	Vanadium-total	AA-Solvent Extraction	SUS
30005	Zinc-total	AA-Solvent Extraction	SUS
10301	pH	Electrometric	SUS
92111	Uranium	Fluometric	SUS

* - Computer Storage and Retrieval System -- Environment Canada
AA - Atomic Absorption
UV - Ultraviolet
NFR - Nonfilterable Residue
ICAP - Inductively Coupled Argon Plasma.
SUS – Suspended

PARAMETERS

Responsible Agency: Water Security Agency
Data Collected by: SaskPower

ESQUADAT* Code	Parameter	Analytical method	Sampling Frequency Station No.				
			2	3	4	5	6
10151	Alkalinity-phenol	Pot-Titration	DIS	Q	DIS	DIS	OF
10101	Alkalinity-tot	Pot-Titration	DIS	Q	DIS	DIS	OF
13004	Aluminum-tot	AA-Direct	DIS	A	DIS	DIS	
33004	Arsenic-tot	Flameless AA	DIS	A	DIS	DIS	
06201	Bicarbonates	Calculated	DIS	Q	DIS	DIS	OF
05451	Boron-tot	ICAP	DIS	Q	DIS	DIS	W
48002	Cadmium-tot	AA-Solvent Extract (MIBK)	DIS	A	DIS	DIS	
20113	Calcium	AA-Direct	DIS	Q	DIS	DIS	OF
06052	Carbon-tot Inorganic	Infrared	DIS	Q	DIS	DIS	OF
06005	Carbon-tot Organic	Infrared	DIS	Q	DIS	DIS	OF
06301	Carbonates	Calculated	DIS	Q	DIS	DIS	OF
17203	Chloride	Automated Colourimetric	DIS	Q	DIS	DIS	OF
06711	Chlorophyll- ‘a’	Spectrophotometry	DIS	Q	DIS	DIS	
24004	Chromium-tot	AA-Direct	DIS	A	DIS	DIS	
36012	Coliform-fec	Membrane filtration	DIS	Q	DIS	DIS	OF
36002	Coliform-tot	Membrane filtration	DIS	Q	DIS	DIS	OF
02041	Conductivity	Conductivity Meter	DIS	Q	DIS	DIS	W
29005	Copper-tot	AA-Solvent Extract (MIBK)	DIS	A	DIS	DIS	
09105	Fluoride	Specific Ion Electrode	DIS	A	DIS	DIS	
82002	Lead-tot	AA-Solvent Extract (MIBK)	DIS	A	DIS	DIS	
12102	Magnesium	AA-Direct	DIS	Q	DIS	DIS	OF
80011	Mercury-tot	Flameless-AA	DIS	A	DIS	DIS	
42102	Molybdenum	AA-Solvent Extract (N-Butyl acetate)	DIS	A	DIS	DIS	
07015	N-TKN	Automated Colourimetric	DIS	Q	DIS	DIS	OF
10401	NFR	Gravimetric	DIS	Q	DIS	DIS	OF
10501	NFR(F)	Gravimetric	DIS	Q	DIS	DIS	OF
28002	Nickel-tot	AA-Solvent Extract (MIBK)	DIS	Q	DIS	DIS	OF
07110	Nitrate + NO_2	Automated Colourimetric	DIS	Q	DIS	DIS	OF
06521	Oil and Grease	Pet. Ether Extraction	DIS	A	DIS	DIS	
08102	Oxygen-diss	Meter	DIS	Q	DIS	DIS	OF
15406	Phosphorus-tot	Colourimetry	DIS	Q	DIS	DIS	OF
19103	Potassium	Flame Photometry	DIS	Q	DIS	DIS	OF
34005	Selenium-Ext	Hydride generation	DIS	A	DIS	DIS	
11103	Sodium	Flame Photometry	DIS	Q	DIS	DIS	OF
16306	Sulphate	Colourimetry	DIS	Q	DIS	DIS	OF
10451	TDS	Gravimetric	DIS	Q	DIS	DIS	OF
02061	Temperature	Thermometer	DIS	Q	DIS	DIS	OF
23004	Vanadium-tot	AA-Direct	DIS	A	DIS	DIS	
30005	Zinc-tot	AA-Solvent Extract (MIBK)	DIS	A	DIS	DIS	
10301	pH	Electrometric	DIS	Q	DIS	DIS	W

* Computer storage and retrieval system - Water Security Agency.

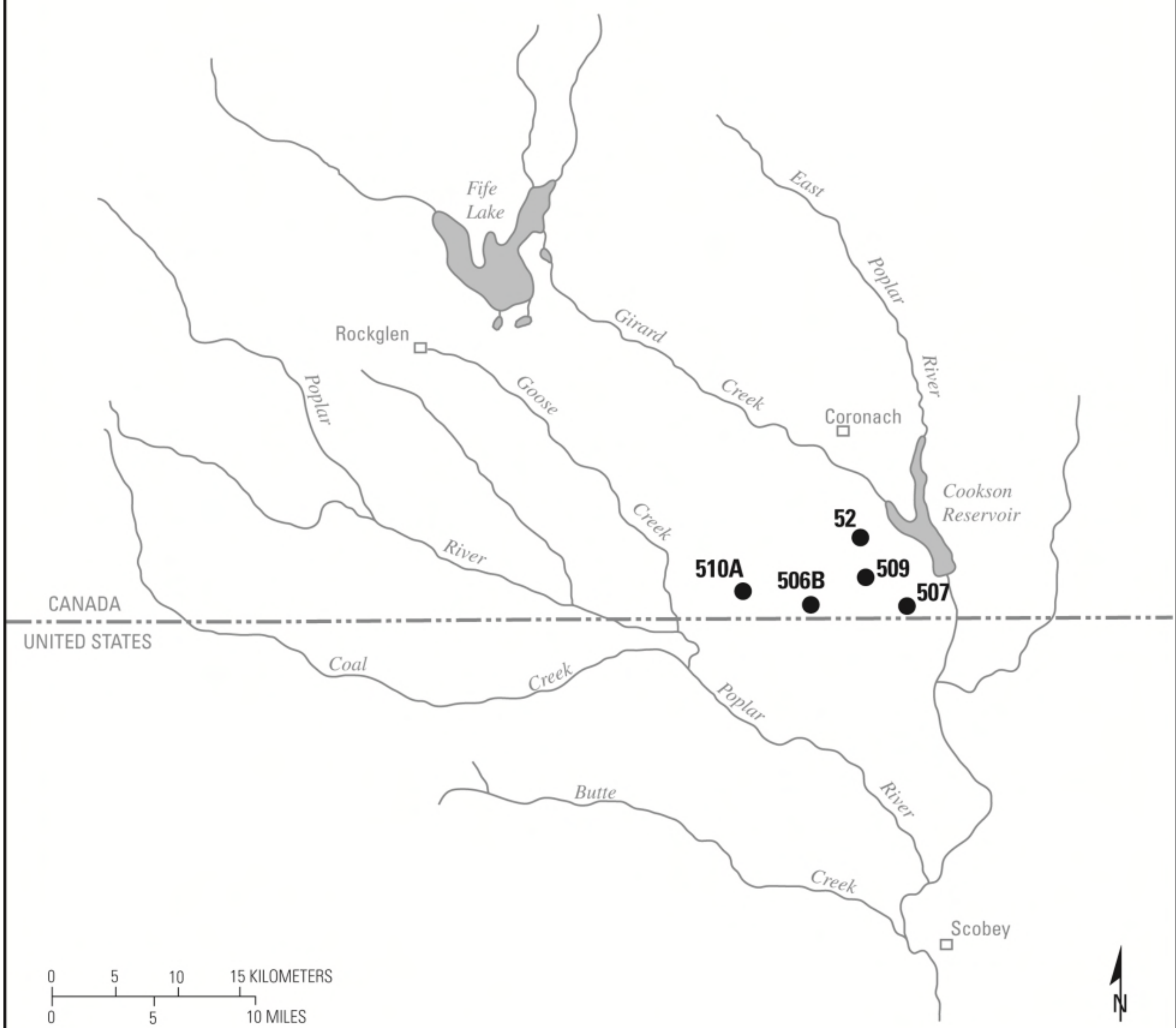
Symbols:
W – Weekly during overflow; OF– Once during each period of overflow greater than 2 weeks’ duration;
Q – Quarterly; A – Annually; AA – Atomic Absorption; Pot – Potentiometric; tot – total; Pet – Petroleum;
fec – fecal; diss – dissolved; EXT – extract; NFR – Nonfilterable residue; NFR(F) – Nonfilterable residue, fixed;
ICAP – Inductively Coupled Argon Plasma; (MIBK) – sample acidified and extracted with Methyl Isobutyl Ketone;
DIS - Discontinued.

GROUNDWATER PIEZOMETERS TO MONITOR POTENTIAL DRAWDOWN

DUE TO COAL-SEAM DEWATERING NEAR THE INTERNATIONAL BOUNDARY

Responsible Agency: Water Security Agency*			
Measurement Frequency: Quarterly			
Piezometer Number	**Location**	**Tip of Screen Elevation (m)**	**Perforation Zone (depth in metres)**
52	NW 14-1-27 W3	738.43	43-49 (in coal)
506B	SW 4-1-27 W3	48.27	81-82 (in coal)
507	SW 6-1-26 W3	725.27	34 - 35 (in coal)
509	NW 11-1-27 W3	725.82	76-77 (in coal)
510A	NW 1-1-28 W3	769.34	28-29 (in coal and clay)

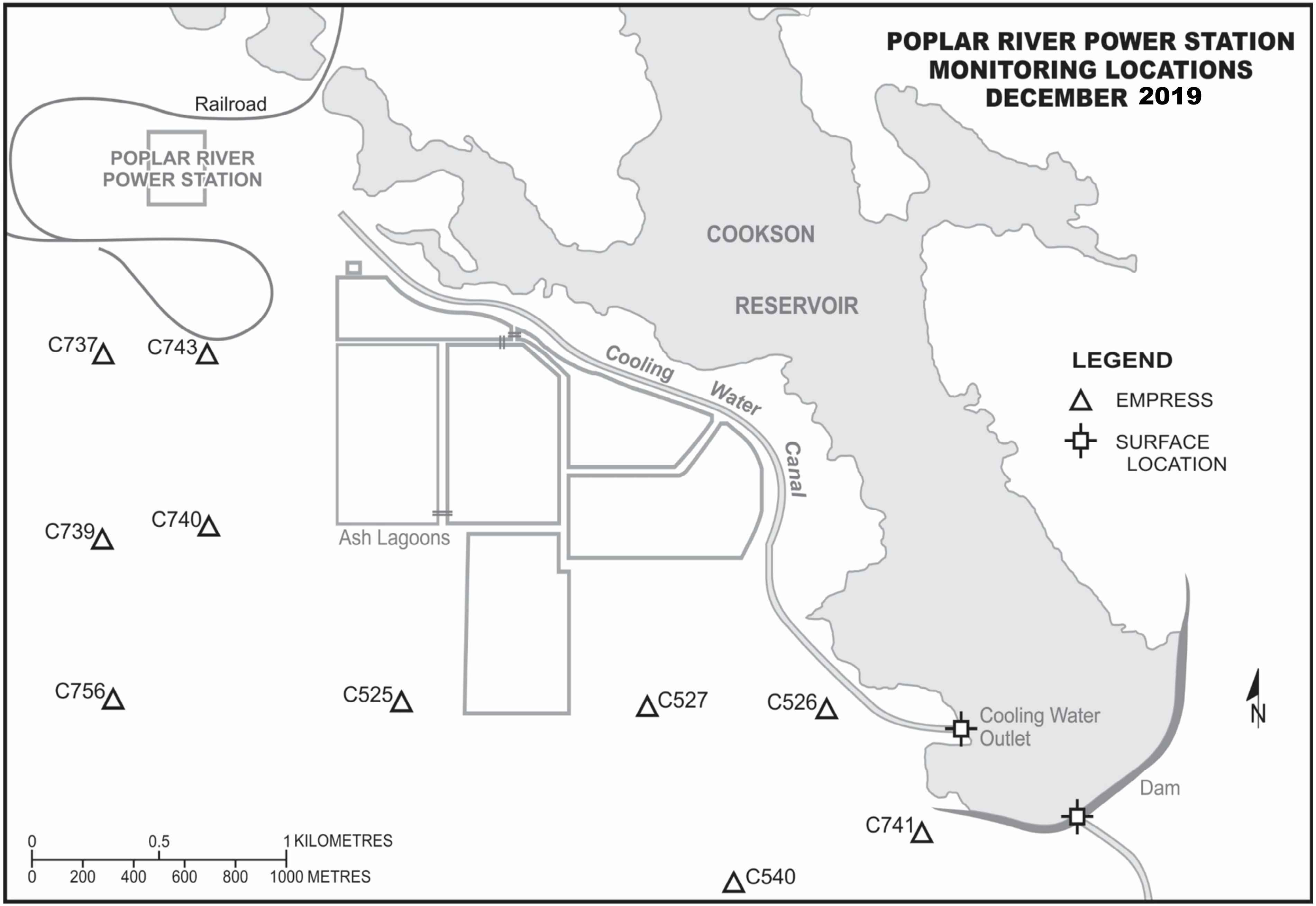
*Data Collected by: SaskPower



GROUND-WATER PIEZOMETERS TO MONITOR POTENTIAL DRAWDOWN DUE TO COAL-SEAM DEWATERING

GROUNDWATER PIEZOMETER MONITORING POPLAR RIVER POWER STATION AREA--WATER LEVELS	
SPC Piezometer Number	**Completion Formation**
C525	Empress
C526	Empress
C527	Empress
C539	Empress
C540	Empress
C737	Empress
C739	Empress
C740	Empress
C741	Empress
C743	Empress
C756	Empress

GROUNDWATER PIEZOMETER MONITORING POPLAR RIVER POWER STATION AREA--WATER QUALITY	
SPC Piezometer Number	**Completion Formation**
C526	Empress
C540	Empress
C741	Empress

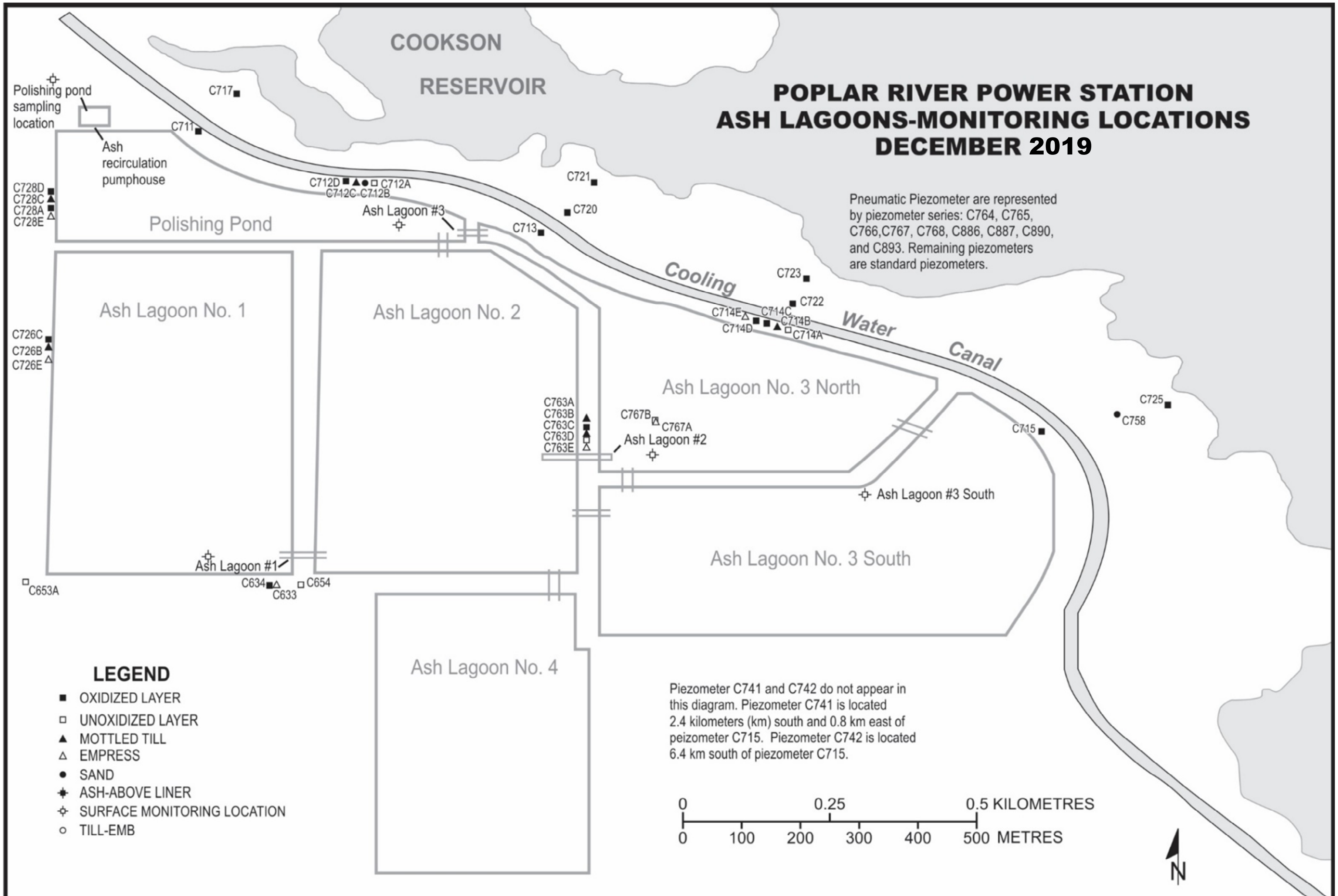

POPLAR RIVER POWER STATION
MONITORING LOCATIONS
DECEMBER 2019
Railroad
POPLAR RIVER
POWER STATION
COOKSON
RESERVOIR
Cooling Water Canal
Ash Lagoons
LEGEND
EMPRESS
SURFACE
LOCATION
C737
C743
C739
C740
C756
C525
C527
C526
C741
C540
Cooling Water
Outlet
Dam
N
0
0.5
1 KILOMETRES
0
200
400
600
800
1000 METRES

GROUNDWATER PIEZOMETER MONITORING ASH LAGOON AREA--WATER LEVEL	
SPC Piezometer Number	**Completion Formation**
C533	Empress
C534	Oxidized Till
C654	Unoxidized Till
C711	Oxidized Till
C712A	Unoxidized Till
C712B	Intra Till Sand
C712C	Mottled Till
C712D	Oxidized Till
C713	Oxidized Till
C714A	Unoxidized Till
C714B	Unoxidized Till
C714C	Oxidized Till
C714D	Oxidized Till
C714E	Empress
C715	Oxidized Till
C717	Oxidized Till
C720	Oxidized Till
C721	Oxidized Till
C722	Oxidized Till
C723	Oxidized Till
C725	Oxidized Till
C726B	Unoxidized Till
C726C	Oxidized Till
C726E	Empress
C728A	Oxidized Till
C728C	Mottled Till
C728D	Oxidized Till
C728E	Empress
C741	Empress
C742	Empress

GROUNDWATER PIEZOMETER MONITORING ASH LAGOON AREA--WATER LEVEL	
SPC Piezometer Number	**Completion Formation**
C758	Intra Till Sand
C763A	Mottled Till
C763B	Oxidized Till
C763D	Unoxidized Till
C763E	Empress

GROUNDWATER PIEZOMETER MONITORING ASH LAGOON AREA -- WATER QUALITY	
SPC Piezometer Number	**Completion Formation**
C533	Empress
C534	Oxidized Till
C654	Unoxidized Till
C711	Oxidized Till
C712A	Unoxidized Till
C712B	Intra Till Sand
C712C	Mottled Till
C712D	Oxidized Till
C713	Oxidized Till
C714A	Unoxidized Till
C714B	Unoxidized Till
C714C	Oxidized Till
C714D	Oxidized Till
C714E	Empress
C715	Oxidized Till
C717	Oxidized Till
C720	Oxidized Till
C721	Oxidized Till
C722	Oxidized Till
C723	Oxidized Till
C725	Oxidized Till
C726B	Unoxidized Till

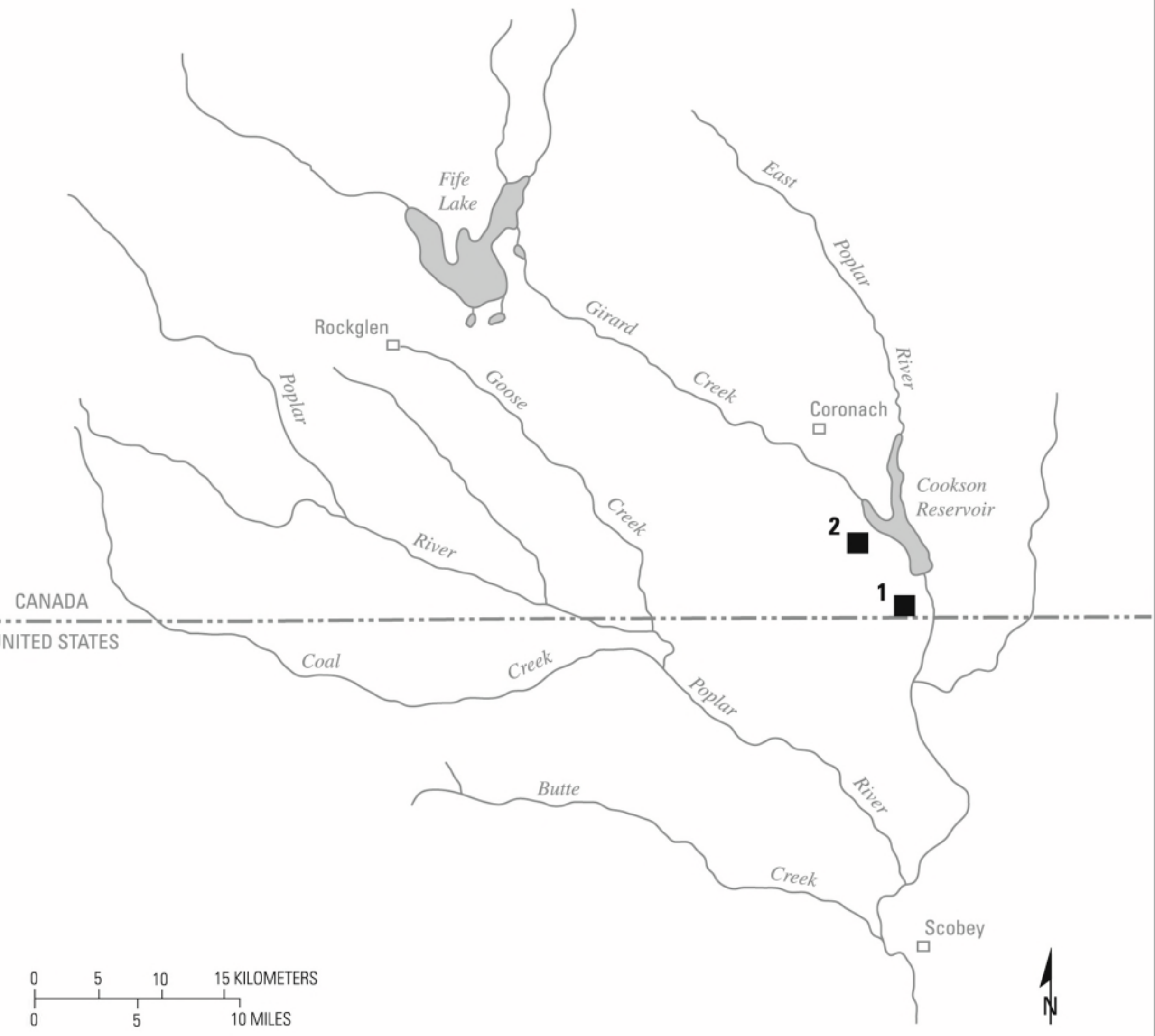
GROUNDWATER PIEZOMETER MONITORING ASH LAGOON AREA -- WATER QUALITY	
SPC Piezometer Number	**Completion Formation**
C726C	Oxidized Till
C726E	Empress
C728A	Oxidized Till
C728C	Mottled Till
C728D	Oxidized Till
C728E	Empress
C741	Empress
C742	Empress
C758	Intra Till Sand
C763A	Mottled Till
C763B	Oxidized Till
C763D	Unoxidized Till
C763E	Empress


POPLAR RIVER POWER STATION
ASH LAGOONS-MONITORING LOCATIONS
DECEMBER 2019
COOKSON
RESERVOIR
Pneumatic Piezometer are represented by piezometer series: C764, C765, C766,C767, C768, C886, C887, C890, and C893. Remaining piezometers are standard piezometers.
Polishing pond sampling location
Ash recirculation pumphouse
Polishing Pond
Ash Lagoon No. 1
Ash Lagoon No. 2
Ash Lagoon No. 3 North
Ash Lagoon No. 3 South
Ash Lagoon No. 4
Ash Lagoon #1
Ash Lagoon #2
Ash Lagoon #3
Ash Lagoon #3 South
Cooling Water Canal
C711
C712A
C712B
C712C
C712D
C713
C714A
C714B
C714C
C714D
C714E
C715
C717
C720
C721
C722
C723
C725
C726B
C726C
C726E
C728A
C728C
C728D
C728E
C758
C763A
C763B
C763C
C763D
C763E
C767A
C767B
C633
C634
C653A
C654
Piezometer C741 and C742 do not appear in this diagram. Piezometer C741 is located 2.4 kilometers (km) south and 0.8 km east of peizometer C715. Piezometer C742 is located 6.4 km south of piezometer C715.
LEGEND
OXIDIZED LAYER
UNOXIDIZED LAYER
MOTTLED TILL
EMPRESS
SAND
ASH-ABOVE LINER
SURFACE MONITORING LOCATION
TILL-EMB
0 0.25 0.5 KILOMETRES
0 100 200 300 400 500 METRES
N

Ambient Air-Quality Monitoring

Responsible Agency: Saskatchewan Environment **Data Collected by: SaskPower**			
No. On Map	**Location**	**Parameters**	**Reporting Frequency**
1	International Boundary	Sulphur Dioxide Total Suspended Particulate	Continuous monitoring with hourly averages as summary statistics. 24-hour samples on 6-day cycle, corresponding to the national air pollution surveillance sampling schedule.
2	Poplar River Power Station	Wind Speed and Direction	Continuous monitoring with hourly averages as summary statistics
METHODS			
Sulphur Dioxide		Saskatchewan Environment Pulsed fluorescence	
Total Suspended Particulate		Saskatchewan Environment High Volume Method	

SaskPower is planning to re-locate its Ambient Air Quality monitoring station to another location directly south of the Power Plant. Total Suspended Particulate and SO_2 will continue to be monitored at the new location. The relocation will take place by the end of October 2019. The Ambient Air Quality Map will be updated in 2020 after the relocation.



AMBIENT AIR-QUALITY MONITORING (CANADA)

A2-24

POPLAR RIVER

COOPERATIVE MONITORING ARRANGEMENT

TECHNICAL MONITORING SCHEDULES

2020

UNITED STATES

STREAMFLOW MONITORING

Daily mean discharge and monthly statistics as normally published in surface-water-data publications.

Responsible Agency: U.S. Geological Survey		
No. on Map	**Station Number**	**Station Name**
1*	06178000 (11AE008)	Poplar River at International Boundary
2*	06178500 (11AE003)	East Poplar River at International Boundary

* International gauging station.

HYDROMETRIC GAUGING STATIONS (UNITED STATES)

SURFACE-WATER-QUALITY MONITORING -- Station Locations

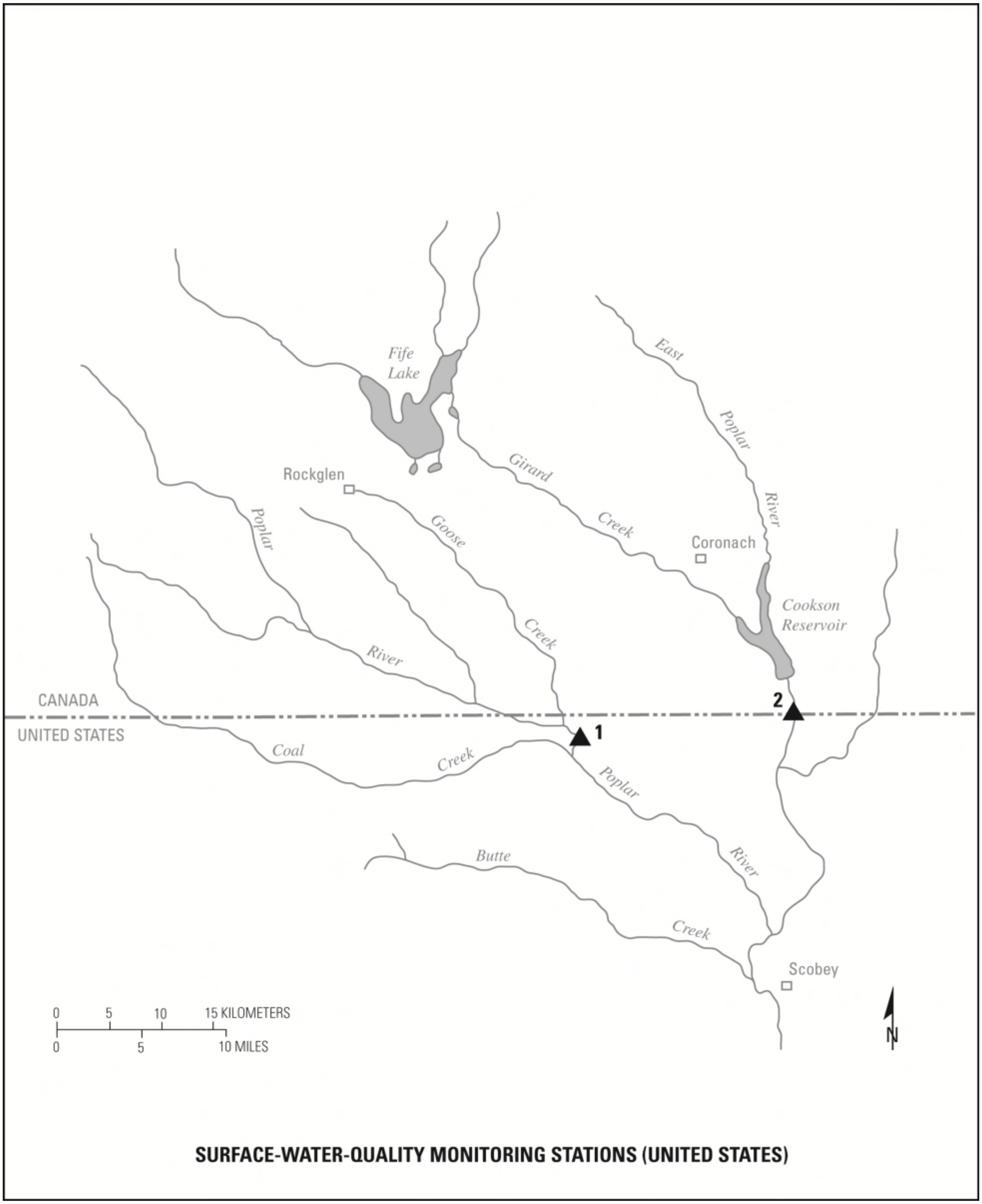
Responsible Agency: U.S. Geological Survey		
No. On Map	**USGS Station No.**	**STATION NAME**
1	06178000	Poplar River at International Boundary
2	06178500	East Poplar River at International Boundary

PARAMETERS

			Annual Sampling Frequency	
Analytical Code	**Parameter**	**Analytical Method**	**Site 1***	**Site 2****
29801	Alkalinity - lab	Fixed endpoint Titration	SUS	SUS
00608	Ammonia - diss	Colorimetric	SUS	SUS
01002	Arsenic - tot	ICP, MS	SUS	SUS
00025	Barometric pressure	Barometer, field	SUS	SUS
01020	Boron – diss	ICP	SUS	SUS
01027	Cadmium - tot/rec	ICP, MS	SUS	SUS
00915	Calcium - diss	ICP, AES	SUS	SUS
00940	Chloride - diss	IC	SUS	SUS
00095	Conductivity	Electrometric, field	SUS	SUS
00061	Discharge - inst	Direct measurement	SUS	SUS
00900	Hardness	Calculated	SUS	SUS
00950	Fluoride - diss	ISE	SUS	SUS
01051	Lead - tot/rec	ICP, MS	SUS	SUS
00925	Magnesium - diss	ICP	SUS	SUS
00613	Nitrate - diss	Colorimetric	SUS	SUS
00631	Nitrate + Nitrite - diss	Colorimetric	SUS	SUS
62855	Nitrogen, total	Colorimetric	SUS	SUS
00300	Oxygen-diss	Oxygen membrane, field	SUS	SUS
00400	pH	Electrometric, field	SUS	SUS
00671	Phos, Ortho-diss	Colorimetric	SUS	SUS
00665	Phosphorous - tot	Colorimetric	SUS	SUS
00935	Potassium - diss	ICP, AES	SUS	SUS
00931	SAR	Calculated	SUS	SUS
80154	Sediment - conc.	Filtration-Gravimetric	SUS	SUS
70331	Sediment - %<.063mm	Sieve	SUS	SUS
80155	Sediment - load	Calculated	SUS	SUS
00955	Silica - diss	ICP, AES	SUS	SUS
00930	Sodium - diss	ICP, AES	SUS	SUS
00945	Sulphate - diss	IC	SUS	SUS
70301	Total Dissolved Solids	Calculated	SUS	SUS
00010	Temp Water	Stem Thermometer	SUS	SUS
00020	Temp Air	Stem Thermometer	SUS	SUS
01092	Zinc - tot/rec	ICP, MS	SUS	SUS

Samples collected obtained during the monthly periods: ***** -- March - April; May; June; July - September
** -- May; June; July; August - September

Abbreviations: **AES** - atomic emission spectroscopy; **conc. –** concentration; **diss** – dissolved; **IC** - ion exchange chromatography; **ICP** - inductively coupled plasma; **ISE** – ion-selective electrode; **MS** – mass spectroscopy; **Org** – organic; phos**.** – phosphate; SAR **–** sodium adsorption ratio; **SUS** – sampling suspended**; tot** – total; **tot**/**rec** - total recoverable


Fife
Lake
East
Poplar
River
Girard
Creek
Rockglen
Coronach
Goose
Creek
Poplar
River
Cookson
Reservoir
CANADA
UNITED STATES
2
1
Coal
Creek
Poplar
River
Butte
Creek
Scobey
0 5 10 15 KILOMETERS
0 5 10 MILES
N
SURFACE-WATER-QUALITY MONITORING STATIONS (UNITED STATES)

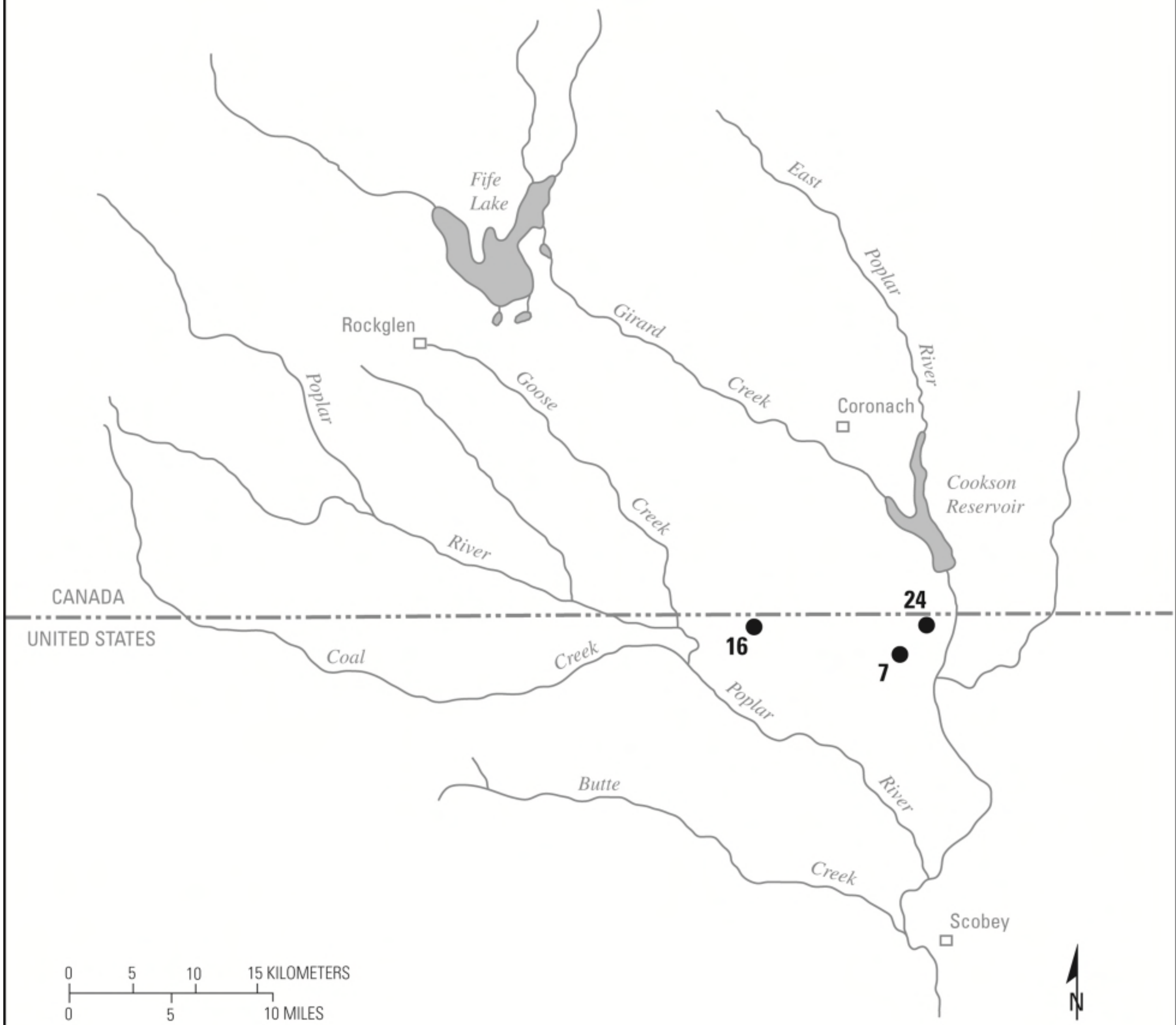
GROUND-WATER-QUALITY MONITORING -- Station Locations

Map Number	Well Location	Total Depth (m)	Casing Diameter (cm)	Aquifer	Perforation Zone (m)
7	37N47E12BBBB	44.1	10.2	Hart Coal	39-44
16	37N46E3ABAB	25.5	10.2	Fort Union	23-25
24	37N48E5AB	9.6	10.2	Alluvium	9.2-9.6

Parameters

Storet ** Code	Parameter	Analytical Method	Sampling Frequency Station No.
00410	Alkalinity	Calculated	Sample collection is annually for all locations identified above. The analytical method descriptions are those of the Montana Bureau of Mines and Geology Laboratory where the samples are analyzed.
01106	Aluminum dissolved	ICP or ICP-MS	
01095	Antimony dissolved	ICP or ICP-MS	
50250	Arsenic dissolved	ICP or ICP-MS	
01005	Barium dissolved	ICP or ICP-MS	
01010	Beryllium dissolved	ICP or ICP-MS	
00440	Bicarbonates	Electrometric Titration	
01020	Boron-diss	Emission Plasma, ICP	
82298	Bromide	Ion Chromatography	
01025	Cadmium,dissolved	ICP or ICP-MS	
00915	Calcium	Emission Plasma	
00445	Carbonates	Electrometric Titration	
00940	Chloride	Ion Chromatography	
01030	Chromium, dissolved	ICP or ICP-MS	
01035	Cobalt, dissolved	ICP or ICP-MS	
00095	Conductivity	Wheatstone Bridge	
01040	Copper, dissolved	ICP or ICP-MS	
00950	Fluoride	Ion Chromatography	
09000	Hardness	Calculated	
01046	Iron-diss	Emission Plasma, ICP	
01049	Lead-diss	Emission Plasma, ICP	
01130	Lithium-diss	Emission Plasma, ICP	
00925	Magnesium	Emission Plasma, ICP	
01056	Manganese-diss	Emission Plasma, ICP	
01060	Molybdenum	Emission Plasma, ICP-MS	
01065	Nickel, dissolved	ICP or ICP-MS	
00630	Nitrate	Ion Chromatography	
00671	Orthophosphate	Ion Chromatography	
00400	pH	Electrometric	
00935	Potassium	Emission Plasma, ICP	
00931	SAR	Calculated	
01145	Selenium-diss	ICP-MS	
00955	Silica	Emission Plasma, ICP-MS	
01075	Silver, dissolved	ICP-MS	
00930	Sodium	Emission Plasma, ICP	
01080	Strontium-diss	Emission Plasma, ICP	
00445	Sulphate	Ion Chromatography	
01057	Thallium, dissolved	ICP or ICP-MS	
01150	Titanium, dissolved	ICP or ICP-MS	
28011	Uranium, dissolved	ICP-MS	
01085	Vanadium, dissoved	ICP or ICP-MS	
00190	Zinc-diss	Emission Plasma, ICP	
01160	Zirconium, dissolved	ICP or ICP-MS	
*	Sum of diss. Constituents	Calculated	
70301	TDS	Calculated	

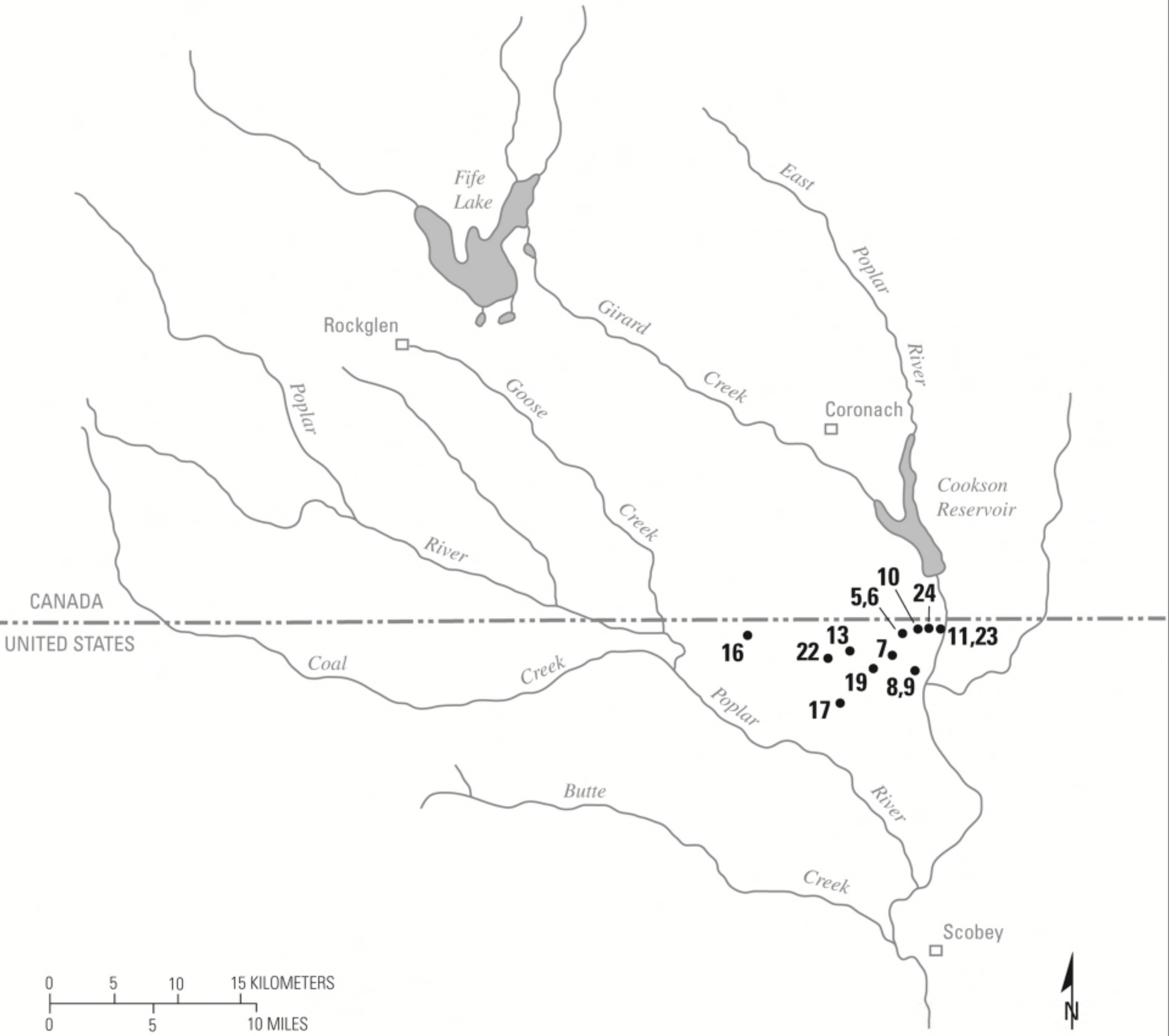
SYMBOLS:
* - Sum of Dissolved Constituents; calculated the same as TDS but includes all reported bicarbonate
****** - Computer storage and retrieval system -- EPA **ICP – Inductively** Coupled Plasma Unit
cm – centimetre ICP **– MS** – Inductively Coupled Plasma – Mass Spectrometry **diss** – dissolved **m** – metre



GROUND-WATER-QUALITY MONITORING (UNITED STATES)

GROUNDWATER LEVELS TO MONITOR POTENTIAL DRAWDOWN DUE TO COAL-SEAM DEWATERING

Responsible Agency: Montana Bureau of Mines and Geology		
No. on Map	**Montana Ground Water Information Center ID No.**	**Sampling**
5	GWIC ID 4231	Determine water levels quarterly
6	GWIC ID 4227	Determine water levels quarterly
7	GWIC ID 4267	Determine water levels quarterly
8	GWIC ID 4287	Determine water levels quarterly
9	GWIC ID 4274	Determine water levels quarterly
10	GWIC ID 4340	Determine water levels quarterly
11	GWIC ID 4329	Determine water levels quarterly
13	GWIC ID 4248	Determine water levels quarterly
16	GWIC ID 4211	Determine water levels quarterly
17	GWIC ID 4297	Determine water levels quarterly
19	GWIC ID 4290	Determine water levels quarterly
22	GWIC ID 4261	Determine water levels quarterly
23	GWIC ID 124105	Determine water levels quarterly
24	GWIC ID 144835	Determine water levels quarterly



GROUND-WATER PIEZOMETERS TO MONITOR POTENTIAL DRAWDOWN DUE TO COAL-SEAM DEWATERING

ANNEX 3

RECOMMENDED FLOW APPORTIONMENT

IN THE POPLAR RIVER BASIN

BY THE INTERNATIONAL SOURIS-RED RIVERS ENGINEERING BOARD,

POPLAR RIVER TASK FORCE (1976)

*RECOMMENDED FLOW APPORTIONMENT IN THE POPLAR RIVER BASIN

The aggregate natural flow of all streams and tributaries in the Poplar River Basin crossing the International Boundary shall be divided equally between Canada and the United States subject to the following conditions:

1. The total natural flow of the West Fork Poplar River and all its tributaries crossing the International Boundary shall be divided equally between Canada and the United States but the flow at the International Boundary in each tributary shall not be depleted by more than 60 percent of its natural flow.

2. The total natural flow of all remaining streams and tributaries in the Poplar River Basin crossing the International Boundary shall be divided equally between Canada and the United States. Specific conditions of this division are as follows:

   (a) Canada shall deliver to the United States a minimum of 60 percent of the natural flow of the Middle Fork Poplar River at the International Boundary, as determined below the confluence of Goose Creek and Middle Fork.

   (b) The delivery of water from Canada to the United States on the East Poplar River shall be determined on or about the first day of June of each year as follows:

      (i) When the total natural flow of the Middle Fork Poplar River, as determined below the confluence of Goose Creek, during the immediately preceding March 1st to May 31st period does not exceed 4,690 cubic decametres (3,800 acre-feet), then a continuous minimum flow of 0.028 cubic metres per second (1.0 cubic foot per second) shall be delivered to the United States on the East Poplar River at the International Boundary throughout the succeeding 12 month period commencing June 1st. In addition, a volume of 370 cubic decametres (300 acre-feet) shall be delivered to the United States upon demand at any time during the 12 month period commencing June 1st.

* Canada-United States, 1976, Joint studies for flow apportionment, Poplar River Basin, Montana-Saskatchewan: Main Report, International Souris-Red Rivers Board, Poplar River Task Force, 43 pp.

(ii) When the total natural flow of the Middle Fork Poplar River, as determined below the confluence of Goose Creek, during the immediately preceding March 1st to May 31st period is greater than 4,690 cubic decametres (3,800 acre-feet), but does not exceed 9,250 cubic decametres (7,500 acre-feet), then a continuous minimum flow of 0.057 cubic metres per second (2.0 cubic feet per second) shall be delivered to the United States on the East Poplar River at the International Boundary during the succeeding period June 1st through August 31st. A minimum delivery of 0.028 cubic metres per second (1.0 cubic feet per second) shall then be maintained from September 1st through to May 31st of the following year. In addition, a volume of 617 cubic decametres (500 acre-feet) shall be delivered to the United States upon demand at any time during the 12-month period commencing June 1st.

(iii) When the total natural flow of the Middle Fork Poplar River, as determined below the confluence of Goose Creek, during the immediately preceding March 1st to May 31st period is greater than 9,250 cubic decametres (7,500 acre-feet), but does not exceed 14,800 cubic decametres (12,000 acre-feet), then a continuous minimum flow of 0.085 cubic metres per second (3.0 cubic feet per second) shall be delivered to the United States on the East Poplar River at the International Boundary during the succeeding period June 1st through August 31st. A minimum delivery of 0.057 cubic metres per second (2.0 cubic feet per second) shall then be maintained from September 1st through to May 31st of the following year. In addition, a volume of 617 cubic decametres (500 acre-feet) shall be delivered to the United States upon demand at any time during the 12 month period commencing June 1st.

(iv) When the total natural flow of the Middle Fork Poplar, as determined below the confluence of Goose Creek, during the immediately preceding March 1st to May 31st period exceeds 14,800 cubic decametres (12,000 acre-feet) then a continuous minimum flow of 0.085 cubic metres per second (3.0 cubic feet per second) shall be delivered to the United States on the East Poplar River at the International Boundary during the succeeding period June 1st through August 31st. A minimum delivery of 0.057 cubic metres per second (2.0 cubic feet per second) shall then be maintained from September 1st through to May 31st of the following year. In addition, a volume of 1,230 cubic decametres (1,000 acre-feet) shall be delivered to the United States upon demand at any time during the 12-month period commencing June 1st.

(c) The natural flow at the International Boundary in each of the remaining individual tributaries shall not be depleted by more than 60 percent of its natural flow.

3. The natural flow and division periods for apportionment purposes shall be determined, unless otherwise specified, for periods of time commensurate with the uses and requirements of both countries.

ANNEX 4

CONVERSION FACTORS

CONVERSION FACTORS

ac	=	4,047 m^3 = 0.04047 ha
ac-ft	=	1,233.5 m^3 = 1.2335 dam^3
ºC	=	5/9(ºF-32)
cm	=	0.3937 in.
cm^2	=	0.155 in^2
dam^3	=	1,000 m^3 = 0.8107 ac-ft
ft^3	=	28.3171 x $10^{-3}m^3$
ha	=	10,000 m^2 = 2.471 ac
hm	=	100 m = 328.08 ft
hm^3	=	1 x 10^6 m^3
I. gpm	=	0.0758 L/s
in	=	2.54 cm
kg	=	2.20462 lb = 1.1 x 10^{-3} tons
km	=	0.62137 miles
km^2	=	0.3861 mi^2
L	=	0.3532 ft^3 = 0.21997 I. gal = 0.26420 U.S. gal
L/s	=	0.035 cfs = 13.193 I. gpm = 15.848 U.S. gpm
m	=	3.2808 ft
m^2	=	10.765 ft^2
m^3	=	1,000 L = 35.3144 ft^3 = 219.97 I. gal= 264.2 U.S. gal
m^3/s	=	35.314 cfs
mm	=	0.00328 ft
tonne	=	1,000 kg = 1.1023 ton (short)
U.S. gpm	=	0.0631 L/s

For Air Samples

ppm = 100 pphm = 1000 x (Molecular Weight of substance/24.45) mg/m^3