# 2018-19 ANNUAL REPORT

PRAIRIE PROVINCES WATER BOARD

*photo credit: Gilbert Katerynych*

# *PRAIRIE PROVINCES WATER BOARD*

**FOR THE FISCAL YEAR**

April 1, 2018 to March 31, 2019

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November 10, 2020

Honourable Ministers:

On behalf of the members of the Prairie Provinces Water Board (PPWB), it is my pleasure to submit the Annual Report of the Prairie Provinces Water Board for the fiscal year covering the period April 1, 2018 to March 31, 2019.

The annual report summarizes the activities of the PPWB, its Secretariat and four technical Committees. The report confirms that the PPWB met the jurisdictional commitments for water apportionment and water quality in fiscal year 2018-2019.

Also during this reporting period, the PPWB considered and made progress in the following areas:

- conducting water quality trend analysis;
- conducting basin reviews;
- improving the apportionment assessment procedures, and continued modernization of the tools used for apportionment calculations;
- continued discussion on harmonizing the mapping of spring runoff for the Prairie region; and
- continued discussion on the proposed new Schedule on groundwater.

The PPWB continues to administer the *Master Agreement on Apportionment (MAA)*, which for 50 years has proven to be a successful model for dealing with inter-jurisdictional issues. The *MAA* – through a consensus approach, collaboration and information sharing – has enabled the equitable sharing and protection of interprovincial streams, and helped prevent transboundary surface and groundwater conflicts. We are very proud that in the entire history of the Agreement that we have not encountered a conflict that the PPWB could not resolve.

Sincerely,

Nadine Stiller
Chair, Prairie Provinces Water Board

**Honourable Jonathan Wilkinson**
Minister of Environment
and Climate Change
Government of Canada

**Honourable Marie-Claude Bibeau**
Minister of Agriculture and Agri-Food
Government of Canada

**Honourable Warren Kaeding**
Minister of Environment
Government of Saskatchewan

**Honourable Joe Hargrave**
Minister Responsible for the
Saskatchewan Water Security Agency
Government of Saskatchewan

**Honourable Jason Nixon**
Minister of Environment and Parks
Government of Alberta

**Honourable Ron Schuler**
Minister of Infrastructure
Government of Manitoba

**Honourable Blaine Pedersen**
Minister of Agriculture and
Resource Development
Government of Manitoba

# *MESSAGE FROM THE **CHAIR***

The Prairie Provinces Water Board (PPWB) continues to be a vital institution of governance that facilitates the sound and collaborative management of shared water resources in the Canadian Prairie region.

In 2018-2019, the PPWB completed its key core commitments and business around apportionment and water quality.

Further to its core mandate, the PPWB continued to track and respond to important water management issues. A number of initiatives took place in 2018 to enhance the ability of the PPWB to deliver on its mandate, including:

- completed the conversion of the apportionment calculations from Fortran to Excel for all but one basin;
- continued discussions toward improvements to evaporation computation methods;
- conducted basin reviews for the Qu'Appelle River and scoped the review for the South Saskatchewan River;
- continued work on establishing water quality objectives; and
- continued discussions on a new Schedule on transboundary aquifers proposed for addition to the Master Agreement on Apportionment.

The PPWB provides a cooperative forum for discussion on transboundary water issues including droughts, floods, and the growing risk of invasive species, and climate change in Prairie watersheds.

In March 2018, I became the Chair of the PPWB, replacing Cheryl Baraniecki who served in the role since June of 2015. I thank her for her solid leadership that supported my smooth transition into this important role.

In 2018, we also welcomed incoming Board Member for Saskatchewan, Sam Ferris. Sam is the Vice President, Water Security Agency and brings a wealth of knowledge and experience to the Board. I would also like to acknowledge outgoing Board Member Lynden Hillier with Agriculture and Agri-Food Canada for his dedicated service with the PPWB since joining the Board in March 2013.

The success of the PPWB depends on the work of the Secretariat and the four standing committees: the Committee on Hydrology (COH), the Committee on Water Quality (COWQ), the Committee on Groundwater (COG) and the Committee on Flow Forecasting (COFF). Dedication and engagement by Board members, jurisdictional representatives on committees, and the Secretariat are essential. Their contributions, that are genuinely appreciated, are a significant asset to the work of the PPWB.

Nadine Stiller
**Chair**

# *MESSAGE FROM THE* ***EXECUTIVE DIRECTOR***

During fiscal year 2018-2019, the work of the PPWB Secretariat and the four standing Committees focused on achieving the goals outlined in the PPWB Strategic Plan and activities in the multi-year (2016-17 to 2021-22) Work Plan.

During the year, the agreed transboundary apportionment of flows on all eastward flowing streams was achieved for all river reaches in 2018, despite drought conditions in much of the Prairie region for much of the year. Also, apportionment calculations were significantly delayed by late delivery of required hydrometric and reservoir data. The delays were not resolved until late 2019.

Adherence to the *MAA's* water quality objectives was good. One note regarding reporting time frames – the PPWB annual report is done to a fiscal year (April to March); the transboundary apportionment and water quality excursion report are done to a calendar year (January to December).

The Committee on Hydrology (COH) continued to review and improve apportionment methods and tools. The Qu'Appelle River Basin Review continued, and the South Saskatchewan River Basin Review was planned. Due to drought conditions, the protocols for low-flow conditions were reviewed in case they were needed. They were not.

The Committee on Water Quality (COWQ) continued work on establishing water quality objectives, for discussion at the Board. The Committee also studied nutrient concentrations to better understand causes of excursions and trends, notably in the Red Deer River. A new study was proposed for the Carrot River.

The Committee on Groundwater (COG) developed a document on the roles and responsibilities for the anticipated new Schedule F on aquifers. They also developed a methodology to classify transboundary aquifers on the basis of risk per the previously-developed Risk Informed Management (RIM) document.

The Committee on Flow Forecasting (COFF) continued to work on information sharing and harmonizing the mapping of spring runoff potentials. This work is ongoing.

Over the past year there was one change within the Secretariat and Committees. Sharon Reedyk (AAFC) withdrew from the Committee on Water Quality after four years of excellent service. Thank you Sharon.

The Board continued its role communicating and coordinating water management and planning issues that have transboundary implications. The Board continued to provide a forum for sharing information and knowledge, including practices, management, and planning for water quantity and quality issues in the Prairie region.

Patrick Cherneski
**Incoming Executive Director**

# *SUMMARY OF* ***PERFORMANCE RESULTS***

During 2018-2019, the Board approved the apportionment calculations and excursion reporting and confirmed that the interprovincial apportionment and water quality obligations were met. As part of the administration of the MAA, the Board also reviewed and approved the PPWB annual budget and an updated multi-year Work Plan for 2016-17 to 2021-22.

The Board is supported by a Secretariat and four technical Committees.

## *The Committee on Hydrology (COH):*

- Continued to review and recommend the apportionment monitoring network comprised of hydrometric and meteorological stations;
- Recommended apportionment computations for approval on Cold Lake, North Saskatchewan River, South Saskatchewan River below the Red Deer River, Battle Creek, Lodge Creek, Middle Creek, Churchill River, Saskatchewan River, Red Deer River (Saskatchewan), Qu'Appelle River, Assiniboine River, and Pipestone Creek;
- Continued to improve apportionment methods. The ongoing Qu'Appelle River Basin Review continued, and a high level scoping of the South Saskatchewan River Basin Review was done;
- Established formal criteria for interprovincial basins subject to apportionment monitoring, with the finalization of the Apportionment Monitoring Assessment Procedure report;
- Continued to investigate evaporation to ensure equitable distribution of water between the Prairie Provinces. The field work was completed in 2017, but the report itself was delayed and results are now expected in 2019;
- Continued to modernize apportionment computation software; and
- Reviewed protocols in preparation for low flow situations if the need arises.

## *The Committee on Water Quality (COWQ) activities included:*

- Performing water quality monitoring to flag concerns and making recommendations as needed;
- Continued work on updating water quality objectives;
- Studied nutrient concentrations to better understand causes of excursions and trends;
- Cooperated with the jurisdictions to ascertain the potential effects of common use pesticides on the health of transboundary waters;
- Worked on the Red Deer River jurisdictional response and report to address water quality concerns and identify data gaps; and
- Completed the review of the fish tissue data collected from seven of the transboundary rivers, and assessed the potential options for a biological monitoring program for all 12 transboundary rivers. A biological program would complement the chemistry program and would provide indicators of riverine health.

## *The Committee on Groundwater (COG) developed:*

- A draft document describing anticipated roles and responsibilities for a proposed Schedule F;
- A methodology to classify transboundary aquifers according to the Risk Informed Management document within the proposed Schedule F; and
- Plans for an in-person workshop on transboundary groundwater in 2018. The event was postponed and the COG agreed to plan for a similar event in future years.

## *The Committee on Flow Forecasting (COFF) discussions included:*

- Improving flow forecasting, including spring runoff, through a soil moisture module, model testing, collaborative modelling, and other potential tools;
- Drought management through drought monitor maps and provincial drought planning;
- Insight into inflow management through consultations with other experts; and
- Reaching out to the Global Water Futures research program to open communication and engagement.

# INTRODUCTION

This report summarizes the activities of the PPWB, its Secretariat, and four standing Committees that supported PPWB activities for the period April 1, 2018 to March 31, 2019.

The PPWB administers the *Master Agreement on Apportionment (MAA),* signed on October 30, 1969 by Canada and the Provinces of Alberta, Saskatchewan, and Manitoba.

The *MAA* provides for an equitable sharing of available waters for all eastward flowing streams that cross interprovincial boundaries, including transboundary lakes. It also serves to protect transboundary aquifers and surface water quality. Schedules to the *MAA* describe the role of the Board, stipulate how the water shall be apportioned, and set water quality objectives for the water passing from Alberta to Saskatchewan and from Saskatchewan to Manitoba.

The Board consists of three provincial members, representing the Provinces of Alberta, Saskatchewan, and Manitoba and two federal members, representing Environment and Climate Change Canada and Agriculture and Agri-Food Canada.

PPWB activities are jointly funded by the provinces and the federal government, with the provinces each contributing one-sixth and the federal government contributing one-half to the annual budget. The *MAA* assigns responsibility to monitor water quantity and quality in support of the Agreement to the federal government. Environment and Climate Change Canada conducts this monitoring on behalf of the Government of Canada. The Board approves the annual budget and costed Work Plan.

Section 2 of this Annual Report presents the performance results for each of the Goals in the Strategic Plan and 2018-2019 activities in the Work Plan. Included in this section is Goal 8, which provides a summary of the administration activities and financial expenditures for the year 2018-2019.

Appendices provide detailed information on the PPWB. Appendix I illustrates where monitoring is conducted to assess whether jurisdictions have met their requirements in the *MAA*. Appendix II presents 2018 apportionable flow data. Appendices III and IV present the water quality parameters that were monitored by Environment and Climate Change Canada and the 2018 Report on Excursions to Interprovincial Water Quality Objectives. Appendix V provides the organization chart, and Appendix VI lists agency representatives on the Board and Committees. Appendix VII provides the Financial Expenditure Statement. Finally, Appendix VIII describes the history of the PPWB.

# PERFORMANCE RESULTS

All activities in the multi-year (2016-17 to 2021-22) PPWB Work Plan are structured to achieve the eight goals in the PPWB's Strategic Plan. Progress made in 2018-2019 is discussed below by goal.

## GOAL 1: Agreed Transboundary Apportionment of Water is Achieved

The PPWB's Strategic Goal 1 is to achieve transboundary apportionment of water as agreed to in the 1969 *Master Agreement on Apportionment (MAA)* Schedule A and Schedule B.

### *Apportionment Monitoring of Rivers*

The *MAA* states that all eastward flowing streams are subject to apportionment. Currently, the Board conducts apportionment monitoring of Cold Lake, North Saskatchewan River, South Saskatchewan River below the Red Deer River confluence, Battle Creek, Lodge Creek, and Middle Creek on the Alberta-Saskatchewan boundary; and Churchill River, Saskatchewan River, Red Deer River, Qu'Appelle River, Assiniboine River, and Pipestone Creek on the Saskatchewan-Manitoba boundary.

All water apportionment obligations were met for the 2018 calendar year.

### *Water Quantity Monitoring*

The PPWB is required to assess and report on whether surface water quantity apportionment requirements have been met. Environment and Climate Change Canada conducts the water quantity monitoring in accordance with the terms of the *MAA*.

In 2018, the PPWB Secretariat calculated apportionable flows with monitoring data from 90 hydrometric stations, 24 meteorological stations, as well as various third party water use measurements. The PPWB requires data from four additional hydrometric stations to support bilateral water management (Appendix I).

Historic river flows and apportionment balances are illustrated in Figures 1 and 2 for the historic period of PPWB monitoring for each basin. The black bars illustrate the amount of apportionable flows that were required to be delivered by Alberta to Saskatchewan (Figure 1) and by Saskatchewan to Manitoba (Figure 2). The blue and red bars indicate the flow surpluses and deficits, respectively.

The historic analysis shows that: large surpluses are fairly common for many of the rivers; annual flow volumes vary considerably over the years; and two rivers experienced flow deficits. Flow deficits were not detected for any of the rivers and creeks crossing the Saskatchewan-Manitoba Boundary (Figure 2). Only Middle and Lodge Creeks at the Alberta-Saskatchewan boundary have experienced deficits in delivery through the apportionment record (Figure 1).

Under the terms of the *MAA*, Alberta is required to pass 75% of the apportionable flow of Middle and Lodge Creeks to Saskatchewan. Under the terms of the international water sharing agreement between Canada and the United States, Saskatchewan must in turn pass 50% of the natural flow of Lodge Creek at the international boundary to Montana. Any early season use within Alberta can put Alberta at a risk of deficit if the remainder of the year is dry. Apportionment delivery deficits between Alberta and Saskatchewan can impact the ability of Saskatchewan to meet its international apportionment requirements. Alberta and Saskatchewan continue to work cooperatively and investigate solutions, including improvements to the timing and accuracy of interim water use reporting, to ensure future deficits on Middle and Lodge Creeks do not occur.

To prepare for next year, the 2019-2020 hydrometric and meteorological monitoring station lists were reviewed and approved by the Board at their November 2, 2018, Meeting No.127. There were no changes to the PPWB Hydrometric Monitoring Stations list from the previous year.

*Figure 1. Historic River Flows on the Alberta-Saskatchewan Boundary*

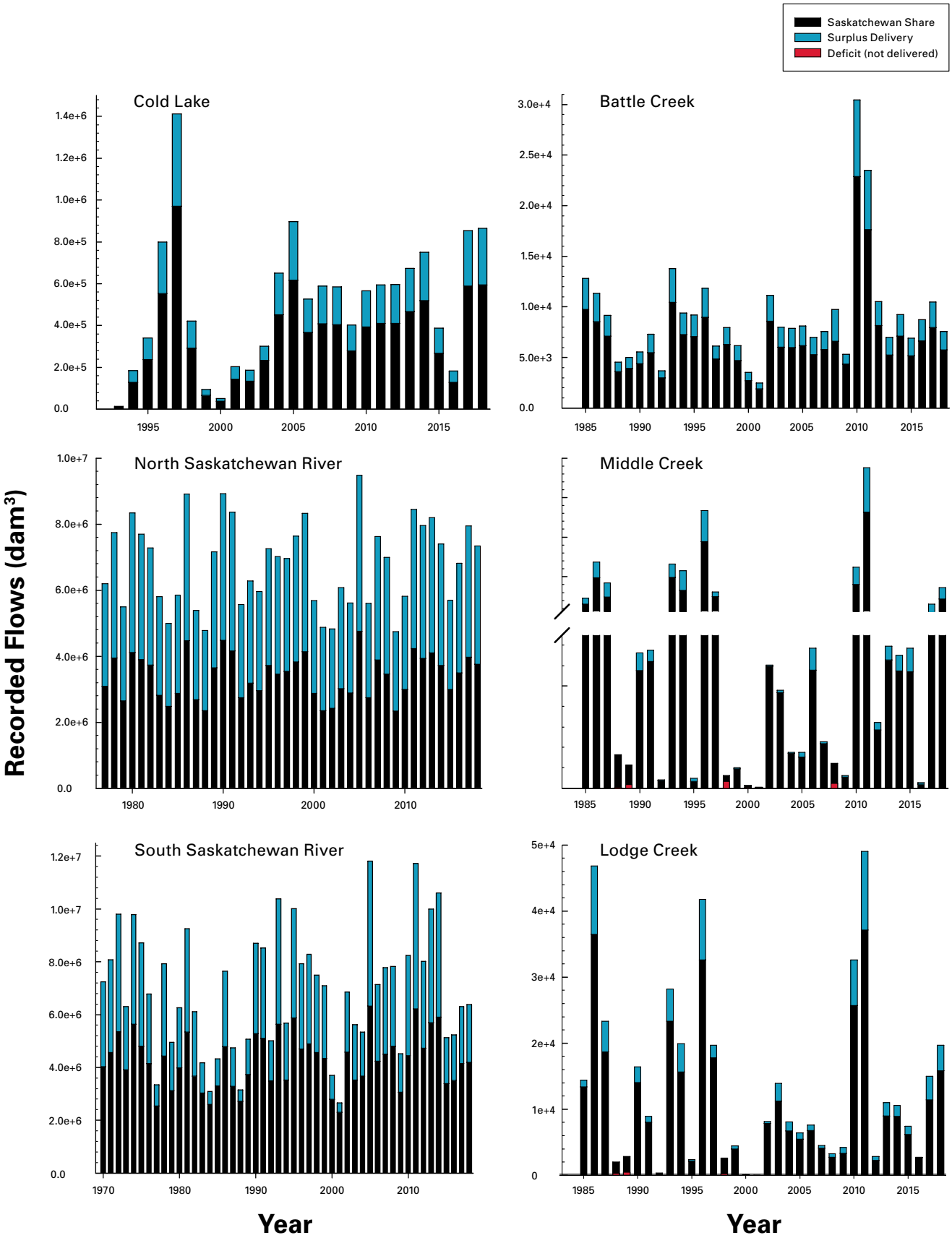
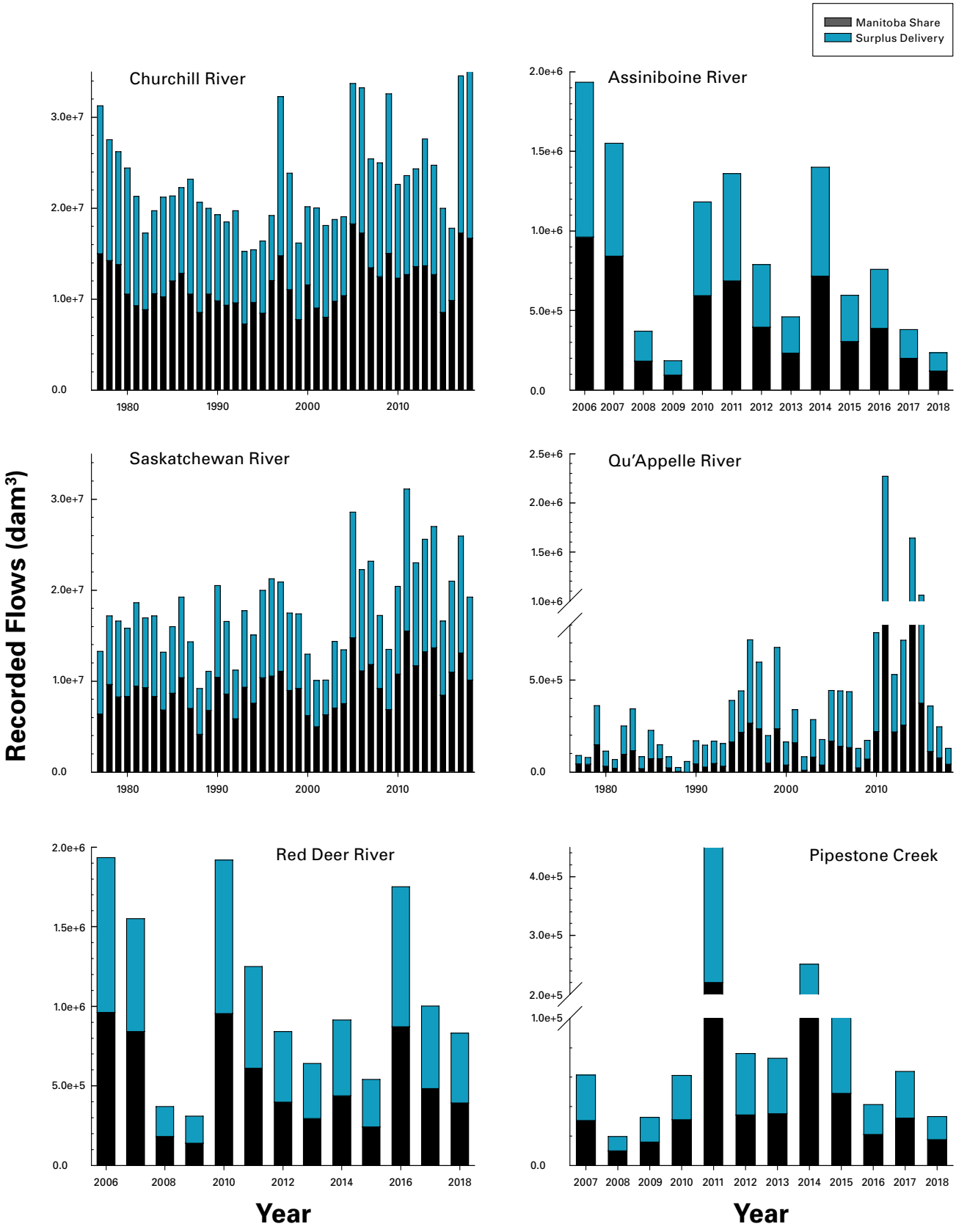


*Figure 2. Historic River Flows on the Saskatchewan-Manitoba Boundary*



# ***PERFORMANCE RESULTS*** *continued*

## *Flows Reported in 2018*

Interim apportionable flow reporting was completed for four basins in 2018. Quarterly reports to the Board presented interim recorded and apportionable flows for the South Saskatchewan River, Middle Creek and Lodge Creek, as well as one mid-year report for Cold Lake.

Appendix II presents the final monthly and total apportionment results. For all apportioned rivers and creeks, the recorded flow at the interprovincial boundary was higher than the amount that the upstream province was required to deliver.

Under *MAA* Schedule A Clause 4, Alberta may not consume or divert greater than 50% of the natural flow on the South Saskatchewan River below its confluence with the Red Deer River, such that it reduces the recorded flow to less than 42.5 $m^3/s$ (1,500 cfs). As Alberta delivered greater than 50% of the natural flow, this condition was met. In summary, all apportionment requirements were met in the 2018 calendar year.

## *Improving Apportionment Methods*

### Apportionment Procedure Review

The Committee on Hydrology (COH) continued with the ongoing review of apportionment methods to ensure apportionment monitoring and calculations have a level of accuracy acceptable to the Committee for the purposes of monitoring compliance with the *MAA*.

The COH continued work on the review of the apportionable flow calculation procedures for the Qu'Appelle River Basin at the Saskatchewan-Manitoba boundary through 2018. The Qu'Appelle River calculation is slightly more complex than some of the other apportioned basins due to the complexity of the connection between the river and Last Mountain Lake. The Qu'Appelle River Basin Review Report was received and ongoing work on the Qu'Appelle River Basin Review continued.

The COH is planning to review the South Saskatchewan River apportionable flow calculation procedure in several phases. A sub-committee of the COH continued to work on an apportionment monitoring needs assessment report to confirm the goal and purpose of apportionment monitoring by the PPWB for the South Saskatchewan River. The findings of the needs assessment report will determine what model time step is required to monitor adherence with the requirements of the *MAA* to the satisfaction of the Board. The decisions made through the needs assessment phase will set the foundation for the subsequent phases of the South Saskatchewan River Basin Review.

### Apportionment Monitoring Criteria

In 2015, a sub-committee of the COH was formed to establish formal criteria by which the PPWB determines which interprovincial basins are subject to apportionment monitoring, as well as the frequency of monitoring for those basins.

The sub-committee finalized the Apportionment Monitoring Assessment Procedure in 2018. This formalized ranking and classification system will be applied by the PPWB to evaluate current apportionment monitoring and reporting, and support decisions regarding changes in the future.

The COH has tested the procedure on the North Saskatchewan River, the Battle River and Gainsborough Creek. The COH will continue testing the application of the assessment procedure on low, medium and high priority rivers and creeks as part of the basin review process.

## ***PERFORMANCE RESULTS*** *continued*

**Modernizing Apportionment Software**

Historically the PPWB relied solely on a suite of FORTRAN programs for the calculation of apportionable flow. This was increasingly a risk to business continuity, and limited operational flexibility as the ability to easily adjust and run these programs on modern computers was rapidly diminishing. To address this, the COH undertook a long-term effort to transition these calculations into either spreadsheets or a customized apportionable flow calculation platform developed for the PPWB called the River Basin Assessment Tool (RBAT).

The overall modernization process is nearing completion and working calculations for all but one of the routinely apportioned basins have been transferred to Excel spreadsheets. The COH has adopted a version control method to ensure protection of the apportionable flow calculations performed in spreadsheets. The COH completed a rigorous review of the functionality and utility of the RBAT and found many deficiencies within the application. Therefore, in FY2018-19 the COH discontinued any further development of the RBAT.

**Evaporation Investigations**

Evaporation is an important component of apportionment calculations used to ensure equitable distribution of water between Alberta, Saskatchewan, and Manitoba. As such, the COH has an interest in continually improving lake/reservoir evaporation estimation methods.

The PPWB contracted researchers at the University of Saskatchewan to conduct a two-year evaporation field study at Newton Lake (Saskatchewan) and Shellmouth Reservoir (Manitoba) using eddy covariance techniques. The study will provide direct measurement of lake evaporation and associated hydrometeorological variables, which can be used to assess evaporation estimates from various models and potentially used to calibrate model parameters for optimized results. Results from this study are expected to improve understanding of lake evaporation in the Canadian Prairie environment and improve PPWB apportionment calculations.

The fieldwork component of the study was completed in 2017. A final report documenting the project has been delayed due to technical issues with instruments that delayed data interpretation. The report is expected to be completed by December 31, 2019. The final deliverable from the study will be measurements of evaporation and associated hydrometeorological variables from both locations at various time increments (hourly, daily, etc.). The next step will be to compare the field-measured evaporation with modelled evaporation and make recommendations on which model provides the best approximation, as well as possible refinements to those models.

**Carrot River Sediment Investigations**

Work continued on sediment issues in the Carrot River. The results of a bathymetric survey of the lower Carrot River completed in 2017 by Manitoba Infrastructure are currently being reviewed. And a progress report is being prepared for the Board on a sediment transport analysis of the lower Carrot River.

# ***PERFORMANCE RESULTS*** *continued*

## *GOAL 2: Transboundary Groundwater Aquifers Are Protected and Used in a Sustainable Manner*

The PPWB Strategic Goal 2 is to protect groundwater quantity and quality and promote sustainable use of transboundary aquifers.

*The Master Agreement on Apportionment (MAA)* currently has a general statement to refer any transboundary groundwater issues to the Board for their review and recommendation. No issues or concerns were identified in 2018.

### *Groundwater Schedule F*

#### Development and Consultation

In October 2007, the Board directed the Committee on Groundwater (COG) to develop a specific groundwater agreement to be added as Schedule F to the *MAA*. The objectives of the proposed Schedule are to promote:

- Effective and efficient management of transboundary aquifers;
- Sustainable use and equitable sharing of transboundary aquifers; and,
- Protection and preservation of transboundary aquifers and associated aquatic environments.

An internal review by each of the signatories to the *MAA* of the draft Schedule F began in 2014 and is progressing. The Government of Canada is also consulting with other federal departments that have an interest in groundwater.

#### Roles and Responsibilities

As part of the internal review and consultation process, a document containing several mock scenarios was developed to illustrate the response to various groundwater situations under the proposed Schedule F. The Board determined that the next step would be to develop a roles and responsibilities document as part of the implementation plan for the proposed Schedule F. Under the direction of the Board, the COG developed a "Schedule F Anticipated Roles and Responsibilities" document that outlines some of the expected duties of the Jurisdictions, the Board, the COG, and the PPWB Secretariat for future implementation of proposed Schedule F. The document is currently under review.

#### Aquifer Inventory

In early 2019, the COG created a sub-committee for developing a methodology to classify transboundary aquifers according to the Risk Informed Management (RIM) document within the proposed Schedule F.

The aquifers identified along the Alberta-Saskatchewan and Saskatchewan-Manitoba boundaries would be subject to the assessment once Schedule F is ratified. The list includes aquifers that have been agreed upon by the Committee along the Alberta-Saskatchewan and Saskatchewan-Manitoba boundaries as test cases for the implementation of the RIM methodology. The aquifer assessment method is currently under development.

#### Notification System

COG members are responsible for notifying their neighbouring jurisdiction of groundwater development proposals that may have transboundary impacts. In 2018, Saskatchewan provided notification to Alberta on two new developments near the Alberta-Saskatchewan boundary. Manitoba provided one notification to Saskatchewan about a new water use application.

#### Transboundary Groundwater Workshop

The COG plan for a technical workshop in 2018 was postponed due to conflicting events and travel restrictions for expected attendees. The COG is investigating options to host a workshop in a future year.

# PERFORMANCE RESULTS *continued*

## GOAL 3: Agreed Transboundary MAA Water Quality Objectives Are Achieved

The PPWB Strategic Goal 3 is to achieve agreed transboundary water quality objectives. Schedule E of the *MAA* includes a list of water quality objectives that were established for a number of key water courses at the Alberta-Saskatchewan and Saskatchewan-Manitoba boundaries.

Each fall a water quality monitoring program is approved by the PPWB and subsequently implemented by ECCC. Monitoring results are compared annually to the objectives to determine if any excursions to the objectives occurred. If there are excursions, the Committee on Water Quality (COWQ) reviews the excursions, and when necessary prepares a work plan to assess the cause and the potential to mitigate. The work plan is then carried out by the member agencies.

### *Water Quality Monitoring*

**Development and Consultation**

The *Master Agreement on Apportionment's (MAA)* water quality monitoring locations are shown in Appendix I. The *MAA's* water quality monitoring parameters are in Appendix III.

In accordance with the terms of the *MAA*, Environment and Climate Change Canada conducted water quality monitoring at 12 major interprovincial rivers in 2018. The water quality monitoring program for 2018 included:

- On-going monthly sampling of nutrient, physical, major ion, metal and biota (bacteria and chlorophyll a) parameters for all of the PPWB Rivers, with the exception of the Churchill River which has a sampling frequency of four times a year (February, May, July and October);
- Pesticide parameters such as neutral herbicides, organo-chlorines and glyphosate were sampled:
  - Monthly on the Carrot and Assiniboine Rivers, with the exception of the organochlorines which were sampled eight times (in February, April, May, June, July, August, October and December);
  - Eight times (in February, April, May, June, July, August, October and December) on the North Saskatchewan River, South Saskatchewan River and Cold River (Alberta-Saskatchewan boundary) as part of the annual rotation for pesticide sampling;
  - Sampling for acid herbicides eight times a year on the Cold River, North Saskatchewan River, Battle River, Red Deer River (Alberta-Saskatchewan boundary); South Saskatchewan River, Saskatchewan River, and the Qu'Appelle River; and monthly on the Carrot River and Assiniboine River as part of the normal pesticide monitoring.

The 2018 monitoring program was completed and approved by the Board at their October 25th, 2017, Meeting No.123, with the following exceptions: chlorophyll a samples were not collected in January to March 2018 for the six Alberta-Saskatchewan transboundary rivers due to a sampling error. On the Saskatchewan-Manitoba boundary, *E. coli* was sampled in April on the Carrot and Saskatchewan rivers but due to a power problem with the incubator, the samples were invalid. In addition, a number of pesticide sample results were not reported including glyphosate on the Carrot River in November and the Assiniboine River in March, October and November; organochlorine pesticides on the Carrot River in July; and the neutral and acid herbicides on the Assiniboine River in November. Pesticide samples that were not reported were either broken in transit, lost in storage, or had a sampling error.

Environment and Climate Change Canada undertook a total of 136 water sampling events at the transboundary river sites in 2018. Details are contained in the 2018 PPWB Report on Excursions of Interprovincial Water Quality Objectives, January-December 2018 in Appendix IV.

## ***PERFORMANCE RESULTS*** *continued*

### *Water Quality Objectives Review*

The COWQ does a review of water quality objectives at least every five years. The Ministers responsible for the PPWB approved the updated interprovincial water quality objectives on July 8th, 2015. The updated objectives recognized the need to protect all water uses for all rivers and included a number of site-specific water quality objectives for selected parameters. The next update of water quality objectives for the transboundary rivers is planned for 2020. The COWQ continues to work on updating water quality objectives for 2020, particularly in those areas where objectives were not established for select parameters and rivers.

### *Adherence or Excursions to Transboundary Water Quality Objectives*

A total of 5,525 water quality parameter values were compared to transboundary water quality objectives that protect aquatic life, source water for drinking, recreation, agriculture uses and fish consumption to determine whether any excursions to the objectives occurred in 2018.

Overall, there were no acute water quality concerns apparent from review of the adherence rate values for 2018. The transboundary water quality objectives were adhered to, on average, 97.1% for all parameters. Adherence rate is the degree to which a river meets the interprovincial water quality objectives. Adherence rates from 2018 are similar to those of previous years. Most rivers showed approximately 4 to 6% variation in adherence rates over the last 15 years.

Alberta-Saskatchewan boundary rivers showed an increase in the overall adherence rate between 2017 and 2018. In particular, the Red Deer River showed the largest increase of adherence rate to the water quality objectives in the past 15 years.

On the Saskatchewan-Manitoba boundary, adherence rates fall well within the historical variation. Three transboundary rivers showed a reduction and three transboundary rivers showed an increase in adherence rate between 2017 and 2018.

Excursions of total metals, nutrients, and bacteria objectives at several sites appear to be related to physical parameters. Trends in metal concentrations continue to be examined for select rivers. Common use pesticides are frequently detected in transboundary rivers. The COWQ is working with the jurisdictions to understand better the potential effects of all these factors to the aquatic environment.

The COWQ is currently completing a pilot study to investigate nutrient levels in two transboundary watersheds: the Red Deer River (Alberta-Saskatchewan boundary) and the Carrot River. On-going work to understand nutrient sources and trends will continue in 2019.

### *Fish Tissue Report and Fish Monitoring Program*

To understand better the utility of using biological indicators of riverine health, the COWQ compiled and reviewed fish tissue data collected by PPWB from 1992 to 2004. A report is being prepared that will provide data to the jurisdictions, the public and other interest groups and provide information for meeting the goals of the PPWB. The report is expected to be completed in 2019.

## ***PERFORMANCE RESULTS*** *continued*

### *Sediment Invertebrate Monitoring*

Sediment invertebrate monitoring activities are being reviewed by COWQ to determine how such monitoring might be useful to the PPWB and what methods would be most appropriate to address the PPWB's objectives and mandate. The intent of this exploration is to determine whether monitoring macroinvertebrates in these rivers is the most appropriate biological approach for assessing ecosystem health. In 2019-20, the COWQ will be contacting provincial macroinvertebrate specialists to discuss their invertebrate programs and to further discuss how a benthic program would meet the objectives of the PPWB jurisdictions.

### *Long-Term Trends at Transboundary River Reaches*

Long-term water quality monitoring has been undertaken on transboundary Prairie rivers by Environment and Climate Change Canada since the late 1960s. Trend assessments are considered to be an important tool for understanding the water quality of PPWB rivers. Trend assessments provides a means of identifying whether there have been long-term statistically significant changes in concentrations. However, identifying the causes of changes can be difficult due to the natural variations in water quality and anthropogenic influences.

The most recent report on trend analyses was released in 2017 and included data up until 2013. The COWQ will continue to update the trending work every five years as more data become available. The COWQ is currently reviewing the most recent trend results (to 2013) and prioritizing which trends to examine more closely.

*The MAA provides for an **equitable sharing of available waters** for all eastward flowing streams that cross interprovincial boundaries, including lakes and **serves to protect** transboundary aquifers and surface water quality.*

# ***PERFORMANCE RESULTS*** *continued*

## ***GOAL 4: Governments Are Informed About Emergency and Unusual Water Conditions***

The PPWB Strategic Goal 4 is to inform jurisdictions of emergency and unusual water conditions, facilitating effective and cooperative transboundary water management.

### *PPWB Contingency Plan*

The PPWB Interprovincial Event Contingency Plan is an effective method of informing government agencies of spills or unusual water quality conditions as well as emergency or unusual surface water quantity or groundwater quantity and quality events in transboundary basins.

The PPWB Event Contingency Plan is not meant to replace any jurisdictional emergency spill response mechanism. The Contingency Plan includes information on: area coverage, responsibilities, pattern of response and organizational structure. The Contingency Plan also ensures that proper communication approaches within each jurisdiction are addressed and that the Board will discuss the effectiveness of this communication on a regular basis.

Two notifications were received and shared in 2018-2019:

One notification was regarding a diesel spill, which occurred on June 9, 2018 on the Highway 36 bridge over the Bow River south of Brooks, Alberta; and

The other notification was related to a saltwater disposal breach near Englishman River, a tributary to the North Saskatchewan River in Saskatchewan. Monitoring results indicated low levels of hydrocarbon in the sediment below the river entry point. Manitoba was unlikely to be negatively impacted.

### *Flood Conditions in the Prairies*

Water levels in the Quill Lakes remain high, but not as high as in past years. Snowfall was above-normal in February, but there was good evaporation loss over the summer. The current high lake water level came about over a relatively short time period, but it will take many years for the level to recede. Saskatchewan Water Security Agency continues to review options to mitigate the impacts of flooding around the Quill Lakes. High water levels have inundated farmland and are affecting infrastructure. The Agency is applying the new agricultural drainage regulations around the Quill Lakes basin as an extreme risk area.

### *Drought Conditions in the Prairies*

In 2018, drought occurred in all three Prairie provinces. Saskatchewan was at the center of the driest conditions and experienced an especially dry year. The Saskatchewan River Basin showed significantly below-normal precipitation over an extended 60-day period, resulting in below-average runoff. To view and explore maps and information on drought conditions in the Prairie region in 2018, or elsewhere in Canada, go to www.agr.gc.ca/drought and click on Canadian Drought Monitor.

# ***PERFORMANCE RESULTS*** *continued*

## ***GOAL 5: Transboundary Water Issues Are Addressed Cooperatively to Avoid Disputes***

The PPWB Strategic Goal 5 is to avoid conflicts and disagreement over transboundary water issues. During the year, the PPWB discussed issues related to several existing projects of interest to different jurisdictions.

### *Committee on Flow Forecasting*

The Committee on Flow Forecasting (COFF) was formed in 2015 to improve collaboration, coordination and communication between jurisdictions as well as federal agencies concerning flow forecasting.

During 2018-2019, COFF initiatives included a project on the harmonization of spring runoff potential, developing a notification system related to Clause 4 of the MAA for the South Saskatchewan River, as recommended by COH, and sharing flow forecasting knowledge.

The COFF created a report documenting the practices of each jurisdiction for spring runoff forecasting and reporting. The jurisdictions are working towards a common approach and accommodating differences in practices. The COFF is also exploring sharing flow forecasting knowledge and experience between agencies.

A warning notification system has been set up between Alberta's and Saskatchewan's forecast centers to alert when flows approach a low flow threshold (42.5 $m^3/s$) on the South Saskatchewan River below its confluence with the Red Deer River.

### *Lake Winnipeg Nutrient Issues*

Lake Winnipeg is Canada's sixth-largest freshwater lake and is fed by a vast international basin covering 960,000 square km, extending over four provinces and four states. Nutrient loading to Lake Winnipeg from agriculture, municipal wastewater, and urban surface runoff from multiple transboundary sources continues to exceed the lake's natural capacity to process them, causing increased magnitude, duration and frequency of algal blooms. The Province of Manitoba, Environment and Climate Change Canada, and many other partners are engaged in numerous initiatives to address water quality issues.

Environment and Climate Change Canada's commitment to Lake Winnipeg includes $25.7 million over 5 years (2017-2022) for the Lake Winnipeg Basin Program in support of the following priority issues:

- on the ground nutrient reducing actions throughout the Lake Winnipeg Basin using a strategically targeted and outcome focused approach;
- enhancing collaborative efforts and increased capacity building to protect freshwater quality throughout the Lake Winnipeg Basin; and
- enhancing engagement of Indigenous peoples in addressing freshwater issues.

For 2018-2019 under the Lake Winnipeg Basin Program there were 11 nutrient reduction projects with Prairie associations and academia, five collaborative governance projects with Prairie consortium and foundations, and seven Indigenous Engagement projects.

## ***PERFORMANCE RESULTS*** *continued*

### *Canada/Manitoba MOU Respecting Lake Winnipeg and Lake Winnipeg Basin*

Canada and Manitoba signed a Memorandum of Understanding (MOU) in September 2010 to continue their joint partnership by establishing a long-term collaborative and coordinated approach to support the sustainability of Lake Winnipeg. In 2015, the MOU was extended to 2020.

The MOU provides a forum for information sharing and the involved agencies provide regular reports on activities. Alberta and Saskatchewan do not participate in this; however any issue that arises can be facilitated for broader discussion through the PPWB Chair.

Under the MOU work continued on the State of the Lake Report and Indicator fact sheets, and initial discussions began on a possible adaptive management framework for Lake Winnipeg.

### *Saskatchewan-Manitoba MOU Respecting Water Management*

Saskatchewan and Manitoba signed a MOU in October 2015 to facilitate a cooperative and coordinated approach to mitigate flooding and drought and to protect and improve water quality and aquatic ecosystem health.

Current dialogue between Saskatchewan and Manitoba includes discussion of upcoming drainage and other water infrastructure projects, watershed planning, and various aspects of drainage including regulatory and enforcement approaches, mitigation measures and assessment of impacts.

## ***PERFORMANCE RESULTS*** *continued*

### *GOAL 6: Ministers, Senior Managers and Appropriate Staff of Governments Are Informed About PPWB Activities*

This Strategic Goal is about keeping jurisdictions informed about PPWB activities. This transparency ensures that cost-shared activities are delivered efficiently and effectively and are consistent with the mandate of the PPWB.

The PPWB member governments were informed about PPWB activities through various means, including the ongoing distribution of Board and Committee Minutes and Quarterly and Annual Reports, as well as through brochures and fact sheets, technical reports, and the PPWB website. The PPWB website (www.ppwb.ca) exists to inform the public and interested parties of PPWB activities, and provide a means for member governments to exchange information and facilitate the business of the PPWB. The PPWB website provides access to a complete suite of PPWB publications and fact sheets. A member portal also facilitates the exchange of information.

To maintain good communications between the Board and the Committees, the Board regularly invites Committee members to participate in Board meetings when the meetings are held in the Committee members' jurisdiction.

# ***PERFORMANCE RESULTS*** *continued*

## *GOAL 7: Information, Knowledge and Research Are Shared Among Governments*

The PPWB provides a forum to foster effective and cooperative water management on the Prairies. Goal 7 facilitates cooperation by exchanging information and knowledge amongst jurisdictions and participating in research projects of mutual interest and relevance to the PPWB mandate.

### *Outreach*

The PPWB has been involved in a number of outreach activities to share information and become engaged and increase public awareness of work conducted by the Board.

Opportunities in 2018-2019 included interfacing with Alberta, Saskatchewan, and Manitoba on Lake Winnipeg activities, presenting at the American Water Resources Association Transboundary Groundwater Conference, and collaborating with Global Water Futures and the Partners FOR the Saskatchewan River Basin.

The Board facilitates regular updates on the Canada-Manitoba MOU respecting Lake Winnipeg and Lake Winnipeg Basin Program. This includes touching base with Alberta and Saskatchewan on MOU developments and activities being carried out related to Lake Winnipeg. The Board member governments were informed that while efforts to reduce nutrients and improve water quality in Lake Winnipeg continue to be a priority and actions continue, the work is no longer being conducted under the Lake Friendly Accord branding.

PPWB made a presentation at the American Water Resources Association Transboundary Groundwater Conference. The PPWB presentation was within the governance workshop stream, more specifically on proactive agreements that help prevent conflict. The PPWB presentation was unique in that it focused on jurisdictions coming together to create water agreements.

The Board and its Committees continued to collaborate with Global Water Futures and Partners FOR the Saskatchewan River Basin on modeling programs and conference participation.

### *Agency Reports*

The PPWB member agencies continue to share information and knowledge on their invasive species programs and legislation.

Alberta's Agency Report provided information on Alberta's Land-use Framework, River Forecast Centre, Water Shortage and Management Update, Whirling Disease Program, Alberta Innovates Water Innovation Program, Water for Life Partnerships and Water Quality Modeling and Allowable Contaminants Loads for the Battle River Basin.

Saskatchewan provided information on Drainage Regulations, Quill Lakes, Current Moisture Conditions, Transfer of Federal Dams, Qu'Appelle Water Quality Study, and the 2016 Husky Oil Spill.

Manitoba provided information on Shellmouth Reservoir and Downstream Flooding, Lake Winnipeg, Manitoba Drought Management Strategy, and the Interprovincial Drainage Task Force.

Environment and Climate Change Canada provided information on the Lake Winnipeg Basin Program, Water Quality Monitoring and Surveillance Report, several risk-based analyses, and support to the PPWB.

# PERFORMANCE RESULTS *continued*

## GOAL 8: PPWB Business is Conducted Effectively

The PPWB Strategic Goal 8 focuses primarily on administration, work planning, and financial management. Goal 8 ensures that work planning and budgeting are consistent amongst jurisdictions, day to day activities are administered effectively, communications are effective, and succession planning is done to ensure continuity of Board, Committee and Secretariat functions.

### *Administrative and Financial Management*

As illustrated by the organization chart in Appendix V, the Board operates through its Executive Director and four technical Standing Committees (Committee on Hydrology, Committee on Groundwater, Committee on Water Quality and Committee on Flow Forecasting). The Board consists of senior officials engaged in the administration of water resources in the Provinces of Alberta, Saskatchewan, and Manitoba and senior officials from Environment and Climate Change Canada and Agriculture and Agri-Food Canada (Appendix VI). Committee members are managers and technical experts within each member agency. The Board is chaired by the Environment and Climate Change Canada member. The Committees are chaired by the Executive Director.

Secretariat support is provided to the PPWB through the Transboundary Waters Unit, Environment and Climate Change Canada. The portion of time each Secretariat staff person spends on PPWB activities is charged to the PPWB and cost-shared by the members. In addition, technical support is provided, as required, by other staff of the Government of Canada and the three Prairie provinces.

Four Board and nine Committee meetings were held during 2018-2019. Note that several meeting dates were deferred due to the Alberta provincial election, thus fall outside the normal reporting period ending March 31, 2019.

**PPWB**
- Meeting No. 127. November 2, 2018 – Teleconference
- Meeting No. 128. November 6-7, 2018 – Winnipeg
- Meeting No. 129. April 11, 2019 – Teleconference
- Meeting No. 130. May 6-7, 2019 – Edmonton

**COH**
- Meeting No. 137A. September 11-12, 2018 – Regina
- Meeting No. 137B. December 13, 2018 – Teleconference
- Meeting No. 138. May 1-2, 2019 – Winnipeg

**COWQ**
- Meeting No. 134. October 30-31, 2018 – Regina
- Meeting No. 135. May 8-9, 2019 – Winnipeg

**COG**
- Meeting No. 74. November 14, 2018 – Videoconference
- Meeting No. 75. April 25, 2019 – Videoconference

**COFF**
- Meeting No. 7. August 22, 2018 – Edmonton
- Meeting No. 8. February 13, 2019 – Videoconference

The Board approved the annual budget for the PPWB. The budget for 2018-2019 was $894,304 and final expenditures were $716,708 as shown in Appendix VII. Final expenditures were below the approved budget due to a number of delays with deliverables for existing contracts, and in initiating the contracting process for the Qu'Appelle River Basin Review.

## ***PERFORMANCE RESULTS*** *continued*

The Board conducts budget planning early in the year and has a substantial discussion on the budget at the fall meetings. This discussion facilitates early input by the Board into the budget processes of the PPWB member governments.

The PPWB approved an updated Work Plan and associated costs which included $20,000 per annum for five years starting in 2020-21 to fund external contract work for the Committee on Groundwater (COG). Similar funds have been set aside for the other Committees. The fund allocations are not fixed and may be redistributed if needed.

The strategic direction for the PPWB was reviewed and validated at a two-day planning session in November 2017. The current multi-year Work Plan was refined in 2018 to reflect the outcomes from this workshop. Additional strategic reviews will be done in the years ahead to identify and adjust to drivers to help ensure relevance and enhance operational efficiencies. Climate change is a significant driver.

### *Renewal and Modernizing of PPWB Documents*

To modernize, enhance, streamline and avoid duplication, the Board reviews PPWB documents periodically.

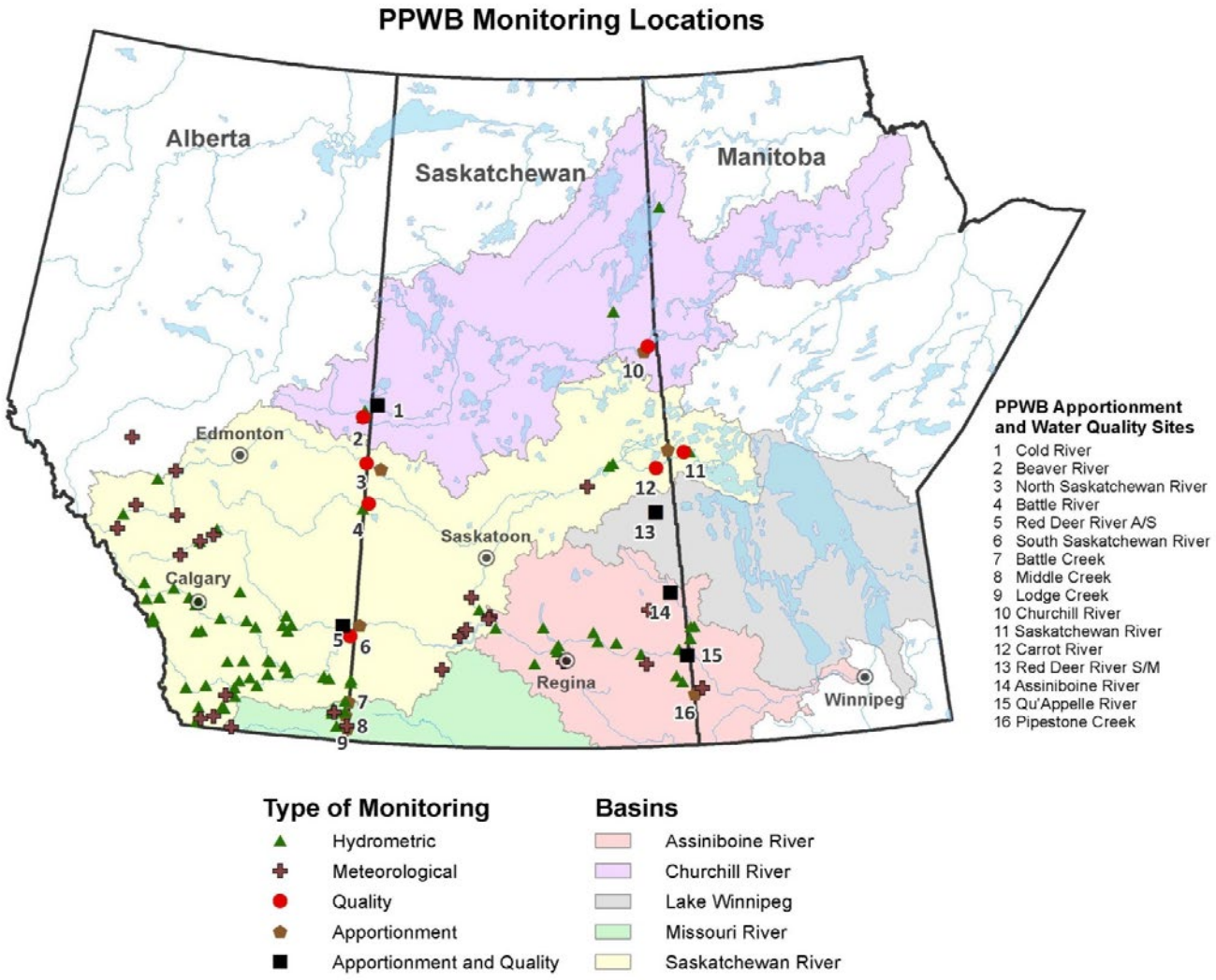
At the November 2017 PPWB work planning meeting, the Board agreed to develop a Value Statement and incorporate it into the Strategic Plan. A draft was completed in 2018.

The PPWB Communications Plan was reviewed with recommendations to: refocus on reporting requirements and sharing in a timely manner; target various modes of social media; and celebrate the Board's 50th Anniversary in 2019. The Communications Strategy was updated, with actions identified for follow-up in 2019.

For 2019, the Board plans to review a costed version of the multi-year Work Plan (2020-21 to 2025-26), and review and update the terms of reference for the technical Committees.

Further information on the history and administration of the PPWB can be found in Appendix VIII.

## *APPENDIX I: PPWB Monitoring Stations for 2018-2019*



# *APPENDIX II: 2018 Recorded and Apportionable Flows*
# *APPENDIX IIA: Flows at the Alberta-Saskatchewan Boundary (in Cubic Decametres)*

## SOUTH SASKATCHEWAN RIVER – ALBERTA-SASKATCHEWAN BOUNDARY

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RECORDED FLOW | 156000 | 134000 | 228000 | 678000 | 939000 | 765000 | 319000 | 152000 | 224000 | 320000 | 229000 | 149000 | 4293000 |
| CONSUMPTIVE USE | 0 | 0 | 0 | 2130 | 271000 | 453000 | 555000 | 433000 | 183000 | 20800 | 0 | 0 | 1918000 |
| CHANGE IN RESERVOIR STORAGE | -22800 | -40800 | -56900 | -14500 | 471000 | 187000 | -57200 | -205000 | -141000 | -22600 | -12900 | -33300 | 51000 |
| INTERBASIN TRANSFER* | 0 | 0 | 0 | 91500 | 21100 | 18200 | 16400 | 15200 | 15500 | 8960 | 0 | 0 | 187000 |
| APPORTIONABLE FLOW | 133000 | 93200 | 171000 | 757000 | 1702000 | 1423000 | 833000 | 395000 | 282000 | 327000 | 216000 | 116000 | 6448000 |

* Irrigation diversions to the Eastern and Western Irrigation Districts which are subsequently returned to the Red Deer River.

## RED DEER RIVER – ALBERTA-SASKATCHEWAN BOUNDARY

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RECORDED FLOW | 42700 | 36200 | 46000 | 726000 | 514000 | 198000 | 162000 | 102000 | 75700 | 86600 | 56900 | 39300 | 2085000 |
| CONSUMPTIVE USE | 0 | 0 | 0 | 0 | 74 | 2780 | 5590 | 6000 | 3200 | 499 | 0 | 0 | 18100 |
| CHANGE IN RESERVOIR STORAGE | -28700 | -26200 | -27200 | 24900 | 23500 | 46900 | 19700 | 14200 | 2490 | 549 | -6870 | -22400 | 20900 |
| INTERBASIN TRANSFER** | 0 | 0 | 0 | -91500 | -21100 | -18200 | -16400 | -15200 | -15500 | -8960 | 0 | 0 | -187000 |
| APPORTIONABLE FLOW | 14000 | 10000 | 18800 | 659000 | 516000 | 229000 | 171000 | 107000 | 65900 | 78700 | 50000 | 16900 | 1936000 |

** Irrigation return flow from the Eastern and Western Irrigation Districts.

## SOUTH SASKATCHEWAN RIVER – BELOW CONFLUENCE WITH RED DEER RIVER

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RECORDED FLOW | 199000 | 170000 | 274000 | 1404000 | 1453000 | 963000 | 481000 | 254000 | 300000 | 407000 | 286000 | 188000 | 6379000 |
| APPORTIONABLE FLOW | 147000 | 103000 | 190000 | 1416000 | 2218000 | 1652000 | 1004000 | 502000 | 348000 | 406000 | 266000 | 133000 | 8385000 |
| NET DEPLETION BY ALBERTA | -52000 | -67000 | -84000 | 12000 | 765000 | 689000 | 523000 | 248000 | 48000 | -1000 | -20000 | -55000 | 2006000 |
| CUMULATIVE PERCENT DELIVERY | 135% | 148% | 146% | 110% | 86% | 78% | 73% | 72% | 73% | 74% | 75% | 76% | 76% |

Recorded flow was 76% of the apportionable flow. Alberta is required to deliver 50% of the apportionable flow to Saskatchewan unless the total annual apportionable flow below the confluence is less than 5,180,000 $dam^3$, in which case Alberta is allowed a total net depletion of 2,590,000 $dam^3$ regardless of the percent delivery. However, Alberta cannot consume, divert or store more than 50% of the apportionable flow if the effect reduces the flow below the confluence to less than 42.5 $m^3/s$ at any time. As the apportionable flow for 2018 was 8,385,000 $dam^3$, and Alberta delivered greater than 50% of the apportionable flow, Alberta has met its obligations.

## NORTH SASKATCHEWAN RIVER – ALBERTA-SASKATCHEWAN BOUNDARY

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ESTIMATED FLOW | 303000 | 285000 | 345000 | 943000 | 1153000 | 772000 | 884000 | 667000 | 526000 | 548000 | 498000 | 415000 | 7339000 |
| APPORTIONABLE FLOW | 98300 | 82000 | 121000 | 752000 | 1393000 | 1179000 | 1374000 | 942000 | 595000 | 500000 | 338000 | 137000 | 7511000 |

Estimated flow at the Alberta-Saskatchewan boundary is calculated by taking the recorded flow at the hydrometric station near Deer Creek, SK and subtracting the estimated net inflow to the river between the boundary and the station. Estimated flow was 98% of the apportionable flow. Alberta is required to deliver 50% of the apportionable flow to Saskatchewan.

## COLD LAKE – ALBERTA-SASKATCHEWAN BOUNDARY (AT THE OUTLET OF COLD LAKE)

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RECORDED FLOW | 60300 | 51100 | 53300 | 50600 | 75900 | 96700 | 116000 | 99400 | 85300 | 72100 | 55800 | 49700 | 866000 |
| APPORTIONABLE FLOW | 60700 | 51400 | 53600 | 51000 | 76300 | 97200 | 116000 | 99800 | 85700 | 72500 | 56200 | 50000 | 870000 |

Recorded flow was 100% of the apportionable flow. Alberta is required to deliver 68.4% of the apportionable flow to Saskatchewan.

## LODGE CREEK – ALBERTA-SASKATCHEWAN BOUNDARY

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RECORDED FLOW | N/A | 0 | 170 | 18000 | 1470 | 67 | 2 | 0 | 10 | 0 | N/A | N/A | 19700 |
| APPORTIONABLE FLOW | N/A | 0 | 229 | 19300 | 1470 | 70 | 2 | 0 | 10 | 0 | N/A | N/A | 21100 |

Recorded flow was 99% of the apportionable flow. Alberta is required to deliver 75% of the apportionable flow to Saskatchewan. Hydrometric data is only collected for the open water season. No minor water use reports were received in 2018, so uses were estimated to be 500 $dam^3$ based on observed reservoir releases and reports of actual uses in previous years with similar runoff conditions.

## MIDDLE CREEK – ALBERTA-SASKATCHEWAN BOUNDARY

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RECORDED FLOW | N/A | 0 | 33 | 6220 | 495 | 46 | 30 | 29 | 28 | 31 | N/A | N/A | 6910 |
| APPORTIONABLE FLOW | N/A | 0 | 33 | 7030 | 437 | 46 | 30 | 26 | 28 | 29 | N/A | N/A | 7660 |

Recorded flow was 90% of the apportionable flow. Alberta is required to deliver 75% of the apportionable flow to Saskatchewan. Hydrometric data is collected only for the open water season. No minor water use reports were received in 2018, so uses were estimated to be 330 $dam^3$ based on observed reservoir releases and reports of actual uses in previous years with similar runoff conditions.

## BATTLE CREEK – ALBERTA-SASKATCHEWAN BOUNDARY

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RECORDED FLOW | N/A | 0 | 365 | 3200 | 1480 | 667 | 511 | 412 | 467 | 461 | N/A | N/A | 7560 |
| APPORTIONABLE FLOW | N/A | 0 | 365 | 3220 | 1500 | 667 | 546 | 416 | 467 | 461 | N/A | N/A | 7640 |

Recorded flow was 99% of the apportionable flow. Alberta is required to deliver 75% of the apportionable flow to Saskatchewan. Hydrometric data is collected only for the open water season.

## *APPENDIX IIB: Flows at the Saskatchewan-Manitoba Boundary (in Cubic Decametres)*

### CHURCHILL RIVER – SASKATCHEWAN-MANITOBA BOUNDARY

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ESTIMATED FLOW | 2399000 | 2083000 | 2151000 | 2281000 | 2998000 | 3060000 | 3570000 | 4135000 | 3949000 | 3328000 | 2697000 | 2556000 | 35207000 |
| APPORTIONABLE FLOW | 2580000 | 2185000 | 2225000 | 1852000 | 2481000 | 2714000 | 3495000 | 3752000 | 3528000 | 3395000 | 2702000 | 2505000 | 33414000 |

Estimated flow includes recorded flow at Sandy Bay, SK and estimated inflow from Sandy Bay to the Saskatchewan-Manitoba Boundary. Estimated flow was near 105% of the apportionable flow. Saskatchewan is required to deliver 50% of the apportionable flow to Manitoba.

### SASKATCHEWAN RIVER – SASKATCHEWAN-MANITOBA BOUNDARY

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ESTIMATED FLOW | 1048000 | 1065000 | 1115000 | 1386000 | 3056000 | 2513000 | 1823000 | 1628000 | 1440000 | 1529000 | 1282000 | 1339000 | 19225000 |
| APPORTIONABLE FLOW | 564000 | 629000 | 803000 | 2357000 | 3611000 | 2847000 | 2189000 | 1807000 | 1541000 | 1652000 | 1117000 | 1059000 | 20178000 |

Estimated flow at the Saskatchewan-Manitoba boundary is calculated using the recorded flow of the Saskatchewan River at The Pas minus 1.34 times (Fall and Winter) and 1.64 times (Spring and Summer) the recorded flow of the Carrot River near Turnberry. Estimated flow was 95% of the apportionable flow. Saskatchewan is required to deliver 50% of the apportionable flow to Manitoba.

### RED DEER RIVER – SASKATCHEWAN-MANITOBA BOUNDARY (NEAR ERWOOD)

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RECORDED FLOW | 7630 | 7230 | 7100 | 179000 | 210000 | 213000 | 142000 | 20900 | 10400 | 13000 | 11700 | 9510 | 831000 |
| APPORTIONABLE FLOW | 7190 | 6820 | 6590 | 172000 | 198000 | 199000 | 133000 | 19500 | 9730 | 12300 | 11000 | 8950 | 784000 |

Recorded flow was 106% of the apportionable flow due to the contribution of agricultural drainage to the flow of the Red Deer River. Saskatchewan is required to deliver 50% of the apportionable flow to Manitoba.

## ASSINIBOINE RIVER – SASKATCHEWAN-MANITOBA BOUNDARY (AT KAMSACK)

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RECORDED FLOW | 1410 | 1170 | 1040 | 74400 | 94800 | 42500 | 11100 | 1610 | 785 | 1680 | 1850 | 1920 | 234000 |
| APPORTIONABLE FLOW | 1390 | 1170 | 939 | 77700 | 95600 | 43000 | 11800 | 2370 | 933 | 1780 | 1820 | 1920 | 240000 |

Recorded flow was 97% of the apportionable flow. Saskatchewan is required to deliver 50% of the apportionable flow to Manitoba.

## QU'APPELLE RIVER – SASKATCHEWAN-MANITOBA BOUNDARY (NEAR WELBY)

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RECORDED FLOW | 2220 | 995 | 3900 | 28000 | 10900 | 26800 | 13500 | 4570 | 3700 | 16500 | 10500 | 6090 | 128000 |
| APPORTIONABLE FLOW | | | | | | | | | | | | | 85700 |

Recorded flow was 149% of the apportionable flow. The current calculation method overestimates the percent delivery. The PPWB is currently undertaking a study to revise the calculation procedures to address these problems. Saskatchewan is required to deliver 50% of the apportionable flow to Manitoba.

## PIPESTONE CREEK – SASKATCHEWAN-MANITOBA BOUNDARY

| | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | TOTALS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RECORDED FLOW | 136 | 123 | 345 | 8570 | 3740 | 16700 | 2270 | 17 | 402 | 372 | 233 | 382 | 33300 |
| APPORTIONABLE FLOW | | | | | | | | | | | | | 34800 |

Recorded flow was 96% of apportionable flow. Saskatchewan is required to deliver 50% of the apportionable flow to Manitoba. Due to unresolved issues with the Fortran program used to calculate monthly apportionable flows, a simplified procedure was developed to determine the annual apportionable flow for Pipestone Creek.

## *APPENDIX III: PPWB Water Quality Monitoring 2018 Parameter List*

Water is collected monthly at all sites with the exception of the Churchill River (4x/yr)

ALKALINITY, phenol & total
ALUMINUM, diss. & total
AMMONIA, total. θ
ANTIMONY, diss. & total
ARSENIC, diss. θ & total θ
BARIUM, diss. & total θ
BERYLLIUM, diss. & total θ
BICARBONATE, calcd.
BISMUTH, diss. & total
BIOLOGICAL OXYGEN DEMAND (BOD)•
BORON, diss. & total θ
CADMIUM, diss. & total θ
CALCIUM, diss.
CARBON, diss. organic
CARBON, part. organic
CARBON, total organic, calcd.
CARBONATE, calcd.
CHLORIDE, diss. θ
CHLOROPHYLL A
CHROMIUM, diss. & total θ
COBALT, diss. & total θ
COLIFORMS FECAL θ
COLOUR TRUE
COPPER, diss. & total θ
*E. COLI* θ
FLUORIDE, diss. θ
FREE CO2, calcd.
GALLIUM, diss. & total
GLYPHOSATE ◆
HARDNESS NON-CARB. (calcd.)
HARDNESS TOTAL (calcd.) CACO3
IRON, diss. θ & total
LANTHANUM, diss. & total
LEAD, diss. & total θ
LITHIUM, diss. & total θ
MAGNESIUM, diss.
MANGANESE, diss. θ & total
MOLYBDENUM, diss. & total θ
NICKEL diss. θ & total
NITROGEN $NO_3$ & $NO_2$, diss. θ
NITROGEN. part.
NITROGEN, total calcd.
NITROGEN, diss.
OXYGEN, diss. θ
pH θ
PHOSPHOROUS ortho, diss.
PHOSPHOROUS, part. calcd.
PHOSPHOROUS, total θ
PHOSPHOROUS, diss.
POTASSIUM, diss.
RESIDUE FIXED NONFILTRABLE
RESIDUE NONFILTRABLE θ
RUBIDIUM, diss. & total
SELENIUM, diss. & total θ
SILVER, diss. & total θ
SILICA,
SODIUM ADSORPTION RATIO, calcd. θ
SODIUM, diss. θ
SODIUM PERCENTAGE, calcd.
SPECIFIC CONDUCTANCE
STRONTIUM, diss. & total
SULPHATE, diss. θ
TEMPERATURE WATER
THALLIUM, diss. & total θ
TOTAL DISSOLVED SOLIDS, calcd. θ
TURBIDITY
URANIUM, diss. & total θ
VANADIUM, diss. & total θ
ZINC diss. & total θ

ACID HERBICIDES*θ
NEUTRAL HERBICIDES◆
ORGANOCHLORINE INSECTICIDES◆

θ Parameters with PPWB site-specific objectives

* Collected from all PPWB Transboundary Rivers except Beaver, Churchill, and Red Deer (S/M) Rivers in 2018

◆ Collected from the Assiniboine, Carrot, Cold, North Saskatchewan, and South Saskatchewan Rivers in 2018

• Collected from Battle, Beaver, and Carrot Rivers in 2018

# *APPENDIX IV:*

## PPWB Report on Excursions of Interprovincial Water Quality Objectives

JANUARY-DECEMBER 2018

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# SUMMARY

This 2018 report fulfils requirements of the *Master Agreement on Apportionment (MAA)* to report on the protection of water quality for major interprovincial prairie rivers. During 2018, water quality samples were collected on 12 major interprovincial rivers. The water quality results were compared to water quality objectives for each site. In general, water quality was suitable for the intended water uses for the rivers. Based on the evaluation of excursions in 2018 and with consideration of results from previous excursion reports, trends, and on-going work by the Committee on Water Quality (COWQ), the following are recommended:

- Understanding the processes affecting nutrient concentrations in prairie rivers continues to be a priority area of investigation. Such information will improve understanding regarding the causes of excursions and trends. Nutrients continue to be a priority area of investigation for these rivers because increasing levels of nutrients can lead to more eutrophic waters, which can affect ecosystem function. The Committee's on-going work to understand nutrient sources and trends will continue in 2019.
- Common use pesticides, such as dicamba, 2-methyl-4-chlorophenoxyacetic acid (MCPA) and glyphosate, are frequently detected in transboundary rivers on the prairies. There are frequent pesticide excursions at several transboundary rivers, notably of MCPA and dicamba. The objectives for these two pesticides are based on irrigation guidelines for sensitive crops and are low compared to other pesticides. Glyphosate and its breakdown products are also detectable at low concentrations in the transboundary rivers. The COWQ is working with the jurisdictions to better understand the potential effects to the aquatic environment and users of these waters. Once this work is complete, the Committee will provide a recommendation to the Board. Given low level but frequent occurrence of certain pesticides, understanding the aquatic life and use implications continues to be a priority.
- Excursions of total metals, nutrients and bacteria objectives at several sites appear to be related to peaks in suspended solids, and sometimes flow, although these relationships cannot explain all of the excursions observed. Trends in metal concentrations and relationships to physical parameters, including flow and suspended solids, continue to be examined for select rivers to gain further understanding on how these factors influence metal concentrations and other parameters in transboundary rivers.

# INTRODUCTION

The governments of Alberta, Saskatchewan, Manitoba and Canada entered into the Master Agreement on Apportionment in 1969. The agreement provided for equitable sharing of water in eastward flowing streams across interprovincial boundaries. Schedule E, the agreement on water quality, was added to the Agreement in 1992. The Agreement is administered by the Prairie Provinces Water Board (PPWB) which has a mandate to foster and facilitate interprovincial water quality management among the parties to encourage the protection and restoration of the aquatic environment. One of the processes the PPWB uses to meet this mandate is this annual report on adherences to the interprovincial water quality objectives. If, as a result of human activity, chemical, biological or physical variables do not meet acceptable limits then the appropriate jurisdiction has agreed to undertake reasonable and practical measures to ensure the quality of the water in that river reach is within acceptable limits (*MAA* Schedule E, 1992).

Schedule E requires the PPWB to monitor the quality of the aquatic environment and make annual comparisons with established interprovincial water quality objectives. Water quality objectives have been established at 12 major interprovincial eastward flowing river reaches (Appendix 1). The water quality objectives were reviewed and updated in 2015, and are designed to protect water uses including the protection of aquatic life, source water for drinking, recreation, agricultural uses (livestock watering and irrigation) and fish consumption. The Alberta-Saskatchewan and Saskatchewan-Manitoba boundaries each have six river sites (Figure 1; Table 1).

Water quality monitoring includes a range of physical, chemical and biological parameters at one site in each of the river reaches. Parameters include nutrients, major ions, metals, fecal coliforms, physical characteristics and pesticides. This report presents adherence of the 2018 water quality data to the interprovincial water quality objectives.

## *Field Program – Summary of (2018) Sampling.*

Environment and Climate Change Canada (ECCC) undertook a total of 136 water sampling outings at the 12 PPWB river sites in 2018. The monitoring program for 2018 was completed, as approved by the PPWB (Appendix 2), with the following exceptions: chlorophyll a was not sampled in January to March 2018 for the six Alberta-Saskatchewan transboundary rivers due to a sampling error. Monitoring of chlorophyll a has only recently been implemented at the transboundary rivers as a measure of algal biomass, and currently there are no transboundary water quality objectives for chlorophyll. Consequently, chlorophyll a is not reported as part of the excursion analysis for these rivers. However, nutrients can play a major role in the amount of algal biomass and the ecological health of these river systems and the Committee on Water Quality (COWQ) determined it would be important to start to collect information on algal biomass that can be used in future assessments.

On the Saskatchewan-Manitoba boundary, *E. coli* was sampled in April on the Carrot and Saskatchewan rivers but due to a power problem with the incubator, the samples were invalid. In addition, a number of pesticide sample results were not reported including glyphosate on the Carrot River in November and the Assiniboine River in March, October and November; organochlorine pesticides on the Carrot River in July; and the neutral and acid herbicides on the Assiniboine River in November. Pesticide samples that were not reported were broken in transit, lost in storage, or there was a sampling error.

*Figure 1: Map showing location of PPWB water quality monitoring stations*

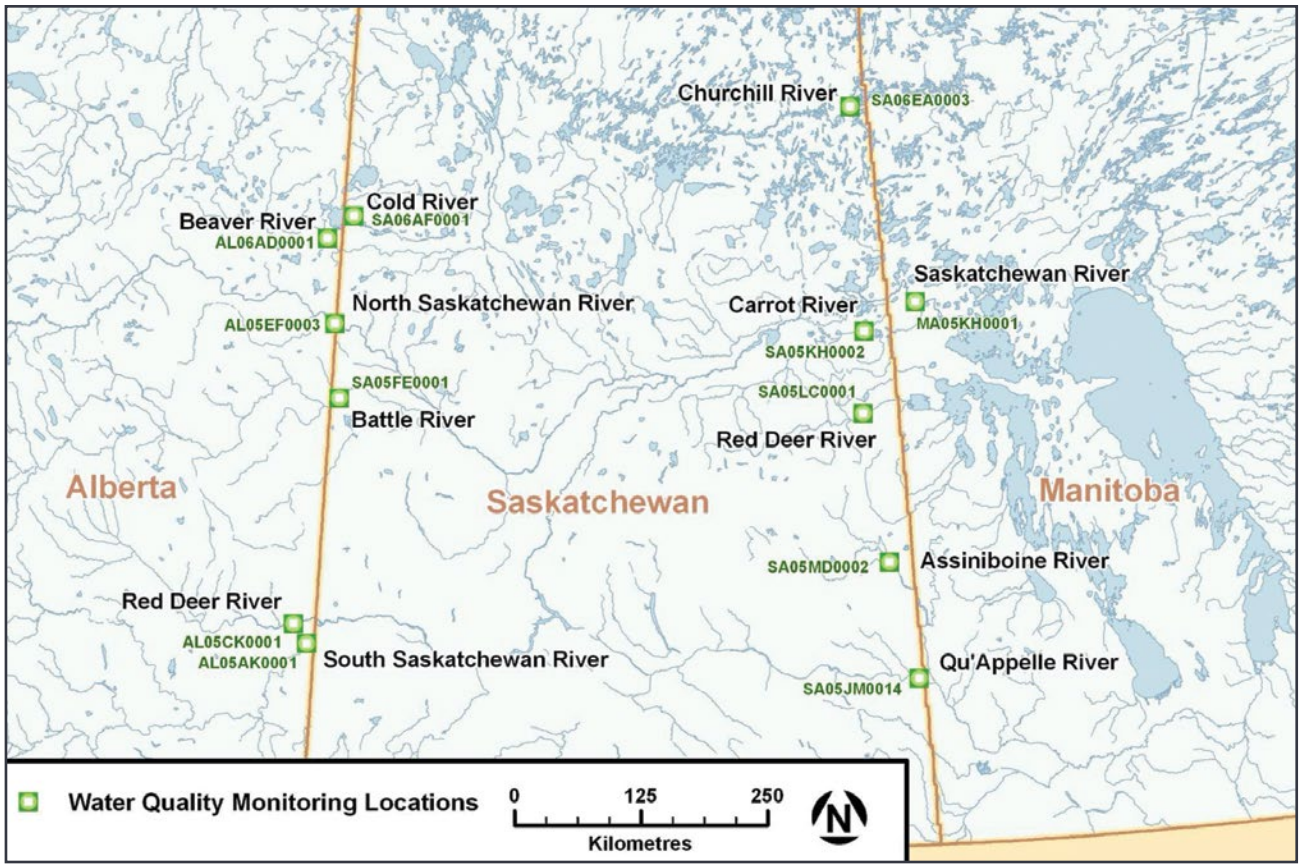


*Table 1: PPWB water quality station information*

| RIVER | STATION NUMBER | LATITUDE | LONGITUDE | LATITUDE | LONGITUDE | HYDROMETRIC SITE(S) |
|---|---|---|---|---|---|---|
| Alberta-Saskatchewan | | Open Season | | Closed Season | | |
| Battle | SA05FE0001 | 52°56'23.09" | 109°52'34.60" | 52°56'23.20" | 109°52'33.55" | 05FE004 |
| Beaver | AL06AD0001 | 54°21'19.06" | 110°12'57.13" | 54°21'19.71" | 110°13'00.19" | 06AD006 |
| Cold | SA06AF0001 | 54°33'56.51" | 109°50'29.23" | 54°33'56.65" | 109°50'29.81" | 06AF001 |
| N. Saskatchewan | AL05EF0003 | 53°36'13.35" | 110°00'38.87" | 53°35'50.28" | 109°59'31.05" | 05EF001 |
| Red Deer | AL05CK0001 | 50°54'11.91" | 110°17'57.69" | 50°54'10.00" | 110°17'48.98" | 05CK004 |
| S. Saskatchewan | AL05AK0001 | 50°43'51.88" | 110°04'10.73" | 50°44'01.31" | 110°05'00.87" | 05AJ001* |
| Saskatchewan-Manitoba | | Open Season | | Closed Season | | |
| Assiniboine | SA05MD0002 | 51°31'57.86" | 101°52'38.33" | 51°31'57.85" | 101°52'37.72" | 05MD004 |
| Carrot | SA05KH0002 | 53°36'52.54" | 102°06'14.75" | 53°36'52.79" | 102°06'15.84" | 05KH007 |
| Churchill | SA06EA0003 | 55°33'40.16" | 102°15'41.83" | 55°33'47.10" | 102°15'48.90" | 06EA002** |
| Qu'Appelle | SA05JM0014 | 50°29'28.38" | 101°33'31.37" | 50°29'28.17" | 101°33'30.93" | 05JM001 |
| Red Deer | SA05LC0001 | 52°51'34.87" | 102°11'44.70" | 52°51'33.73" | 102°11'44.88" | 05LC001 |
| Saskatchewan | MA05KH0001 | 53°50'36.19" | 101°19'59.70" | 53°51'08.80" | 101°20'33.90" | 05KJ001*** |

*Estimated flow for the PPWB South Saskatchewan site is based on recorded flow at Medicine Hat plus the flow from Seven Persons Creek and Ross Creek with a two-day lag.
**Estimated flow for PPWB Churchill site includes recorded flow at Sandy Bay and estimated inflow from Sandy Bay to the boundary.
***Estimated flow for PPWB Saskatchewan site includes recorded flow at 05KJ001 minus flow at the Carrot River 05KH007.

# RESULTS

## *Overall Adherence to Interprovincial Water Quality Objectives*

The overall adherence rate to the interprovincial water quality objectives was, on average, 97.1% in 2018 (Figure 2). This adherence rate is based on the comparison of 5,525 water quality results to water quality objectives (Table 8 and 9). There are no acute water quality concerns apparent from review of these data or as indicated by the adherence rates in 2018.

Site adherence rates from 2018 are similar to those from previous years (Figure 3). While water quality objectives were updated in 2015 and have been applied to the PPWB river reaches since then, adherence rates were calculated retroactively for 2004 through 2014 with the revised water quality objectives to understand how rates have changed over a longer period of time. This analysis allows for comparison of adherence rates for 2018 with previous years using the same 2015 water quality objectives.

Most rivers show little variation in adherence rates among years (approximately 4 to 6%). The Red Deer River on the Alberta-Saskatchewan boundary has had the greatest variability in adherence rate among years, with an 8% variation in adherence rate over the past 15 years. For this river, high and low adherence rates were observed in 2018 and 2005, respectively. The lower adherence rate in 2005 was not specifically attributable to a single variable or one group of variables, although annual discharge was on the higher end for this river in 2005. However, the higher adherence rate in 2018 was attributed to no excursions for metals and fewer nutrient excursions. Quite often the variability of adherence rates demonstrates the susceptibility of river water quality to various weather/hydrological events (e.g. storm, drought) and environmental factors (e.g. farming, erosion) that may also vary annually.

Between 2017 and 2018, all of the Alberta-Saskatchewan boundary rivers showed an increase in the overall adherence rate, although in some cases the improvement was small, ranging from 0.07% on the Beaver River to 3.39% on the Red Deer River. In 2018, the adherence rate to the interprovincial water quality objectives for the Red Deer River and the North Saskatchewan River were the highest they have been over the last 15 years.

On the Saskatchewan-Manitoba boundary, the Red Deer River near Erwood has historically shown the greatest fluctuations in overall adherence rate to water quality objectives. In 2018, the overall adherence rate for the Red Deer River was slightly higher than the 2017 adherence rate. In 2017, the Red Deer River near Erwood had 23 excursions and this was reduced to 16.5 in 2018 but continued to include exceedances to objectives for nutrients, TSS, and several metals.

In 2018, three of the transboundary rivers on the Saskatchewan-Manitoba boundary (Churchill, Saskatchewan and Qu'Appelle) showed a reduction in adherence rate and three rivers (Carrot, Red Deer and Assiniboine) showed an increase in adherence rate as compared to 2017. The Assiniboine River showed the largest increase in adherence rate at 2.2% and the Qu'Appelle River has the largest decrease in adherence rate at 0.78% between 2017 and 2018.

The 2018 adherence rate for each river was similar to that river's 15-year median adherence rate (with eight sites within less than 1%, and the others within 1.5%, with the exception of three rivers on the Alberta-Saskatchewan boundary: North Saskatchewan, Battle and Red Deer rivers). The larger variation in the adherence rate for the North Saskatchewan and Red Deer rivers was due to the higher adherence rates to the water quality objectives in 2018, which were the highest reported in the last 15 years.

*Figure 2: Percent adherences to interprovincial water quality objectives in 2018.*

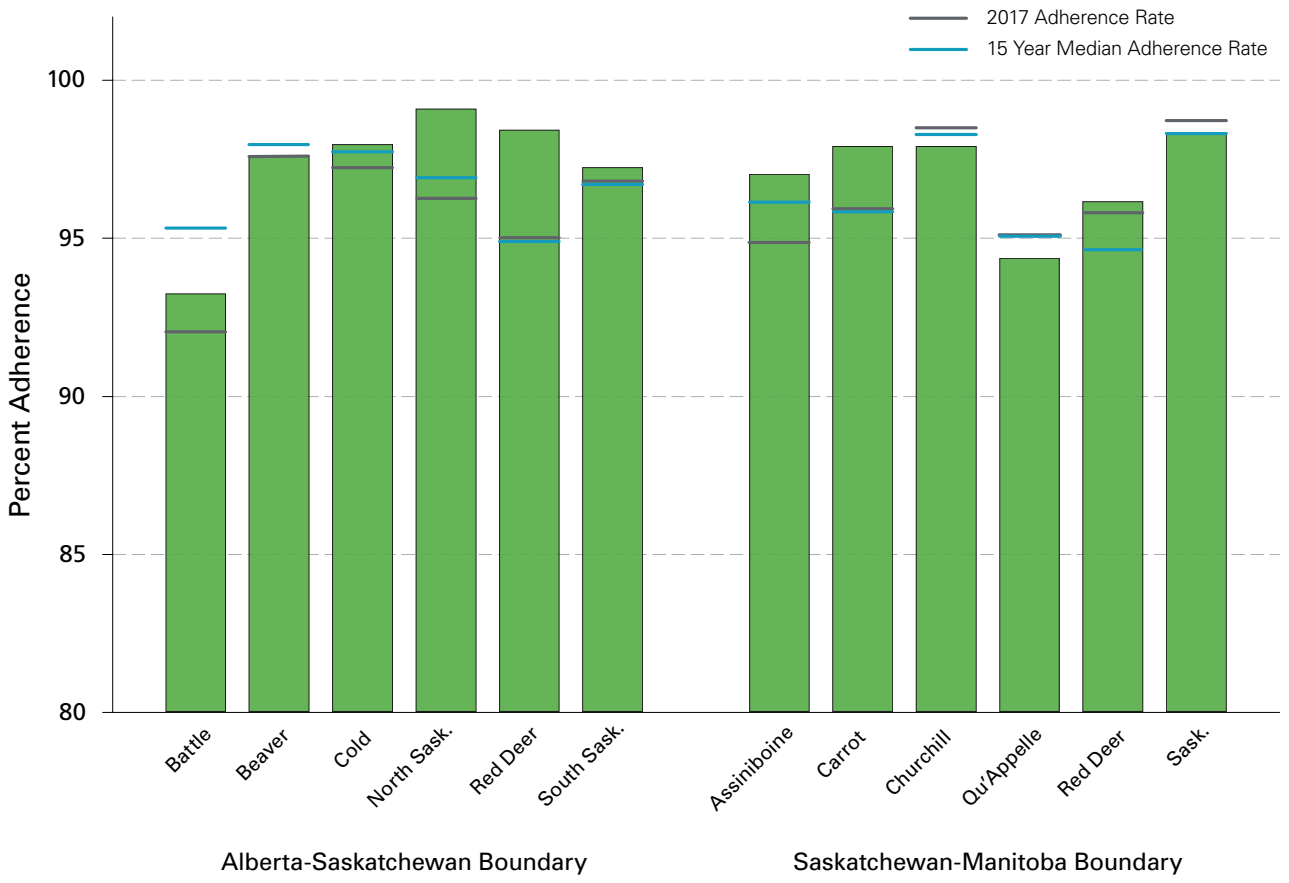
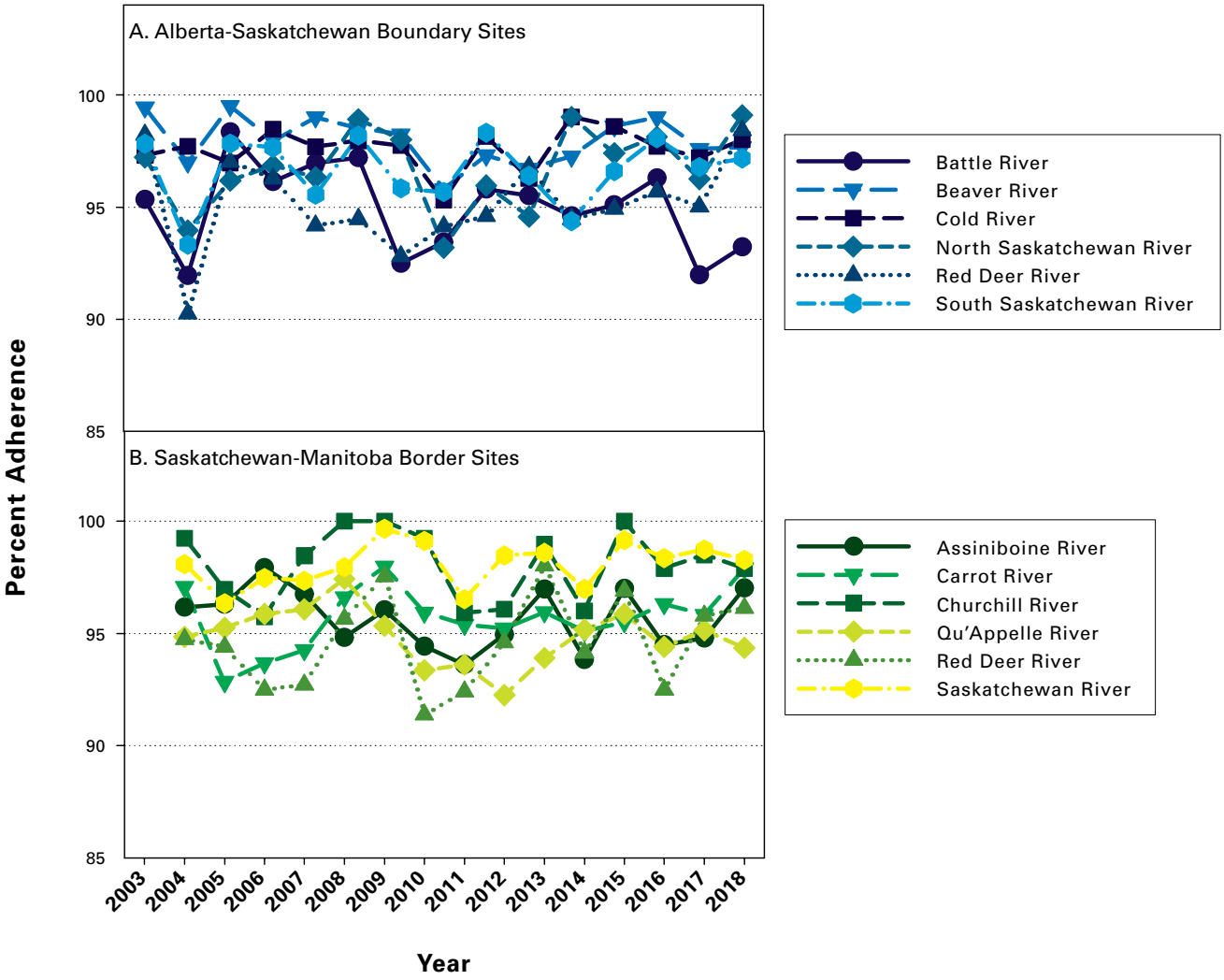


*Figure 3: Percent adherences to interprovincial water quality objectives for (A) the Alberta-Saskatchewan and (B) the Saskatchewan-Manitoba boundaries from 2004 to 2018.*



# ***RESULTS*** *continued*

## *Examination of Specific Parameter Excursions for 2018*

**Alberta-Saskatchewan Boundary**

For the Alberta-Saskatchewan transboundary rivers, there were excursions of objectives for nutrients (total phosphorus (TP), total nitrogen (TN), and total dissolved phosphorus (TDP)), total suspended solids (TSS), metals (arsenic, cadmium, copper, iron, lead, and zinc), major ions (sodium, sulphate and total dissolved solids (TDS)), bacteria (fecal coliforms), and pesticides (dicamba) (Tables 2, 4, 6 and 8).

Total suspended solids is a measure of sediment and particulate matter in the water column. In the water column, sediment may be contributed by erosion of soil and riverbanks and re-suspension of bottom sediments. When TSS concentrations are elevated, elevated levels of nutrients, total metals and coliform bacteria can occur. Elevated TSS concentrations are typical during spring runoff and other episodic events such as high flows following summer storms. The lower water quality objective for TSS was set in recognition of the turbid nature of prairie rivers and recognizing that some fish species require turbidity (e.g. Goldeye). The lower TSS objective was not met (water was low in TSS) at some sites on some dates in 2018 (e.g. Cold River). Flow has an influential effect on water quality and is therefore important to consider when understanding inter- and intra-annual changes in water quality.

Since 2015, site-specific nutrient objectives have been established for TP, TDP and TN for each of the transboundary rivers. The objectives were established using a statistical approach that evaluated long-term data from each site. In all cases, a site-specific nutrient objective was set at the 90th percentile of data for each season. Where statistical trends existed, an additional objective was established based on the lowest running 10-year 90th percentile. It is known that there will be a certain proportion of excursions over the long term. For objectives set using the complete period of record it is expected that the excursion rate will be, 10% on average. Typically, these excursions are expected to be more frequent in some years and less frequent in other years based on annual variability that can be impacted by hydrology, precipitation and temperatures.

Nutrient excursions occurred in five of the six rivers at the Alberta-Saskatchewan boundary in 2018 (Tables 2 and 6). No excursions to the nutrient objectives were observed on the North Saskatchewan River. Nutrient excursions occurred, in both seasons, for all other locations on this border except the Red Deer River. The Battle River had the highest number of nutrient excursions on the Alberta-Saskatchewan boundary in 2018. While this is similar to 2017, the number of nutrient excursions was less in 2018 compared to 2017. In 2017, 14 nutrient excursions to the water quality objectives were reported compared to 8.5 in 2018, which represents 24% of the samples collected. The Red Deer River (near Bindloss) had the second highest number of nutrient excursions in 2017. However in 2018, only one excursion to the TN objective was observed, in January. In 2018, the Cold River had the second highest number of nutrient excursions with at least one excursion to each of the TP, TDP and TN objectives.

The Battle River had excursions of total nitrogen (TN) throughout the early part of the year (January and February) during low winter flows. Phosphorus (TP and TDP) excursions to the interprovincial objectives occurred in February and March with excursions of TP also occurring in May and excursions of TDP in occurring in July. High TSS values were found in May, during spring freshet.

The Cold River had five excursions to the nutrient objectives in 2018, exceeding TP, TDP and TN objectives at least once. Total nitrogen exceeded the water quality objective once in January. This TN sample was comprised mostly of total dissolved nitrogen (99%), which in turn was largely dissolved organic nitrogen. This is similar to previous years where the TN concentration has exceeded the site-specific objective. For TDP, an excursion to the site-specific objective occurred in April and November and for TP in May and November. While flow increased through May, June and July in the river, this increase did not coincide with

## ***RESULTS*** *continued*

increases in TSS. In fact, excursions to the minimum TSS value were reported for April through September with the exception of July in 2018. It is noted that the low levels of temperature and turbidity in April may indicate an ice covered condition in a late spring despite the assigned open water season, which might explain the exceedance to the relative low open-water TDP objective in April this year.

The South Saskatchewan River had the third highest number of excursions to the nutrient objectives in 2018 on the Alberta-Saskatchewan boundary. Total nitrogen exceeded the site-specific nutrient objectives in April and May, with an excursion of the lower objective (based on lowest running 10-year 90th percentile) in January. In January and April, the majority of TN was comprised of total dissolved nitrogen. However, in May the majority of the TN was comprised of particulate nitrogen and coincided with elevated TSS, which exceeded the upper TSS interprovincial objective. Total dissolved phosphorus exceeded the water quality objective in April, while the TP exceeded the objective in May. Similar to TN, the TP exceedance in May was comprised of particulate phosphorus and coincided with peak flows, and elevated TSS.

The Beaver River also had excursions to all three site-specific nutrient objectives in 2018. Of note in 2018 is that nutrient excursions to the site-specific objectives on the Alberta-Saskatchewan boundary were lower in 2018 at all six of the transboundary rivers. Total nitrogen excursions occurred mainly during the closed water season, with the exception of the South Saskatchewan River in May and the Beaver River in April. The TN excursions, with the exception of the South Saskatchewan River in May, did not appear to be related to TSS or river flow. Total phosphorus excursions that did appear to be related to spring freshet and TSS, included the May excursions on the South Saskatchewan and Battle rivers. The TP excursions on the Alberta-Saskatchewan Boundary in the closed water season (January, February, March and November) do not appear to be related to flow.

The Cold River sampling location is located at the outlet for Cold Lake, and therefore the water quality and the relationships observed at other prairie rivers are not seen at this site. Particulate material will typically settle out in the lake making the water at the outlet to the lake low in TSS. Consequently, the phosphorus excursions observed for this river are not related to TSS.

The Committee continues to work towards a better understanding of nutrient dynamics and sources and while peaks in flow and TSS can explain some of the observed excursions to objectives, these factors do not explain all of the excursions observed in these rivers. The statistical method used to derive the objectives may also account for some of the observed excursions but again would not explain all of the observed excursions.

Objectives for TSS were set using historical data and included an upper and lower limit to protect aquatic life, in particular to protect turbid water fish that are present in prairie river systems. Total suspended solids site-specific objectives were based on the open water season only as this is the most critical time for the protection of fish and early life stages. Given the statistical approach used to set the TSS objectives, there is an expectation that a certain number of excursions will occur over the long term (10% lower objective plus 10% upper objective).

Four of the six rivers on the Alberta-Saskatchewan boundary exceeded the open water site-specific objective for TSS in 2018. The upper water quality objective was exceeded once on the South Saskatchewan River in May during spring freshet. This was the only river to exceed the upper TSS objective in 2018. The lower TSS objective was exceeded on the Red Deer, Battle and Cold rivers throughout the open water season. The Beaver and North Saskatchewan rivers did not exceed the site-specific open water season TSS objectives in 2018.

Of note, for the Cold River was that all observed TSS excursions (6 of 7 samples) were a result of low TSS concentrations for this river, which resulted in TSS not meeting the lower objective. This was also the case in 2015, 2016 and 2017. Low concentrations of TSS as noted above are not unexpected given the water quality is

## ***RESULTS*** *continued*

monitored at the outflow from Cold Lake. Cold Lake is a substantial deep-water lake and it has a moderating effect on the water quality of the outlet.

Six metals (arsenic, cadmium, copper, iron, lead, and zinc) exceeded water quality objectives on the Alberta-Saskatchewan transboundary rivers in 2018. Four of the rivers monitored on this boundary, had at least one exceedance to a metal objective. Cold and Red Deer rivers did not exceed a metal objective in 2018. The objectives are for the total metal with the exception of iron, manganese and nickel, which are in the dissolved form.

The Battle River exceeded water quality objectives for four metals (arsenic, cadmium, copper and iron) in 2018. Excursions for cadmium and copper occurred during the spring and early summer. A peak in TSS was reported in May for this river and this coincided with the excursions for total cadmium and copper. Additional metal excursions occurred in February for arsenic (total), and iron (dissolved). Iron excursions also occurred in March and September 2018.

The South Saskatchewan River had excursions of cadmium, copper, lead and zinc in May 2018. These excursions coincided with a distinctly elevated TSS level and a peak in the river flow on the same date. Cadmium (total) also had excursions in June and December 2018. For the North Saskatchewan River, cadmium was the only metal to exceed the water quality objectives in 2018. Excursions occurred in April, September, November and December and did not coincide with high flows or TSS.

The Beaver River exceeded the cadmium objective twice in 2018 as compared to four times in 2017. Excursions occurred in September and November; while these excursions do not appear to be related to flow, the peak in TSS for this river occurred in November. The Beaver River also had five excursions of dissolved iron throughout the closed water season (January, February, October, November and December).

In 2018, the Red Deer River and the Cold River did not exceed any of the metal water quality objectives. For the Red Deer River, this was unusual, as this river has a history of exceeding the total metals objectives. These historical total metal excursions usually coincide with an elevated TSS level. In a recent publication, elevated metal concentrations on the Red Deer River were explained by erosion of natural soils and high instream sediment mass (Kerr and Cooke, 2017). In 2018, flow and TSS levels were low, with TSS values well below the TSS upper water quality objective. The three excursions to the TSS on the Red Deer River were related to the lower TSS objective in 2018. The COWQ is continuing to follow up on excursions on the Red Deer River and is working with the Province of Alberta as the upstream jurisdiction.

The Battle River was the only river on the Alberta-Saskatchewan boundary to exceed a major ion or total dissolved solids (TDS) objective in 2018. This same pattern occurred in 2017. Sodium, sulphate and TDS exceeded the water quality objectives in the Battle River during the ice-cover season. These exceedances are considered to be a result of low flows in the Battle River in late winter under ice conditions. In recognition of higher salinity in the Battle River, a site-specific objective was established using a similar approach to nutrients (90th percentile), therefore there is an expectation that this objective will be exceeded 10% of the time over the long-term.

Sources of fecal coliform are numerous and include wildlife and pet waste, discharge of wastewater, and runoff from agricultural activities including livestock operations and agricultural fields that receive animal-waste products. Occasional exceedances of fecal coliform objectives are not unexpected in surface waters, particularly in response to rainfall events that can transport fecal bacteria through runoff. All rivers on the Alberta-Saskatchewan boundary, except the Beaver and Cold rivers, exceeded the fecal coliform bacteria water quality objective of 100 No./100 mL occasionally in 2018. The fecal coliform densities ranged

## ***RESULTS*** *continued*

from less than 2 to 680 No./100 mL. Peak densities for the North Saskatchewan, South Saskatchewan, Battle, and Red Deer rivers were 680, 580, 150, and 120 No./100 mL respectively.

In the case of the Red Deer River, the detection of fecal coliform bacteria occurred in April and June, and while the TSS levels were well below water quality objectives the exceedances did occur during the highest TSS levels on this river in 2018. For the other three rivers Battle, North Saskatchewan and South Saskatchewan rivers the detection of fecal coliform bacteria did not appear to be related to any significant increase in TSS or peak flow but could have been attributed to a small local event such as a rainstorm. All bacteria detections occurred during the open water season. *Escherichia coli (E. coli)*, is also a measure of fecal contamination in water supplies and is often the preferred indicator. In 2018, *E. coli* did not exceed the water quality objectives in any of the rivers on the Alberta-Saskatchewan boundary. The interprovincial water quality objective for fecal coliform is lower than the objective for densities of E.coli with an objective of 200 No./100 mL for recreation. Escherichia coli ranged from less than two to 160 No./100 mL for the six transboundary rivers.

Pesticide monitoring on the transboundary rivers is conducted on a rotational basis with each river being monitored once every four years. As a result of this rotational sampling, the full suite of pesticide monitoring was conducted on the South Saskatchewan, North Saskatchewan and Cold rivers on the Alberta-Saskatchewan boundary in 2018. In addition, the acid herbicide group of pesticides were also measured on the Battle and Red Deer rivers on this boundary as part of additional monitoring implemented on select rivers with more frequent excursions to this group of pesticides. MCPA and dicamba are two acid herbicides commonly used throughout the prairie provinces. A review of recent PPWB pesticide data for the Alberta-Saskatchewan rivers (2006 to 2013) showed that these herbicides are often detected at low concentrations in water samples and frequently exceed the PPWB water quality objectives (PPWB Report # 175, 2016).

In 2018, excursions were observed for the acid herbicide dicamba (Table 4). Dicamba exceeded the water quality objective twice in the South Saskatchewan River (June and October) and once in the Red Deer River (August). The Committee will continue to follow up with each of the jurisdictions on the presence of these pesticides in the transboundary river systems.

Glyphosate is a nonselective systemic herbicide that is used extensively throughout the prairies. The PPWB does not currently have a numerical objective for glyphosate, but given its extensive use throughout the prairies, the PPWB has chosen to report detections of this herbicide. In 2018, glyphosate was monitored on the South Saskatchewan, North Saskatchewan and Cold rivers. While glyphosate was not detected on the Cold River, it was detected in both the North and South Saskatchewan rivers. Glyphosate was detected at low levels in two water samples collected from the South Saskatchewan River and ranged in concentration from 142 ng/L in April to 24.2 ng/L in August. For the North Saskatchewan River, glyphosate was detected in two samples in August and December ranging from 419 to 20.5 ng/L, respectively. Aminomethylphosphonic acid (AMPA), a breakdown product of glyphosate, was also reported for the South and North Saskatchewan rivers in 2018. Aminomethylphosphonic acid was detectable in three of the eight samples collected from the South Saskatchewan River and six of the eight samples collected from the North Saskatchewan River at low levels.

**Saskatchewan-Manitoba Boundary**

In 2018, water quality excursions for the Saskatchewan-Manitoba boundary included objectives for nutrients (TP, TDP, TN), total suspended solids (TSS), metals (arsenic, cadmium, copper, lead, manganese, selenium and zinc), major ions (sulphate and TDS), bacteria (E.coli and fecal

## ***RESULTS*** *continued*

coliforms), dissolved oxygen, and pesticides (MCPA and dicamba) (Tables 3, 5, 7 and 9).

Nutrient objectives for the Saskatchewan-Manitoba boundary, similar to the Alberta-Saskatchewan boundary, were established with a statistical approach that evaluated long-term data from each site. There were multiple nutrient excursions at all sites on the Saskatchewan-Manitoba boundary in 2018 (Tables 3 and 7). The highest number of excursions to the site-specific objectives occurred in the Carrot River (7.5), Red Deer River (6.5) and the Qu'Appelle River (4). All three rivers, as well as, the Assiniboine River and Churchill River had excursions of all three site-specific nutrient objectives (TN, TP and TDP). The Saskatchewan River exceeded two of the three site-specific objectives (TN and TP).

The Carrot River had statistically significant increasing trends in phosphorus (TP and TDP), and nitrogen (TN) so site-specific objectives were established for the 90th percentile of the entire period of record and the 90th percentile of the lowest running 10-years for each of the two seasons. For TP, excursions of the 90th percentile objective occurred in September. When this objective is exceeded, the lowest running 10-year 90th percentile objective (lower objective) will also be exceeded (Table 7). In January, February, June, July and August, while the 90th percentile site-specific objective was not exceeded, the lowest running 10-year 90th percentile objective did exceed its seasonal objective. For TDP the 90th percentile site-specific objective was exceeded in July and August 2018, and the lowest running 10-year 90th percentile objective was also exceeded in May and June.

Total nitrogen for the Carrot River did not exceed the higher 90th percentile objective but there were excursions to the lowest running 10-year 90th percentile in winter (January), and spring (May). Overall, for the Carrot River, 33% of the samples collected in 2018 exceeded one or both of the site-specific nutrient objectives, with an excursion rate of 21%. However, this is lower than the number of excursions reported in 2017 for this river. For this river, a peak in flow was recorded in May, which gradually declined through June, with a smaller secondary peak in early July. Elevated TSS was reported in September, with a TSS of 136 mg/L. This TSS peak did coincide with exceedances to both TP seasonal site-specific objectives. For TN, the lowest running 10-year 90th percentile objective was exceeded in January under ice conditions and again in spring during freshet. However, not all of the nutrient excursions on this river could be related to either flow or the TSS.

The Red Deer River (Erwood) had the second highest number of excursions to the site-specific nutrient objectives on the Saskatchewan-Manitoba boundary. Nutrient excursions TP and TN exceeded the site-specific objectives in the spring (April and May). For TP and TN, the excursions to the water quality objectives occurred at the same time as the peak in flow and a large peak in TSS. During April and May, 61 and 74% respectively of the total phosphorus was in the particulate form, which is a greater percentage than in the other months (average percent for the other 10 months was 42%). Conversely, total nitrogen in April and May was comprised of 82 and 83% dissolved nitrogen, respectively. However, the majority of TN for the other ten months had a higher proportion of dissolved nitrogen, with an average of 97% of TN being comprised of dissolved nitrogen. Thus, during April and May there was an increased contribution from particulates making up the TN concentration. The TDP also exceeded both the 90th percentile and the lowest running 10-year 90th percentile objectives in April during spring freshet. The lowest running 10-year 90th percentile objective was also exceeded throughout the early summer (May, June and July). No excursions to the site-specific water quality objectives for nutrients occurred in the winter months in 2018 on the Red Deer River.

The Qu'Appelle River had excursions of TN, TP and TDP in April during spring freshet and a correspondingly large (670 mg/L) peak in TSS. There was also an excursion of the TP objective in January under ice conditions.

The Assiniboine River had an excursion to the TN, TP and TDP site-specific objectives in April 2018. These excursions occurred in spring during peak flow and coincided with a peak in TSS. For the Saskatchewan River, the TN 90th

## ***RESULTS*** *continued*

percentile objective was exceeded in June, while TP exceeded both the lowest running 10-year 90th percentile and 90th percentile in November. In addition, TP also exceeded the lowest running10-year 90th percentile in May, and July. The TN and TP exceedances did not appear to coincide with increases in TSS for the Saskatchewan River.

Understanding specific factors affecting nutrients continues to be a priority for all jurisdictions. The Committee has focussed work on the Red Deer River (AB) and the Carrot River watersheds to assess point and non-point sources of nutrients to these transboundary rivers. It is anticipated that this work will be completed in 2019. Trend analysis and a prioritization process highlighted TN as the nutrient with the highest priority for understanding temporal changes in prairie rivers.

The total suspended solids objectives, which have only been established for the open water season, were exceeded on at least one occasion for five of the six Saskatchewan-Manitoba boundary river sites in 2018. The TSS objectives were not exceeded on the Churchill River. For the Assiniboine and the Qu'Appelle rivers, only the upper objective was exceeded in 2018. These exceedances corresponded with peak freshet flows. For the Red Deer River, there was an excursion to the TSS objective four times in 2018, including one exceedance of the upper objective during peak freshet flow and three exceedances of the lower objective. For the Carrot River there was one excursion of the upper objective. The Saskatchewan River had one excursion each of the upper and lower objectives.

Seven metals (arsenic, cadmium, copper, lead, manganese, selenium and zinc) exceeded water quality objectives at one or more river sites on the Saskatchewan-Manitoba boundary in 2018. Five of the six transboundary rivers had at least one excursion, with the Churchill River being the only river not to exceed a metal objective.

Cadmium and copper exceeded water quality objectives at five of the transboundary rivers on this boundary in 2018, which is similar to the number of excursions observed in 2017. For all five rivers, the elevated cadmium and copper levels coincided with peaks in TSS with exceedances occurring in the spring during freshet. For the Saskatchewan River and the Qu'Appelle River, copper (total) also exceeded the water quality objective in July and January, respectively. These copper exceedances also coincided with elevated TSS levels.

Lead (total) exceeded water quality objectives in two of the six-transboundary rivers on the Saskatchewan-Manitoba boundary in 2018. Lead excursions occurred in the Qu'Appelle and Red Deer rivers, and coincided with spring freshet, and elevated TSS levels. Similarly, zinc (total) exceeded the water quality objective on the Qu'Appelle River in April, while manganese (dissolved) exceeded the water quality objective on the Red Deer River in April. These exceedances also occurred during spring freshet and peak TSS levels.

Arsenic (total) exceeded the water quality objectives on the Assiniboine River twice in 2018 (July and August) and was the only metal that did not appear to coincide with increased flows or elevated TSS levels. On the Saskatchewan-Manitoba boundary, the Assiniboine, Qu'Appelle and Red Deer rivers had the most number of metals that were exceeded (four each).

Two rivers, the Assiniboine and Qu'Appelle, on the Saskatchewan-Manitoba boundary had excursions to sulphate and TDS in 2018. The Churchill, Carrot, Red Deer and Saskatchewan rivers did not have any reported excursions to major ion and/or TDS objectives in 2018.

For the Assiniboine River, sulphate and TDS objectives were set with a similar approach to nutrients, whereby statistical analysis using historical data was used to define an expected range of concentrations. As with nutrients, there is an expectation that there will be a certain proportion of excursions over the long term. The percent exceedances in 2018 were 8% for sulphate and 17% for TDS, which is considerably lower than in 2017, when percent exceedances were 50% for sulphate and 42% for TDS.

## ***RESULTS*** *continued*

Sulphate and TDS exceeded the site-specific objectives on the Assiniboine River in October, while the TDS also exceeded the objective in January under ice conditions. Sulphate and TDS levels were lower in the Assiniboine River in 2018 than has been observed over the last number of years (since about 2008). Trend analysis work completed by the Committee to the end of 2013 has shown increasing trends for sulphate in a number of the transboundary rivers including the Assiniboine River. Initial review of these data suggests that during periods of higher flow in the Assiniboine River, the Whitesand River, which is a tributary to the Assiniboine River and has higher concentrations of sulphate and TDS, contributes a greater proportion of flow.

For the Qu'Appelle River, similar to the Assiniboine River, site-specific objectives for TDS and sulphate were established based on historical background data. In 2018, the Qu'Appelle River had four excursions to the sulphate and TDS objectives. Excursions for sulphate occurred in late winter (March) before spring freshet, and then from October through to December. For TDS, all the excursions occurred in the winter months under ice-cover with excursions occurring in January, February, March and December. These results were similar to the 2017 excursions for this river.

There were no TDS excursions on the Carrot River in 2018. Similar to the Assiniboine and Qu'Appelle rivers, site-specific objectives for TDS were established based on historical background data. The Red Deer (Erwood) River has a water use TDS objective of 500 mg/L and also did not have any excursions in 2018. Historically, this river has had excursions to the TDS objective during the late winter months (January to March). Long-term assessment has shown that more than half of the winter samples typically are greater than the objective. No observed excursions of the lower TDS objective in 2018 is atypical of what has been observed in the last few years. While it is unclear as to what would be driving the change it does appear what winter flows in 2018 were low in comparison to previous years.

On the Saskatchewan-Manitoba boundary, three rivers had excursions to the fecal coliform bacteria objective, with one river having an excursion to the E.coli objective in 2018. The Qu'Appelle River had excursions to fecal coliforms in July, September and October, and *E. coli* in October. Escherichia coli is a subgroup of bacteria within the fecal coliform group, so it is not unexpected that excursions may occur at the same time for the two measures. Fecal coliform bacteria did exceed water quality objectives more frequently than the *E. coli*, but the interprovincial water quality objective for fecal coliform is lower than the water quality objective for densities of *E.coli*.

The Red Deer River exceeded the fecal coliform objective in April and September in 2018. The April exceedance coincided with the peak in TSS, but in September, the TSS was low. The Assiniboine River also exceeded the fecal coliform interprovincial objective once in 2018 (May). This exceedance did not occur with the peak in TSS.

The pesticides dicamba and MCPA were found to exceed water quality objectives in 2018 (Table 5). MCPA and dicamba belong to a group of pesticides known as acid herbicides. A recent report on the PPWB pesticide data by the Committee highlighted that MCPA and dicamba exhibit regular patterns of excursions to the water quality

## ***RESULTS*** *continued*

objectives on the Carrot and Assiniboine rivers (PPWB Report #175). Other rivers have not historically been sampled annually for acid herbicides, consequently making the excursion frequency and patterns more difficult to evaluate. The report highlighted that the pesticide exceedances occur primarily during the spring and summer months. The Committee is continuing to follow up on pesticides and is working with the jurisdictions on the recommendations and follow-up actions from this report. Additional annual monitoring of the acid herbicides has been implemented for the rivers that most frequently exhibited pesticide excursions. Therefore, in 2018, in addition to the Assiniboine and Carrot rivers, the acid herbicide group of pesticides was also sampled on the Qu'Appelle and Saskatchewan rivers. MCPA was detected above the water quality objective in the Assiniboine, Carrot and Qu'Appelle rivers. For the Assiniboine River, MCPA was above the objective in April and July. For the Carrot River and the Qu'Appelle River, MCPA was above the objective once in May and June, respectively. Dicamba was detected above the water quality objective twice in the Qu'Appelle River in February and April in 2018.

The PPWB, as noted earlier, has also implemented the monitoring of glyphosate and its metabolites, as this is the highest single use pesticide in the prairies. In 2018, glyphosate was monitored on the Carrot and Assiniboine rivers on the Saskatchewan-Manitoba boundary. For each of these rivers, glyphosate was detected in the open and closed water seasons. For the Carrot River, seven of the 11 samples collected had detectable concentrations of glyphosate with the peak concentration being reported in August. The concentrations in the Carrot River were considered low, ranging from non detectable to 55 ng/L. For the Assiniboine River, glyphosate was detected in seven of the nine samples collected in 2018 with non-detections occurring in January and February. Peak concentration for the Assiniboine River occurred in April with a concentration of 4120 ng/L during spring freshet. This is the highest concentration of glyphosate that has been reported for the transboundary rivers since PPWB started monitoring glyphosate in 2011. Aminomethylphosphonic acid (AMPA) was also detected in the Assiniboine and Carrot rivers in 2018. Aminomethylphosphonic acid was detected in all of the samples collected from the Assiniboine River with a peak concentration of 1720 ng/L in April. For the Carrot River, AMPA was detected in six of 11 samples and occurred at low levels. The Committee will continue to monitor and report detections of glyphosate in the transboundary rivers given its extensive use throughout the prairies.

*Table 2: Excursion frequency summary table for Alberta-Saskatchewan water quality stations. (The number of excursions is provided on the left and the total number of objective comparisons for each parameter is provided in brackets to the right).*

| | ALBERTA-SASKATCHEWAN BOUNDARY | | | | | |
|---|---|---|---|---|---|---|
| | BATTLE RIVER | BEAVER RIVER | COLD RIVER | NORTH SASK. RIVER | RED DEER RIVER A/S | SOUTH SASK. RIVER |
| **METALS** | | | | | | |
| ARSENIC DISSOLVED | — | — | — | — | — | — |
| ARSENIC TOTAL | 1(12) | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) |
| BARIUM TOTAL | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) |
| BERYLLIUM TOTAL | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) |
| BORON TOTAL | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) |
| CADMIUM TOTAL | 4(12) | 2(12) | 0(12) | 4(12) | — | 3(12) |
| CHROMIUM TOTAL | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) |
| COBALT TOTAL | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) |
| COPPER TOTAL | 2(12) | 0(12) | 0(12) | 0(12) | — | 1(12) |
| IRON DISSOLVED | 3(12) | 5(12) | 0(12) | 0(12) | 0(12) | 0(12) |
| LEAD TOTAL | 0(12) | 0(12) | 0(12) | 0 (12) | 0(12) | 1(12) |
| LITHIUM TOTAL | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) |
| MANGANESE DISSOLVED | — | — | 0(12) | 0(12) | 0(12) | 0(12) |
| MOLYBDENUM TOTAL | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) |
| NICKEL DISSOLVED | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) |
| SELENIUM TOTAL | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) |
| SILVER TOTAL | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) |
| THALLIUM TOTAL | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) |
| URANIUM TOTAL | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) |
| VANADIUM TOTAL | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) |
| ZINC TOTAL | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) | 1(12) |
| **NUTRIENTS** | | | | | | |
| AMMONIA UN-IONIZED | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) |
| PHOSPHORUS TOTAL * | 3.5(12) | 1(12) | 2(12) | 0(12) | 0(12) | 1(12) |
| PHOSPHORUS TOTAL DISSOLVED * | 3(12) | 0.5(12) | 2(12) | 0(12) | 0(12) | 1(12) |
| NITROGEN TOTAL * | 2(12) | 1(12) | 1(12) | 0(12) | 1(12) | 2.5(12) |
| NITROGEN DISSOLVED NO3 and NO2 | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) |
| **MAJOR IONS** | | | | | | |
| CHLORIDE DISSOLVED | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) |
| FLUORIDE DISSOLVED | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) |
| SODIUM DISSOLVED/FILTERED | 2(12) | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) |
| SULPHATE DISSOLVED | 2(12) | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) |
| TOTAL DISSOLVED SOLIDS | 2(12) | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) |
| **BIOTA** | | | | | | |
| COLIFORMS FECAL | 3(12) | 0(12) | 0(12) | 1(12) | 2(12) | 1(12) |
| ESCHERICHIA COLI | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) |
| **PHYSICALS and OTHERS** | | | | | | |
| OXYGEN DISSOLVED | 0(5) | 0(5) | 0(12) | 0(12) | 0(12) | 0(12) |
| PH | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) |
| SODIUM ADSORPTION RATIO | — | 0(12) | 0(12) | 0(12) | 0(12) | 0(12) |
| TOTAL SUSPENDED SOLIDS | 2(7) | 0(7) | 6(7) | 0(7) | 3(7) | 2(7) |
| Number of Excursion Comparisons | 396 | 408 | 427 | 427 | 403 | 427 |
| Total Number of Excursions Observed | 29.5 | 9.5 | 11 | 5 | 6 | 13.5 |
| Sampling Frequency (no./year) | 12 | 12 | 12 | 12 | 12 | 12 |

* Summary information – details in Table 6

*Table 3: Excursion frequency summary table for Saskatchewan-Manitoba water quality stations. (The number of excursions is provided on the left and the total number of objective comparisons for each parameter is provided in brackets to the right).*

| | SASKATCHEWAN-MANITOBA BOUNDARY | | | | | |
|---|---|---|---|---|---|---|
| | ASSINIBOINE RIVER | CARROT RIVER | CHURCHILL RIVER | QU'APPELLE RIVER | RED DEER RIVER S/M | SASK. RIVER |
| **METALS** | | | | | | |
| ARSENIC DISSOLVED | — | 0(12) | — | 0(12) | — | — |
| ARSENIC TOTAL | 2(12) | — | 0(4) | — | 0(12) | 0(12) |
| BARIUM TOTAL | 0(12) | 0(12) | 0(4) | 0(12) | 0(12) | 0(12) |
| BERYLLIUM TOTAL | 0(12) | 0(12) | 0(4) | 0(12) | 0(12) | 0(12) |
| BORON TOTAL | 0(12) | 0(12) | 0(4) | 0(12) | 0(12) | 0(12) |
| CADMIUM TOTAL | 1(12) | 1(12) | 0(4) | 1(12) | 1(12) | 1(12) |
| CHROMIUM TOTAL | 0(12) | 0(12) | 0(4) | 0(12) | 0(12) | 0(12) |
| COBALT TOTAL | 0(12) | 0(12) | 0(4) | 0(12) | 0(12) | 0(12) |
| COPPER TOTAL | 1(12) | 1(12) | 0(4) | 2(12) | 1(12) | 2(12) |
| IRON DISSOLVED | 0(12) | — | 0(4) | 0(12) | 0(12) | 0(12) |
| LEAD TOTAL | 0(12) | 0(12) | 0(4) | 1(12) | 1(12) | 0(12) |
| LITHIUM TOTAL | 0(12) | 0(12) | 0(4) | 0(12) | 0(12) | 0(12) |
| MANGANESE DISSOLVED | — | — | 0(4) | — | 1(12) | 0(12) |
| MOLYBDENUM TOTAL | 0(12) | 0(12) | 0(4) | 0(12) | 0(12) | 0(12) |
| NICKEL DISSOLVED | 0(12) | 0(12) | 0(4) | 0(12) | 0(12) | 0(12) |
| SELENIUM TOTAL | 1(12) | 0(12) | 0(4) | 0(12) | 0(12) | 0(12) |
| SILVER TOTAL | 0(12) | 0(12) | 0(4) | 0(12) | 0(12) | 0(12) |
| THALLIUM TOTAL | 0(12) | 0(12) | 0(4) | 0(12) | 0(12) | 0(12) |
| URANIUM TOTAL | 0(12) | 0(12) | 0(4) | 0(12) | 0(12) | 0(12) |
| VANADIUM TOTAL | 0(12) | 0(12) | 0(4) | 0(12) | 0(12) | 0(12) |
| ZINC TOTAL | 0(12) | 0(12) | 0(4) | 1(12) | 0(12) | 0(12) |
| **NUTRIENTS** | | | | | | |
| AMMONIA UN-IONIZED | 0(12) | 0(12) | 0(4) | 0(12) | 0(12) | 0(12) |
| PHOSPHORUS TOTAL * | 1(12) | 3.5(12) | 1(4) | 2(12) | 2(12) | 2(12) |
| PHOSPHORUS TOTAL DISSOLVED * | 1(12) | 3(12) | 1(4) | 1(12) | 2.5(12) | 0(12) |
| NITROGEN TOTAL * | 1(12) | 1(12) | 1(4) | 1(12) | 2(12) | 1(12) |
| NITROGEN DISSOLVED NO3 and NO2 | 0(12) | 0(12) | 0(4) | 0(12) | 0(12) | 0(12) |
| **MAJOR IONS** | | | | | | |
| CHLORIDE DISSOLVED | 0(12) | 0(12) | 0(4) | 0(12) | 0(12) | 0(12) |
| FLUORIDE DISSOLVED | 0(12) | 0(12) | 0(4) | 0(12) | 0(12) | 0(12) |
| SODIUM DISSOLVED/FILTERED | 0(12) | 0(12) | 0(4) | 0(12) | 0(12) | 0(12) |
| SULPHATE DISSOLVED | 1(12) | 0(12) | 0(4) | 4(12) | 0(12) | 0(12) |
| TOTAL DISSOLVED SOLIDS | 2(12) | 0(12) | 0(4) | 4(12) | 0(12) | 0(12) |
| **BIOTA** | | | | | | |
| COLIFORMS FECAL | 1(12) | 0(12) | 0(4) | 3(12) | 2(12) | 0(12) |
| ESCHERICHIA COLI | 0(12) | 0(11) | 0(4) | 1(12) | 0(12) | 0(12) |
| **PHYSICALS and OTHERS** | | | | | | |
| OXYGEN DISSOLVED | 2(12) | 0(5) | 0(4) | 0(12) | 0(12) | 0(12) |
| PH | 0(12) | 0(12) | 0(4) | 0(12) | 0(12) | 0(12) |
| SODIUM ADSORPTION RATIO | 0(12) | — | 0(4) | — | 0(12) | 0(12) |
| TOTAL SUSPENDED SOLIDS | 1(7) | 1(7) | 0(4) | 1(7) | 4(6) | 2(7) |
| Number of Excursion Comparisons | 415 | 383 | 143 | 403 | 426 | 426 |
| Total Number of Excursions Observed | 15 | 10.5 | 3 | 22 | 16.5 | 8 |
| Sampling Frequency (no./year) | 12 | 12 | 4 | 12 | 12 | 12 |

* Summary information – details in Table 7

*Table 4: Excursion frequency summary table of pesticides for Alberta-Saskatchewan water quality stations. (The number of excursions is provided on the left and the total number of objective comparisons for each parameter is provided in brackets to the right).*

| | ALBERTA-SASKATCHEWAN BOUNDARY | | | | | |
|---|---|---|---|---|---|---|
| | BATTLE RIVER | BEAVER RIVER | COLD RIVER | NORTH SASK. RIVER | RED DEER RIVER A/S | SOUTH SASK. RIVER |
| **PESTICIDES** | | | | | | |
| 2,4-D | 0(8) | Not Sampled | 0(8) | 0(8) | 0(8) | 0(8) |
| ATRAZINE | NA) | | 0(8) | 0(8) | NA | 0(8) |
| BROMOXYNIL | 0(8) | | 0(8) | 0(8) | 0(8) | 0(8) |
| DICAMBA | 0(8) | | 0(8) | 0(8) | 1(8) | 2(8) |
| DICLOFOP-METHYL | NA | | 0(8) | 0(8) | NA | 0(8) |
| ENDOSULFAN | NA | | 0(8) | 0(8) | NA | 0(8) |
| GAMMA-BENZENEHEXACHLORIDE | NA | | 0(8) | 0(8) | NA | 0(8) |
| HEXACHLOROBENZENE | NA | | 0(8) | 0(8) | NA | 0(8) |
| MCPA | 0(8) | | 0(8) | 0(8) | 0(8) | 0(8) |
| METOLACHLOR | NA | | 0(8) | 0(8) | NA | 0(8) |
| METRIBUZIN | NA | | 0(8) | 0(8) | NA | 0(8) |
| PENTACHLOROPHENOL (PCP) | — | | — | — | — | — |
| PICLORAM | 0(8) | | 0(8) | 0(8) | 0(8) | 0(8) |
| SIMAZINE | NA | | 0(8) | 0(8) | NA | 0(8) |
| TRIALLATE | NA | | 0(8) | 0(8) | NA | 0(8) |
| TRIFLURALIN | NA | | 0(8) | 0(8) | NA | 0(8) |
| GLYPHOSATE | Not Sampled | Not Sampled | 0(8) | 2(8)[a] | Not Sampled | 2(8)[a] |
| Number of Excursion Comparisons | 40 | | 120 | 120 | 40 | 120 |
| Total Number of Excursions Observed | 0 | | 0 | 3 | 1 | 2 |
| Sampling Frequency (no./year) | 8 | | 8 | 8 | 8 | 8 |

a= Detected but no numerical objective has been established, not included in the excursion counts

*Table 5: Excursion frequency summary table of pesticides for Saskatchewan-Manitoba water quality stations. (The number of excursions is provided on the left and the total number of objective comparisons for each parameter is provided in brackets to the right).*

| | SASKATCHEWAN-MANITOBA BOUNDARY | | | | | |
|---|---|---|---|---|---|---|
| | ASSINIBOINE RIVER | CARROT RIVER | CHURCHILL RIVER | QU'APPELLE RIVER | RED DEER RIVER S/M | SASK. RIVER |
| **PESTICIDES** | | | | | | |
| 2,4-D | 0(11) | 0(12) | Not Sampled | 0(8) | Not Sampled | 0(8) |
| ATRAZINE | 0(11) | 0(12) | | NA | | NA |
| BROMOXYNIL | 0(11) | 0(12) | | 0(8) | | 0(8) |
| DICAMBA | 0(11) | 0(12) | | 2(8) | | 0(8) |
| DICLOFOP-METHYL | 0(11) | 0(12) | | NA | | NA |
| ENDOSULFAN | 0(8) | 0(7) | | NA | | NA |
| GAMMA-BENZENEHEXACHLORIDE | 0(8) | 0(7) | | NA | | NA |
| HEXACHLOROBENZENE | 0(8) | 0(7) | | NA | | NA |
| MCPA | 2(11) | 1 (12) | | 1(8) | | 0(8) |
| METOLACHLOR | 0(11) | 0(12) | | NA | | NA |
| METRIBUZIN | 0(11) | 0(12) | | NA | | NA |
| PENTACHLOROPHENOL (PCP) | — | — | | --- | | — |
| PICLORAM | 0(11) | 0(12) | | 0(8) | | 0(8) |
| SIMAZINE | 0(11) | 0(12) | | NA | | NA |
| TRIALLATE | 0(11) | 0(12) | | NA | | NA |
| TRIFLURALIN | 0(11) | 0(12) | | NA | | NA |
| GLYPHOSATE | 7(9)[a] | 7(11)a | Not Sampled | Not Sampled | Not Sampled | Not Sampled |
| Number of Excursion Comparisons | 156 | 165 | | 40 | | 40 |
| Total Number of Excursions Observed | 2 | 1 | | 3 | | 0 |
| Sampling Frequency (no./year) | 11 | 12 | | 8 | | 8 |

a= Detected but no numerical objective has been established, not included in the excursion counts

## *Table 6: Nutrient Excursions for Alberta-Saskatchewan water quality stations*

| LOCATION | | TOTAL PHOSPHORUS | | TOTAL DISSOLVED PHOSPHORUS | | TOTAL NITROGEN | | NUMBER OF EXCURSION COMPARISONS | TOTAL NUMBER OF EXCURSIONS OBSERVED |
|---|---|---|---|---|---|---|---|---|---|
| BATTLE RIVER | Open Water<br>Ice-Covered | 1(7)<br>3(5) | 1(7)<br>2(5) | 1(7)<br>2(5) | | 0(7)<br>2(5) | | 36 | 8.5 |
| BEAVER RIVER | Open Water<br>Ice-Covered | 0(7)<br>1(5) | | 1(7)<br>0(5) | 0(7)<br>0(5) | 1(7)<br>0(5) | | 36 | 2.5 |
| COLD RIVER | Open Water<br>Ice-Covered | 1(7)<br>1(5) | | 1(7)<br>1(5) | | 0(7)<br>1(5) | 0(7)<br>1(5) | 36 | 5 |
| NORTH SASK. RIVER | Open Water<br>Ice-Covered | 0(7)<br>0(5) | 0(7)<br>0(5) | 0(7)<br>0(5) | 0(7)<br>0(5) | 0(7)<br>0(5) | 0(7)<br>0(5) | 36 | 0 |
| RED DEER RIVER A/S | Open Water<br>Ice-Covered | 0(7)<br>0(5) | 0(7)<br>0(5) | 0(7)<br>0(5) | 0(7)<br>0(5) | 0(7)<br>1(5) | | 36 | 1 |
| SOUTH SASK. RIVER | Open Water<br>Ice-Covered | 1(7)<br>0(5) | 1(7)<br>0(5) | 1(7)<br>0(5) | 1(7)<br>0(5) | 2(7)<br>1(5) | 2(7)<br>0(5) | 36 | 4.5 |

Open water season = April or May to October

Downward Trend | Upward Trend | No Trend

Nutrient objectives were established based on analyses of historical data, which indicated that concentrations vary with season (open water versus ice-covered) and in some cases showed trends. In all cases, a site-specific base nutrient objective was set at the 90th percentile of the data for each season, which would be exceeded on average 10% of the time (values in yellow and white boxes). Where statistical trends existed, an additional objective was established based on the 90th percentile of the lowest value 10 year period (values in grey boxes = decreasing trend; green boxes = increasing trend). Exceedance of this second objective indicates a nutrient concentration greater than the 90th percentile of the lowest 10-year period for that site.

The total number of excursions is calculated as the sum of the base objective exceedances (yellow boxes) or the arithmetic average of the trend (grey or green boxes) and corresponding base (white boxes) objective exceedances.

## *Table 7: Nutrient Excursions for Saskatchewan-Manitoba water quality stations*

| LOCATION | | TOTAL PHOSPHORUS | | TOTAL DISSOLVED PHOSPHORUS | | TOTAL NITROGEN | | NUMBER OF EXCURSION COMPARISONS | TOTAL NUMBER OF EXCURSIONS OBSERVED |
|---|---|---|---|---|---|---|---|---|---|
| ASSINIBOINE RIVER | Open Water<br>Ice-Covered | 1(7)<br>0(5) | | 1(7)<br>0(5) | | 1(7)<br>0(5) | | 36 | 3 |
| CARROT RIVER | Open Water<br>Ice-Covered | 4(6)<br>2(6) | 1(6)<br>0(6) | 4(6)<br>0(6) | 2(6)<br>0(6) | 1(6)<br>1(6) | 0(6)<br>0(6) | 36 | 7.5 |
| CHURCHILL RIVER | Open Water<br>Ice-Covered | 1(3)<br>0(1) | | 0(3)<br>1(1) | | 0(3)<br>1(1) | | 12 | 3 |
| QU'APPELLE RIVER | Open Water<br>Ice-Covered | 0(6)<br>2(6) | 0(6)<br>2(6) | 0(6)<br>1(6) | 0(6)<br>1(6) | 0(6)<br>1(6) | | 36 | 4 |
| RED DEER RIVER S/M | Open Water<br>Ice-Covered | 1(6)<br>1(6) | 1(6)<br>1(6) | 3(6)<br>1(6) | 0(6)<br>1(6) | 1(6)<br>1(6) | | 36 | 6.5 |
| SASK. RIVER | Open Water<br>Ice-Covered | 2(7)<br>1(5) | 0(7)<br>1(5) | 0(7)<br>0(5) | 0(7)<br>0(5) | 1(7)<br>0(5) | | 36 | 3 |

Open water season = April or May to October

Downward Trend | Upward Trend | No Trend

*Table 8: Overall excursion summary, by category, for Alberta-Saskatchewan water quality stations. (The number of excursions is provided on the left and the total number of objective comparisons for each parameter is provided in brackets to the right).*

| | ALBERTA-SASKATCHEWAN BOUNDARY | | | | | |
|---|---|---|---|---|---|---|
| | BATTLE RIVER | BEAVER RIVER | COLD RIVER | NORTH SASK. RIVER | RED DEER RIVER A/S | SOUTH SASK. RIVER |
| CATEGORY | | | | | | |
| METALS | 10(228) | 7(228) | 0(240) | 4(240) | 0(216) | 6(240) |
| NUTRIENTS (TN, TP, TDP) | 8.5(36) | 2.5(36) | 5(36) | 0(36) | 1(36) | 4.5(36) |
| NUTRIENTS (TOXICITY) | 0(24) | 0(24) | 0(24) | 0(24) | 0(24) | 0(24) |
| MAJOR IONS | 6(60) | 0(60) | 0(60) | 0(60) | 0(60) | 0(60) |
| BIOTA | 3(24) | 0(24) | 0(24) | 1(24) | 2(24) | 1(24) |
| PHYSICALS and OTHERS | 2(24) | 0(36) | 6(43) | 0(43) | 3(43) | 2(43) |
| PESTICIDES | 0(40) | 0(0) | 0(120) | 0(120) | 1(40) | 2(120) |
| Number of Excursion Comparisons | 436 | 408 | 547 | 547 | 443 | 547 |
| Total Number of Excursions Observed | 29.5 | 9.5 | 11 | 5 | 7 | 15.5 |
| Sampling Frequency (no./year) | 12 | 12 | 12 | 12 | 12 | 12 |
| Overall Adherence Rate | 93.2 | 97.7 | 98.0 | 99.1 | 98.4 | 97.2 |

*Table 9: Overall excursion summary, by category, for Saskatchewan-Manitoba water quality stations. (The number of excursions is provided on the left and the total number of objective comparisons for each parameter is provided to the right.)*

| | SASKATCHEWAN-MANITOBA BOUNDARY | | | | | |
|---|---|---|---|---|---|---|
| | ASSINIBOINE RIVER | CARROT RIVER | CHURCHILL RIVER | QU'APPELLE RIVER | RED DEER RIVER S/M | SASK. RIVER |
| CATEGORY | | | | | | |
| METALS | 5(228) | 2(216) | 0(80) | 5(228) | 4(240) | 3(240) |
| NUTRIENTS (TN, TP, TDP) | 3(36) | 7.5(36) | 3(12) | 4(36) | 6.5(36) | 3(36) |
| NUTRIENTS (TOXICITY) | 0(24) | 0(24) | 0(8) | 0(24) | 0(24) | 0(24) |
| MAJOR IONS | 3(60) | 0(60) | 0(20) | 8(60) | 0(60) | 0(60) |
| BIOTA | 1(24) | 0(23) | 0(8) | 4(24) | 2(24) | 0(23) |
| PHYSICALS and OTHERS | 3(43) | 1(24) | 0(15) | 1(31) | 4(42) | 2(43) |
| PESTICIDES | 2(156) | 1(165) | 0(0) | 3(40) | 0(0) | 0(40) |
| Number of Excursion Comparisons | 571 | 548 | 143 | 443 | 426 | 466 |
| Total Number of Excursions Observed | 17 | 11.5 | 3 | 25 | 16.5 | 8 |
| Sampling Frequency (no./year) | 12 | 12 | 4 | 12 | 12 | 12 |
| Overall Adherence Rate | 97.0 | 97.9 | 97.9 | 94.4 | 96.1 | 98.3 |

# CONCLUSION

Interprovincial water quality objectives established at the 12 transboundary river reaches are designed to protect water uses for aquatic life, agriculture, recreation, treatability of source water for drinking water, and fish consumption. Interprovincial water quality objectives were met on average 97.1% of the time in 2018. There is an expectation that objectives will be exceeded occasionally (particularly for those sites with a statistically derived site-specific objective) and that some exceedances will occur naturally (for example, during high flow events). The adherence rate to interprovincial water quality objectives ranged from 99.1% (North Saskatchewan River) to 93.2% (Battle River) in 2018. It was concluded that the water quality in the transboundary rivers was generally suitable for the intended water uses for these rivers.

Overall, each of the 12 transboundary river reaches has shown little variation in adherence rate during the past 15 years. However, of the 12 rivers, the Red Deer River on the Alberta-Saskatchewan boundary has shown the greatest variation in compliance to the water quality objectives, with an adherence rate variation of 8%. On the Saskatchewan-Manitoba boundary, the river with the greatest variation in compliance to the water quality objectives was the Red Deer River near Erwood with a variation of 6.6%.

Excursions from the water quality objectives for nutrients, biota (bacteria), TSS and major ions were the most common among sites. Excursions of TDS, sulphate, metals and pesticides occurred for specific rivers on both boundaries.

In 2018, the highest number of excursions to the interprovincial water quality objectives was observed for the Battle River on the Alberta-Saskatchewan boundary (93.2% overall adherence rate). Of note on this boundary in 2018 was the higher than average adherence rate to the interprovincial water quality objectives for the Red Deer and North Saskatchewan rivers. Each of these rivers had the highest adherence rates reported in the last 15 years. For the Saskatchewan-Manitoba boundary, the river with the highest number of excursions was the Qu'Appelle River (94.4% overall adherence rate).

The results of this excursion report, in addition to those from previous years, indicates a number of areas that warrant further consideration by the Committee, Board, and/or provinces:

- Nutrients remain a priority for the PPWB. The Committee's work to understand sources and trends in nutrients is ongoing. The Committee continues to work on the Red Deer River (AB-SK) and Carrot River pilot project, and while this project is still on-going, it is anticipated to be completed within the next year. The recent completion and update of the trend analysis work to the end of 2013, and a review of priority parameters across both boundaries, has highlighted that TN is increasing in a number of the transboundary rivers and will continue to be a high priority for further study. In 2019, the Committee will continue to discuss and follow up on nutrient issues in the transboundary rivers.

## ***CONCLUSION*** *continued*

- Suspended solids and flow can play an important role with respect to their influence on certain water quality parameters, in particular certain metals (total) and nutrients. While TSS and flow appear to be related to spikes in metals and nutrients observed in the transboundary rivers, this does not explain all the exceedances or variations observed with these parameters. Further investigation of the relationship between flow and TSS to these parameters is warranted to better understand these relationships. The Committee is assessing several potential integrated studies to assess changes in hydrology and TSS within several watersheds to further investigate this issue.
- For pesticides, the more frequent exceedances of the acid herbicides, MCPA and dicamba objectives in prairie rivers is suggestive of a generally low-concentration but wide spread presence of these pesticides in the environment. The COWQ is currently working with the jurisdictions to complete a review of the prevalence of these pesticides and potential effects to the aquatic environment and users of these waters. Monitoring of glyphosate and its breakdown products show that this widely used pesticide is also frequently present at low-concentrations. Glyphosate is a nonselective systemic herbicide that is used extensively throughout the prairies. Given its detection in the larger transboundary river systems it is considered to be present at a broad scale across the prairie provinces.
- Overall, in comparison to other sites, the Battle River on the Alberta-Saskatchewan boundary, had the lowest adherence rates to the water quality objectives (due to excursions in nutrients, metals, major ions, bacteria, and TSS) in 2018. On the Saskatchewan-Manitoba boundary, the Qu'Appelle River had the lowest compliance to the water quality objectives in 2018, due to excursions in nutrients, major ions, biota, TSS, pesticides and metals.
- A number of the transboundary prairie rivers have higher saline waters and constituent ions that vary based on precipitation, flow and groundwater inputs. Total dissolved solids and sulphate are the two parameters that exceeded water quality objectives the most in certain transboundary rivers, particularly on the Saskatchewan-Manitoba transboundary rivers. In addition, increasing trends of these parameters have been noted in a number of rivers. The COWQ will continue to track these parameters and evaluate as more data become available.

## ON-GOING

On July 8th, 2015 Ministers responsible for the PPWB approved revised interprovincial water quality objectives. The revised objectives recognize the need to protect all water uses for all rivers and included a number of site-specific water quality objectives for selected parameters. This report represents the fourth year that the PPWB is reporting against these water quality objectives. However, the Committee is continuing to work on updating water quality objectives, particularly in those areas where objectives were not established for select parameters and rivers. It is anticipated that the objectives will continue to be revised with updated water quality objectives proposed for the transboundary rivers in 2020.

The COWQ also continues to work on the review of excursions to the approved interprovincial water quality objectives and prioritization of any potential issues for further consideration or actions. Several areas have been flagged by the COWQ including nutrients, and in particular TN trends, which have been assessed as a priority.

Other areas of interest to the Committee include pesticides that have also been identified as a priority area for future work. The COWQ continues to follow up on pesticides with the jurisdictions with particular emphasis on the acid herbicides and glyphosate, which are the most frequently detected pesticides in transboundary rivers.

In the 2015 Excursion report, the Committee recommended a further review of the Red Deer River (AB-SK) following a number of excursions on that river, and some observed unusual water quality conditions. Alberta Environment and Parks is continuing to review provincial data and assess the potential causes of these exceedances.

The assessment of excursions to water quality objectives will continue to assist the Committee to assess areas of potential concern and to set future priorities. In conjunction with the excursion assessment, the Committee will continue to look at long term trends in water quality for each of the transboundary rivers. Trend analysis work incorporating additional data was completed in 2017 and the report is available on the PPWB website (PPWB 2018). The COWQ will continue to update the trending work as more long-term data becomes available.

# REFERENCES

Kerr, J.G. and Cooke, C.A. 2017. Erosion of the Alberta badlands produces highly variable and elevated heavy metal concentrations in the Red Deer River, Alberta. Science of the Total Environment 596-597: 427-436.

*MAA* Schedule E 1992. Agreement on water quality. http://www.ppwb.ca/information/115/index.html

PPWB Report #175. 2016. Response to the 2011 pesticide excursions in transboundary rivers in the prairie provinces of Canada. pp. 103.

PPWB Report #179. 2018. Long-Term Trends in Water Quality Parameters at Twelve Transboundary River Reaches (from the beginning of the data record until the end of 2013). pp 1072.

# APPENDIX 1: Water Quality Objectives

**Table A1: AB-SK**

| PARAMETER | 2015 Interprovincial Water Quality Objectives – AB-SK Boundary | | | | | |
|---|---|---|---|---|---|---|
| | BATTLE RIVER | BEAVER RIVER | COLD RIVER | NORTH SASK. RIVER | RED DEER RIVER (BINDLOSS) | SOUTH SASK. RIVER |
| **NUTRIENTS** | | | | | | |
| Nitrate as N (mg/L) | 3 | 3 | 3 | 3 | 3 | 3 |
| Ammonia Un-ionized (mg/L) | 0.019[a] | 0.019[a] | 0.019[a] | 0.019[a] | 0.019[a] | 0.019[a] |
| **MAJOR IONS** | | | | | | |
| Total Dissolved Solids (mg/L) | 872 | 500 | 500 | 500 | 500 | 500 |
| Sulphate Dissolved (mg/L) | 250 | 250 | 250 | 250 | 250 | 250 |
| Sodium Dissolved (mg/L) | 200 | 200 | 200 | 200 | 200 | 200 |
| Fluoride Dissolved (mg/L) | 0.31 | 0.19 | 0.12 | 0.18 | 0.2 | 0.19 |
| Chloride Dissolved (mg/L) | 100 | 100 | 100 | 100 | 100 | 100 |
| **PHYSICALS AND OTHER** | | | | | | |
| pH Lab | 6.5-9.0 | 6.5-9.0 | 6.5-9.0 | 6.5-9.0 | 6.5-9.0 | 6.5-9.0 |
| pH Field | 6.5-9.0 | 6.5-9.0 | 6.5-9.0 | 6.5-9.0 | 6.5-9.0 | 6.5-9.0 |
| Oxygen Dissolved (mg/L) | | | | | | |
| Open Water Season (>5°C) | 5 | 5 | 5 | 5 | 5 | 5 |
| Ice-Covered Season (<5°C) | Under Review | Under Review | 3 | 3 | 3 | 3 |
| Sodium Adsorption Ratio | Under Review | 3 | 3 | 3 | 3 | 3 |
| Total Suspended Solids (mg/L) | 5.0-320.0 | 3.0-48.8 | 1.2-4.8 | 5.0-295.8 | 30.0-832.6 | 5.6-339.8 |
| **BIOTA** | | | | | | |
| *E. Coli* (No./100 mL) | 200 | 200 | 200 | 200 | 200 | 200 |
| Coliforms Fecal (No./100 mL) | 100 | 100 | 100 | 100 | 100 | 100 |
| **METALS** | | | | | | |
| Arsenic Total (µg/L) | 5 | 5 | 5 | 5 | 5 | 5 |
| Arsenic Dissolved (µg/L) | No Objective | No Objective | No Objective | No Objective | No Objective | No Objective |
| Barium Total (µg/L) | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 |
| Beryllium Total (µg/L) | 100 | 100 | 100 | 100 | 100 | 100 |
| Boron Total (µg/L) | 500[b] | 500[b] | 500[b] | 500[b] | 500[b] | 500[b] |
| Cadmium Total (µg/L) | Calculated[c] | Calculated[c] | Calculated[c] | Calculated[c] | Under Review | Calculated[c] |
| Chromium Total (µg/L) | 50 | 50 | 50 | 50 | 50 | 50 |
| Cobalt Total (µg/L) | 50 | 50 | 50 | 50 | 50 | 50 |
| Copper Total (µg/L) | Calculated[c] | Calculated[c] | Calculated[c] | Calculated[c] | Under Review | Calculated[c] |
| Iron Dissolved (µg/L) | 300 | 300 | 300 | 300 | 300 | 300 |
| Lead Total (µg/L) | Calculated[c] | Calculated[c] | Calculated[c] | Calculated[c] | Calculated[c] | Calculated[c] |
| Lithium Total (µg/L) | 2500 | 2500 | 2500 | 2500 | 2500 | 2500 |
| Manganese Dissolved (µg/L) | Under Review | Under Review | 50 | 50 | 50 | 50 |
| Molybdenum Total (µg/L) | 10[d] | 10[d] | 10[d] | 10[d] | 10[d] | 10[d] |
| Nickel Dissolved (µg/L) | Calculated[c] | Calculated[c] | Calculated[c] | Calculated[c] | Calculated[c] | Calculated[c] |
| Selenium Total (µg/L) | 1 | 1 | 1 | 1 | 1 | 1 |
| Silver Total (µg/L) | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Thallium Total (µg/L) | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| Uranium Total (µg/L) | 10 | 10 | 10 | 10 | 10 | 10 |
| Vanadium Total (µg/L) | 100 | 100 | 100 | 100 | 100 | 100 |
| Zinc Total (µg/L) | 30 | 30 | 30 | 30 | 30 | 30 |

**Superscripts**

a. Ammonia guideline: Expressed as mg un-ionized ammonia per L. This would be equivalent to 15.6 mg/L ammonia-nitrogen. Guideline for total ammonia is temperature and pH dependent.

b. Guideline is crop-specific 500 to 6000µg/L.

c. Value is a function of hardness (mg/L) in the water column. The objective is a calculated value.
Cadmium Concentration = $10^{0.86[\log10(\text{hardness})]-3.2}$ µg/L
Copper Concentration = $e^{0.8545[\ln(\text{hardness})-1.465}*0.2$ µg/L
The copper objective is a minimum of 2 µg/L regardless of water hardness. If the water hardness is not known, the objective is 2 µg/L. The Objective maximum is 4 µg/L.
Lead Concentration = $e^{1.273[\ln \text{hardness})]-4.705}$ µg/L The objective is a minimum of 1 µg/L regardless of water hardness. If the water hardness is not known, the objective is 1 µg/L.
Nickel Concentration = $\exp^{\{0.8460[\ln(\text{hardness})]+0.0584\}*0.997}$ µg/L.

d. Molybdenum guideline = up to 50 µg/L for short-term use on acidic soils.

**Table A2: AB-SK**

| PARAMETER / PESTICIDES | 2015 Interprovincial Water Quality Objectives – AB-SK Boundary | | | | | |
|---|---|---|---|---|---|---|
| | BATTLE RIVER | BEAVER RIVER | COLD RIVER | NORTH SASK. RIVER | RED DEER RIVER (BINDLOSS) | SOUTH SASK. RIVER |
| **ACID HERBICIDES** | | | | | | |
| 2,4-D (µg/L) | 4 | 4 | 4 | 4 | 4 | 4 |
| Bromoxynil (µg/L) | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 |
| Dicamba (µg/L) | 0.006 | 0.006 | 0.006 | 0.006 | 0.006 | 0.006 |
| MCPA (µg/L) | 0.025 | 0.025 | 0.025 | 0.025 | 0.025 | 0.025 |
| Picloram (µg/L) | 29 | 29 | 29 | 29 | 29 | 29 |
| **ORGANOCHLORINE PESTICIDES IN WATER** | | | | | | |
| Endosulfan (µg/L) | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 |
| Hexachlorocyclohexane (gamma-HCH) (Lindane) (µg/L) | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Hexachlorobenzene (µg/L) | 0.52 | 0.52 | 0.52 | 0.52 | 0.52 | 0.52 |
| Pentachlorophenol (PCP) (µg/L) | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| **NEUTRAL HERBICIDES IN WATER** | | | | | | |
| Atrazine (µg/L) | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 |
| Diclofopmethyl (Hoegrass)* (µg/L) | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 |
| Metolachlor (µg/L) | 7.8 | 7.8 | 7.8 | 7.8 | 7.8 | 7.8 |
| Metribuzin (µg/L) | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Simazine (µg/L) | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Triallate (µg/L) | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 |
| Trifluralin (µg/L) | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| **OTHER** | | | | | | |
| Glyphosate (ng/L) | Report Detections | Report Detections | Report Detections | Report Detections | Report Detections | Report Detections |

Legend

| Protection of Aquatic Life | Ag-Livestock | Ag-Irrigation | Recreation | Treatability | Ag-Irrigation + Treatability | Ag-Irrigation and Livestock | Fish Consumption |
|---|---|---|---|---|---|---|---|

# *APPENDIX 1: Water Quality Objectives* continued

**Table A3: SK-MB**

| PARAMETER | 2015 Interprovincial Water Quality Objectives – SK-MB Boundary | | | | | | |
|---|---|---|---|---|---|---|---|
| | ASSINIBOINE RIVER | CARROT RIVER | | CHURCHILL RIVER | QU'APPELLE RIVER | RED DEER RIVER (ERWOOD) | SASKATCHEWAN RIVER |
| | | OPEN | CLOSED | | | | |
| **NUTRIENTS** | | | | | | | |
| Nitrate as N (mg/L) | 3 | 3 | | 3 | 3 | 3 | 3 |
| Ammonia Un-ionized (mg/L) | 0.019[a] | 0.019[a] | | 0.019[a] | 0.019[a] | 0.019[a] | 0.019[a] |
| **MAJOR IONS** | | | | | | | |
| Total Dissolved Solids (mg/L) | 834 | 742 | 1672 | 500 | 1144 | 500 | 500 |
| Sulphate Dissolved (mg/L) | 299 | 250 | | 250 | 486 | 250 | 250 |
| Sodium Dissolved (mg/L) | 200 | 164 | 442 | 200 | 200 | 200 | 200 |
| Fluoride Dissolved (mg/L) | 0.26 | 0.20 | 0.29 | 0.12 | 0.25 | 0.18 | 0.18 |
| Chloride Dissolved (mg/L) | 100 | 267 | 728 | 100 | 100 | 100 | 100 |
| **PHYSICALS AND OTHER** | | | | | | | |
| pH Lab | 6.5-9.0 | 6.5-9.0 | | 6.5-9.0 | 6.5-9.0 | 6.5-9.0 | 6.5-9.0 |
| pH Field | 6.5-9.0 | 6.5-9.0 | | 6.5-9.0 | 6.5-9.0 | 6.5-9.0 | 6.5-9.0 |
| Oxygen Dissolved (mg/L) | | | | | | | |
| Open Water Season (>5°C) | 5 | 5 | | 5 | 5 | 5 | 5 |
| Ice-Covered Season (<5°C) | 3 | Under Review | | 3 | 3 | 3 | 3 |
| Sodium Adsorption Ratio | 3 | Under Review | | 3 | Under Review | 3 | 3 |
| Total Suspended Solids (mg/L) | 5.0-69.2 | 6.08-98.2 | | 2.2-6.2 | 22.6-122.2 | 1.0-19.7 | 27.0-125.0 |
| **BIOTA** | | | | | | | |
| *E. Coli* (No./100 mL) | 200 | 200 | | 200 | 200 | 200 | 200 |
| Coliforms Fecal (No./100 mL) | 100 | 100 | | 100 | 100 | 100 | 100 |
| **METALS** | | | | | | | |
| Arsenic Total (µg/L) | 5 | No Objective | | 5 | No Objective | 5 | 5 |
| Arsenic Dissolved (µg/L) | No Objective | 50 | | No Objective | 50 | No Objective | No Objective |
| Barium Total (µg/L) | 1000 | 1000 | | 1000 | 1000 | 1000 | 1000 |
| Beryllium Total (µg/L) | 100 | 100 | | 100 | 100 | 100 | 100 |
| Boron Total (µg/L) | 500[b] | 500[b] | | 500[b] | 500[b] | 500[b] | 500[b] |
| Cadmium Total (µg/L) | Calculated[c] | Calculated[c] | | Calculated[c] | Calculated[c] | Calculated[c] | Calculated[c] |
| Chromium Total (µg/L) | 50 | 50 | | 50 | 50 | 50 | 50 |
| Cobalt Total (µg/L) | 50 | 50 | | 50 | 50 | 50 | 50 |
| Copper Total (µg/L) | Calculated[c] | Calculated[c] | | Calculated[c] | Calculated[c] | Calculated[c] | Calculated[c] |
| Iron Dissolved (µg/L) | 300 | Under Review | | 300 | 300 | 300 | 300 |
| Lead Total (µg/L) | Calculated[c] | Calculated[c] | | Calculated[c] | Calculated[c] | Calculated[c] | Calculated[c] |
| Lithium Total (µg/L) | 2500 | 2500 | | 2500 | 2500 | 2500 | 2500 |
| Manganese Dissolved (µg/L) | Under Review | Under Review | | 50 | Under Review | 50 | 50 |
| Molybdenum Total (µg/L) | 10[d] | 10[d] | | 10[d] | 10[d] | 10[d] | 10[d] |
| Nickel Dissolved (µg/L) | Calculated[c] | Calculated[c] | | Calculated[c] | Calculated[c] | Calculated[c] | Calculated[c] |
| Selenium Total (µg/L) | 1 | 1 | | 1 | 1 | 1 | 1 |
| Silver Total (µg/L) | 0.1 | 0.1 | | 0.1 | 0.1 | 0.1 | 0.1 |
| Thallium Total (µg/L) | 0.8 | 0.8 | | 0.8 | 0.8 | 0.8 | 0.8 |
| Uranium Total (µg/L) | 10 | 10 | | 10 | 10 | 10 | 10 |
| Vanadium Total (µg/L) | 100 | 100 | | 100 | 100 | 100 | 100 |
| Zinc Total (µg/L) | 30 | 30 | | 30 | 30 | 30 | 30 |

**Superscripts**

a. Ammonia guideline: Expressed as mg un-ionized ammonia per L. This would be equivalent to 15.6 mg/L ammonia-nitrogen. Guideline for total ammonia is temperature and pH dependent.

b. Guideline is crop-specific 500 to 6000µg/L.

c. Value is a function of hardness (mg/L) in the water column. The objective is a calculated value.
Cadmium Concentration = $10^{0.86[\log10(\text{hardness})]-3.2}$ µg/L
Copper Concentration = $e^{0.8545[\ln(\text{hardness})-1.465}$ *0.2 µg/L.
The copper objective is a minimum of 2 µg/L regardless of water hardness. If the water hardness is not known, the objective is 2 µg/L. The Objective maximum is 4 µg/L
Lead Concentration = $e^{1.273[\ln \text{hardness})]-4.705}$ µg/L The objective is a minimum of 1 µg/L regardless of water hardness. If the water hardness is not known, the objective is 1 µg/L.
Nickel Concentration = $\exp^{\{0.8460[\ln(\text{hardness})]+0.0584\}*0.997}$µg/L.

d. Molybdenum guideline = up to 50 µg/L for short-term use on acidic soils.

**Table A4: SK-MB**

| PARAMETER / PESTICIDES | 2015 Water Quality Objectives – SK-MB Boundary | | | | | | |
|---|---|---|---|---|---|---|---|
| | ASSINIBOINE RIVER | CARROT RIVER | | CHURCHILL RIVER | QU'APPELLE RIVER | RED DEER RIVER (ERWOOD) | SASKATCHEWAN RIVER |
| | | OPEN | CLOSED | | | | |
| **ACID HERBICIDES** | | | | | | | |
| 2,4-D (µg/L) | 4 | 4 | | 4 | 4 | 4 | 4 |
| Bromoxynil (µg/L) | 0.33 | 0.33 | | 0.33 | 0.33 | 0.33 | 0.33 |
| Dicamba (µg/L) | 0.006 | 0.006 | | 0.006 | 0.006 | 0.006 | 0.006 |
| MCPA (µg/L) | 0.025 | 0.025 | | 0.025 | 0.025 | 0.025 | 0.025 |
| Picloram (µg/L) | 29 | 29 | | 29 | 29 | 29 | 29 |
| **ORGANOCHLORINE PESTICIDES IN WATER** | | | | | | | |
| Endosulfan (µg/L) | 0.003 | 0.003 | | 0.003 | 0.003 | 0.003 | 0.003 |
| Hexachlorocyclohexane (gamma-HCH) (Lindane) (µg/L) | 0.01 | 0.01 | | 0.01 | 0.01 | 0.01 | 0.01 |
| Hexachlorobenzene (µg/L) | 0.52 | 0.52 | | 0.52 | 0.52 | 0.52 | 0.52 |
| Pentachlorophenol (PCP) (µg/L) | 0.5 | 0.5 | | 0.5 | 0.5 | 0.5 | 0.5 |
| **NEUTRAL HERBICIDES IN WATER** | | | | | | | |
| Atrazine (µg/L) | 1.8 | 1.8 | | 1.8 | 1.8 | 1.8 | 1.8 |
| Diclofopmethyl (Hoegrass)* (µg/L) | 0.18 | 0.18 | | 0.18 | 0.18 | 0.18 | 0.18 |
| Metolachlor (µg/L) | 7.8 | 7.8 | | 7.8 | 7.8 | 7.8 | 7.8 |
| Metribuzin (µg/L) | 0.5 | 0.5 | | 0.5 | 0.5 | 0.5 | 0.5 |
| Simazine (µg/L) | 0.5 | 0.5 | | 0.5 | 0.5 | 0.5 | 0.5 |
| Triallate (µg/L) | 0.24 | 0.24 | | 0.24 | 0.24 | 0.24 | 0.24 |
| Trifluralin (µg/L) | 0.2 | 0.2 | | 0.2 | 0.2 | 0.2 | 0.2 |
| **OTHER** | | | | | | | |
| Glyphosate (ng/L) | Report Detections | Report Detections | | Report Detections | Report Detections | Report Detections | Report Detections |

Legend

| Protection of Aquatic Life | Ag-Livestock | Ag-Irrigation | Recreation | Treatability | Ag-Irrigation + Treatability | Ag-Irrigation and Livestock | Fish Consumption |
|---|---|---|---|---|---|---|---|

# *APPENDIX 1: Water Quality Objectives* continued

**Table A5: AB-SK**

| PARAMETER | 2015 Water Quality Objectives – Alberta-Saskatchewan Boundary | | | | | |
|---|---|---|---|---|---|---|
| | BATTLE RIVER | BEAVER RIVER | COLD RIVER | NORTH SASK. RIVER | RED DEER RIVER (BINDLOSS) | SOUTH SASK. RIVER |
| PHYSICALS AND OTHER | | | | | | |
| Reactive Chlorine Species (mg/L) | 0.0005 | 0.0005 | 0.0005 | 0.0005 | 0.0005 | 0.0005 |
| Cyanide (free) (mg/L) | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 | 0.005 |
| METALS | | | | | | |
| Mercury (total) (µg/L) | 0.026 | 0.026 | 0.026 | 0.026 | 0.026 | 0.026 |
| FISH TISSUE | | | | | | |
| Mercury in Fish (muscle) (µg/kg) | 200 | 200 | 200 | 200 | 200 | 200 |
| Arsenic in fish (muscle) (µg/kg) | 3500 | 3500 | 3500 | 3500 | 3500 | 3500 |
| Lead In fish (muscle) (µg/kg) | 500 | 500 | 500 | 500 | 500 | 500 |
| DDT (total) in fish (muscle) (µg/kg) | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 |
| AQUATIC BIOTA CONSUMPTION | | | | | | |
| PCB in fish (muscle) mammalian (µg TEQ/kg diet wet weight) | 0.00079 | 0.00079 | 0.00079 | 0.00079 | 0.00079 | 0.00079 |
| PCB in fish (muscle) avian (µg TEQ/kg diet wet weight) | 0.0024 | 0.0024 | 0.0024 | 0.0024 | 0.0024 | 0.0024 |
| DDT total in fish (muscle) (µg/kg diet wet weight) | 14 | 14 | 14 | 14 | 14 | 14 |
| Toxaphene in fish (muscle) (µg/kg diet wet weight) | 6.3 | 6.3 | 6.3 | 6.3 | 6.3 | 6.3 |
| RADIOACTIVE | | | | | | |
| Cesium-137 (Bq/L) | 10 | 10 | 10 | 10 | 10 | 10 |
| Iodine-131 (Bq/L) | 6 | 6 | 6 | 6 | 6 | 6 |
| Lead-210 (Bq/L) | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Radium-226 (Bq/L) | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Strontium-90 (Bq/L) | 5 | 5 | 5 | 5 | 5 | 5 |
| Tritium (Bq/L) | 7000 | 7000 | 7000 | 7000 | 7000 | 7000 |

Legend

| Protection of Aquatic Life | Treatability | Fish Consumption |
|---|---|---|

# *APPENDIX 1: Water Quality Objectives* continued

**Table A6: SK-MB**

| PARAMETER | 2015 Water Quality Objectives – SK-MB Boundary | | | | | | |
|---|---|---|---|---|---|---|---|
| | ASSINIBOINE RIVER | CARROT RIVER | | CHURCHILL RIVER | QU'APPELLE RIVER | RED DEER RIVER (ERWOOD) | SASKATCHEWAN RIVER |
| | | OPEN | CLOSED | | | | |
| PHYSICALS AND OTHER | | | | | | | |
| Reactive Chlorine Species (mg/L) | 0.0005 | 0.0005 | | 0.0005 | 0.0005 | 0.0005 | 0.0005 |
| Cyanide (free) (mg/L) | 0.005 | 0.005 | | 0.005 | 0.005 | 0.005 | 0.005 |
| METALS | | | | | | | |
| Mercury (total) (µg/L) | 0.026 | 0.026 | | 0.026 | 0.026 | 0.026 | 0.026 |
| FISH TISSUE | | | | | | | |
| Mercury in Fish (muscle) (µg/kg) | 200 | 200 | | 200 | 200 | 200 | 200 |
| Arsenic in fish (muscle) (µg/kg) | 3500 | 3500 | | 3500 | 3500 | 3500 | 3500 |
| Lead In fish (muscle) (µg/kg) | 500 | 500 | | 500 | 500 | 500 | 500 |
| DDT (total) in fish (muscle) (µg/kg) | 5000 | 5000 | | 5000 | 5000 | 5000 | 5000 |
| AQUATIC BIOTA CONSUMPTION | | | | | | | |
| PCB in fish (muscle) mammalian (µg TEQ/kg diet wet weight) | 0.00079 | 0.00079 | | 0.00079 | 0.00079 | 0.00079 | 0.00079 |
| PCB in fish (muscle) avian (µg TEQ/kg diet wet weight) | 0.0024 | 0.0024 | | 0.0024 | 0.0024 | 0.0024 | 0.0024 |
| DDT total in fish (muscle) (µg/kg diet wet weight) | 14 | 14 | | 14 | 14 | 14 | 14 |
| Toxaphene in fish (muscle) (µg/kg diet wet weight) | 6.3 | 6.3 | | 6.3 | 6.3 | 6.3 | 6.3 |
| RADIOACTIVE | | | | | | | |
| Cesium-137 (Bq/L) | 10 | 10 | | 10 | 10 | 10 | 10 |
| Iodine-131 (Bq/L) | 6 | 6 | | 6 | 6 | 6 | 6 |
| Lead-210 (Bq/L) | 0.2 | 0.2 | | 0.2 | 0.2 | 0.2 | 0.2 |
| Radium-226 (Bq/L) | 0.5 | 0.5 | | 0.5 | 0.5 | 0.5 | 0.5 |
| Strontium-90 (Bq/L) | 5 | 5 | | 5 | 5 | 5 | 5 |
| Tritium (Bq/L) | 7000 | 7000 | | 7000 | 7000 | 7000 | 7000 |

Legend

| Protection of Aquatic Life | Treatability | Fish Consumption |
|---|---|---|

# *APPENDIX 1: Water Quality Objectives* continued

**Table A7: Site-specific nutrient objectives, both boundaries.**

| Nutrient Objectives | | | | | | | |
|---|---|---|---|---|---|---|---|
| OBJECTIVES FOR NUTRIENTS | | TOTAL PHOSPHORUS (MG/L) | | TOTAL DISSOLVED PHOSPHORUS (MG/L) | | TOTAL NITROGEN (MG/L) | |
| Alberta-Saskatchewan Boundary | | | | | | | |
| BATTLE RIVER NEAR UNWIN | Open Water | 0.267 | 0.335 | 0.051 | | 2.260 | |
| | Ice-covered | 0.075 | 0.100 | 0.045 | | 1.550 | |
| BEAVER RIVER AT BEAVER CROSSING | Open Water | 0.171 | | 0.043 | 0.060 | 1.140 | |
| | Ice-covered | 0.127 | | 0.042 | 0.060 | 1.862 | |
| COLD RIVER AT OUTLET OF COLD LAKE | Open Water | 0.023 | | 0.010 | | 0.453 | 0.460 |
| | Ice-covered | 0.024 | | 0.017 | | 0.452 | 0.467 |
| NORTH SASKATCHEWAN RIVER AT HIGHWAY 17 | Open Water | 0.253 | 0.278 | 0.026 | 0.046 | 1.169 | 1.230 |
| | Ice-covered | 0.063 | 0.115 | 0.048 | 0.101 | 1.175 | 1.225 |
| RED DEER RIVER NEAR BINDLOSS | Open Water | 0.315 | 0.563 | 0.023 | 0.035 | 2.320 | |
| | Ice-covered | 0.035 | 0.069 | 0.008 | 0.024 | 0.860 | |
| SOUTH SASKATCHEWAN RIVER | Open Water | 0.159 | 0.246 | 0.014 | 0.018 | 1.073 | 1.114 |
| | Ice-covered | 0.054 | 0.110 | 0.010 | 0.067 | 1.638 | 1.771 |

Legend

| | | | |
|---|---|---|---|
| No Trend – 90th % of Database | 90th % of Database | Decreasing Trend – Lowest 90th % of 10yr Running | Increasing Trend – Lowest 90th % of 10yr Running |

# *APPENDIX 1: Water Quality Objectives* continued

**Table A7: Site-specific nutrient objectives, both boundaries.**

| Nutrient Objectives | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| OBJECTIVES FOR NUTRIENTS | | TOTAL PHOSPHORUS (MG/L) | | TOTAL DISSOLVED PHOSPHORUS (MG/L) | | TOTAL NITROGEN (MG/L) | |
| Saskatchewan - Manitoba Boundary | | | | | | | |
| ASSINIBOINE RIVER AT HWY 8 BRIDGE | Open Water | 0.311 | | 0.186 | | 1.801 | |
| | Ice-covered | 0.180 | | 0.115 | | 2.252 | |
| CARROT RIVER NEAR TURNBERRY | Open Water | 0.099 | 0.140 | 0.027 | 0.057 | 1.087 | 1.417 |
| | Ice-covered | 0.170 | 0.266 | 0.031 | 0.059 | 1.814 | 2.052 |
| CHURCHILL RIVER BELOW WASAWAKASIK | Open Water | 0.025 | | 0.010 | | 0.484 | |
| | Ice-covered | 0.021 | | 0.010 | | 0.411 | |
| QU'APPELLE RIVER | Open Water | 0.278 | 0.304 | 0.156 | 0.190 | 1.822 | |
| | Ice-covered | 0.221 | 0.290 | 0.129 | 0.249 | 1.767 | |
| RED DEER RIVER AT ERWOOD | Open Water | 0.052 | 0.066 | 0.021 | 0.029 | 1.195 | |
| | Ice-covered | 0.074 | 0.161 | 0.025 | 0.055 | 1.998 | |
| SASKATCHEWAN RIVER | Open Water | 0.088 | 0.124 | 0.014 | 0.018 | 0.838 | |
| | Ice-covered | 0.028 | 0.034 | 0.011 | 0.017 | 0.761 | |

Legend

| | | | |
|---|---|---|---|
| No Trend – 90th % of Database | 90th % of Database | Decreasing Trend – Lowest 90th % of 10yr Running | Increasing Trend – Lowest 90th % of 10yr Running |

# APPENDIX 2: Water Quality Monitoring

**PPWB Water Quality Monitoring 2018**

The recommended water quality monitoring for 2018 is provided in the attached tables. The changes to be implemented for 2018 from 2017 are highlighted.

In 2017, pesticide sampling was undertaken on the Beaver, Churchill, and Red Deer (S/M) rivers in accordance with the standard rotation of the pesticide sampling in addition to the annual sampling at the Carrot and Assiniboine rivers. Since 2013, the COWQ has recommended that the acid herbicides be sampled on the Battle River and the South Saskatchewan River due to a number of detections of these pesticides on these two rivers. In 2015, the COWQ had also recommended that the acid herbicide pesticides be monitored on the Saskatchewan River and the Qu'Appelle River due to frequent detections of this group of pesticides on these rivers.

In 2018, pesticide sampling is recommended on the North Saskatchewan, South Saskatchewan and Cold rivers in accordance with the standard rotation of the pesticide sampling program in addition to the annual sampling at the Carrot and Assiniboine rivers.

A rotational strategy for the sampling of pesticides was developed and implemented in 2006. Sampling of pesticides was switched from annual to rotational sampling at sites with a long data record and where most data points were below detection. Following a review of the pesticide data for all 12 transboundary rivers in 2016, the COWQ recommended that acid herbicide samples be collected as part of the annual monitoring program for the following transboundary rivers: Battle, South Saskatchewan, North Saskatchewan, Red Deer (AB-SK), Saskatchewan, and Qu'Appelle rivers. In addition, the Committee has recommended that the acid herbicides continue to be monitored on the Assiniboine and Carrot rivers on an annual basis. Monitoring for the other pesticide groups (neutral herbicides and organochlorines) was recommended to continue on a rotational sampling basis, with the exception of the Assiniboine and Carrot rivers, which are recommended to remain as an annual sampling program. The Carrot River and the Assiniboine River are sampled every year because they are agricultural watersheds and pesticide detections occur frequently. The annual monitoring of these two rivers will provide pesticide information on an on-going basis and could be used as a benchmark for other prairie rivers. However, in 2018 the organochlorine pesticides will be reduced from 12 times a year to 8 times a year.

The continued monitoring of the biological oxygen demand (BOD) is recommended for the Battle, Beaver and Carrot Rivers in 2018 due to low dissolved oxygen levels in these rivers during the winter months.

In 2018, the COWQ is recommending that chlorophyll a be added to the annual monitoring program at all transboundary sites as a measure of algal productivity in the transboundary rivers.

The proposed 2018 and existing 2017 monitoring programs are summarized below in tables.

**Other Objectives**

Monitoring was not recommended for radionuclides, total residual chlorine, cyanide and mercury in 2018. Water quality objectives are available in Schedule E for radionuclides, total residual chlorine, cyanide and mercury. However, these water quality objectives were included in Schedule E in the event of a future water quality issue or emergency but are not intended to be routinely monitored due to low risk. Radionuclides have not been monitored since January 1984.

Monitoring is not recommended for contaminants in fish in 2018. The historical data set of contaminants in fish for the transboundary sites has been compiled and is currently being reviewed by the Committee. Any future fish monitoring program will reflect the results of the previous program.

# *APPENDIX 2: Water Quality Monitoring* continued

**PPWB MONITORING 2018: Alberta-Saskatchewan Sites**

| SITE | NUTRIENTS and PHYSICALS/BOD; MAJOR IONS/ SAR; METALS (Total and Dissolved); BACTERIA (Fecal and *E. coli*) CHLOROPHYLL *a* | PESTICIDES | | | |
|---|---|---|---|---|---|
| | | Acid Herbicides | Neutral Herbicides | Organochlorine | Glyphosate |
| Site 1 Cold River | 12x / year | 8x/year | 8x/year | 8x/year | 8x/year |
| Site 2 Beaver River | 12x / year | — | — | — | — |
| Site 3 North Saskatchewan River | 12x / year | 8x/year | 8x/year | 8x/year | 8x/year |
| Site 4 Battle River | 12x / year | 8x/year | — | — | — |
| Site 5 Red Deer River A/S | 12x / year | 8x/year | — | — | — |
| Site 6 South Saskatchewan River | 12x / year | 8x/year | 8x/year | 8x/year | 8x/year |

Pesticides sampled 8x / year in Feb, Apr, May, June, July, Aug, Oct, and Dec.
Highlighting indicates changes from previous year's sampling schedule

**PPWB MONITORING 2018: Saskatchewan-Manitoba Sites**

| SITE | NUTRIENTS and PHYSICALS/BOD; MAJOR IONS/ SAR; METALS (Total and Dissolved); BACTERIA (Fecal and *E. coli*) CHLOROPHYLL *a* | PESTICIDES | | | |
|---|---|---|---|---|---|
| | | Acid Herbicides | Neutral Herbicides | Organochlorine | Glyphosate |
| Site 7 Churchill River[1] | 4x / year | — | — | — | — |
| Site 8 Saskatchewan River | 12x / year | 8x/year | — | — | — |
| Site 9 Carrot River | 12x / year | 12x/year | 12x/year | 8x/year | 12x/year |
| Site 10 Red Deer River S/M | 12x / year | — | — | — | — |
| Site 11 Assiniboine River | 12x / year | 12x/year | 12x/year | 8x/year | 12x/year |
| Site 12 Qu'Appelle River | 12x / year | 8x/year | — | — | — |

[1] Churchill River Months sampled = Feb, May, July, Oct
Pesticides sampled 8x/year in Feb, Apr, May, June, July, Aug, Oct, and Dec
Highlighting indicates changes from previous year's sampling schedule

# *APPENDIX 2: Water Quality Monitoring* continued

**PPWB MONITORING 2018: Alberta-Saskatchewan Sites**

| SITE | NUTRIENTS and PHYSICALS/BOD; MAJOR IONS/ SAR; METALS (Total and Dissolved); BACTERIA (Fecal and *E. coli*) CHLOROPHYLL *a* | PESTICIDES | | | |
|---|---|---|---|---|---|
| | | Acid Herbicides | Neutral Herbicides | Organochlorine | Glyphosate |
| Site 1<br>Cold River | 4x / year | — | — | — | — |
| Site 2<br>Beaver River | 12x / year | 8x/year | 8x/year | 8x/year | 8x/year |
| Site 3<br>North Saskatchewan River | 12x / year | 8x/year | — | — | — |
| Site 4<br>Battle River | 12x / year | 8x/year | — | — | — |
| Site 5<br>Red Deer River A/S | 12x / year | 8x/year | — | — | — |
| Site 6<br>South Saskatchewan River | 12x / year | 8x/year | — | — | — |

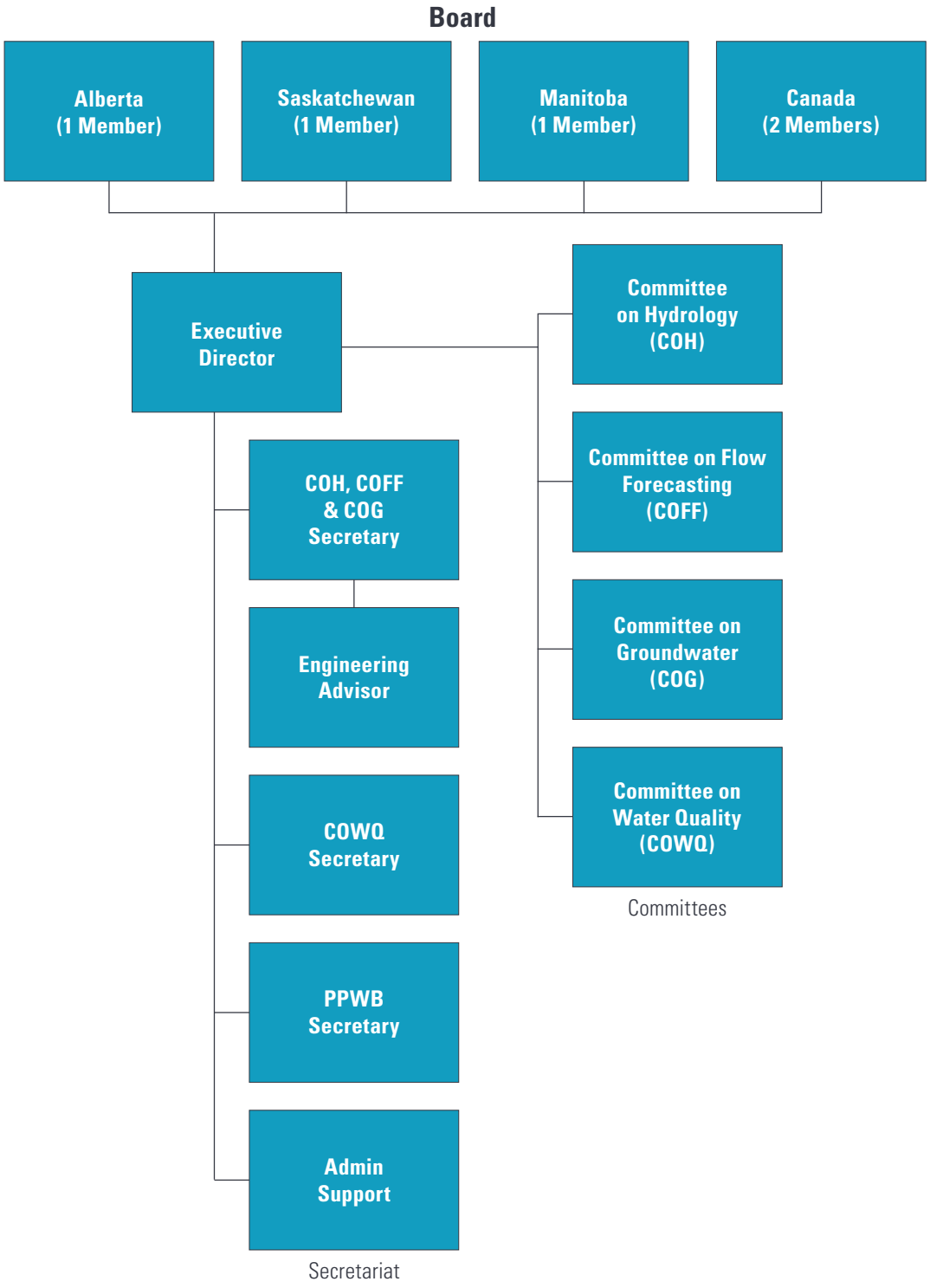
Pesticides sampled 8x / year in Feb, Apr, May, June, July, Aug, Oct, and Dec.

**PPWB MONITORING 2018: Saskatchewan-Manitoba Sites**

| SITE | NUTRIENTS and PHYSICALS/BOD; MAJOR IONS/ SAR; METALS (Total and Dissolved); BACTERIA (Fecal and *E. coli*) CHLOROPHYLL *a* | PESTICIDES | | | |
|---|---|---|---|---|---|
| | | Acid Herbicides | Neutral Herbicides | Organochlorine | Glyphosate |
| Site 7<br>Churchill River[1] | 4x / year | 4x/year | 4x/year | 4x/year | 4x/year |
| Site 8<br>Saskatchewan River | 12x / year | 8x/year | — | — | — |
| Site 9<br>Carrot River | 12x / year | 12x/year | 12x/year | 12x/year | 12x/year |
| Site 10<br>Red Deer River S/M | 12x / year | 8x/year | 8x/year | 8x/year | 8x/year |
| Site 11<br>Assiniboine River | 12x / year | 12x/year | 12x/year | 12x/year | 12x/year |
| Site 12<br>Qu'Appelle River | 12x / year | 8x/year | — | — | — |

[1] Churchill River Months sampled = Feb, May, July, Oct
Pesticides sampled 8x/year in Feb, Apr, May, June, July, Aug, Oct, and Dec

## *APPENDIX V: PPWB Organizational Chart*



# APPENDIX VI: Board / Committee Membership 2018-2019

## PRAIRIE PROVINCES WATER BOARD

Manitoba, Saskatchewan, Alberta and Canada agree to establish and there is hereby established a Board to be known as the Prairie Provinces Water Board to consist of five members to be appointed as follows:

(a) two members to be appointed by the Governor General in Council, one of whom shall be Chairman of the Board, on the recommendation of the Minister of Energy, Mines and Resources,

(b) one member to be appointed by the Lieutenant Governor in Council of each of the Provinces of Manitoba, Saskatchewan and Alberta.

Schedule C, Section 1
Master Agreement on Apportionment

**PPWB BOARD MEMBERS**

| | | |
|---|---|---|
| CHAIR | Nadine Stiller<br>(Apr 2018 to current) | Associate Regional Director General<br>West & North<br>Environment and Climate Change Canada |
| | Lynden Hillier<br>(Mar 2013 to 2018) | Director General<br>Asset Management and Capital Planning<br>Corporate Management Branch<br>Agriculture and Agri-Food Canada |
| | Brian Yee<br>(Jul 2014 to current) | Director<br>Transboundary Waters Secretariat<br>Alberta Environment and Parks |
| | Vacant<br>(Nov 2017 to current) | Manitoba |
| | Sam Ferris<br>(Sep 2018 to current) | Senior Vice President<br>Regulatory Division<br>Water Security Agency (Saskatchewan) |

# *APPENDIX VI: Board / Committee Membership 2018-2019 continued*

**SECRETARIAT**

| | | |
|---|---|---|
| EXECUTIVE DIRECTOR | Mike Renouf<br>(Apr 2008 to current) | Transboundary Waters Unit<br>Prairie Provinces Water Board |
| SECRETARY | Lynne Quinnett-Abbot<br>(Mar 2013 to current) | Transboundary Waters Unit<br>Prairie Provinces Water Board |

**PPWB ALTERNATE BOARD MEMBERS**

| | |
|---|---|
| Paula Siwik<br>(Nov 2017 to current) | Regional Program Integration Manager<br>Environment and Climate Change Canada |
| Dave Zapshala<br>(Feb 2016 to current) | Director, Water Infrastructure Division<br>Corporate Management Branch<br>Agriculture and Agri-Food Canada |
| Carmen de la Chevrotière<br>(Aug 2014 to current) | Transboundary Water Quantity Specialist<br>Transboundary Waters Secretariat<br>Alberta Environment and Parks |
| John Fahlman<br>(Sep 2018 to current) | Senior Vice President<br>Technical Services and Chief Engineer<br>Water Security Agency (Saskatchewan) |
| Nicole Armstrong<br>(May 2013 to current) | Director<br>Water Science and Watershed Management Branch<br>Agriculture and Resource Development (Manitoba) |

# *APPENDIX VI: Board / Committee Membership 2018-2019 continued*

## *COMMITTEE ON HYDROLOGY*

At the request of, and under the direction of the PPWB, the Committee on Hydrology (COH) shall investigate, oversee, review, report and recommend on matters pertaining to hydrology of interprovincial or interjurisdictional basins.

The committee may consider such things as natural flow; forecasting; network design; collection, processing and transmission of data; basin studies and other items of interprovincial interest involving hydrology.

The COH will engage the Committee on Groundwater, the Committee on Flow Forecasting and the Committee on Water Quality on items of mutual interest or when the expertise of those committees will assist the COH.

PPWB Board Minute 92-65 (Oct. 7, 2009)

**COMMITTEE ON HYDROLOGY MEMBERS**

| | | |
|---|---|---|
| CHAIR | Mike Renouf | Executive Director<br>Prairie Provinces Water Board |
| MEMBERS | Malcolm Conly | Hydrometric Operations<br>Environment and Climate Change Canada |
| | Ron Woodvine | Corporate Management Branch<br>Agriculture and Agri-Food Canada |
| | Carmen de la Chevrotière | Transboundary Waters Secretariat<br>Alberta Environment and Parks |
| | Mark Lee | Water Science and Watershed Management Branch<br>Agriculture and Resource Development (Manitoba) |
| | Bart Oegema | Hydrology Services<br>Water Security Agency (Saskatchewan) |
| | Anthony Liu | Meteorological Service of Canada<br>Environment and Climate Change Canada |
| SECRETARY | Megan Garner | Transboundary Waters Unit<br>Prairie Provinces Water Board |
| | Marie Hyde | Transboundary Waters Unit<br>Prairie Provinces Water Board |

# ***APPENDIX VI: Board / Committee Membership 2018-2019*** *continued*

## *COMMITTEE ON WATER QUALITY*

**Terms of Reference: Mandate**

Under the direction of the Prairie Provinces Water Board (PPWB), the Committee on Water Quality (COWQ) shall investigate, oversee, review, report, recommend and advise the Board on matters pertaining to the water quality and aquatic ecosystem integrity of interprovincial waters.

The responsibilities of the committee shall include directing, planning, and coordinating a water quality monitoring and trend assessment program by identifying monitoring requirements and overseeing transboundary monitoring and synoptic surveys. The committee shall promote an ecosystem approach to water quality management and the protection and enhancement of interprovincial waters by ensuring the compatibility of water quality guidelines, objectives, sampling and analytical protocols, monitoring approaches, quality assurance and data bases. It shall interpret data and identify, investigate and define existing and potential interprovincial water quality problems through the application of PPWB Water Quality Objectives, trend assessment and other approaches. The committee shall inform the Board and member agencies, through the PPWB contingency plan, of any spills or unusual water quality conditions that have the potential to adversely affect interprovincial streams. It shall assess the implications of these problems and may recommend remedial or preventative measures for avoiding and resolving water quality issues and if required, additional synoptic water quality monitoring.

The committee shall foster awareness and understanding of the importance of effective water quality management, encourage the use of "state of the art" procedures for evaluating water quality and identify research needs pertinent to water quality management on the prairies. The committee shall facilitate effective water quality management practices through integration of agency initiatives and the promotion of joint planning on interprovincial streams.

The COWQ will engage the Committee on Hydrology, Committee on Flow Forecasting and the Committee on Groundwater on items of mutual interest or when the expertise of those committees will assist COWQ.

PPWB Board Minute 92-65 (Oct. 7, 2009)

## *APPENDIX VI: Board / Committee Membership 2018-2019 continued*

**COMMITTEE ON WATER QUALITY MEMBERS**

| | | |
|---|---|---|
| CHAIR | Mike Renouf | Executive Director<br>Prairie Provinces Water Board |
| MEMBERS | Paul Klawunn | Science and Technology Branch<br>Environment and Climate Change Canada |
| | Elaine Page | Water Science and Watershed Management Branch<br>Agriculture and Resource Development (Manitoba) |
| | John-Mark Davies | Water Quality Services<br>Water Security Agency (Saskatchewan) |
| | Gongchen Li | Transboundary Waters Secretariat<br>Alberta Environment and Parks |
| | Claudia Sheedy | Lethbridge Research and Development Centre<br>Agriculture and Agri-Food Canada |
| SECRETARY | Joanne Sketchell | Transboundary Waters Unit<br>Prairie Provinces Water Board |

# *APPENDIX VI: Board / Committee Membership 2018-2019 continued*

## *COMMITTEE ON GROUNDWATER*

**Terms of Reference: Mandate**

Recognizing the inter-relationship between surface and groundwater, the Committee on Groundwater shall, at the request of, and under the direction of the Prairie Provinces Water Board, investigate, oversee, review, report, and recommend on matters pertaining to quantity and quality of groundwater at or near interprovincial boundaries.

Responsibilities of the committee may include: exchange of information; compilation and interpretation of existing data; recommendations on groundwater information and monitoring requirements; determination of implications of proposed projects which may impact the quantity and/or quality of waters at interprovincial boundaries; and other items of interjurisdictional interest involving groundwater.

The COG will engage the Committee on Hydrology, Committee on Flow Forecasting and the Committee on Water Quality on items of mutual interest or when the expertise of those committees will assist the COG.

PPWB Board Minute 92-65 (Oct. 7, 2009)

**COMMITTEE ON GROUNDWATER MEMBERS**

| | | |
|---|---|---|
| CHAIR | Mike Renouf | Executive Director<br>Prairie Provinces Water Board |
| MEMBERS | Garth van der Kamp | Groundwater Hydrology<br>Water Science and Technology Directorate<br>Environment and Climate Change Canada |
| | Tony Cowen | Science and Technology Branch<br>Agriculture and Agri-Food Canada |
| | Guy Bayegnak | Groundwater Policy Specialist<br>Alberta Environment and Parks |
| | Kei Lo | Hydrology and Groundwater Services<br>Water Security Agency (Saskatchewan) |
| | Graham Phipps | Water Science and Watershed Management Branch<br>Agriculture and Resource Development (Manitoba) |
| SECRETARY | Megan Garner | Transboundary Waters Unit<br>Prairie Provinces Water Board |
| | Marie Hyde | Transboundary Waters Unit<br>Prairie Provinces Water Board |

# *APPENDIX VI: Board / Committee Membership 2018-2019 continued*

## *COMMITTEE ON FLOW FORECASTING*

**Terms of Reference: Mandate**

At the request of, and under the direction of the Prairie Provinces Water Board (PPWB), the Committee on Flow Forecasting (COFF) shall investigate, oversee, review, report and improve the accuracy of flow forecasting at the interprovincial boundaries; and, recommend on matters pertaining to streamflow forecasting of interprovincial basins.

The committee may consider such things as flow forecasting methods, hydraulic and hydrologic basin forecast models, tools and techniques, inter-jurisdictional communications, provision and transmission of data, studies, and other items of interprovincial interest involving streamflow forecasting.

The COFF will engage the Committee on Hydrology, Committee on Groundwater and the Committee on Water Quality on items of mutual interest or when the expertise of those committees will assist the COFF.

PPWB Board Minute 115-27 (November 2-3, 2015)

**COMMITTEE ON FLOW FORECASTING MEMBERS**

| | | |
|---|---|---|
| CHAIR | Mike Renouf | Executive Director<br>Prairie Provinces Water Board |
| MEMBERS | Bruce Davison | National Hydrologic Services<br>Meteorological Service of Canada (Hydrology)<br>Environment and Climate Change Canada |
| | Anthony Liu | Meteorological Service of Canada (Meteorology)<br>Environment and Climate Change Canada |
| | Patrick Cherneski | National Agroclimate Information Service<br>Agriculture and Agri-Food Canada |
| | Fisaha Unduche | Hydrologic Forecasting & Coordination<br>Manitoba Infrastructure |
| | Curtis Hallborg | Flow Forecasting & Operations Planning<br>Water Security Agency (Saskatchewan) |
| | Bernard Trevor | Watershed Resilience and Mitigation<br>Alberta Environment and Parks |
| SECRETARY | Megan Garner | Transboundary Waters Unit<br>Prairie Provinces Water Board |

# APPENDIX VII: Statement of Final Expenditures 2018-2019

| *For the year 2018/19* | Budget | Actual |
|---|---|---|
| **Salary Component** | | |
| PY'S | 4.800 | 4.610 |
| Base Salary | $ 519,003 | $ 499,713 |
| BPE | $ 103,801 | $ 99,700 |
| **Total Salary** | **$ 622,804** | **$ 599,413** |
| **O&M Component** | | |
| Contracts & Students | | |
| **Goal 1** | | |
| Cont. Improvement | $ 130,000 | $ 50,983 |
| Modernization | $ 13,500 | |
| **Goal 2** | | |
| Cont. Improvement | $ 30,000 | $ 0 |
| **Goal 3** | | |
| Cont. Improvement | $ 45,000 | $ 49,122 |
| **Goal 5** | | |
| Cont. Improvement | $ 13,000 | $ 0 |
| **Goal 7** | | |
| Cont. Improvement | $ 20,000 | $ 0 |
| **Sub-total contracts** | **$ 251,500** | **$ 100,105** |
| **Operating Expenses** | **$ 20,000** | **$ 17,190** |
| **Total O&M** | **$ 271,500** | **$ 117,295** |
| **Grand Total** | **$ 894,304** | **$ 716,708** |

# APPENDIX VIII: History of the PPWB

The PPWB was formed on July 28, 1948 when Canada and the Provinces of Alberta, Saskatchewan, and Manitoba signed the Prairie Provinces Water Board Agreement. This Agreement established a Board to recommend the best use of interprovincial waters, and to recommend allocations between provinces.

From 1948 to 1969, the Engineering Secretary to the Board was a Prairie Farm Rehabilitation Administration (PFRA) employee. The support staff for studies and office accommodation during these years was provided by the PFRA in Regina at no charge.

After twenty years, changes in regional water management philosophies resulted in a need to modify the role of the Board. Consequently, the four governments entered into the *Master Agreement on Apportionment (MAA)* on October 30, 1969. This Agreement provided an apportionment formula for eastward flowing interprovincial streams, gave recognition to the problem of water quality, and reconstituted the Prairie Provinces Water Board.

The *MAA* has five schedules which form part of the Agreement. These Schedules are:

1. Schedule A. An apportionment agreement between Alberta and Saskatchewan.
2. Schedule B. An apportionment agreement between Saskatchewan and Manitoba.
3. Schedule C. The Prairie Provinces Water Board Agreement describes the composition, functions and duties of the Board.
4. Schedule D. A list of Orders-in-Council for allocations of interprovincial waters made before 1969.
5. Schedule E. A Water Quality Agreement describes the role of the PPWB in interprovincial water quality management and established Water Quality Objectives for 12 interprovincial river reaches. This Schedule became part of the Master Agreement in 1992 and was updated in 2015.

Under Schedule C, the PPWB was reconstituted and was given the responsibility of administering the agreement. Schedule C also provided for the necessary Board staff, accommodation, and supplies to be jointly financed by the four participating governments. Following the reconstitution of the PPWB, the members also agreed to the establishment of a semi-autonomous Board Secretariat.

The PPWB's change in administration policy was implemented when an Executive Director was appointed on July 1, 1972. The By-laws, and Rules and Procedures also came into effect on this date.

On April 2, 1992, the *MAA* was amended to include a Water Quality Agreement that became Schedule E to the Master Agreement. The Agreement sets interprovincial water quality objectives at 12 transboundary river reaches and commits each of the Parties to take reasonable and practical measures to maintain or improve existing water quality.

At the March 1995 meeting, the Board agreed that full time Secretariat staff was no longer necessary and that functional support would be provided by staff of Environment and Climate Change Canada. The process of disbanding the PPWB Secretariat and integrating its functions into Environment and Climate Change Canada was completed during 1995-1996. The portion of time each Environment and Climate Change Canada staff person spends on PPWB activities is charged to the PPWB and cost-shared by the members.

The Board currently operates through its Executive Director, supported by four standing committees: the Committee on Hydrology, the Committee on Groundwater, the Committee on Water Quality and the Committee on Flow Forecasting.

The Board approves an annual PPWB budget with one-half the operating budget being provided by Canada and one-sixth by each of the three provinces. The Government of Canada is responsible to conduct and pay for the costs of water quantity and quality monitoring.

## ***APPENDIX VIII: History of the PPWB*** *continued*

In March 2018, a costed multi-year Work Plan was reviewed and approved by the Board to identify activities and projected budgets for 2017-2022.

A work planning meeting took place in November 2017 to validate strategic direction for updating and reviewing the multi-year Work Plan, the PPWB Strategic Plan and the Communications Strategy to ensure the PPWB's continued success and relevance.

*Prairie Provinces Water Board*
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