CANADA • ALBERTA • SASKATCHEWAN • MANITOBA

PRAIRIE PROVINCES WATER BOARD

Report #ƕШl

ËËÌÕËÜÔ Û Ö Û Ï Ì Review of the ƕŊŊl Interprovincial Water Quality Objectives and Recommendations for Change

Technical Report **Prepared for the Prairie Provinces Water Board**

November 2019

Addendum to the Review of the 1992 Interprovincial Water Quality Objectives and Recommendations for Change

Prepared for the Prairie Provinces Water Board

Prepared by the Committee on Water Quality

November 2019

Executive Summary

The Master Agreement on Apportionment (MAA) is a multi-jurisdictional agreement that was signed in 1969 by the governments of Alberta, Saskatchewan, Manitoba and the Government of Canada. The agreement provides for equitable sharing of surface water in eastward flowing rivers across the Canadian Prairie. The Prairie Provinces Water Board (PPWB) is accountable for the administration of the agreement and reporting of achievements to governments.

Schedule E to the MAA is a water quality agreement that defines the mandate and role of the PPWB in interprovincial water quality management. As part of Schedule E, water quality objectives (WQOs) have been established for twelve transboundary rivers crossing the Alberta/Saskatchewan and Saskatchewan/Manitoba boundaries. Schedule E also directs the PPWB to review the interprovincial water quality objectives on a periodic basis of at least every five years (PPWB1969).

The interprovincial WQOs for the twelve transboundary rivers were last updated in July 2015 (PPWB 2015). This review of the interprovincial WQOs was comprehensive and included a review of which parameters to include and the methods for selecting or develop objectives. Two approaches were used to establish WQOs: i) adoption of the most protective appropriate water quality guideline/objective at each site from existing guidelines/objectives used by ECCC, within the prairie provinces, or in the United States; and ii) where there was no appropriate guideline/objective, a background approach was developed based on historical ambient water quality data. The objectives are numerical values either known to protect specific water quality uses or are based on background levels. Established objectives are acceptable to upstream and downstream provinces.

The PPWB is committed to reviewing interprovincial WQOs on a five-year basis. The Committee on Water Quality (COWQ) (a standing Committee to the PPWB) has completed its review of the 2015 objectives, known as the 2020 review. The scope of the 2020 WQO review was small compared to that of the 2015 review because the PPWB has only been reporting against the 2015 WQOs for three years. Waiting for more time to assess how the 2015 objectives are performing in relation to the needs of PPWB is important and a more detailed review of these will be undertaken at a later date. This is especially notable for objectives derived with the background approach using ambient water quality data.

The scope of the 2020 review focused on parameters examined in the 2015 review but for which an objective was not defined. These parameters were identified in the 2015 review as being “under review”. In 2015 the COWQ recommended 71 interprovincial WQOs objectives, which included parameters in the general categories of nutrients, major ions, metals, pesticides, and general water chemistry (pH, dissolved oxygen, sodium adsorption ratio, total suspended solids).

Objectives were not established in 2015 on select rivers for a few parameters. This decision was made by COWQ because the Committee determined that existing water use/toxicology-based objectives were not appropriate for these river reaches and there was insufficient information available to support the development of background (site-specific) WQO.

Water quality objectives were not established for the following parameters and river reaches in 2015:

- dissolved oxygen on the Battle, Beaver, and Carrot rivers during the ice-covered season
- cadmium (total) on the Red Deer River near Bindloss
- copper (total) on the Red Deer River near Bindloss
- sodium adsorption ratio (SAR) on the Battle, Carrot and Qu'Appelle rivers
- manganese (dissolved) on the Battle, Beaver, Assiniboine, Carrot and Qu'Appelle rivers
- iron (dissolved) on the Carrot River

Since the completion of the 2015 WQOs review the COWQ continued its work to review these parameters and to understand better the water quality conditions within the different river reaches. The outcome of the 2020 review provides recommended objectives for the following parameters considered as "under review" from the 2015 objective review process: cadmium and copper on the Red Deer River and iron and manganese for the remaining rivers.

Recommendations from the 2020 review process also include that no water quality objectives be established for dissolved oxygen in the ice-covered season for the Battle, Beaver and Carrot rivers. This recommendation is based on the low water levels and flows in these rivers during winter months and what is considered to be a natural oxygen demand.

Sodium adsorption ratio is an irrigation specific water use objective. The SAR objective was retained for rivers that had a SAR value of "3" in 2015. However, the SAR objective is no longer supported by CCME and therefore an objective is not being recommended for the three sites listed as being "under review" after the 2015 objective review process (Battle, Carrot and Qu'Appelle rivers).

This 2020 review also included a review of the most protective water use objectives adopted by the PPWB, including either provincial guidelines/objectives used within the jurisdictions party to the MAA or national guidelines developed by the Canadian Council of Ministers of the Environment (CCME) or Heath Canada. Changes are recommended for several water quality objectives for metals [cadmium (total), silver (total) and zinc (dissolved)] at all twelve transboundary rivers to reflect the most recent national (CCME) water quality guidelines. Of note is that the cadmium (total) and silver (total) objectives are now less stringent than those included in the 2015 water quality objectives, and there has been a shift from using zinc (total) to zinc (dissolved) for the protection of aquatic life.

Table of Contents

List of Tables

1. Introduction and Background

The Master Agreement on Apportionment (MAA) is a transboundary water agreement that was signed by the governments of Alberta, Saskatchewan, Manitoba and the Government of Canada in 1969. The Prairie Provinces Water Board (PPWB) was established to administer the agreement and report on the achievements to governments. In 1992, the MAA was amended to include Schedule E, a water quality agreement. Schedule E defines the mandate of the PPWB in interprovincial water management and its roles and responsibilities in carrying out that mandate. As part of schedule E, water quality objectives (WQOs) have been established for 12 transboundary rives crossing the Alberta/Saskatchewan and Saskatchewan/Manitoba boundaries.

The interprovincial water quality objectives for the twelve transboundary rivers monitored and reported on by the PPWB were last updated in 2013 and officially came into effect on July 8th, 2015. During this comprehensive review, 71 objectives were established for the twelve interprovincial river reaches. Water quality objectives were established for a range of water quality parameters including nutrients, major ions, metals, pesticides, and general water chemistry (total suspended solids, pH, dissolved oxygen, and sodium adsorption ratio). Water quality objectives were established to protect a range of water uses including: protection of aquatic life (PAL), agricultural uses (irrigation and livestock uses), recreation, fish consumption (for human and aquatic biota consumers), and source water treatability for drinking water.

The 2015 comprehensive water quality objectives (WQOs) review developed two main approaches for establishing updated interprovincial WQOs for the transboundary river reaches. These two approaches were:

i) to adopt the most protective appropriate water quality guideline/objective for each site from existing guidelines/objectives used nationally (CCME), within the prairie provinces, or the US; or
ii) where there was no appropriate guideline/objective, to develop and apply a background approach using historic ambient water quality data at each site.

Following completion of the 2015 water quality objectives review, a number of parameters for select rivers were listed as “under review” and as such no water quality objectives were established. Water quality objectives were not set at these sites because the water use objectives were either not appropriate for these rivers and/or insufficient information was available to support the development of a site-specific objective. The Committee on Water Quality (COWQ), a standing Committee to the PPWB, has continued to work on the objectives listed as “under review” to get a better understanding of the water quality conditions and requirements needed to establish objectives.

Schedule E of the MAA identifies that a principal responsibility of the PPWB is to review the interprovincial WQOs for each transboundary river reach on a periodic

basis of at least every five years (PPWB 1969). The PPWB has committed to reviewing water quality objectives every five years and as such, a revised and updated list of interprovincial WQOs for the transboundary rivers is proposed for 2020, five years following the implementation of the last updated WQOs. This addendum to the *Review of the 1992 Interprovincial Water Quality Objectives and Recommendations for Change* (PPWB 2015*)* will incorporate the COWQ's recommended changes and updates to the 2015 interprovincial WQOs.

2. Scope for the 2020 Review

Given that the 2015 PPWB water quality objectives have only been in use for three years, the scope of the 2020 review was limited. COWQ recommended to the Board that the scope of the review for 2020 be limited to:

- Review current PPWB objectives that are derived from use-specific criteria from other agencies or jurisdictions for any updates/changes (e.g., CCME toxicology guidelines) and update PPWB objectives accordingly.
- Establish the site-specific objectives and/or justification for lack of objectives for those parameters that were listed as "under review" in the 2015 objectives.
- Identify processes to exempt sites from toxicology-based metal objectives and identify options for setting alternative objectives.

3. Water Quality Objectives under review following the 2015 update.

Following the completion of the 2015 water quality objectives review, a number of WQOs were listed as "under review". Interprovincial WQO's were not established for dissolved oxygen, sodium adsorption ratio (SAR), and several metals for a number of the transboundary river reaches. Objectives were not established at these sites because COWQ agreed that toxicology-based objectives were not appropriate for these prairie rivers and insufficient information was available to support the development of a site-specific objective. Objectives were not established for the following parameters and river reaches:

- dissolved oxygen on the Battle, Beaver, and Carrot rivers during the ice-covered season
- manganese (dissolved) on the Battle, Beaver, Assiniboine, Carrot and Qu'Appelle rivers
- iron (dissolved) on the Carrot River
- cadmium (total) on the Red Deer River near Bindloss
- copper (total) on the Red Deer River near Bindloss
- sodium adsorption ratio (SAR) on the Battle, Carrot and Qu'Appelle rivers

Since the completion of the last WQOs review, the COWQ has continued to work to understand better the water quality conditions and requirements needed to address the “under review” status of these parameters.

4. Water Quality Objectives based on Existing Guidelines

In Canada, water quality guidelines (WQGs) are derived to protect major water uses and to define acceptable water quality. National WQGs have been developed by the Canadian Council of Ministers of the Environment (CCME) for the protection of several water uses, including the protection of aquatic life, agricultural uses (livestock watering and irrigation), and fish consumption for birds and wildlife (CCREM 1987). Health Canada also issues water quality guidelines for recreation, fish consumption, and drinking water to protect human health (Health Canada 1996, 2010).

Each of the three provincial jurisdictions have established water quality standards, objectives and guidelines for different water uses. In many cases, jurisdictions adopt or modify national guidelines to meet regional specific conditions. As part of this review, interprovincial WQOs national and provincial water quality guidelines and objectives were reviewed, notably to identify whether there were updates or changes since 2013. The same approach used during the 2013 review was applied for this update. This included adopting the most protective water quality use objective for all water uses (PPWB 2015).

(a) Cadmium (total)

Cadmium (total) has a CCME toxicological guideline developed for the protection of aquatic life calculated based on hardness. In 2014, CCME updated the cadmium (total) guideline. The PAL WQG for cadmium (total) is the most stringent water use guideline. However, this updated national guideline is less stringent than the earlier CCME guideline adopted by the PPWB in 2013 and implemented in 2015. After a review of PPWB data for the 12 transboundary rivers, the Committee is recommending that the 2014 updated CCME cadmium (total) guideline be adopted at all 12 transboundary rivers, including the Red Deer River near Bindloss that was previously listed as “under review”.

(b) Copper (total)

The CCME Copper (total) guideline is toxicology-based for the protection of aquatic life. This guideline is calculated based on the total hardness. In the 2015 WQO review, the CCME copper guideline was adopted for all the transboundary rivers, with the exception of the Red Deer River near Bindloss. This guideline was applied to the other transboundary sites, as it was the most sensitive water use guideline available. The Committee reviewed copper (total) data for the Red Deer River near Bindloss. While there are frequent exceedances, the CCME guideline has been adopted by Alberta in its provincial guidelines and is applied to the Red Deer River within their jurisdiction. Therefore, the Committee is recommending adopting the CCME copper guideline for the Red Deer River near Bindloss.

(c) Silver (total)

The CCME silver (total) guideline is a toxicology-based objective for the protection of aquatic life. In 2015, the CCME updated the silver (total) guideline from 0.1 µg/L to 0.25 µg/L (CCME 2015). The COWQ is recommending that the 2015 updated CCME silver (total) guideline be adopted at all 12 transboundary rivers.

(d) Zinc (dissolved)

The CCME guideline for zinc was updated from a zinc total guideline to a zinc dissolved guideline in 2018. This guideline is calculated based on total hardness, pH, and dissolved organic carbon (DOC). The guideline is a toxicology-based guideline developed for the protection of aquatic life.

The COWQ is recommending that the PPWB replace the zinc total PAL objective adopted in 2015 with the 2018 zinc dissolved guideline developed by CCME, and that the revised interprovincial WQO be applied to all 12 transboundary rivers reaches.

(e) Sodium Adsorption Ratio

Sodium adsorption ratio (SAR) is an irrigation suitability measurement for water supply used to assess soil - water compatibility. In 2015, the PPWB established the SAR value of three (CCREM 1987) for nine of the 12 transboundary rivers. For the Battle, Carrot, and Qu'Appelle rivers, SAR values were above this value due to naturally high cation levels (sodium, calcium and magnesium). As such, an objective was not established for these three river reaches. SAR was listed as "under review" pending further exploration of appropriate values. However, if water from these river reaches was used for irrigation then it was recommended

that consultation with an agricultural irrigation specialist is important to ensure soil – water compatibility for the crop type being irrigated.

Since PPWB's 2015 WQO review, the CCME no longer supports its previous SAR guideline for irrigation. COWQ is recommending that the existing PPWB SAR objective on nine of the 12 river reaches be retained because irrigation is an important water use on the prairies. However, for the three rivers where an objective was not established (Battle, Carrot and Qu'Appelle), the Committee is not recommending a SAR objective. Consultation with an agricultural irrigation specialist is still recommended if these three rivers are to be used for irrigation. The Committee will continue to monitor and track sodium, calcium and magnesium in all transboundary rivers.

(f) AMPA (Aminomethylphosphonic acid)

Aminomethylphosphonic acid (AMPA) is one of the primary metabolites of the herbicide glyphosate. Glyphosate and AMPA are frequently detected in prairie rivers, and often the AMPA concentrations are present at higher levels than glyphosate. While there are no current water quality guidelines/objectives for AMPA, this glyphosate metabolite may be toxic, if not more toxic in the aquatic environment, than its parent compound. Consequently, the COWQ is recommending that given the widespread use of glyphosate in the prairies, the PPWB should report on AMPA values above detection similar to the approach used for detections of glyphosate.

5. Water Quality Objectives based on Background Water Quality

In 2013, the COWQ developed a background (site-specific) approach to setting objectives for water quality parameters for which appropriate water quality objectives were not available (PPWB 2015). This approach was based on the 90th percentile of the historical ambient data. Where data exhibited strong seasonality, 90th percentiles were developed for each of the open and closed water seasons. This approach was also applied in the development of background objectives during this review of interprovincial WQOs.

(a) Iron (dissolved) and Manganese (dissolved)

In the 2015 interprovincial WQOs review, iron and manganese (dissolved) objectives were established for the transboundary rivers. These objectives were based on an aesthetic objective rather than a toxicology objective. However, objectives were not established for iron and manganese (dissolved) on the Carrot River, and manganese (dissolved) on the Assiniboine, Battle, Beaver, Carrot and

Qu'Appelle rivers. For these rivers, iron and/or manganese were described as "under review ". Iron and manganese can be high in prairie rivers, especially during the winter months under ice-covered conditions. Concentrations were considered by the Committee to largely be a function of natural condition.

Since the completion of the 2015 WQOs review, the COWQ has reviewed data for iron (dissolved) on the Red Deer River near Bindloss and for manganese (dissolved) on the Assiniboine, Battle, Beaver, Carrot and Qu'Appelle rivers. These rivers routinely have iron and/or manganese levels above the aesthetic objectives, particularly during the winter months.

Given that the water use objectives for iron and manganese are based on an aesthetic objective and not a toxicity-based objective, the Committee is recommending that iron and manganese (dissolved) objectives on the Carrot River and manganese (dissolved) objectives on the Assiniboine, Battle, Beaver, Carrot and Qu'Appelle rivers be established as background (site-specific) objectives using historical ambient data from 1994 to 2008. The start of the timeframe used for setting background (*i.e*. 1994) was selected because of analytical method changes making pre- and post-1994 metal data not directly comparable. The end period of the time frame was chosen to correspond with that used in developing background objectives in the 2015 review. Objectives based on background data (historical ambient) are not based on protection of a specific water use but they do provide a historical benchmark value that can be used to monitor and assess changes in concentrations of these parameters.

6. Dissolved Oxygen Objectives

Dissolved oxygen (DO) objectives were not established on the Battle River, Beaver River and Carrot River during the ice-covered season during the last WQOs review. These three rivers exhibit low winter flows and low under-ice water depth and as a result, low DO concentrations occur under ice. After the completion of the 2015 WQOs review, the Committee worked to understand better the conditions within these three rivers that affected winter oxygen levels. A report on the available DO information for these three rivers was prepared. The Committee also requested that Environment and Climate Change Canada (ECCC) install continuous dissolved oxygen sensors in the three rivers over the winters of 2015/16 and 2016/17. Review of historic data and continuous DO data demonstrated that DO levels decline rapidly in these rivers once the rivers become ice-covered. The rate of oxygen decline was rapid and similar between years when DO was monitored continuously. Dissolved oxygen levels do not recover until ice-out in the spring. The Committee also followed up with provincial fishery biologists, who noted that there have been no known reported cases of fish kills in these rivers. It is thought that these three rivers do not have major fish populations present in winter.

Given the rate of decline of DO concentrations in these three rivers and that there is no practical or reasonable approach to increase flow in any of the three rivers,

the Committee recommends not establishing a WQO for the ice-covered (winter) period in the Battle, Beaver and Carrot rivers. Low DO conditions are considered to occur naturally due to low under ice water levels, minimal winter flows, and exclusion of atmospheric oxygen transfer due to ice-cover. While no objective is being recommended for these three rivers during the winter period, the dissolved oxygen levels continue to be monitored annually, and objectives reported against for the open-water season.

7. Interprovincial Water Quality Objectives retained but not Currently Monitored by Environment and Climate Change Canada.

As with the 2015 interprovincial water quality objectives review, the COWQ recognizes that some water quality objectives established are not anticipated to be regularly monitored in the foreseeable future. These include reactive chlorine species, cyanide, mercury (in water) radionuclides and fish tissue parameters (Tables 3 and 4). These objectives were included in the Schedule E (1992) objectives and do have nationally supported guidelines or provincial objectives. At this time, the COWQ is recommending retaining these objectives in the event of situations where a related water quality issue arises or in case of an emergency. Retaining the objectives can aid in the prevention and resolution of disputes between the member jurisdictions. In a future WQO review it is recommended that a detailed review of the uses protected by these values be examined.

8. Recommended Interprovincial Water Quality Objectives

The 2020 review of interprovincial WQOs focussed on updating the “under review” status of interprovincial WQOs identified after the *Review of the 1992 Interprovincial Water Quality Objectives and recommendations for Change* (PPWB 2015). The 2020 review also included a review of the national and provincial water use guidelines/objectives for any changes since the completion of the last WQOs review by the PPWB. Given the current interprovincial water quality objectives have only been in use for three years, the scope of the review was limited to these two key areas. Protocols for developing water quality objectives for each water use and the background objectives remained the same as those used in the 2015 review.

The interprovincial WQOs recommended for the transboundary rivers are still predominately based on the most protective water use guideline. The COWQ continues to recommend that all transboundary rivers be protected for all water uses including; the protection of aquatic life, agricultural uses, recreation and aesthetics, treatability for use as a drinking water source, and fish tissue consumption by humans and wildlife. The water use objectives are either provincial guidelines or objectives used within the jurisdiction party to the MAA, or are national guidelines developed by CCME, Health Canada or the United States

Environmental Protection Agency (USEPA). In the case of background (or site-specific) objectives, the objectives are based on historical ambient water quality data. In some cases, background objectives differ based on season.

Similar to the 2015 interprovincial WQOs review, WQOs are recommended for 71 different water quality parameters for the 12 transboundary rivers (Tables 1 to 5). Adoption of water quality objectives for copper (total), iron and manganese (dissolved) are recommended. It is also recommended that three protection of aquatic life metal objectives [cadmium (total), silver (total), and zinc (dissolved)] be updated based on updates made by CCME. Finally, the COWQ recommends that no water quality objectives be adopted for oxygen or SAR on the Battle, Beaver and Carrot Rivers.

9. Monitoring Program Suitability

Assessment of exceedances/adherence resulting from changing WQOs based on the recommended changes outlined above are supported within the existing PPWB water quality monitoring program. This is because the parameter list for the interprovincial water quality objectives remains essentially the same as the list associated with the 2015 interprovincial WQOs update. The only addition relates to the recommendation to report detections of AMPA (Aminomethylphosphonic acid) which is already being monitored at transboundary sites.

Although not affected or altered by the current recommendations (2020) exceedance/adherence to the fish tissue objectives cannot presently be evaluated because fish tissue is not currently sampled. The fish tissue program was suspended pending a review of existing but previously unanalyzed PPWB fish tissue data and a review of the previous fish tissue/biological monitoring program design. COWQ is currently exploring options for future fish tissue or biological monitoring activities.

10. Recommended Next Steps

The next review of PPWB water quality objectives is scheduled for completion in 2025.

Table 1 Recommended Interprovincial Water Quality Objectives for the Transboundary River Reaches at the Alberta/Saskatchewan Boundary Currently Monitored by Environment and Climate Change Canada

2020 Recommended Interprovincial Water Quality Objectives– AB/SK Boundary						
Parameter	**River**					
Nutrients	**Battle River**	**Beaver River**	**Cold River**	**North Saskatchewan River**	**Red Deer River (Bindloss)**	**South Saskatchewan River**
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
General Water Chemistry						
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 Season (>5°C)	5	5	5	5	5	5
Closed Season (<5°C)	No Objective	No objective	3	3	3	3
Sodium Adsorption Ratio	No Objective	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	500	500	500	500	500
Cadmium Total (µg/L)	Calculated[b]	Calculated[b]	Calculated[b]	Calculated[b]	Calculated[b]	Calculated[b]
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[b]	Calculated[b]	Calculated[b]	Calculated[b]	Calculated[b]	Calculated[b]
Iron Dissolved (µg/L)	300	300	300	300	300	300
Lead Total (µg/L)	Calculated[b]	Calculated[b]	Calculated[b]	Calculated[b]	Calculated[b]	Calculated[b]
Lithium Total (µg/L)	2500	2500	2500	2500	2500	2500
Manganese Dissolved (µg/L)	27.0 | 1257.0	40.0 | 2270.0	50	50	50	50
Molybdenum Total (µg/L)	10	10	10	10	10	10
Nickel Dissolved (µg/L)	Calculated[b]	Calculated[b]	Calculated[b]	Calculated[b]	Calculated[b]	Calculated[b]
Selenium Total (µg/L)	1	1	1	1	1	1
Silver Total (µg/L)	0.25	0.25	0.25	0.25	0.25	0.25
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 Dissolved (µg/L)	Calculated[b]	Calculated[b]	Calculated[b]	Calculated[b]	Calculated[b]	Calculated[b]

2020 Recommended Water Quality Objectives – AB/SK Border						
Parameter / **Pesticides**	**River**					
	Battle River	**Beaver River**	**Cold River**	**North Saskatchewan River**	**Red Deer River (Bindloss)**	**South Saskatchewan 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 (µg/L)	Report Detections	Report Detections	Report Detections	Report Detections	Report Detections	Report Detections
AMPA (µg/L)	Report Detections	Report Detections	Report Detections	Report Detections	Report Detections	Report Detections

Superscripts

a. Ammonia objective: Expressed as mg unionized ammonia/L. This would be equivalent to 0.0156 mg ammonia-nitrogen/L (0.019*14.0067/17.031).

b. The objective value in µg/L is a function of total hardness (CaCO3 mg/L) in the water column: Cadmium Total is calculated using Cadmium = $10^{\{0.83(\log[\text{hardness}]) - 2.46\}}$ for hardness values between 17 and 280 mg $CaCO_3$/L. Copper Total's objective is 2 when total hardness is <82 or unknown, 4 when >180, and calculated using $0.2*e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ when total hardness is ≥82 to ≤180. Lead Total's objective is 1 when total hardness is ≤60 or unknown, 7 when >180, and calculated using $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ when total hardness is >60 to ≤180. Nickel Dissolved is calculated using $0.998*e^{\{0.8460[\ln(\text{hardness})]+2.255\}}$. Zinc dissolved is calculated using Zinc = $\exp^{(0.947[\ln(\text{hardness mg·L-1})] - 0.815[\text{pH}] + 0.398[\ln(\text{DOC mg·L-1})] + 4.625)}$.

Legend

Protection of Aquatic Life	Ag-Livestock	Ag-Irrigation	Recreation	Treatability	Ag-Irrigation + Treatability	Ag-Irrigation and Livestock	Background

Table 2 Recommended Interprovincial Water Quality Objectives for the Transboundary River Reaches at the Saskatchewan/Manitoba Boundary, Monitored by Environment and Climate Change Canada

2020 Recommended Interprovincial Water Quality Objectives – SK/MB Boundary							
Parameter	**River**						
Nutrients	**Assiniboine River**	**Carrot River**		**Churchill River**	**Qu'Appelle River**	**Red Deer River (Erwood)**	**Saskatchewan River**
		Open	Closed				
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
General Water Chemistry							
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 Season (>5°C)	5	5		5	5	5	5
Closed Season (<5°C)	3	No Objective		3	3	3	3
Sodium Adsorption Ratio	3	No Objective		3	No Objective	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	500		500	500	500	500
Cadmium Total (µg/L)	Calculated[b]	Calculated[b]		Calculated[b]	Calculated[b]	Calculated[b]	Calculated[b]
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[b]	Calculated[b]		Calculated[b]	Calculated[b]	Calculated[b]	Calculated[b]
Iron Dissolved (µg/L)	300	237.2	2121.0	300	300	300	300
Lead Total (µg/L)	Calculated[b]	Calculated[b]		Calculated[b]	Calculated[b]	Calculated[b]	Calculated[b]
Lithium Total (µg/L)	2500	2500		2500	2500	2500	2500
Manganese Dissolved (µg/L)	224.8 | 329.0	271.8	2014.0	50	93.8	116.8	50	50
Molybdenum Total (µg/L)	10	10		10	10	10	10
Nickel Dissolved (µg/L)	Calculated[b]	Calculated[b]		Calculated[b]	Calculated[b]	Calculated[b]	Calculated[b]
Selenium Total (µg/L)	1	1		1	1	1	1
Silver Total (µg/L)	0.25	0.25		0.25	0.25	0.25	0.25
Thallium Total	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 Dissolved (µg/L)	Calculated[b]	Calculated[b]		Calculated[b]	Calculated[b]	Calculated[b]	Calculated[b]

2020 Recommended Water Quality Objectives– SK/MB Boundary							
Parameter	**River**						
Pesticides	**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 (µg/L)	Report Detections	Report Detections		Report Detections	Report Detections	Report Detections	Report Detections
AMPA (µg/L)	Report Detections	Report Detections		Report Detections	Report Detections	Report Detections	Report Detections

Superscripts

a. Ammonia objective: Expressed as mg unionized ammonia/L. This would be equivalent to 0.0156 mg ammonia-nitrogen/L (0.019*14.0067/17.031).

b. The objective value in µg/L is a function of total hardness (CaCO3 mg/L) in the water column: Cadmium Total is calculated using Cadmium = $10^{\{0.83(\log[\text{hardness}]) - 2.46\}}$. Copper Total's objective is 2 when total hardness is <82 or unknown, 4 when >180, and calculated using $0.2*e^{\{0.8545[\ln(\text{hardness})]-1.465\}}$ when total hardness is ≥82 to ≤180. Lead Total's objective is 1 when total hardness is ≤60 or unknown, 7 when >180, and calculated using $e^{\{1.273[\ln(\text{hardness})]-4.705\}}$ when total hardness is >60 to ≤180. Nickel Dissolved is calculated using $0.998*e^{\{0.8460[\ln(\text{hardness})]+2.255\}}$. Zinc dissolved is calculated using $\text{Zinc} = \exp^{(0.947[\ln(\text{hardness mg·L-1})] - 0.815[\text{pH}] + 0.398[\ln(\text{DOC mg·L-1})] + 4.625)}$.

Legend

Protection of Aquatic Life	Ag-Livestock	Ag-Irrigation	Recreation	Treatability	Ag-Irrigation + Treatability	Ag-Irrigation and Livestock	Background

Table 3 Recommended Interprovincial Water Quality Objectives for the Transboundary River Reaches at the Alberta/Saskatchewan Boundary, not Currently Monitored by Environment and Climate Change Canada.

2020 Recommended Water Quality Objectives – Alberta/Saskatchewan Boundary						
Parameter	**River**					
	Battle River	**Beaver River**	**Cold River**	**North Saskatchewan River**	**Red Deer River (Bindloss)**	**South Saskatchewan River**
General Water Chemistry						
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

Table 4 Recommended Interprovincial Water Quality Objectives for the Transboundary River Reaches at the Saskatchewan/Manitoba Boundary not Currently Monitored by Environment and Climate Canada.

2020 Recommended Water Quality Objectives– Saskatchewan/Manitoba Border						
Parameter	**River**					
	Assiniboine River	**Carrot River**	**Churchill River**	**Qu'Appelle River**	**Red Deer River (Erwood)**	**Saskatchewan River**
General Water Chemistry						
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

Table 5 Recommended Nutrient Objectives for the Transboundary River Reaches Based on a Background Approach

Recommended Nutrient Objectives							
Proposed Objectives for Nutrients		Total Phosphorus (mg/L)		Total Dissolved Phosphorus (mg/L)		Total Nitrogen (mg/L)	
Alberta - Saskatchewan Border							
Battle River Near Unwin	Summer	0.267	0.335	0.051		2.260	
	Winter	0.075	0.100	0.045		1.550	
Beaver River at Beaver Crossing	Summer	0.171		0.043	0.060	1.140	
	Winter	0.127		0.042	0.060	1.862	
Cold River at Outlet of Cold Lake	Summer	0.023		0.010		0.453	0.460
	Winter	0.024		0.017		0.452	0.467
North Saskatchewan River at Highway 17	Summer	0.253	0.278	0.026	0.046	1.169	1.230
	Winter	0.063	0.115	0.048	0.101	1.175	1.225
Red Deer River Near Bindloss	Summer	0.315	0.563	0.023	0.035	2.320	
	Winter	0.035	0.069	0.008	0.024	0.860	
South Saskatchewan River	Summer	0.159	0.246	0.014	0.018	1.073	1.114
	Winter	0.054	0.110	0.010	0.067	1.638	1.771

Recommended Nutrient Objectives							
Proposed Objectives for Nutrients		Total Phosphorus (mg/L)		Total Dissolved Phosphorus (mg/L)		Total Nitrogen (mg/L)	
Saskatchewan - Manitoba Border							
Assiniboine River at Hwy 8 Bridge	Summer	0.311		0.186		1.801	
	Winter	0.180		0.115		2.252	
Carrot River near Turnberry	Summer	0.099	0.140	0.027	0.057	1.087	1.417
	Winter	0.170	0.266	0.031	0.059	1.814	2.052
Churchill River below Wasawakasik	Summer	0.025		0.010		0.484	
	Winter	0.021		0.010		0.411	
Qu'Appelle River	Summer	0.278	0.304	0.156	0.190	1.822	
	Winter	0.221	0.290	0.129	0.249	1.767	
Red Deer River at Erwood	Summer	0.052	0.066	0.021	0.029	1.195	
	Winter	0.074	0.161	0.025	0.055	1.998	
Saskatchewan River	Summer	0.088	0.124	0.014	0.018	0.838	
	Winter	0.028	0.034	0.011	0.017	0.761	

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

10. Acknowledgements

This interprovincial water quality objectives update document was prepared by Dr. Joanne Sketchell of the PPWB Secretariat, with reviews and comments provided by the COWQ. Environment and Climate Change Canada, Water Quality Monitoring and Surveillance provided water quality data used in the objectives review and Environment and Climate Change Canada, Water Survey of Canada provided water flow data. Many thanks are also extended to the students who worked with the PPWB Secretariat under the supervision of Dr. Joanne Sketchell on the statistical analysis and data calculations provided to the COWQ throughout this water quality objectives review.

11. Committee on Water Quality Members

Mike Renouf, PPWB Executive Director (Chair)
Joanne Sketchell, Environment and Climate Change Canada (COWQ Secretary)
Paul Klawunn, Environment and Climate Change Canada
Claudia Sheedy, Agriculture and Agri-Food Canada
Gongchen Li, Alberta Environment and Parks
John-Mark Davies, Saskatchewan's Water Security Agency
Elaine Page, Manitoba Sustainable Development

12. References

Canadian Council of Ministers of the Environment. 1999. Canadian water quality guidelines for the protection of aquatic life: Summary table. *In* Canadian environmental quality guidelines, 1999. Winnipeg: Canadian Council of Ministers of the Environment. Updated guidelines on the Internet at http://ceqg-rcqe.ccme.ca/

Canadian Council of Resource and Environment Ministers. 1987. Canadian water quality guidelines. Prepared by the Task Group on Water Quality Guidelines of the Canadian Council of Resource and Environment Ministers. Ottawa: Environment Canada.

Health Canada. 1996. Guidelines for Canadian drinking water quality. 6th edition. Prepared by the Federal-Provincial-Territorial Committee on Drinking Water. Ottawa: Health Canada. ISBN 0-660-16295-4. Updated guidelines on the Internet at http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/2010-sum_guide-res_recom/index-eng.php

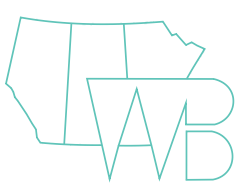
Health Canada. 2010. Guidelines for Canadian recreational water quality. 3rd edition. Prepared by the Federal-Provincial-Territorial Committee on Drinking Water. Ottawa: Health Canada. Updated guidelines on the

Internet at http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/guide_water-2012-guide_eau/index-eng.php

Prairie Provinces Water Board. 1969 Master Agreement on Apportionment

Prairie Provinces Water Board. 1992. Schedule E to the master agreement on apportionment. Regina: PPWB. Internet URL http://www.ppwb.ca/uploads/files/general/37//ppwb-water-quality-objectives.pdf

PPWB (2015). Review of the 1992 Interprovincial Water Quality Objectives and Recommendations for Change. PPWB Technical Report #174 608 pp.



Prairie Provinces Water Board
Suite 1001 - 10th Floor, Alvin Hamilton Building
1783 Hamilton Street
Regina, SK S4P 2B6
www.ppwb.ca