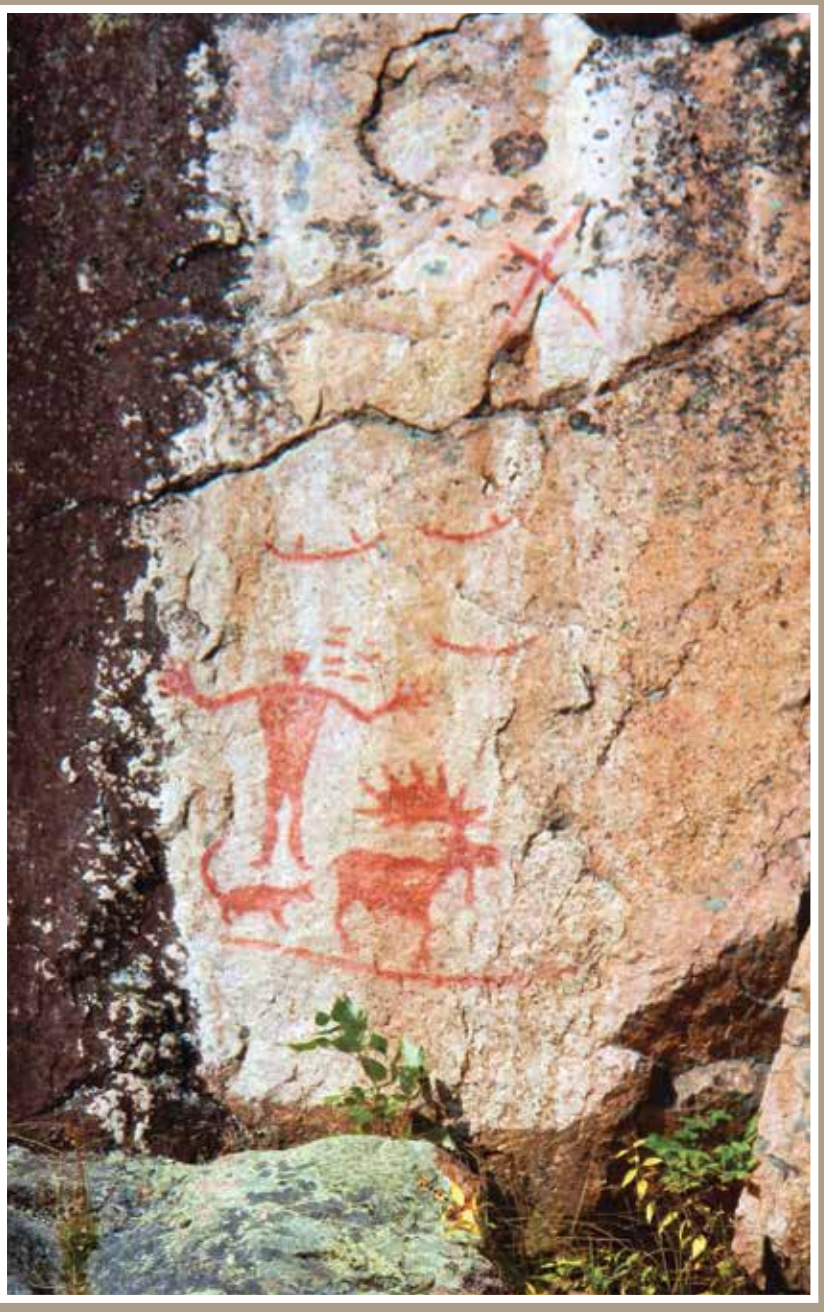
OVERVIEW

RAINY-LAKE OF THE WOODS

State of the Basin Report

3RD EDITION
March 2022



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About this Overview Report:
This Overview report contains information summarized from the full technical version of the Rainy-Lake of the Woods State of the Basin Report, March 2022. This Overview provides summary highlights, in non-technical language, of the detailed technical information and data contained in the full report. We encourage interested readers to explore additional details in the full 148-page version, available from the Foundation's website, https://www.lowwsf.com/sobr

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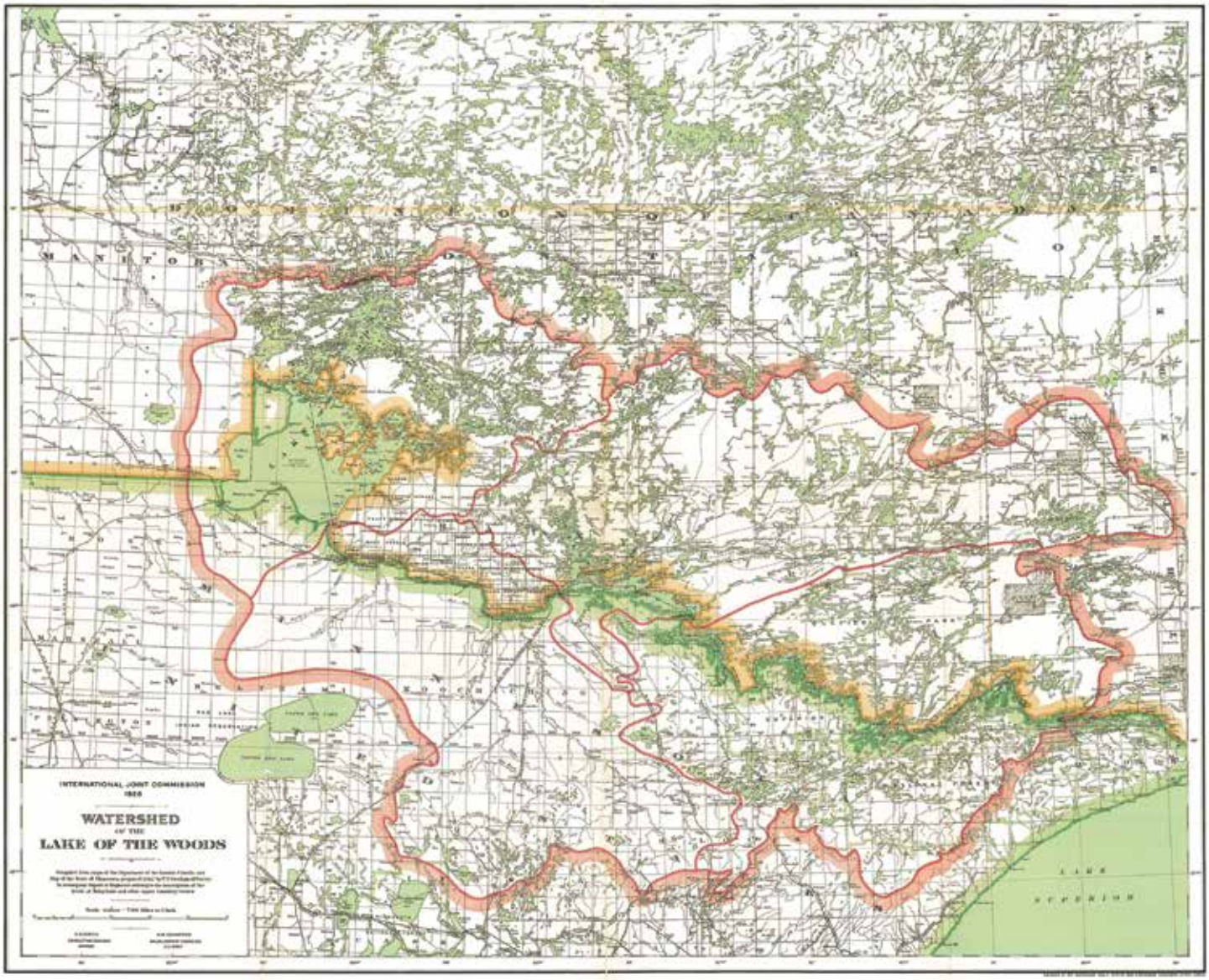
Editors' Note

This report was a collaborative effort, and its completion would not have been possible without the contributions of numerous researchers, resource managers and agencies in the basin. We extend special thanks to the Western Science and Indigenous Advisors for their contributions.

The information contained in this State of the Basin Report – 3rd Edition was compiled and/or synthesized by the Editors and the Editorial Committee from information in the original 2009 and 2014 reports and from published and unpublished research that has become available since 2014.

This project was undertaken with the financial support of the International Joint Commission, the Lake of the Woods Water Sustainability Foundation, the Government of Canada through the federal Department of Environment and Climate Change – Lake Winnipeg Basin Program, Grand Council Treaty #3, and inestimable in-kind contributions from researchers, resource managers and agencies in the Rainy-Lake of the Woods Basin. We extend our great thanks to all these contributors. We also thank Patrice Nelson for graphical design and layout of this report.

Cover photo: Paul Haverkamp: Pictographs, North Hegman Lake, Minnesota



The Rainy-Lake of the Woods Watershed, IJC 1928

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INTRODUCTION

Over the past several decades, an impressive amount of research and monitoring has been conducted in the Rainy-Lake of the Woods Basin. The previous State of the Basin Reports (SOBR) in 2009 and 2014 provided details on a wide range of topics, including: drainage basin characteristics, water chemistry and nutrients, biotic communities, emerging threats and an overview of the information gaps and monitoring needs that were identified at those times.

The focus of the current State of the Basin Report is on changes that have occurred since 2014 in the primary areas of concern. These were identified by various studies as **nutrients, contaminants, climate change, aquatic invasive species, and erosion/water levels**. Since 2014 there have been additional concerns with respect to the health of the fishery in the north end of Lake of the Woods (LoW) and thus this was added as a concern in this report. In addition, aspects of human health concerns are included for the first time in this SOBR 3rd Edition 2022.

The SOBR 3rd Edition 2022 contains a review of governance in the basin and a chapter to describe Indigenous Knowledge systems and worldview from the standpoint of the Anishinaabe Nation of Treaty #3, US Tribes and the Métis Nation of Ontario. The report also includes aspects of Traditional Knowledge or Indigenous perspective in recognition of a multi-jurisdictional basin. Throughout the report, highlighted are Indigenous concerns or impacts, and questions to shift our lens of view to ensure respect and acknowledgement of the Indigenous Nations in the basin.

The SOBR 3rd Edition 2022 examines the recommendations provided in previous key reports to establish if these recommendations are still valid and, more importantly, have they been followed?

This Overview provides summary highlights, in non-technical language, of the detailed technical information and data contained in the full report. We encourage interested readers to explore additional details in the full 148-page version, available from the Foundation's website, https://www.lowwsf.com/sobr.

WATERSHED GOVERNANCE AND INDIGENOUS NATIONS

The first chapter of the 3rd Edition examines the nature of a multijurisdictional basin. What makes this basin and governance unique is that the United States and Canada are not the only nations with jurisdiction in the basin as US Tribes, Métis Nation of Ontario, and Anishinaabe Nation in Treaty #3 all have rights and jurisdiction as Nations in the watershed. Governance is examined with suggestions about how governance, regulation, and management of resources in the basin can be better represented by Canada, the US and the Indigenous Nations in the Basin. This is aligned with the concept of two eyed seeing. As we look at governance in this report and the science developed in the basin, it is important to ask the following questions; How does the basin and those working within it acknowledge and respect the treaties both Canada and the US have signed? Where are the gaps in terms of the development of a vision for the basin that is inclusive and encompasses the rights of all jurisdictions?

The second chapter in the report is devoted to describing Indigenous Nations within the basin (Figure 1) together with the Treaties and rights associated with each. These include:

- **Anishinaabe Nation of Treaty #3**, including an overview of Anishinaabe law, Manito Aki Inaakonigaawin, and the Treaty #3 Nibi Declaration.
- **Métis Nation of Ontario**, Northwestern Ontario Métis Community, highlighting how this way of life contributes to the collective knowledge of the community and acknowledges the oral traditions of Indigenous peoples across Canada.

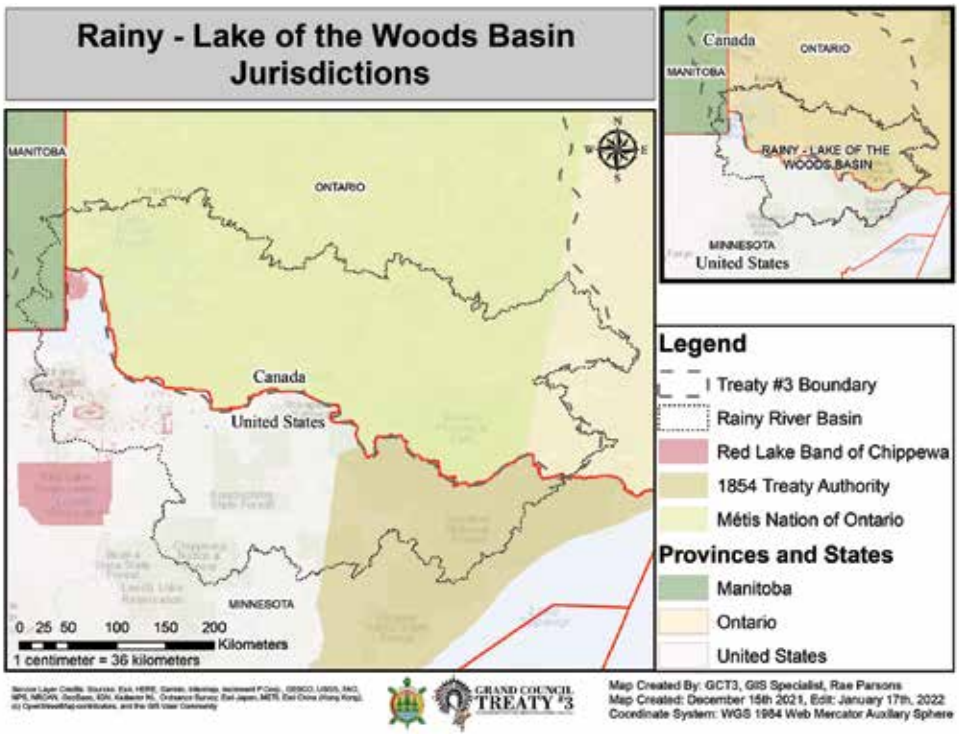


Figure 1: The boundaries and overlap of Nations in the basin.

- **Red Lake Band of Chippewa** describing aspects of tribal government and involvement in fisheries and water resource management.
- **1854 Treaty Authority** including an overview of the rights of the Grand Portage and Bois Forte Bands of Lake Superior.

Indigenous Statements/Questions

Throughout the full 148-page version of the 2022 SOBR, there are Indigenous questions or statements highlighted in blue callout boxes. The context of these can be lost in a summary document, so these Indigenous statements, questions, or concerns are listed at the end of each chapter in this summary of the SOBR.

NUTRIENTS AND ALGAE

Overview

Algal blooms continue to be a concern in many areas of the basin and in Lake of the Woods (LoW) in particular. Blooms continued in 2021, extending to the north portion of the lake as illustrated by satellite data showing chlorophyll which is a photosynthetic pigment used as an indicator of algal biomass (Figure 2).

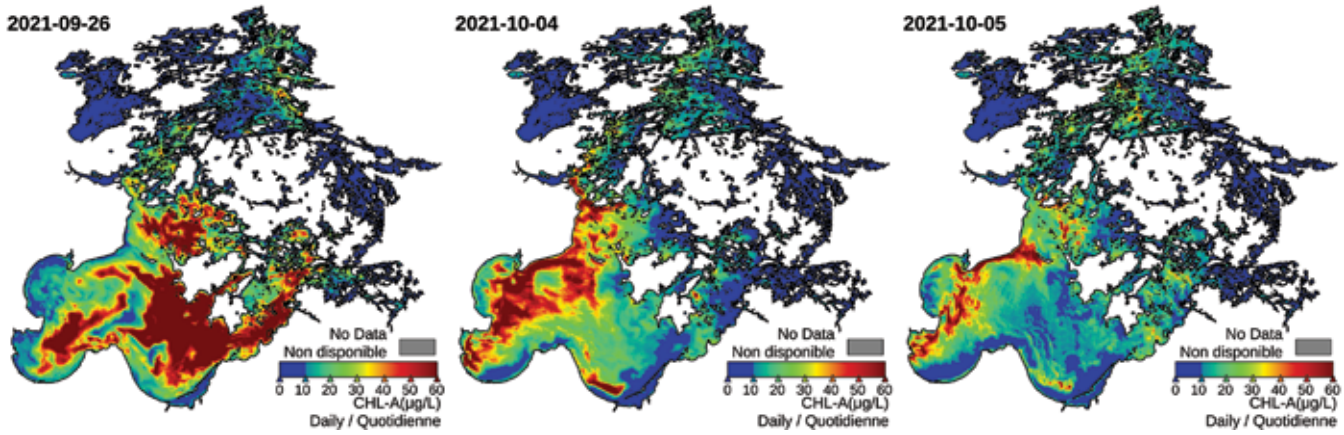


Figure 2: Chlorophyll concentrations on three dates in 2021 in Lake of the Woods (EOLakeWatch, Caren Binding ECCC).

There has been a great deal of progress with respect to understanding and managing nutrients and their impact on algal blooms since 2014. Much of this work has focused on Lake of the Woods and its primary source of water, the Rainy River. In all cases the research has focused on phosphorus (P) which is the primary nutrient that controls the growth of algae in the basin. All measurements presented in this report are as total phosphorus (TP).

The 3rd Edition describes three major watershed studies devoted to nutrients. These are:

1. IJC's Objectives and Alerts project (IJC O&A). This is a whole watershed study which examines other objectives in addition to nutrients.
2. Lake of the Woods Science Program (2016–2020) and Ecosystem Objective and Phosphorus Reduction Scenario development which pertains to the Rainy River and the entire Lake of the Woods.
3. Minnesota's TMDL study which focuses on the Rainy River and the south basin of Lake of the Woods.

There has been a great deal of progress with respect to understanding and managing nutrients and their impact on algal blooms since 2014.

IJC Objectives and Alerts Project

This report summarizes the results of the first phase (2019) of a project to examine the need for international water quality objectives (WQOs) and alert levels (Als) for the boundary waters in the Rainy-Lake of the Woods watershed. Alert levels are used by the International Rainy-Lake of the Woods Watershed Board as advisory triggers where internationally-agreed upon water quality objectives do not exist.

Phase I of the project, now completed, recommended that outdated WQOs for the Rainy River be replaced, and that the only issue that rose to the level of concern requiring internationally-agreed upon objectives was phosphorus on Lake of the Woods and the Rainy River. It recommended development of a set of total phosphorus objectives for various segments of the Lake of the Woods and the Rainy River. No other parameters were considered as requiring objectives. It was proposed that the four remaining priorities (contaminants, climate change, aquatic invasive species, and erosion/water levels) be addressed using ALs. The individual specific guidelines associated with proposed WQOs and ALs will be established during Phase II.

ECCC Lake of the Woods Science Program (2016–2020) and Ecosystem Objective and Phosphorus Reduction Scenario development

Environment and Climate Change Canada's Lake of the Woods Science Program (2016-2020) focused on four themes including: enhanced monitoring of Lake of the Woods, Rainy River and select tributaries in Canada; nutrient and algae research; development of tools to identify and monitor algae blooms using remote sensing; and development of integrated watershed and lake-based models to assess lake responses to nutrient reductions.

Empirical data and these integrated models were used to develop phosphorus-load-response curves for open-water TP and Chl-*a* concentrations for various sectors of the lake.

Empirical data and these integrated models were used to develop phosphorus-load-response curves for open-water TP and Chl-*a* concentrations for various sectors of the lake. A number of options for future desirable water quality and ecosystem health conditions were identified and the computer models were used to determine the level of phosphorus reduction that would be needed to achieve each. The scenario of a 20% reduction in total phosphorus load to Lake of the Woods was considered to best satisfy the proposed desired Ecosystem Objectives, which were to:

1. Maintain the diversity of trophic status (lake productivity) for different areas of the lake.
2. Maintain levels of algae below those constituting a nuisance and/or harmful condition.
3. Minimize the extent of hypoxia (low oxygen events) in the southern basin to protect aquatic life and maintain a healthy aquatic ecosystem.

Minnesota Total Maximum Daily Load (TMDL) Study

The Minnesota TMDL study provides a comprehensive assessment of TP loads from all sources to the Rainy River and south basin of Lake of the Woods, illustrated as percent of total load in Figure 3. The TMDL, approved in July 2021, sets TP targets for each US source, with the goal of reducing TP and chlorophyl-*a* concentrations in the US portion of Lake of the Woods to within the State's water quality standards.

Minnesota is using these targets to set revised permits for point sources and to develop Watershed Restoration Protection Strategies (WRAPS) for non-point, more diffuse landscape sources of phosphorus. Most point source

permits meet the requirements now, with two soon to be amended during regular reissue. WRAPS development is in progress.

It is worth noting that although many of the model components or approaches are not directly comparable between the ECCC and Minnesota models, there is general agreement with respect to the magnitude of loads and potential reductions. The understanding of P loads and required reductions seems to be converging among the different agencies.

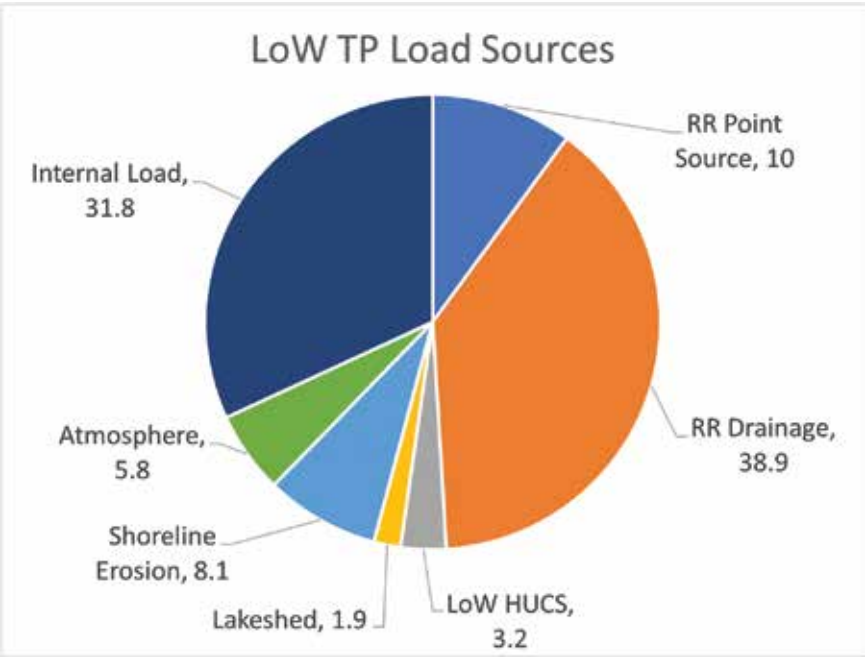


Figure 3: Percent of total loads to LoW from various sources (for portion of the watershed included in the TMDL).

Total Phosphorus Concentrations Across the Rainy-Lake of the Woods Basin

The 2022 Edition of the SOBR examines total phosphorus concentrations in four areas of the watershed from the headwaters, downstream to Lake of the Woods, namely:

1. Rainy River headwaters.
2. Rainy River.
3. Lake of the Woods South.
4. Lake of the Woods North.

There is no evidence of significant changes in phosphorus concentrations since the 2014 SOBR for the areas of the Rainy-Lake of the Woods Basin described in this report. Both seasonal and between-year variations in TP concentrations coupled with extreme observed spatial variation make it difficult to describe average conditions in any one area of the basin.

Rainy River Headwaters

Monitoring in the Rainy River headwaters indicate that concentrations of phosphorus, chlorophyll-a (Chl-*a*), and Secchi transparencies are at expected and acceptable levels given the area's dominant forest and wetlands, limited

Lake Kabetogama algal bloom. (Lee Grim)

lakeshore development, and high percentage of protected lands. Headwater lakes are, with few exceptions, below 20 µg/L TP. All lakes, except for Blueberry Lake near Ely meet eutrophication standards. Shallow Lake Kabetogama supports recreational use but is susceptible to algal blooms and is nearing eutrophic conditions. Sixty-two of sixty-four assessed streams fully supported aquatic life and none of the stream reaches were classified as limited resource waters by the Minnesota Pollution Control Agency.

Voyageurs National Park's (VNP) larger lakes have seen an improvement in water quality with a reduction in Chl-*a* concentrations since about 2000. This is a result of a change in water level management that allowed a more natural water regime.

Ontario Ministry of the Environment, Conservation and Parks' (MECP) Lake Partner Program (LPP) data show that most areas in the headwaters have TP concentrations below 20 µg/L. This is acceptable water quality according to Ontario's Provincial Water Quality Objectives (PWQOs).

The Ontario Broadscale monitoring program has collected comprehensive data for many inland lakes in the headwaters over two sample cycles. These cannot be used yet for trend analysis but are useful to characterize water quality in these lakes. These data are included in the full technical version of the SOBR.

Manitou Rapids on the Rainy River. (Lee Grim)

The Rainy River

The focus of attention with respect to phosphorus loading to LoW has been to examine loads from the Rainy River. This is because the only substantial and realistically controllable sources of phosphorus to LoW enter via the Rainy River. It is difficult to describe mean concentrations of any parameter in the river environment due to daily and seasonal variations in runoff and river flow. Flow-weighted means are used to account for this and present the best estimate of ambient concentration over time. TP in the Rainy River has remained remarkedly consistent over the past decade, with an average flow-weighted mean of 33 µg/L

based on detailed data collected at Manitou Rapids. The recent MPCA 2020 Rainy River Study reports that the Rainy River has improved substantially compared to previous decades and is now considered to be in excellent condition. Nevertheless, TP load reductions prescribed in the TMDL are required to restore Lake of the Woods to state water quality standards and de-list the US portion of the lake as an impaired water.

Lake of the Woods South

In the southern basin of Lake of the Woods, phosphorus concentrations increase throughout the summer and into the late fall. ECCC TP data for the stations monitored in the south portion of the lake show average concentrations of pooled, mixed layer and surface samples collected between 2015 and 2019 having a June mean of 19.3 µg/L (nine stations in the south basin) and a mean of 33.2 µg/L for the September data.

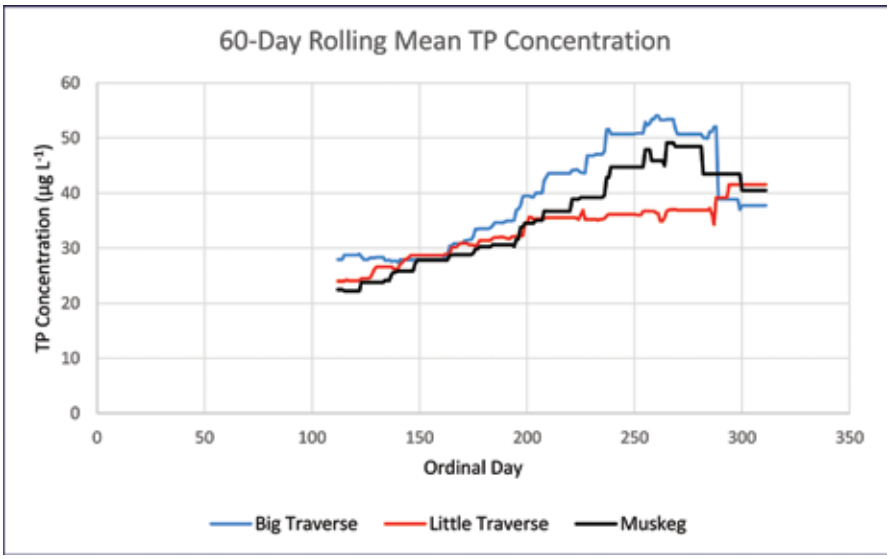


Figure 4: 60 day rolling means of total phosphorus from the TMDL study in Minnesota.

Ontario's Ministry of the Environment Conservation and Parks - Lake Partner Program continues to collect TP data at many locations in the south basin of LoW although the large areas in Big Traverse that lie within the US are not sampled. Many datasets show a range in concentrations that are low in the spring (20-30 µg/L) and higher in the fall (40-50 µg/L). Seasonal monitoring conducted by the MPCA shows the pattern of increasing TP concentration above 30 µg/L in late summer and continuing higher through late fall (Figure 4). A process called internal loading likely contributes to these increasing concentrations through the summer season. These seasonal data demonstrate the importance of seasonal monitoring and, in particular, examining the TP concentrations in the lake at those times when algal blooms are most likely to occur.

Lake of the Woods North

Lake Partner Program data for the northern area of Lake of the Woods indicate that most of the TP measurements in the north end of the lake

What Is Internal Loading?

Internal loading is a process whereby lake sediments can contribute phosphorus to the overlying water and thereby potentially exacerbate algal blooms. It has been recognised for many decades that internal loads can be influenced by factors including anoxia, temperature, sediment P concentration and the presence of certain elements like iron. Phosphorus built up in lake sediments from previous decades of uncontrolled pollution can recycle into the overlying water. Research now suggests that this pool of available phosphorus is decreasing slowly as it gets flushed out of the lake. Researchers have estimated that, with continued decreases in watershed phosphorus loading, the internal load will decrease approximately 1% per year.

are below 20 µg/L. This is acceptable water quality according to Ontario's provincial water quality objectives. Water below 20 µg/L has a reduced risk of nuisance algal blooms. Water flowing from the south can result in concentrations in central areas that are over 20 µg/L. Water flows from the north central area near Kenora into the Winnipeg River at concentrations between 20 and 30 µg/L depending on the time of year, with a seasonal average of 23 µg/L.

An excellent long-term data record from the Lake Partner Program, at a station near Coney Island in the north central portion of the lake, indicates that there has not been any significant change in TP concentrations since 2014 (Figure 5). Concentrations have been stable with perhaps a slight, but not significant, decline since around 2008. Long-term trends are difficult to interpret due to higher variability in the earlier data.

The bays in the northwest (e.g., the Ptarmigan-Clearwater complex of bays) and northeast (i.e., Whitefish Bay) have lower TP concentrations, typically between 10–15 µg/L. Although connected to the north end of the lake, these embayments are isolated from the influence of the south to north flow of the main lake.

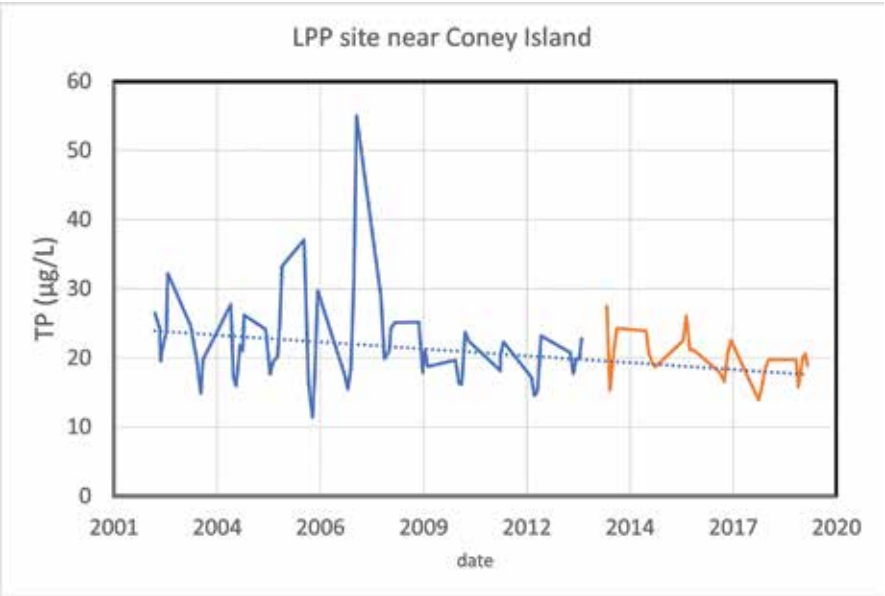


Figure 5: Long- term data record from the Lake Partner Program at Coney Island. Orange data indicates samples collected since 2014. Long-term trends are difficult to interpret due to higher variability in the earlier data.

Lake of the Woods TP Concentration Summary

Both seasonal and between-year variations in TP concentrations coupled with extreme observed spatial variation make it difficult to describe average conditions in any one area of the basin. Still, there is a great deal of empirical data to help us derive estimates. A very useful dataset collected by the Ontario Lake of the Woods Fisheries Assessment Unit contains 30 to 90 observations for many sites throughout the lake. Sample locations are shown in Figure 6.

The large volume of TP data for each site can be summarized with "box and whisker" plots which graphically present averages and ranges in the data.

Figure 7 shows box and whisker plots for sample locations from the south (left plots) to the north (right plots) up through the central portion of the lake. Note that these data include MPCA data for Buffalo Bay and Lake Partner data for a site near Coney Island. Median and mean values are around 30 µg/L (or above) in the south sites and concentrations decrease to slightly above 20 µg/L for the sites towards the outflow at the Norman Dam.

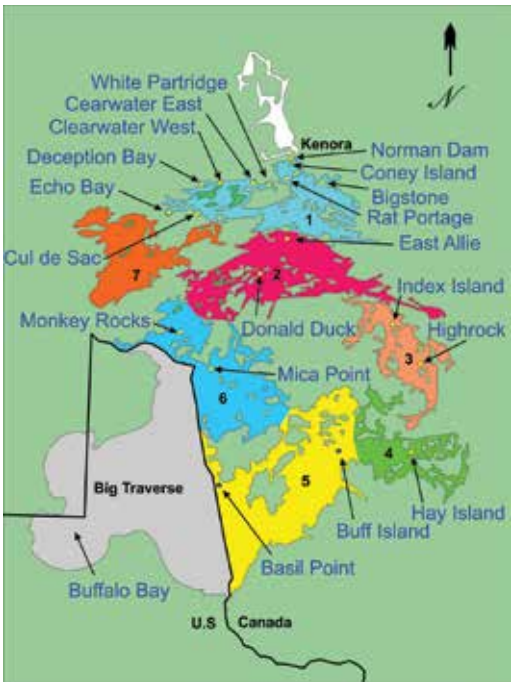
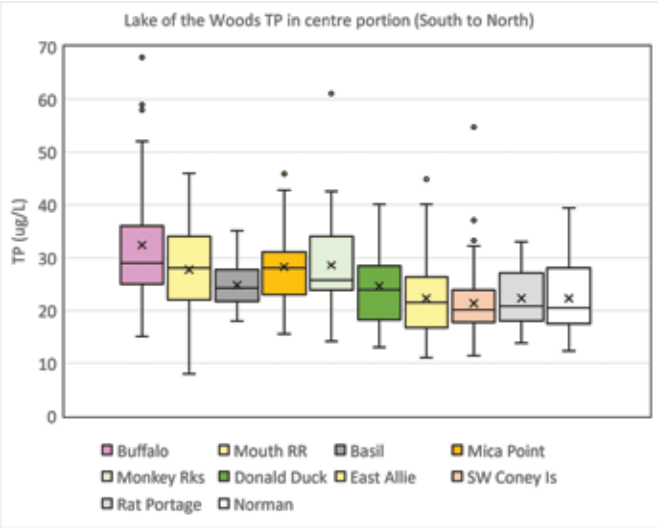


Figure 6: Sample locations for FAU /Broadscale monitoring data including 1 site using MPCA data (Buffalo Bay) and 1 site using LPP data (Coney Island).



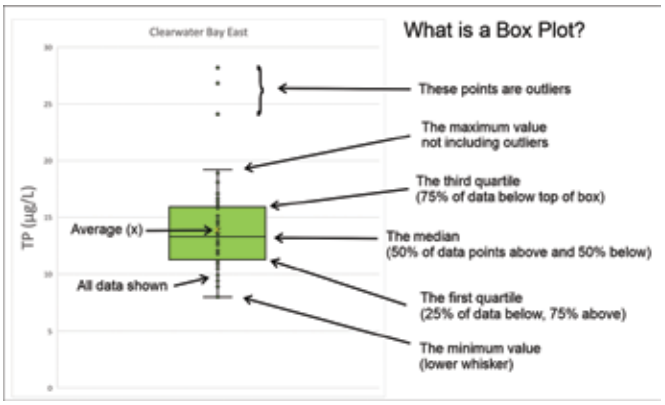


Figure 7: Box plots for TP datasets spanning the south (left) to north (right) centre lake sample locations. Data were collected by the Lake of the Woods Fisheries Assessment Unit.

Sentinel-2 satellite image of algal blooms in Lake of the Woods, October 4, 2021

Action and Tools Development for Nutrients and Algal Blooms

Recently developed tools include Minnesota's TMDL TP load reduction targets for sources to the Rainy River and Lake of the Woods, and ECCC's proposed potential reductions scenarios. For the latter, next steps could eventually include proposed reductions to support in-lake processes that should improve bloom severity, the effectiveness of which could be monitored using satellite technology.

In Minnesota, actions resulting from TMDLs include revisions to permits for point sources and development of Watershed Restoration and Protection Strategies (WRAPS) for diffuse non-point sources, and then funded actions to implement WRAPS, typically with a combination of local landowner and local, state, and federal governments' funds.

Satellite images can now be used to determine the extent and intensity of algal blooms, and these can be combined to give a measure of bloom severity. These measures, produced operationally by ECCC's EOLakeWatch, are reported on a daily basis and compiled both as growing season average and maximum indices. Satellite data can be used to examine changes that may be tied to weather or to TP concentrations.

By multiplying bloom extent (km^2) by bloom intensity (µg/L chlorophyll), it is possible to derive an index of severity (Figure 8) with units of µg/L km^2. The severity scale can be based on maximum or average conditions. Presentation here is based on maximum data and thus relates to the worst conditions noted for each year.

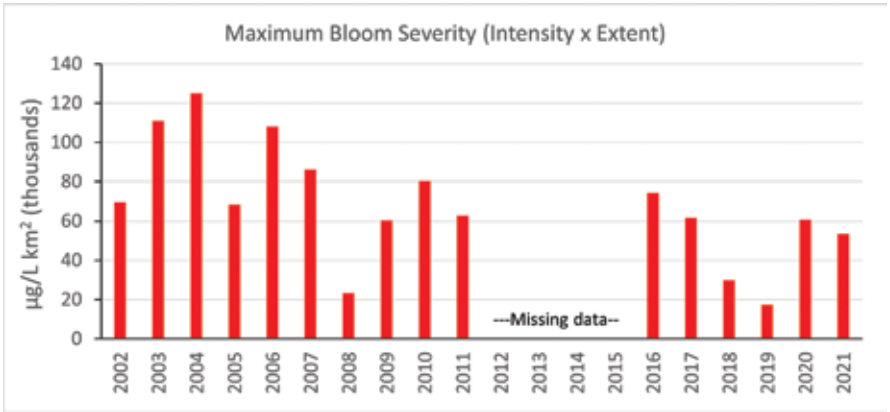


Figure 8: Satellite data showing maximum bloom severity on Lake of the Woods, 2002-2021 (ECCC EOLakeWatch).

Indigenous Questions and Comments About Nutrients

- How can Indigenous Knowledge systems improve our understanding of nutrients and algae?
- What mechanisms are needed to expand the Lake Partner Program to work with Indigenous Nations? Or include data from Indigenous Nations at their choosing?
- What relational mechanisms are available to understand some water quality objectives of Indigenous Nations?
- Moving forward, how can Indigenous Knowledge shape selection of key areas for monitoring?
- Can a process be undertaken to develop a joint phosphorous reduction plan between Indigenous Nations and ECCC?
- What are the current and historical concerns of Indigenous Nations regarding water level management?
- How does the unilateral permitting of resource development impact the nutrient loading in the basin?
- Are there oral histories of Indigenous Nations that can provide support or historical context of algal blooms in the basin?

"It's appropriate to say we have some good news to report. Satellite data from ECCC suggest declining trends in algal bloom extent and severity, TP concentrations in LoW are stable or slightly declining at long-term monitoring sites, and current TP concentrations in Rainy River are very stable presently, after significant reductions following improvement in wastewater treatment from the late 1970s through the 1990s." Jesse Anderson, MPCA.

CONTAMINANTS

The IJC Objectives & Alerts Study noted very few contaminant exceedances in basin waters except for phosphorus in Lake of the Woods and Rainy River segments (Table 1). Most other contaminant exceedances were in the Rainy River.

Table 1: Contaminant exceedances identified by the IJC O&A Study

Concern	Exceedance	Boundary Segment	Document
Phosphorus	> Alert Levels	LoW, RR (US & CDN tributaries) Rainy Lake outlet not monitored	**, ***, *
Hg	Fish consumption	LoW, RR, Headwaters	**
Fe	3% > 300 µg/L	Rainy River	*
PCB	Fish consumption	LoW, Rainy River	**
Arsenic	1 exceedance	Rainy River	*
Cd	2 exceedances	Rainy River	*
Cu	2 exceedances	Rainy River	*
Sediment	Metals - various exceedances of Fe_2O_3, Mn, TKN	LoW, Rainy River	***, *

* LoW Monitoring Update 2014-17 McDaniel and Pascoe (2018)
** IRLWWB Aquatic Ecosystem Health Report (2017)
*** EC WQMS (2015) Results of EC's water quality monitoring program 2012-14

Mercury

Mercury contamination in fish is a basin-wide problem. Minnesota has a state-wide TMDL for mercury (Hg), which was last revised in 2020. The TMDL lists lakes impaired for Hg – mostly for fish tissue but also for some water exceedances. Notably, Gunflint Lake, in the headwaters, was removed from the impaired list in the 2020 revision.

The Ontario guide *Eating Ontario Fish* lists consumption restrictions (e.g., meals per month) for many fish species based on contaminant groupings (last updated in 2018). Guide users can search by lake or use an interactive map. There are consumption restrictions listed for many lakes especially for Hg.

Mining Concerns

There are concerns about mining activities and future proposed activities in the basin. Large scale mining operations have begun since 2014. The New Gold Rainy River mine commenced processing ore on September 14, 2017.

This large mine is at Emo, approx. 20 km north of the Rainy River. Tailings water from the Steeprock Mine near Atikokan remain as a long-term concern in the basin.

The Community Advisory Group to the International Rainy-Lake of the Woods Watershed Board has recommended development of a map to show mining activities in the basin and continues to have interest in binational assessment of cumulative impacts.

In 2021, officials with the U.S. Forest Service took a decisive step toward long-term protection of the Boundary Waters Canoe Area Wilderness. The agency announced it is seeking to block mining on federal lands upstream of the wilderness. If approved, the move would put 223,000 acres off limits to mining activity.

Steeprock Mine pit filled with water near Atikokan, Ontario. The Seine River was diverted to get to the iron ore below it. Lee Grim)

Transport of Hazardous Materials

The IRLWWB has conducted a review to assess whether appropriate plans are in place to respond to an environmental emergency in a binationally-coordinated manner. This was undertaken in response to concerns raised by the IRLWWB's Community Advisory Group of increased transport of hazardous materials such as petrochemicals by rail in the region. The report titled, Review of Environmental Emergency Planning, Preparedness and Response in the Boundary Waters of the Rainy-Lake of the Woods Drainage Basin 2019, was submitted to the IJC in 2021.

2014 flood year high water under bridge at Ranier 7/14/2014

Indigenous Questions and Comments with respect to Contaminants

- What are the historical current impacts of mercury in fish to Indigenous Nations as fish harvest and consumption are part of a traditional way of life and sustenance?
- What are the Indigenous Nation health implications through consumption of fish and deterioration of access to treaty right to fish?
- How are mines permitted by Indigenous Nations? What are the cumulative impacts of continued mine development in the basin?
- How do emergency events impact rights of the Indigenous Nations?

CLIMATE CHANGE

Most ecological studies will contain a statement allowing that ongoing climate change has the potential to affect their conclusions. In many cases, climate change is directly implicated as a driver of the results.

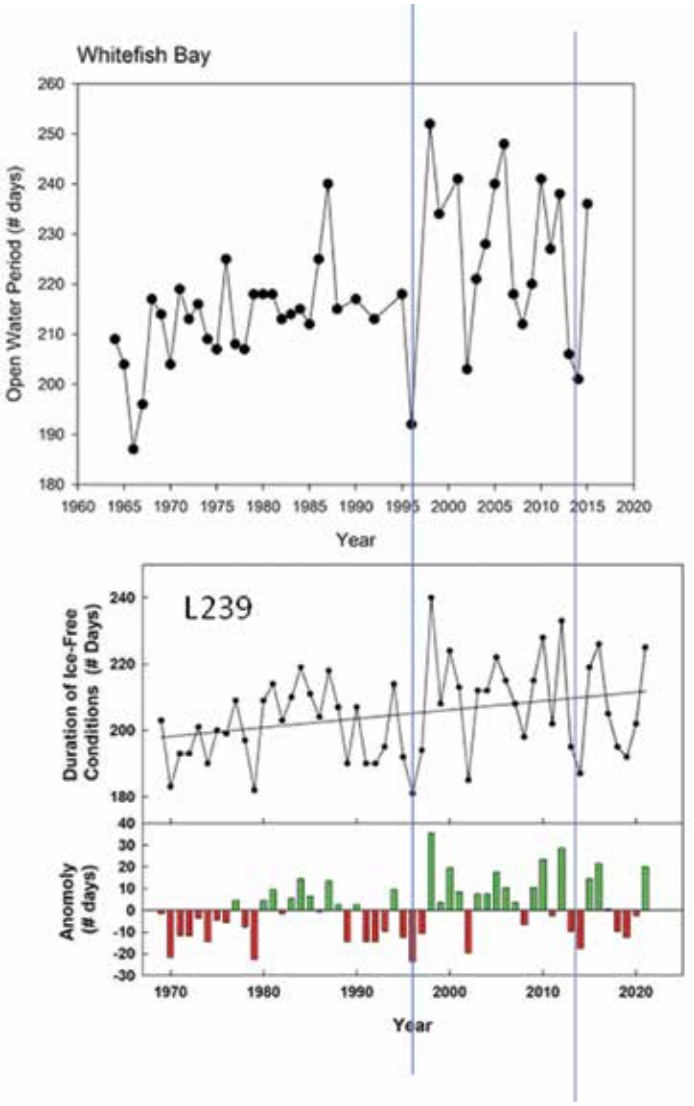


Figure 9: Duration of open water season on Whitefish Bay (LoW) between 1969 and 2016 (top) and Lake 239 at ELA (bottom) between 1969 and 2021

Increases in air and water temperatures, longer ice-free periods, more intense rain events at earlier times of the year, changes in wind patterns and conditions favourable to internal loading are just some examples of how the climate is influencing water quality in the lake.

In the future, climate change is expected to result in greater P loads resulting from more variable and extreme weather events. Warmer water temperatures could also lead to a shift towards more frequent toxin-producing algal blooms.

In the previous SOBR (2nd Edition) we showed an increase in the number of ice-free days on Whitefish Bay in LoW. Unfortunately, it appears that collection of these ice-on and ice-off records has not continued. However, comparing with the ice-free data from the long-term record on Lake 239 in the IISD-Experimental Lakes Area, there is a clear correspondence between the Whitefish Bay record and the L239 record, especially after the 1990s (Figure 9). At ELA there are about 2 more days of open water now than there was when we first looked at this in 2014. the increased variability between years is apparent.

The IJC's International Watersheds Initiative (IWI) is examining climate change as one of its strategic initiatives. One initiative has been the development of a Climate Change Guidance Framework (CCGF). The CCGF recommends planning guidance methods that can be used by the IJC's control, watershed, and pilot watershed boards.

Indigenous Questions and Comments with respect to Climate Change

- Indigenous Knowledge systems lend a holistic view to mother earth. How can this be included to better understand the changing climate?
- Climate concerns can include: human health, access to traditional lands, medicines, foods, economies, education, movements of animals and uptake of invasive species that impact access to assert rights.

AQUATIC INVASIVE SPECIES

In 2015, the Ontario provincial government introduced the Invasive Species Act (2015), which explicitly regulates the prevention and management of invasive species in Ontario. Sixteen species are prohibited under this Act, meaning it is illegal to import, possess, transport, or release these species anywhere in Ontario. Four additional species are restricted, meaning it is illegal to bring them into provincial parks or conservation reserves and illegal to import or release them anywhere in Ontario.

Invasive species in the Rainy-Lake of the Woods Basin include spiny water fleas, zebra mussels, rainbow smelt, rusty crayfish, flowering rush and hybrid cattails.

Minnesota maintains its own list of infested waters. Additions since the 2014 SOBR include for zebra mussels: Rainy Lake (2021), Lake of the Woods (2019), Big Fork River (2019) downstream of Dora Lake, Dora Lake (2017) and for spiny water fleas in Lake Vermilion (2015) near Tower, MN. Spiny water fleas are widespread throughout the boundary waters, including Lake of the Woods, Rainy River, Rainy Lake, and many others in the headwaters, and have been listed for many years, predating the 2015-2021 period covered by this SOBR report.

A coarse-scale assessment of aquatic invasive species risk in the basin was completed in 2021 for the International Rainy-Lake of the Woods Watershed Board.

Based on proximity, ease of transport or introduction, and known impacts, priority species identified as concerns were:

- *Bythotrephes longimanus* (spiny waterflea)
- *Faxonius rusticus* (rusty crayfish)

- *Neogobius melanostomus* (round goby)
- *Dreissena polymorpha* (zebra mussel)
- *Bithynia tentaculata* (mud bithynia, faucet snail)
- *Potamopyrgus antipodarum* (New Zealand mudsnail)
- *Butomus umbellatus* (flowering rush)
- *Nitellopsis obtusa* (starry stonewort)
- *Myriophyllum spicatum* (Eurasian watermilfoil)
- *Phragmites australis* (common reed)

Zebra mussels (David Britton, US FWS)

Recent confirmations of presence and continued spread of zebra mussels in the basin should be a concern. Zebra mussels have invaded several headwaters upstream in the Rainy-Lake of the Woods Basin and infested hundreds of lakes nearby, outside the basin. Zebra mussels were first confirmed in 2013 in the basin in Sand Lake and the closely connected Little Sand Lake and Rice Lake in Itasca County, Minnesota. In late 2017, the Minnesota Department of Natural Resources confirmed the presence of zebra mussels downstream of the initial 2013 invasion, in Dora Lake and the upper reaches of the Big Fork River, which ultimately flows to the Rainy River. Most recently (2021) zebra mussel larvae (veligers) were confirmed in Black Bay of Rainy Lake, suggesting a reproducing population in Rainy Lake, although adults have not been found.

Equally concerning are the confirmations by MNDNR in 2019, 2020, and 2021 of zebra mussel larvae at sites in the southern portion of LoW. Although the numbers in 2021 were lower than in previous years, the comparative significance is difficult to assess and to date, there has been no confirmation of adults or a reproductive colony in the lake.

Indigenous Questions and Comments with respect to AIS

- How do AIS impact the access to asserting Indigenous rights? How can Indigenous Knowledge systems lend historical information to the movement of species?
- Indigenous Nations monitoring data can be incorporated to address gaps and capacity to better inform AIS planning.

WATER LEVELS, EROSION AND FLOODING

The Rainy-Lake of the Woods Basin includes the international boundary between Minnesota and Ontario, where water flows from the Great Lakes Basin divide, west through the chain lakes to Namakan Lake, Rainy Lake, the Rainy River and LoW. From the LoW outflow at Kenora it enters the upper reaches of the Winnipeg River which flows to Lake Winnipeg.

Aerial view of Kenora and LoW outflow (Lee Grim)

The IJC formed the International Rainy-Lake of the Woods Watershed Board to assist with binational coordination of water quality efforts for the entire boundary watershed and to coordinate the management of the water levels and flows on Rainy and Namakan lakes and the Rainy River in accordance with the IJC's orders. Water levels and flows are controlled as prescribed by rule curves which maintain seasonal water levels between the highest or lowest water levels that will provide the best water usage for a wide variety of stakeholders.

Levels on Lake of the Woods are managed by the (Canadian) Lake of the Woods Control Board, between lower and upper elevations (1056 and 1061 feet above sea level) set by the 1925 Lake of the Woods Convention and Protocol. The International Lake of the Woods Control Board, appointed by the two national governments approves the actions of the Canadian LWCB whenever the level of LoW falls below or rises above these prescribed extreme elevations.

The outlets of Rainy and Namakan lakes have been controlled by dams for more than 100 years. Formal rules to control water levels have been in place since 1949, under Orders and Supplementary Orders of the IJC, updated periodically. Since the 2014 SOBR, the IJC has completed a study in 2017 to assess whether the rule curves in place since 2000 remained appropriate. The study found that they performed as expected and had positive ecological outcomes. Minor changes were made to reduce flooding risk in

Rainy Lake and reduce over-winter drawdown. These changes were ratified in the 2018 IJC Supplementary Order for regulation of levels on Rainy and Namakan Lakes.

Manoomin (wild rice)

In 2018, the IJC reported that manoomin has been struggling in Rainy Lake due to the damming and the water management regime and also due to aspects of climate change and the prevalence of invasive cattails. There were infrequent successful harvests leading up to 2018. Harvests of wild rice in Ontario have declined over 150,000 pounds on Rainy Lake, and over 1 million pounds on LoW since the 1970s, to less than 100,000 pounds in total.

A bed of wild rice in Kathio State Park in Minnesota (Brett Whaley)

Hybrid cattails have become established in Rainy Lake, displacing manoomin. The cattails grow in thick mats, outcompeting native plants. Muskrats are a major natural control source for the cattails but were rarely surviving the winter due to winter water level draw down under the historic rule curve regulations.

One of the goals of new rule curves that went into effect in August 2018, is to improve wild rice survival and harvest rates. Changes to drawdown timing, which reduces the winter drawdown period substantially, should help more muskrats to survive the winter months, which should help control the invasive cattail problem. First Nations that are part of Treaty #3 and the Northwestern Ontario Métis Community have commenced conversations on wild rice protocols, including an International Watersheds Initiative (of the IJC) project to begin mapping control structures and their relation to wild rice areas to better understand the water level impacts on wild rice.

Sturgeon Protocol for Managing Rainy River Flows

A protocol for protecting the sturgeon spawn in the Rainy River is now part of the considerations in operating the dam at the outflow of Rainy Lake. In spring 2013, dam operations led to a rapid drop in flows and levels in the Rainy River below the dam, leading to egg loss from air exposure. Following a review of this event, the Water Levels Committee of the International Rainy-Lake of the Woods Watershed Board created a collaborative

arrangement, known as the “Sturgeon Protocol”, to include consideration of sturgeon spawning needs in management decisions on flows, to avoid dewatering of eggs.

Since the establishment of this Sturgeon Protocol, several flow changes have been undertaken to maintain stable and appropriate flows for the benefit of sturgeon spawning.

Drought

Recently (2021) the Winnipeg River basin experienced an unusual period of prolonged dry conditions. Regulated and natural river discharges across the basin were well below normal as were water levels in all major lakes (see photos below). The development of dry conditions began in 2020 with precipitation on an annual basis being below normal through the 12-month period ending June 30, 2021.

Photos showing low flow conditions in Big Fork River at Big Falls on August 12, 2021 (left) and high flow at the same location in July 2014 (right). (Lee Grim)

Erosion

The MPCA, in its P budget estimates for the Lake of the Woods TMDL, concluded that 8.8% of the total budget was from erosion, equivalent to 72 t (Table 10). The TMDL targets an 11.5 t/yr reduction in this load. ECCC, in its P budget estimates, concluded that 8% of the total budget was from erosion, estimated as 70.2 MT, roughly similar to the estimates derived by the MPCA in its TMDL.

Staff collecting sediment fingerprinting samples.

In fall of 2019, the USGS, MPCA, and Koochiching and North St. Louis Soil and Water Conservation Districts began a sediment fingerprinting study in the Little Fork River watershed to address a 105-mile stretch of the river that is impaired by turbidity. The sediment fingerprinting process is an analysis of sediment that can attribute the particles' source to different locations in the watershed. Sediment properties are matched to their source fingerprints. Determining the erosion sites and deposit locations of sediment is important in developing strategies to reduce sediment loads to water bodies that have been impaired by turbidity. It is also potentially important in targeting remediation of areas contributing to sediment-born phosphorus loading to Lake of the Woods.

The Lake of the Woods TMDL calls for a 30% plus reduction of phosphorus out of the Little Fork system. This sediment fingerprinting study will help with understanding the relationship between erosion, sediments, and phosphorus loading. This should help inform remedial strategies and projects to implement the LoW TMDL phosphorus targets.

Indigenous Questions and Comments with respect to Flooding/Erosion

- Concerns include erosion effects on burial sites, access to lands, and reduction to reserve lands.
- How is equitable space created for Indigenous governance in water regulation?
- In 2018, Treaty #3 hosted a forum to discuss the development of a Wild Rice Communication protocol. Currently, this work is looking at the mapping of control structures to better understand the impacts to ricing areas in the Treaty #3 Territory.
- What are the historical and present concerns and impacts of Indigenous Nations as it relates to shoreline erosion including loss of land and destruction of burial sites?
- Flood Vulnerability Studies led by Indigenous Nations can inform erosion impacts and risks to Indigenous Nations that can also provide a larger understanding of land loss and change across the Rainy-Lake of the Woods Basin.
- Thirteen Treaty #3 First Nations on Lake of the Woods/Shoal Lake/ Winnipeg River, with a total of 45 separate reserves, filed flooding claims with Ontario and Canada.

FISH AND FISHERIES

In 2017, MNDNR and NDMNRF published the Fifth Edition of the Ontario– Minnesota Boundary Waters Fisheries Atlas (MNDNR and OMNRF, 2017). Conclusions indicate that there is evidence of over-harvest of walleye in the northern sectors of Lake of the Woods in Ontario and that declines in walleye biomass and fishing quality are expected if harvest reduction is not implemented. In the central sector of the lake, close monitoring is indicated.

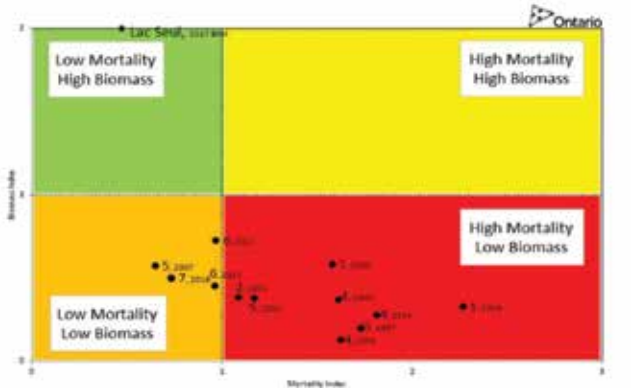


Figure 10: Lake of the Woods Assessment data with Sector and year assessed, indicating high mortality and low biomass for walleye populations.

In a separate study, NDMNRF similarly showed that the walleye population in these Ontario waters of LoW is experiencing high fishing mortality and low biomass of mature fish (Figure 10), further suggesting that the current fishery is unsustainable. NDMNRF has established a stakeholder Advisory Council to assist it in developing a management plan for the recreational walleye fishery. Changes to recreational fishing regulations for walleye are expected to be proposed in early 2022.

With respect to other fish, northern pike are likely doing well in northern and central sectors, musky maintain a strong fishery with most fish released but with few data. Smallmouth bass annual harvest is well below targets. In Sector 3 (Whitefish Bay) lake trout regulated harvest size restrictions maintain an abundance of large-bodied lake trout but harvest levels may prevent the population from reaching its full potential to support trophy angling opportunities.

Indigenous Questions and Comments with respect to Fisheries

- What is the process to jointly manage and permit fishing in the basin between Crowns and Indigenous Nations?

HUMAN HEALTH

Drinking Water

Work to end long-term boil water advisories and provide clean water in 37 First Nation communities across Ontario is set to begin soon, with 12 projects in northwestern Ontario communities.

As it stands, the Kenora and Kiiwetinoong districts have the largest concentrations of long-term boil water advisories across the country. As of March 19, 2021, Indigenous Services Canada reports there are still 58 long-term drinking water advisories in effect in 38 communities in Canada.

The Minnesota Department of Health is the authority for drinking water in the US portion of the basin. Areas that are proposed for upgraded drinking water infrastructure in Minnesota are added to the Project Priority List and priority is ranked based on public health protection, adequate water supply and financial need. No US Tribe in the basin is listed on the list, however further study is needed to evaluate the true state of drinking water supply of US Tribes in the Rainy-Lake of the Woods Basin.

Fish harvest and consumption are part of a lifelong traditional way of life for many Indigenous peoples, who now suffer from the negative health impacts of mercury contamination throughout the region.

Mercury

Human health impacts of mercury pollution are of concern to communities in the Rainy-Lake of the Woods Basin, particularly considering problems with mercury in neighboring communities adjacent and/or downstream to this watershed. Fish harvest and consumption are part of a lifelong traditional way of life for many Indigenous peoples, who now suffer from the negative health impacts of mercury contamination throughout the region. Work is currently underway to address historic mercury contamination in the English and Wabigoon Rivers near Grassy Narrows First Nation and Wabaseemoong Independent Nations.

Algal Toxins

Cyanobacteria (commonly known as blue-green algae) blooms are common in the Rainy-Lake of the Woods Basin. Cyanobacteria can produce toxins that may be hazardous to human health. Humans can be exposed to cyanobacterial toxins by drinking untreated water that contains the toxins, swimming in water that contains high concentrations of cyanobacterial cells or breathing air that contains aerosolized cyanobacterial cells or toxins. Although the risk exists, there have been no confirmed deaths attributed to cyanotoxins in North America. In Lake of the Woods, there is evidence that cyanobacterial toxins have increased in recent decades. This is not surprising given related evidence of increases in cyanobacteria in recent decades, associated with climate change and a surfeit of the nutrient phosphorus.

Blastomycosis

Blastomycosis is a disease caused by the soil-born fungi (*Blastomyces dermatitidis* or *Blastomyces gilchristii*). *Blastomyces* species are present in the Rainy-Lake of the Woods Basin, and other areas including the Ohio and Mississippi River basins, and some areas of the Great Lakes. Blastomycosis is a substantial health threat in the Rainy-Lake of the Woods Basin, with elevated but regionally varying incidence in Ontario, Minnesota, and Manitoba. The impacts of the disease on the lives of those who live in or visit the basin can be substantial, resulting in serious illnesses and death in dogs, humans, and other mammals.

Soil is the only known reservoir for Blastomyces with moist, slightly acidic soils enriched with decaying organic matter being implicated Epidemiologically, incidence of human and canid infection by this pathogen is associated with proximity to the waterways in our basin.

GAPS AND EMERGING CONCERNS

A major requirement for the future is to establish a core monitoring program that can coordinate and sustain monitoring at key locations throughout the Rainy-Lake of the Woods Basin. Elements of a core monitoring program have previously been assembled and this project should be moved forward for recognition by the various agencies responsible for monitoring.

Other potential gaps that are noted include:

- The Community Advisory Group maintains concerns around mining in the watershed such that the need for developing an inventory of mining activities should be considered a gap.
- There does not seem to be a comprehensive data source in Canadian waters for AIS.
- The threat of invasive cattail expansion and negative impacts to fisheries, wildlife, diversity, wild rice might also be considered a major gap and concern.
- Groundwater information remains sparse and may constitute a gap with respect to some studies, but it is unclear how groundwater gaps relate to the current list of concerns.

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- The lack of information available for the assessment of rule curve impacts on Rainy River was highlighted as a major data gap (IRLWWB – Sixth Annual Report, April 2018-March 2019).
- It is clear from a review of existing data that many agencies collect data without providing regular reviews of the data.
- There must be commitment to respect the multijurisdictional nature of the basin by highlighting Indigenous Knowledge systems and to illustrate how western and indigenous systems can work together through the lens of two eyed seeing.
- There may still be some gaps in governance infrastructure that need to be addressed.

RECOMMENDATIONS

There have been many successful responses to previous recommendations especially if examined within the context of the first SOBR in 2009. Current recommendations that remain include:

There have been many successful responses to previous recommendations especially if examined within the context of the first SOBR in 2009.

Governance

1. Research into the historical impacts to and grievances with Indigenous Nations.
2. Research and development of a framework of multi-jurisdictional watershed planning.
3. Indigenous Engagement to understand how each Nation looks to be included in decision making and governance.
4. Development of understanding of western mechanisms and how they impact the Boundary Waters Treaty (UNDRIP, FPIC, Truth and Reconciliation Commission, etc.).
5. Establish table of Indigenous Nations in the basin.
6. Establish a multi-national agreement for the basin inclusive of Indigenous Nations.
7. Explore frameworks of co-management that can be applied to the Rainy Lake of the Woods Basin.

Nutrients and algal blooms

8. A core monitoring program should be established to monitor effects of nutrient reduction strategies (effectiveness monitoring).
9. Relationship between nutrients and satellite derived bloom intensity should be formed.

Climate change

10. Continue to recognise and advocate for reduced emissions of green house gasses.
11. Develop adaptive management strategies.

Contaminants

12. Develop a watershed mining activity map.
13. Continue and expand public awareness of mercury contamination in fish.

Aquatic invasive species

14. Complete phase 2 of risk assessment.
15. Harmonize AIS prevention efforts in the full watershed.
16. Need for Canadian AIS data.
17. Need for Typha management.

Water levels/erosion

18. Develop tools to address effects of drought.
19. Explore need for better understanding with respect to groundwater.

Fish & fisheries

20. Continued support for ON/MN Fish Atlas.

Other

21. Consider sustainability in management decisions.
22. Examine aspects of changing human activity in the basin.
23. Continue to improve multinational governance models.
24. Continue to embrace the concept of adaptive management.
25. Establish core monitoring requirements.
26. Encourage summaries and synthesis for existing data.