PROPOSED ECOSYSTEM OBJECTIVES AND PHOSPHORUS REDUCTION SCENARIOS TO MANAGE ALGAE BLOOMS IN LAKE OF THE WOODS

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WE WANT TO HEAR FROM YOU

The Lake of the Woods community is passionate about the health of the lake and interested in ways that they can contribute to improving water quality and ecosystem health.

Your feedback will help confirm desired Lake Ecosystem Objectives, associated phosphorus reduction scenarios and support decisions by governments on measures protective of the lake.

It is important that the knowledge and perspectives of all who live, work and enjoy the lake are reflected in this process.

Please visit our online engagement portal at https://www.placespeak.com/lakeofthewoods to:

- Provide feedback on the topics presented in this factsheet
- Provide your perspectives on specific discussion questions
- Find more information on upcoming events and how you can participate

INTRODUCTION

In 2010, recognizing water quality concerns in Lake of the Woods, the Governments of Canada and the United States asked the International Joint Commission (IJC) to identify and assess the priority water quality issues in the lake. The IJC responded in 2012, with a Report[1] with advice to both governments for binational water management of the Lake of the Woods-Rainy River watershed, which included a recommendation to identify what scientific work is needed to address priority threats to water quality. Canada and the United States agreed to the 2012 report, and in 2015, the IJC responded by delivering a Water Quality Plan of Study[2] (WQPOS) for the Lake of the Woods Basin to the Governments of Canada and the United States identifying nutrient enrichment and harmful algae blooms as the key threat to water quality and aquatic ecosystem health.

In response to the advice from the IJC, Environment and Climate Change Canada (ECCC) launched a 4-year Lake of the Woods Science Plan in 2016. The purpose of the plan was to develop research, modeling and monitoring to determine the level of nutriend (phosphorus) reduction required to achieve various water quality improvements.

Based on the results of this work, it is possible to use computer models to predict how reductions in phosphorus to Lake of the Woods will affect algae growth throughout the lake. The models can also be used to determine whether actions are needed to reduce phosphorus loads, and the results that can be expected from different levels of action.

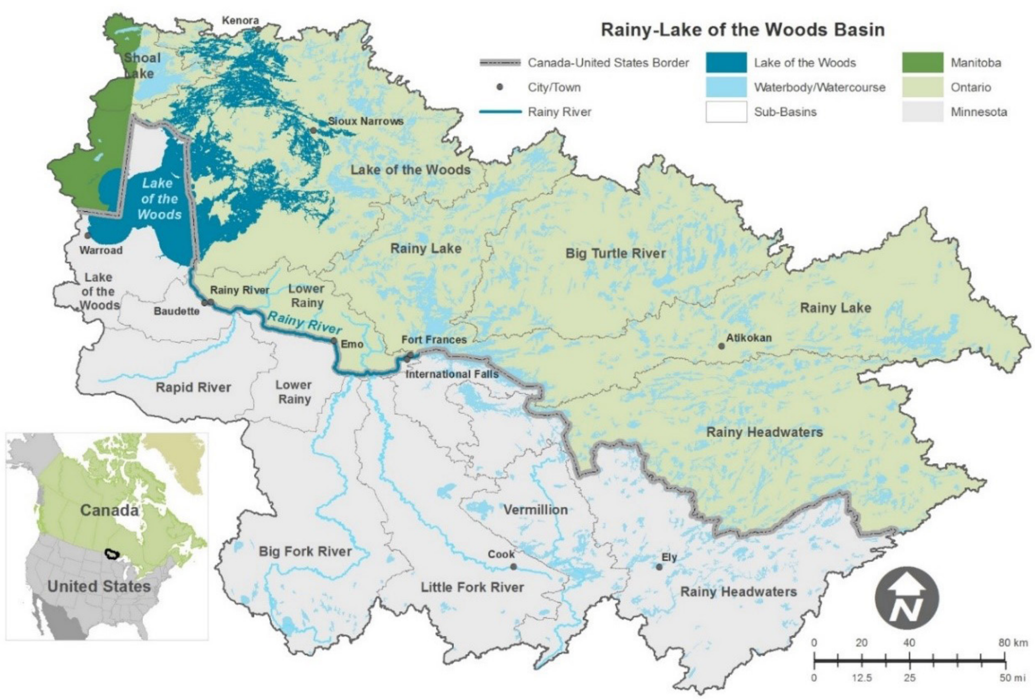
1 International Joint Commission (2012). *Report to the Governments of the United States and Canada on Bi-national Water Management of the Lake of the Woods and Rainy River Watershed*. Retrieved from: https://ijc.org/sites/default/files/7%20-%20Lake%20of%20the%20Woods%20Final%20Report.pdf.

2 International Joint Commission (2015). *A Water Quality Plan of Study for the Lake of the Woods Basin*. Retrieved from: https://legacyfiles.ijc.org/publications/LOWPOS_EN_01282015.pdf.

The purpose of this factsheet is to provide information to Indigenous Peoples, the public and other partners on the issue of harmful algal blooms in Lake of the Woods. This factsheet describes potential Lake Ecosystem Objectives (desired lake conditions) and the phosphorus reduction required to achieve them.

UNDERSTANDING THE PROBLEM

Lake of the Woods is a large lake (over 3,850 km²) shared between Canada and the U.S. that spans the borders of Minnesota, Ontario and Manitoba, within the Lake Winnipeg drainage basin. The Lake is an important natural and economic resource and is world renowned for its recreational fishing. The lake provides drinking water to approximately 700,000 people in Ontario, Minnesota and Manitoba. Located in Treaty #3 Territory, the Lake of the Woods region is culturally significant to Indigenous Nations and peoples abundant in fish, wildlife, medicines, wild rice and other resources. It is the home of the 28 communities of the Anishinaabe Nation in Treaty #3, whose traditional territory spans from west of Thunder Bay to north of Sioux Lookout, along the international border, to the province of Manitoba. The region is also home to Métis communities in the Métis Nation of Ontario’s Treaty #3, Lake of the Woods/Lac Seul and Rainy Lake/Rainy River traditional territories. These nations and communities have relied on and acted as stewards of the land, water and wildlife for countless generations.

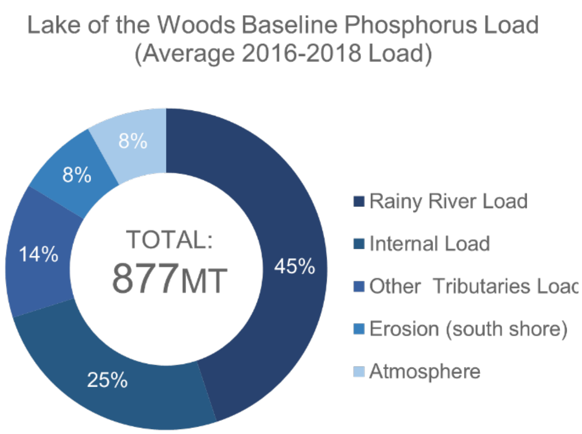


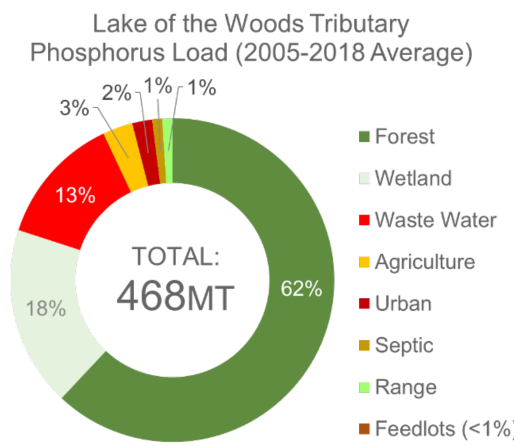
Rainy River-Lake of the Woods Basin. Credit: Environment and Climate Change Canada.

Phosphorus is a nutrient. It is a naturally occurring element, and part of all plant and animal tissue. High levels of phosphorus in water can promote excessive algal growth and result in low-oxygen zones in lakes and rivers. Excess phosphorus loadings to Lake of the Woods and the resulting development of **harmful algal blooms (HABs)** has been a growing problem for a number of years, and is a significant public concern on both sides of the border. HABs threaten drinking water quality, increase costs associated with water treatment, adversely impact recreational fishing activities and other recreational pursuits, and could degrade fish and wildlife habitat and populations if conditions deteriorate further. HABs also adversely affect cultural practices and traditional ways of life.

Historical accounts indicate that Lake of the Woods has had algae blooms dating back hundreds of years, with sediment core analyses tracing them back even further. However, since the 1980s, the lake has experienced a sharp increase in toxin-producing blue-green algae blooms. These harmful algae grow extensively during the summer and fall months. During the last decade, and as recently as fall 2020, harmful algal blooms have covered up to 70% of the lake surface. There is significant year-to-year variability in bloom severity driven by fluctuations in weather and phosphorus loads to the lake. The extent of blooms has not decreased over the last 20 years but there is some suggestion that maximum bloom intensity and severity may be trending downward[3]. Continued monitoring will strengthen our knowledge of bloom trends and our ability to detect lake response to phosphorus management activities.

The Rainy River-Lake of the Woods Basin is largely natural, comprised mainly of Forest (46%), Wetland (31%), and Water (19%) and to a lesser extent, Agriculture (2%), Range (1%), and Urban (1%). The phosphorus feeding blooms comes from both external and internal sources. External sources, like the Rainy River, account for the largest proportion of phosphorus, driven largely by natural sources. Recent monitoring suggests that developed areas along the river may be contributing more phosphorus than previously reported. Phosphorus that is being released from accumulated sediments in both the Canadian and U.S. portions of the lake is considered internal load. Internal load also accounts for a large portion of phosphorus in Lake of the Woods and is the result of long-term historical inputs from human activity in the Rainy River.





Sources of phosphorus to Lake of the Woods. The Rainy River and internal loads combined account for roughly 70% of the phosphorus in the lake (left). The sources of phosphorus in creeks and rivers come predominantly from natural sources but also human-based activities (right). Total amounts of phosphorus are reported in metric tonnes (MT).Current wastewater contributions are lower due to the closing of the Resolute Pulp and Paper Mill in Fort Frances in 2014.

Climate change is expected to exacerbate the harmful algal problem. 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 loadings are just some examples of how the climate is influencing water quality in the lake. Looking ahead, climate change is expected to result in greater phosphorus loads from more variable and extreme weather events. Warmer water temperatures could also lead to shifts to more frequent toxin-producing algae (e.g. Microcystis).

3 Environment and Climate Change Canada (2020). EOLakeWatch: Interactive algal bloom monitoring tool. Retrieved from: https://www.canada.ca/en/environment-climate-change/services/water-overview/satellite-earth-observations-lake-monitoring/interactive-algal-bloom-monitoring-tool.html

Agricultural expansion is occurring on the Canadian side of the Rainy River. Recent monitoring of rivers and creeks that flow into the Rainy River suggests that the area experiencing land use changes is likely a hotspot of phosphorus. Changes in land use can affect the amount, type, and seasonality of phosphorus that ends up in the lake and contributes to algae blooms. Natural vegetation and soils in forests, wetlands and grasslands provide benefits like filtering and trapping phosphorus-rich sediment, and slowing water that runs off the land. Development reduces natural land cover and the water quality benefits associated with it. Agriculture development can also result in higher levels of phosphorus in our waterways associated with the application of fertilizers. There are ways to mitigate the risks of increased phosphorus loads from agricultural activities, which include responsible planning and the implementation of best management practices such as vegetated buffers along waterways and cover crops to minimize runoff and erosion. The rate of expansion in the basin is not well known at this time.

The health of Lake of the Woods also matters to our U.S. neighbours who share this important natural resource. The State of Minnesota, through the Minnesota Pollution Control Agency (MPCA), and the U.S. Environmental Protection Agency, under authorities in the Federal Clean Water Act, are developing a plan for the lake's restoration. This includes the setting of reduction targets for U.S. sources of phosphorus[4]. Canada and the U.S. have a long history of working collaboratively in the Lake of the Woods watershed, including sharing data and science, working together on joint monitoring programs and developing science priorities. As both governments continue to work towards the common goal of addressing excess phosphorus and algae in the Lake of the Woods, we recognize the critical value in continuing open communication that will ensure conditions in the shared waterway are improved.

AN ECOSYSTEM APPROACH

Using an Ecosystem Approach, potential desirable water quality and ecosystem health conditions were identified and computer models were used to determine the level of phosphorus reduction that would be needed to achieve these conditions.

The key steps of this approach include describing potential desired ecosystem conditions for the lake (i.e. **Lake Ecosystem Objectives**), identifying ecosystem indicators to determine when an ecosystem objective has been achieved (i.e. **Ecosystem Response Indicators**), and applying computer models to determine the level of phosphorus reduction required to meet the objectives (i.e. **Scenario Reductions**).

PROPOSED LAKE ECOSYSTEM OBJECTIVES

A **Lake Ecosystem Objective** describes desired conditions in the lake. The objectives represent key lake issues and guide the development of science and action to prevent further decline in water quality and ecosystem health. Lake of the Woods is unique and complex. Differences in the lake system mean that water quality varies during the year, and throughout the lake. Lake Ecosystem Objectives need to recognize the importance of these differences and ensure that the lake's productivity, (the amount of algae and aquatic plants the lake can support), is maintained for organisms such as invertebrates and fish.

Based on a review of available science, the following three Lake Ecosystem Objectives to support a healthy and productive Lake of the Woods ecosystem are being proposed:

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.

4 Minnesota Pollution Control Agency. (2020). Lake of the Woods - Excess Nutrients: TMDL Project. Retrieved from: https://www.pca.state.mn.us/water/tmdl/lake-woods-excess-nutrients-tmdl-project.

PROPOSED ECOSYSTEM RESPONSE INDICATORS

Ecosystem Response Indicators are used to translate the Lake Ecosystem Objectives into something we can measure. They are used to quantify, assess and track progress towards meeting the objectives. Indicators require a benchmark or threshold that identifies when a Lake Ecosystem Objective is achieved. Indicators also have to be something that can be modeled, so we can understand whether reducing phosphorus will have the desired effect. The indicators outlined below are measured as an average for the June-October period to capture when blooms occur in Lake of the Woods.

Lake Ecosystem Objective #1: Maintain the diversity of trophic status (lake productivity) for different areas of the lake.

Total Phosphorus and chlorophyll a were selected as ecosystem response indicators to measure the achievement towards meeting this ecosystem objective.

Total Phosphorus (TP) is a standard and recognized parameter to measure trophic status, as phosphorus is the main nutrient that controls aquatic plant and algae growth in many freshwater lakes. TP is also a routinely monitored parameter in water quality monitoring programs. The indicator is based on groundbreaking research done at the Experimental Lakes Area that demonstrates that reductions in phosphorus will contribute to a reduction in the growth of harmful algae in the lake. This will improve water quality and reduce risks to human health and the environment.

Chlorophyll a (chl a) is a common measure of algae biomass and lake productivity, which indicates the amount of algae that is present in the lake (biomass) and the lake's ability to support algae and aquatic plant and animal life (productivity or trophic status). Reducing algae biomass will mean that there will be less opportunity for toxin-producing harmful algae to grow. Less harmful algae would mean reduced risk to human health, the environment, and other uses in the lake.

Lake Ecosystem Objective #2: Maintain levels of algae below those constituting a harmful and/or nuisance condition.

Bloom Severity Index was selected as an ecosystem response indicator to measure the achievement towards meeting this ecosystem objective.

Bloom Severity Index was developed as a tool to monitor algal blooms using satellite images. The index combines the intensity and extent of blooms[5]. Bloom intensity is the mean chlorophyll a (chl a) concentration measured within a bloom. Bloom extent is the surface area of the lake covered by a bloom. This index is currently being used to monitor, assess and report on blooms as an online interactive tool[6].

A reduction in bloom severity to mild conditions would mean there is lower likelihood of harmful algae in the lake. Future work with this index will consider appropriate whole-lake measures and desired conditions that represent mild bloom conditions.

Lake Ecosystem Objective #3: Minimize the extent of hypoxia (low oxygen events) in the southern basin to protect aquatic life and maintain a healthy aquatic ecosystem.

There was insufficient science to propose an ecosystem response indicator for this Objective at this time.

Objective #3 recognizes the impacts hypoxia can have on the ecosystem and on important socio-economic and cultural resources. Additional research and modelling efforts are needed to support improving our understanding of factors contributing to hypoxia development. Establishing an indicator will be re-evaluated at a later time as part of an adaptive management approach, as described in our next steps.

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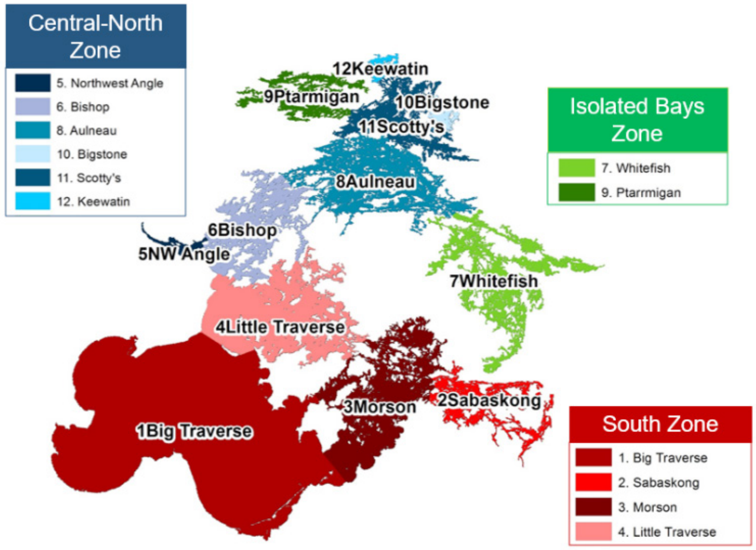
5 Caren E. Binding, Larissa Pizzolato & Chuiqing Zeng (2021) EOLakeWatch; delivering a comprehensive suite of remote sensing algal bloom indices for enhanced monitoring of Canadian eutrophic lakes, Ecological Indicators, 121. 106999, DOI: https://doi.org/10.1016/j.ecolind.2020.106999

6 Environment and Climate Change Canada (2020). EOLakeWatch: Interactive algal bloom monitoring tool. Retrieved from: https://www.canada.ca/en/environment-climate-change/services/water-overview/satellite-earth-observations-lake-monitoring/interactive-algal-bloom-monitoring-tool.html



Proposed South, Central-North and Isolated Bays Zones for Lake of the Woods. Zones are comprised of several smaller and distinct bays that form the 12 geographic units modelled. Credit: Environment and Climate Change Canada.

GEOGRAPHIC ZONES

Lake of the Woods is a large and complex lake. To characterize the parts of the lake that have distinct water chemistry and physical properties, 12 distinct bays[7] were grouped into three **geographic zones** that have similar characteristics and responses to changes in phosphorus. The three zones are represented and delineated as follows:

1. **South Zone:** Represents areas southern portion of the lake that is shallow and open, and where phosphorus loads are greatest, and blooms most frequent, extensive and severe. Waters in the Southern zone lie within both Canada and the U.S.
2. **Central-North Zone:** Represent deeper and less productive bays. They experience blooms from a combination of localized lake processes, and from wind and water driven movement from the more productive southern zone.
3. **Isolated Bays Zone:** Represent the two bays identified as “lake trout bays” that are less productive and isolated from the northerly flow of water through the lake.

IDENTIFYING PHOSPHORUS REDUCTION SCENARIOS TO MEET ECOSYSTEM OBJECTIVES

Over the past 4 years, ECCC developed a computer model that combines the processes that occur in the lake with those in the watershed. This is called an **integrated lake-watershed model** and its purpose is to help us understand how the lake will respond to different phosphorus reduction scenarios. These scenarios are presented below and indicate the level of phosphorus reduction required to meet the proposed Lake Ecosystem Objectives. The scenarios are based on phosphorus reductions from the entire lake-watershed, including both U.S. and Canadian loads, and account for both internal and external sources.

The three scenarios are:

- A 5% reduction of the total lake phosphorus load (internal load reduction only).
- A 20% reduction of the total lake phosphorus load.
- A 30% reduction of the total lake phosphorus load.

7 Bay delineations based on: David G. Malaher (2005). Sites for Sampling Transportation of Algae Nutrients in Lake of the Woods. Unpublished report. 8pp.

The results of the scenarios are described in detail below by Lake Ecosystem Objective for each geographic zone.

What is the baseline?

The lake's response to each scenario is estimated relative to the amount of phosphorus reduced from a fixed reference point, called a baseline load. The baseline load selected is a 3-year average from 2016-2018 which is 877 metric tonnes (MT) per year. These years were selected as they represent years with good data coverage, varying load conditions and capture both dry and wet flow years.

How long will it take to meet the phosphorus reductions under these scenarios?

The computer model simulates a lake response to a load reduction scenario. The lake's response is estimated relative to the baseline load for a given scenario (e.g. natural recovery), and not over a specific period of time. Natural recovery is included in all three scenarios and has an estimated timeframe of when internal reductions will occur (i.e. in 20 years). This timeframe is approximate and assumes no increase in phosphorus loads from external sources during that period. For scenarios that also include external load reductions, the actual timeframe for when the lake response will occur is difficult to estimate, as it is dependent on several factors such as the strategies and actions that will be implemented to reduce phosphorus loads.

How are climate change impacts factored into the scenarios?

Scenarios do not take into account future conditions under climate change. Developing and incorporating climate change scenarios into the modelling will help to understand climate impacts on phosphorus loads. This is a priority for continued research and science.

SCENARIO DESCRIPTIONS

SCENARIO 1 (5% REDUCTION; NATURAL RECOVERY)

This scenario is based on a reduction in the internal lake load through natural processes. Scenario 1 is expected to result in a **decrease of approximately 5% (or 44MT) of the lake's total phosphorus load**. This scenario assumes that phosphorus from external sources does not increase due to increases caused by land use changes or other factors.

This scenario is based on best available science that suggests the phosphorus being released from lake bottom sediment is decreasing over time, by either flushing out of the system or by being buried in deeper sediment. The estimated rate of reduction in the amount of phosphorus entering the water from the sediment is 1% per year over 20 years, which is equivalent to 5% of the total phosphorus load.

SCENARIO 2 (20% REDUCTION)

This scenario includes the internal load reduction from the natural recovery scenario described above (44 MT), plus an external phosphorus load reduction of 160MT from the Rainy River (largest source of phosphorus to the lake), soil erosion and other tributary sources. **This scenario would reduce the lake's total phosphorus load by approximately 20% (or 204 MT) from the baseline load (877 MT).**

SCENARIO 3 (30% REDUCTION)

This scenario includes the internal load reduction from the natural recovery scenario described above (44 MT), in addition to an external phosphorus load reduction of 238 MT from the Rainy River (largest source of phosphorus to the lake), soil erosion and other tributary sources. **This scenario would reduce the lake's total phosphorus load by approximately 30% (or 282 MT) from the baseline load (877 MT).**

LAKE RESPONSES TO PHOSPHORUS REDUCTION SCENARIOS

It is important to note that at baseline conditions, total phosphorus, chlorophyll a and bloom severity values are highest in the south of the lake and decrease as you move north. This means that the lake has more phosphorus and can support more algae growth in the south of the lake. This is expected and consistent with our understanding of water quality in the lake. Almost half of the phosphorus in the lake comes from the Rainy River, which empties into the south of the lake in Big Traverse Bay, where total phosphorus, chlorophyll a and bloom severity index values are the highest. The South zone is also generally more sensitive to changes in phosphorus. This means that we see more response or change in an indicator with each scenario. This also means that the scenarios with larger phosphorus reductions, lead to larger improvements in the South zone, such as lower total phosphorus, lower chlorophyll a and lower bloom severity index. These responses are required to improve lake health and meet the Lake Ecosystem Objectives.

Lake Ecosystem Objective #1: Maintain the diversity of trophic status (lake productivity) for different areas of the lake.

Indicator 1: Total Phosphorus

Under each of the three scenarios, Total Phosphorus concentration in the lake decreases. This decrease occurs throughout the lake in each of the three zones.

In the South zone, there is a consistent decrease from smallest (Scenario 1) to largest (Scenario 3). In the North-Central and Isolated Bays zones, there is a small decrease from Scenario 1 and larger decreases from Scenarios 2 and 3. **TP levels in the baseline and all three scenarios meet the Lake Ecosystem Objective of maintaining a diversity of trophic status in the lake.**

Although the desired outcome is met in all cases, this does not necessarily mean that no action is required. Actions may be needed to ensure that no future increase in TP occurs. Future increases in TP could cause a shift to a new and higher trophic state. A higher trophic state would mean the lake would support greater amounts of algae and lead to greater impacts to lake health and those who use the lake.

It is also important to remember that the TP indicator is the average over the summer and early fall (June-October). Maximum TP values do exceed the desired levels and are reduced with each of the scenarios. Maximum TP was not selected as an indicator but provides useful information to understand how conditions are improved and risks are minimized with less phosphorus in the lake.

Indicator 2: Chlorophyll a

Baseline chlorophyll a exceeds the objective in several bays in the South and North-Central zones (Big Traverse, Little Traverse, NW Angle and Bishop Bays). These are the bays where blooms are most frequent and severe and **where reductions in algae (i.e. algae biomass) are needed to maintain differences in lake productivity (i.e. Objective #1).**

In these bays, the objective is achieved under different scenarios. Morson, Little Traverse Bay, and Bishop meet the objective under Scenario 1. Morson, Little Traverse Bay, Bishop and the NW Angle meet the objective under Scenario 2. Morson, Little Traverse Bay, Bishop, the NW Angle and Big Traverse Bay meet the objective under Scenario 3. **It is important to note that Scenario 2 nearly meets the objective, as blooms in Big Traverse Bay are the most frequent, severe and persistent. Improving conditions in Big Traverse Bay is key to improving lake health.** Reducing the amount of algae in Big Traverse Bay will lead to improvements elsewhere in the lake due to the movement of algae blooms with wind and waves.

For the rest of the Central-North and Isolated Bays zones, baseline chlorophyll a levels meet the objective. For these less productive bays, decreases in chlorophyll a occur under Scenario 1 due to reduction in internal load, but are not further reduced in Scenarios 2 and 3. This is consistent with the fact that the Rainy River has less influence in these parts of the lake and that much of the reductions in Scenarios 2 and 3 come from reductions from the Rainy River. This also means that the natural reduction in internal load plays an important role in achieving the Objective in all parts of the lake.

Lake Ecosystem Objective #2: Maintain levels of algae below those constituting a harmful and/or nuisance condition.

Indicator: Bloom Severity

Similar to the other indicators, bloom severity index is highest in the South zone and much lower in the Central-North and Isolated Bays zones. It is even at or near zero for several bays in the north of the lake where blooms are less frequent.

Bloom severity is reduced in all three scenarios in Big Traverse Bay (South zone), where blooms are most frequent, intense, and severe. The smallest reduction occurs with Scenario 1 and the greatest reduction with Scenario 3. This improvement in conditions in Big Traverse Bay is important for the rest of the lake. Less severe blooms in the South zone could lead to improved conditions elsewhere in the lake because blooms can move with wind, waves and water flow. Other bays show some improvement under Scenario 1 (for example Morson, Sabaskong and Scotty's) which may be related to the role that internal load plays for smaller and less intense blooms. The Isolated Bays zone has a bloom severity index of zero and so the scenarios have no effect on conditions that do not require any change.

More work is needed with this indicator to determine what a desired bloom severity is for each bay or for the lake as a whole. The goal is to use it alongside our bloom monitoring and mapping tool. This will give us a way to easily track and assess conditions, and compare it to our objective.

WHAT LEVEL OF ACTION WOULD BE REQUIRED UNDER EACH SCENARIO?

In all three scenarios, the most noticeable improvements occur in the southern portion of the lake. This is mainly because phosphorus loads are highest in this area (coming from the Rainy River), and where algae blooms are the most persistent and severe.

There is a less noticeable change in the lake's response in the Central-North and Isolated Bays zones, as the algae problem is less pronounced because phosphorus loads are much lower. In fact, these two zones already meet desired lake conditions at the baseline load in most cases. The regional differences in conditions is the reason why the zones were proposed, and highlight the purpose of Objective #1 to maintain the diversity of trophic status in the lake. There is a delicate balance to achieve in Lake of the Woods. There is the need to reduce algae blooms in areas of high productivity by managing phosphorus. There is also the need to protect against reducing phosphorus too much in any areas of the lake, which could have broader consequences on the ecosystem, such as reductions in fish productivity.

The following section describes the level of action that would be required to achieve the scenario reductions as well as risks and potential challenges.

SCENARIO 1 (5% REDUCTION; NATURAL RECOVERY)

Under **Scenario 1**, modelling indicates that the lake will eventually respond to reductions in phosphorus loads from natural recovery, but because the reduction is so small (1% of internal load per year), it could take several decades to detect and achieve expected reductions in total phosphorus, algae biomass and bloom severity index. **Scenario 1 relies on natural processes to reduce loads.** However, this scenario will not result in projected reductions in algae if net external phosphorus loads increase due to growth in the basin or other factors such as the effects of climate change. Ensuring that natural recovery results in projected reductions in algae will require that external sources be actively managed to ensure no net increase in phosphorus loads from external sources occurs while internal loads diminish naturally over time.

SCENARIO 2 (20% REDUCTION)

Under **Scenario 2**, we see noticeably greater improvements in desired conditions compared with Scenario 1, and a moderate improvement in the lake overall. Some, but not all, Lake Ecosystem Objectives are met and those that are not (e.g. algal biomass), are very close to desired conditions. **Scenario 2 requires action to reduce external sources of phosphorus by roughly 20%.** While this might seem like a modest level of external reduction, achieving this reduction will be challenging based on the manageable sources of phosphorus in the basin and would likely require development of new approaches and practices to manage natural sources (e.g. from forests and wetlands). The level of action required to reduce loads under Scenario 2 would also have to compensate for the influences of development and climate change so that a net reduction of 20% in external loads is achieved. This scenario is most similar to the level of reduction proposed by the MPCA to improve conditions in the U.S. waters of the lake.

SCENARIO 3 (30% REDUCTION)

Under **Scenario 3**, the lake responds to the larger phosphorus reduction with a significant improvement in lake conditions and all the Lake Ecosystem Objectives are met. This scenario has the greatest improvements in total phosphorus, algae biomass and bloom severity when comparing the three scenarios. **Scenario 3 requires action to reduce sources of phosphorus which will result in a total lake load reduction of approximately 30%.** However, because the Lake of the Woods basin is largely natural, there are limited opportunities for reducing sources and it is unclear whether this level of reduction in external loads could be achieved. Greater action would also be required by the United States. A 30% reduction would require a total phosphorus reduction of 282MT (from combined Canadian and U.S. sources), which is greater than the MPCA proposed 150MT reduction in total basin phosphorus load.

It is important to note that under no scenario does algae entirely disappear. Lake of the Woods has always been productive, which means that blooms will still occur even when phosphorus loads are reduced. Algae are important for maintaining lake productivity, and are relied upon by fish, and many other organisms living in the ecosystem. Severe shifts in lake productivity would have significant implications for recreation and tourism, two major components of the local economy. However, by reducing phosphorus loads to the lake, the likelihood that nuisance and more importantly, harmful, algae blooms will form will be reduced.

TAKING ACTION

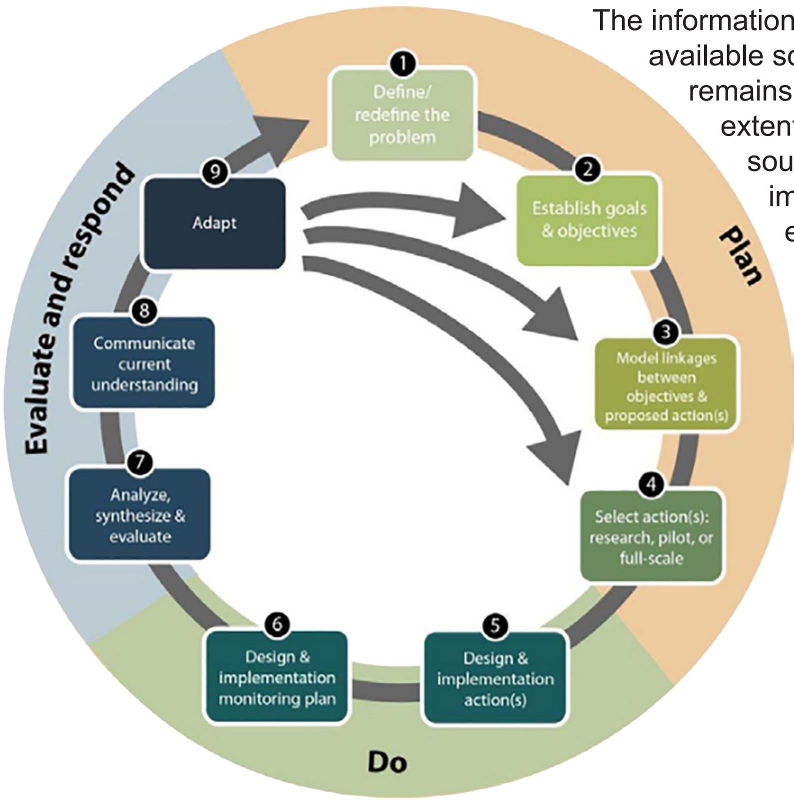
SETTING TARGETS

One potential tool used in other waterbodies to guide decision making and actions needed to reduce phosphorus loads is the setting of phosphorus reduction targets. Setting targets has a number of benefits such as:

- Establishing a clear and measurable goal against which to assess progress;
- Directing planning and decision making on strategies, actions and other measures to reduce phosphorus;
- Supporting coordination and collaboration among levels of government and with U.S. partners;
- Providing clarity to stakeholders and the public on what is required to be protective of the lake.

Although setting targets provides governments and their partners a clear goal for reducing phosphorus, any process, strategy or program that directs action also needs to verify through continuous monitoring and assessment that the reductions in phosphorus loads are having the predicted effect in terms of achieving the Lake Ecosystem Objectives.

ADAPTIVE MANAGEMENT



Example Adaptive Management Framework. Credit: Delta Stewardship Council.

The information presented in this document is based on best available science, and recognizes that some uncertainty remains. Examples include the understanding and extent of internal loading, identifying phosphorus sources, and limitations with projecting the impacts of climate change. Waiting for all the evidence to direct action is not necessary, as there is a sufficient body of knowledge to act while more is learned and uncertainty reduced.

One way to manage uncertainty is through the implementation of an adaptive management approach supported by monitoring, research and modelling efforts. Such an approach provides a framework to progress toward meeting goals and objectives, and adjust actions as required. Uncertainty is even greater with a changing climate and ecosystem changes such as the introductions of invasive species. Performance measures are a key component of adaptive management and provide a way to measure progress that will support making new management decisions over the duration of a program. Federal, provincial, academic and local scientists strongly support adopting an adaptive management approach to address uncertainty, and to consider new information as it becomes available.

NEXT STEPS

Through this process, Canada is engaging with Indigenous Peoples, the public and other partners on proposed Lake Ecosystem Objectives, phosphorus reduction scenarios and on the issue of measures to control phosphorus such as reduction targets to address harmful algal blooms in Lake of the Woods. The next step will be to gather input to determine the level of support for the proposed objectives and on taking action to reduce phosphorus loads to the lake. This would include the mechanisms that governments and our partners can take to achieve desired conditions in the lake.

In Canada, water and environmental protection falls under the jurisdiction of both federal and provincial governments, and whether the establishment of Canadian phosphorus reduction targets is appropriate will need to be decided by the Governments of Canada, Ontario and Manitoba. Concurrence among levels of government is important because each jurisdiction has a role to play in managing the issue, conducting science (e.g. research, modeling and monitoring), and protecting water quality and aquatic ecosystem health. Canada manages boundary and transboundary waters and has a commitment to work with U.S. Federal and State governments to ensure a coordinated approach and protection of water quality in both Canadian and U.S. portions of the lake. Ontario and Manitoba have primary responsibility over domestic water resources, pollution control and natural resource management, development and regulation. Federal and

Provincial agencies work closely to coordinate action to reduce phosphorus in other major transboundary lakes such as the Great Lakes and Lake Winnipeg.

CONTACT

In addition to providing your feedback through the https://www.placespeak.com/lakeofthewoods you can also contact us directly at the email address provided below.

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