

~ FIRST TRIENNIAL ASSESSMENT OF PROGRESS ON~

GREAT LAKES WATER QUALITY

DRAFT REPORT FOR PURPOSES
OF PUBLIC CONSULTATION

© John and Ann Mahan



Prepared by
The International Joint Commission Pursuant to Article
7 (1) (k) of the 2012 Great Lakes Water Quality Agreement

JANUARY 2017



NOAA Great Lakes Environmental Research Laboratory

“I grew up on the Great Lakes and there are a couple of pictures I took where it’s almost like a music conductor sweeps out his hand to the entire brass section. I tried to get pictures that show it as one great geologic, geographic and really important part of the world and our country.”

Canadian astronaut Chris Hadfield, a native of Sarnia, ON, which is adjacent to Lake Huron at the headwaters of the St. Clair River, about photographs of the Great Lakes he captured from the International Space Station. Photo taken April 20, 2013

~ FIRST TRIENNIAL ASSESSMENT OF PROGRESS ON~

GREAT LAKES WATER QUALITY

DRAFT REPORT FOR PURPOSES OF PUBLIC CONSULTATION



Prepared by
The International Joint Commission
Pursuant to Article 7 (1) (k)
of the 2012 Great Lakes Water Quality Agreement

JANUARY 2017



© Timur Gulitashvili

MESSAGE FROM THE INTERNATIONAL JOINT COMMISSION

This draft assessment of progress report has been prepared as a catalyst for public engagement, to seek answers and opinions from the broad range of individuals and constituencies who value the Great Lakes and wish to see them sustainably used and protected.

Since the signing of the United States-Canada Great Lakes Water Quality Agreement in 1972, the governments of both great nations have recognized their responsibilities, as trustees of the lakes on behalf of their citizens, to protect, defend and restore the multiple values of these freshwater jewels. This report is a direct outgrowth of their commitment to be accountable for the fulfillment of these responsibilities.

The Great Lakes Water Quality Agreement has evolved since 1972 to reflect a changing scientific understanding of the lakes, a growing binational relationship, and emerging challenges such as climate change. Since the 1978 revision of the water quality agreement, the International Joint Commission has served as an independent assessor of the progress made by the two governments in achieving the Agreement's objectives. In fulfilling this role, the Commission is informed not only by the best science, but also by the public that it and the governments serve.

Among the many questions to be answered in this report, two are overarching:

- Are the Canadian and US governments making adequate progress towards achieving the objectives of the revised Great Lakes Water Quality Agreement? and
- What advice can the International Joint Commission give to governments to help them better meet those objectives?

The answers we receive to these questions will be an important guide in revising this assessment of progress before it is submitted to the governments later in 2017.

The Great Lakes are often called a global treasure. At one point in history, the phrase referred to the economics of resource extraction. Today we know that the riches of the Great Lakes are inspirational as well as material, recreational as well as financial. And these manifold riches are shared by our two nations.

The International Joint Commission looks forward to engaging with interested members of the public on this draft report. Despite differences of perspective and opinion, there is a value shared among the peoples of the lakes: that all the riches of the Great Lakes matter, and that we must do our best to preserve them for all time.



Gordon Walker
Canadian Section Chair

Lana Pollack
United States Section Chair

Benoît Bouchard
Canadian Commissioner

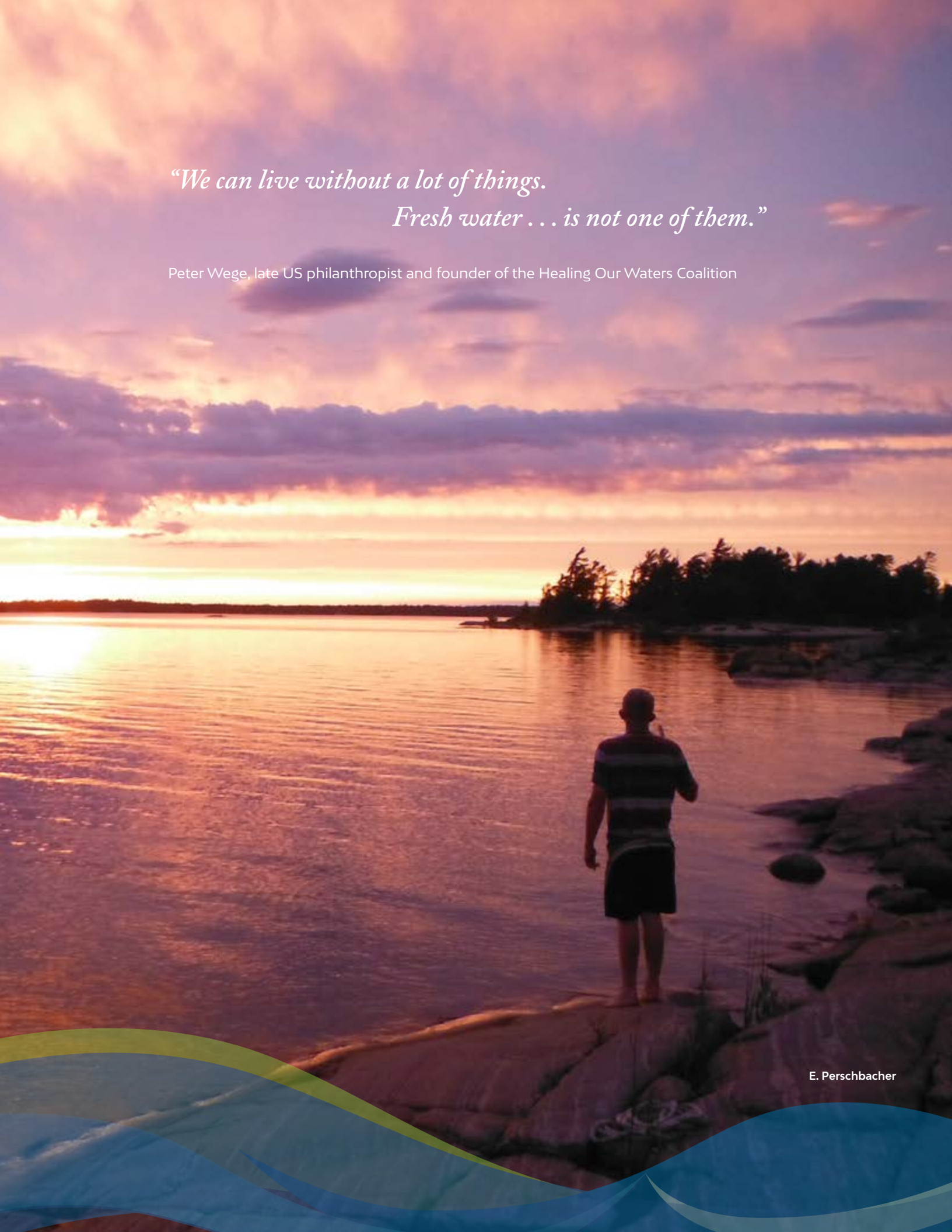
Rich Moy
US Commissioner

Richard Morgan
Canadian Commissioner



TABLE OF CONTENTS

Message from the International Joint Commission.....	5
Executive Summary.....	9
1. Introduction.....	13
2A. A Review of the Progress Report of the Parties.....	17
2B. A Summary of Public Input on the Progress Report of the Parties.....	23
3. Assessment of Progress Toward General Objectives.....	29
4. Consideration of Most Recent SOGL Report: Informing the Public About Great Lakes Status and Trends	63
5. Key Findings and Questions for Consultation	67
List of Acronyms, Figures and Glossary.....	79
List of Acronyms	79
List of Figures.....	80
Glossary	80



*“We can live without a lot of things.
Fresh water . . . is not one of them.”*

Peter Wege, late US philanthropist and founder of the Healing Our Waters Coalition

EXECUTIVE SUMMARY



The International Joint Commission (IJC) is charged by the 2012 revision of the Great Lakes Water Quality Agreement (referred to throughout this report as GLWQA) with submitting to the US and Canadian governments (the Parties to GLWQA) a triennial assessment of progress regarding Great Lakes water quality. Pursuant to Agreement Article 7.1 (k) the Assessment of Progress Report is to include:

- i. a review of the Progress Report of the Parties;
- ii. a summary of public input on the Progress Report of the Parties;
- iii. an assessment of the extent to which government programs and measures are achieving the General and Specific Objectives of this Agreement;
- iv. Consideration of the most recent State of the Great Lakes Report; and
- v. other advice and recommendations, as appropriate.

The IJC has developed this draft triennial assessment report, informed by a larger staff developed technical appendix that includes fuller analyses, technical information, discussion of relevant science and references. This report and the staff technical appendix report will be revised after consideration of comments received from the public. The final report will be submitted to the Parties and will also be useful to other levels of government, nonprofit environmental organizations, and all citizens who care about the well-being of the lakes.

At the outset, the IJC finds much to commend in the Parties' work under the GLWQA. In this first triennial cycle of implementation, the Parties devoted considerable effort to institutionalizing processes and procedures and meeting deadlines for initial commitments. For example, they successfully met deadlines for developing priorities for science and action, proposing a nearshore framework, and setting targets for Lake Erie phosphorus target reduction. The 2012 GLWQA also galvanized new energies and activity over a larger span of issues than were covered by previous versions of the Agreement and were not being actively addressed. Achievements realized in the past three years reflect robust binational public and governmental support and continuing investments in cleaning up past pollution and preventing new damages to the Great Lakes.



The programs and measures reviewed in this triennial assessment are a patchwork of varying effectiveness. Successful progress toward meeting the GLWQA's General Objectives includes accelerated restoration of contaminated Areas of Concern (AOCs) and no new introductions of aquatic invasive species (AIS). But more work needs to be done. Significant challenges include the decline in Lake Erie water quality, the slow pace in addressing chemicals of mutual concern (CMCs) and the spread of previously introduced invasive species.

IJC's assessment has led to 10 key findings that it is bringing forth for public consultation:

1. The 2012 GLWQA galvanized new energies, activity and binational cooperation over a larger span of issues than were being actively addressed under previous versions of the Agreement. The Parties are

to be commended for authoring the new GLWQA and for giving it momentum. No two countries in the world equal this cooperative effort – harmonized amongst not just two countries, but eight states and two provinces. The Commission salutes the Parties for this accomplishment.

2. The Parties have made considerable progress in implementing GLWQA, institutionalizing processes and procedures and meeting deadlines for initial Agreement commitments.
3. The Parties have not demonstrated sufficient progress toward the achievement of the human health objectives in their implementation of the GLWQA. Greater binational focus on the achievement of drinkability, swimmability and fishability objectives is needed.

4. There has been little progress in the identification of chemicals of concern and no publicly available progress in the development and implementation of binational strategies to address them.
5. The Parties have shown significant progress in addressing water quality contamination at Areas of Concern.
6. The water quality of western and central Lake Erie is unsatisfactory and unacceptable. New mandatory protections should supplement voluntary initiatives to reduce phosphorus loadings.
7. The Parties have not sufficiently engaged with the public in their implementation of the Agreement to date. This gap is notable in the development and implementation of Lakewide Action and Management Plans (LAMP), where more effective engagement of nongovernment organizations, indigenous peoples, minorities and other constituencies could meaningfully improve LAMPs and enhance actions to improve lake conditions. Engagement with communities that rely on Great Lakes fish consumption for subsistence is of particular importance.
8. Climate change has been altering Great Lakes water quality and levels and further forecast changes will have detrimental impacts.
9. There has been significant progress in preventing the introduction of aquatic invasive species to the Great Lakes.

The spread of previously introduced invasive species is a major concern. Further progress on AIS prevention and control could be enhanced by improving long term program funding mechanisms, reaching agreements on permitting the use of all types of control measures across jurisdictions and requiring ballast water exchange and flushing in addition to discharge treatment.

10. The Parties have significantly improved the selection of indicators to support the assessment of progress toward the achievement of GLWQA objectives. Reporting could be further enhanced with improved binational coordination and focus on key vital signs.

The IJC welcomes a vigorous public discussion of the Parties' Great Lakes actions in support of GLWQA, the reporting of their actions in the Progress Report of the Parties, the state of the Great Lakes, and the content of this report. Any citizen can participate in the discussion by attending public meetings sponsored by IJC or through the online democracy platform, ParticipateIJC.

The IJC intends to publish the final Assessment of Progress report later in 2017. It will include a summary of public input and recommendations and advice to government developed considering the input.



INTRODUCTION

The International Joint Commission (IJC) is an independent binational organization created by Canada and the United States under the *Boundary Waters Treaty of 1909* (the Treaty). Under the Treaty, the two countries cooperate to prevent and resolve disputes relating to the use and quality of the many lakes and rivers along their shared border. The Great Lakes Water Quality Agreement (GLWQA) assigns the IJC a role in assessing progress, engaging the public and providing scientific and policy advice to help the two countries restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes.



© Craig Sterken 2015

This report provides the IJC's first triennial assessment of progress under the authority of the 2012 Protocol to the GLWQA. Article 7 (1) (k) of the Agreement specifies that the IJC's triennial "Assessment of Progress Report" will include:

- (i) a review of the Progress Report of the Parties (PROP);
- (ii) a summary of public input on the PROP;
- (iii) an assessment of the extent to which programs and other measures are achieving the General and Specific Objectives of the GLWQA;
- (iv) consideration of the most recent State of the Lakes Report; and
- (v) other advice and recommendations, as appropriate

This triennial report replaces and redefines the IJC's previous biennial reporting on Great Lakes Water Quality, the last biennial report, the 16th, having been issued in 2013.

In order to offer the governments a timely first triennial assessment following the release of the Progress Report of the Parties (PROP) by the Canadian and US governments in September 2016, the IJC will present its required report in two phases: this draft report and a final report later in 2017 following a period of public input.

REPORTS REQUIRED BY THE GREAT LAKES WATER QUALITY AGREEMENT

Progress Report of the Parties (PROP)

This report documents actions relating to the Agreement, taken domestically and binationally, by the US and Canadian governments. PROP is to be issued before each triennial Great Lakes Public Forum.

State of the Great Lakes Report (SOGL)

Also issued triennially, this report provides data on progress towards achieving the overall purpose of the Agreement to restore and maintain the physical, chemical and biological integrity of the Great Lakes Basin Ecosystem through reporting on ecosystem conditions and trends. It is a report on ecosystem conditions, rather than actions and programs of the governments, which are covered in PROP.

Triennial Assessment of Progress Report (TAP)

The Agreement requires IJC to prepare and submit to the governments a report that reviews PROP, summarizes public input on PROP, assesses the extent to which programs and other measures are achieving the General and Specific Objectives of the Agreement, considers the most recent SOGL and provides other advice and recommendations, as appropriate.

In contrast to the PROP, which is organized around the annexes in the GLWQA, the IJC organized this assessment by the nine general objectives set out in the Agreement. This approach is consistent with the charge to the IJC under the GLWQA and the way the Parties plan to present their State of the Great Lakes (SOGL) report.

In this draft report, the IJC assesses the extent to which programs and measures are achieving GLWQA objectives in a narrative form based

on its own review, the PROP and material from the upcoming SOGL report, as reported at the Great Lakes Public Forum on October 4, 2016.

The IJC is tasked with considering the most recent SOGL report in its assessment. However, the 2016 SOGL report is currently being prepared by the Parties and only a presentation of what might be expected in the final SOGL report was given the Great Lakes Public Forum. This draft report uses the available information from the Forum

and from the latest State of the Lakes Ecosystem Conference which was published in 2014 and based on data from 2011. It is expected that the final 2016 SOGL report will be issued before this triennial assessment is finalized later in 2017 and, if so, this assessment will be updated accordingly.

In addition to considering the available SOGL data in the assessment of progress toward Agreement objectives, the assessment also considers SOGL reporting more generally and presents the IJC's findings on the set of SOGL indicators.

The IJC's final responsibility is to provide advice and recommendations to the governments, which will be included in the final report to governments. This draft report instead presents key findings and discussion questions for public input.

The IJC strongly believes that along with science-based assessment, public engagement is essential to good public policy and governance. The IJC has committed to a schedule of public engagement activities to capture input on the PROP and on this draft IJC Triennial Assessment of Progress Report.

This report is informed by a substantive staff developed technical appendix that presents more detailed analysis on the topics presented in this report. Both this report and the staff technical appendix report will be revised after consideration of comments received from the public.

The IJC hopes this assessment stimulates a continued vigorous dialogue about progress and supports ideas and action to further strengthen Great Lakes protection and restoration.



Tim D. Malinich

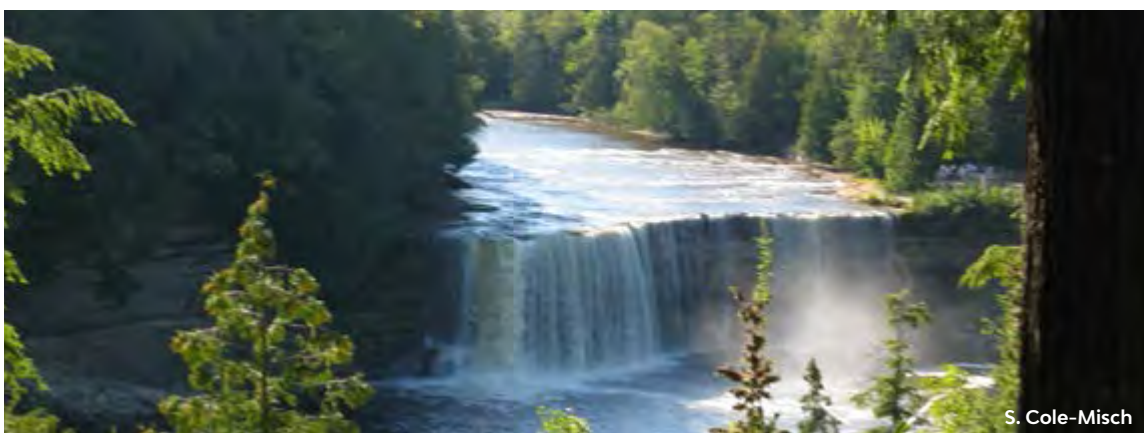
“When I was nine years old my parents used to take us to a friend’s cottage along Lake Erie, and one summer we were walking along the beach and found a dead sturgeon. It wasn’t a very large sturgeon, but we thought it was a sea monster, and we found out the name from a fisherman who was in the area, he knew it was a sturgeon. Back then there was no internet, so after that I really read all I could, I went to the library and got all the information I could on sturgeon. I think sturgeon are a prime example of the magnitude of the lakes because they’ve lived since the time of the dinosaurs, they can grow so large, and unfortunately it’s also an image that we can look back and see how people have impacted them negatively.”¹

Helen Domske, Lake Erie basin, New York

¹ These quotes are part of longer Watermark stories. The Great Lakes Watermark Project is a basinwide binational effort to collect and archive true stories about the ways Canadians and Americans interact with and treasure the Great Lakes. The IJC is partnering with Lake Ontario Waterkeeper to gather and share Great Lakes Watermark stories—written, spoken, or filmed—that connect the personal, emotional and cultural ways we use and value our precious shared waters. Watermark stories are being archived on a special Watermark Project site. Have a Great Lakes story to share? Submit yours online today.

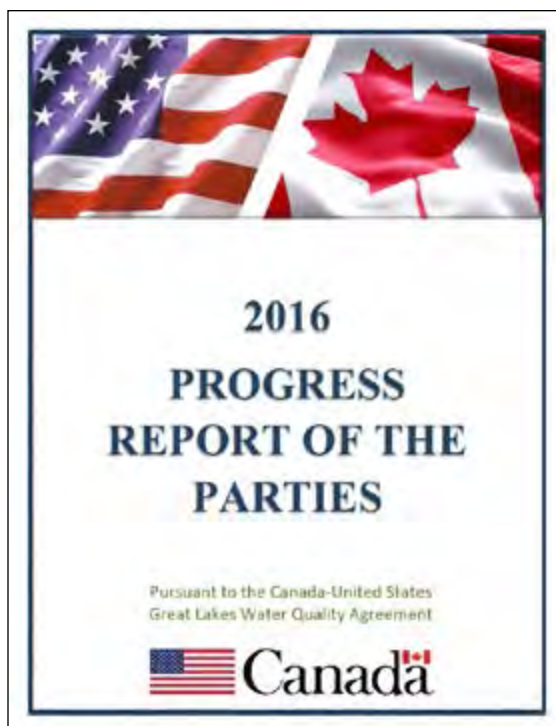
2A.

A REVIEW OF THE PROGRESS REPORT OF THE PARTIES



The GLWQA provides that the IJC's Triennial Assessment of Progress will include a review of the PROP, produced by the governments of Canada and the United States as parties to the GLWQA. This chapter assesses the quality of the PROP in meeting reporting requirements and demonstrating implementation of relevant principles and approaches established in the GLWQA. Chapter 3 assesses the progress, programs and measures reported in PROP.

The production of the PROP is a new commitment by the Parties under the 2012 GLWQA. Article 5.2(e) specifies that PROP shall document actions taken domestically and binationally in support of the Agreement. The government production of the PROP and the IJC review are key government accountability features under the 2012 GLWQA. The IJC commends the Parties for including these accountability mechanisms in the GLWQA and for moving forward with their implementation.





How well does the PROP meet the reporting requirements set out in the GLWQA? Most notably, the PROP report is required to document actions relating to the GLWQA that have been taken domestically and binationally. The PROP accomplishes this with a clear and readable catalogue of actions related to the articles and annexes. The PROP also addresses each of the specific reporting requirements identified in the annexes, though some are addressed to only a limited extent.

Article 2.4 of the GLWQA sets forth the principles and approaches to guide the Parties in implementing the Agreement, including the preparation of the PROP. Principles and approaches relevant to the review of the PROP are: accountability; adaptive management; coordination; and public engagement.

The first principle is accountability, defined as: establishing clear objectives; regularly reporting on progress to the public; and evaluating, in a transparent manner, the effectiveness of work undertaken to achieve the General and Specific Objectives of the GLWQA. The PROP clearly reports on commitments made in the 2012 GLWQA. This is most effective where commitments are specific and time-bound. In cases where commitments are more general, assessment of the appropriateness of the extent, depth and timing of the task(s) undertaken is more problematic.

Priorities for Science and Action set at the beginning of each three-year work cycle offer additional objectives against which to measure progress. The PROP would benefit from addressing priorities for the 2014-2016 work cycle as directly and clearly as the time-bound commitments in the GLWQA.

On the implementation of the Chemicals of Mutual Concern (CMC) Annex, for example, the PROP fails to mention that progress falls well short of the Annex's 2014-2016 priorities for action that included the development of binational strategies for the first set of CMCs by summer 2015 (no strategies had been developed as of the publication of this report). However, to effectively fulfill the role of setting objectives for a work cycle and improving accountability, the priorities for science and action must be better defined. Unfortunately, the Parties' proposed 2017-2019 priorities for science and action lack specific milestones for proposed CMC activities.



If the PROP is to be sustained as an accountability mechanism under the GLWQA, then reporting on the sort of near-term objectives that should be set in the priorities for science and action will become increasingly important. The number of GLWQA commitments with specific deadlines declines sharply after this first work cycle and, apart from one further time-bound requirement, only general and cyclical commitments remain. Cyclical commitments include the triennial reporting and priority setting processes, as well as the annual requirement to produce a Lakewide Action and Management Plan (LAMP) document as part of the five-year cycle for reporting on each of the lakes.

Under the GLWQA, the Parties commit to publicly reporting in the PROP, SOGL and LAMPs on progress in achieving the Agreement's objectives. The PROP does not significantly discuss progress relative to the GLWQA's General Objectives. Data and discussion of progress relative to the General Objectives are expected to be the focus of the SOGL 2016 report. The IJC cannot fully assess progress toward the GLWQA objectives without this information.

The PROP was published on September 28, 2016; however, the SOGL report will not be published until sometime in 2017. Coordinated release of these two reports in the future – though not required in the GLWQA – would enable review of the actions presented in the PROP in comparison to the indicator levels associated with each of the objectives.

The PROP paints a very positive picture of the implementation of the GLWQA. Although that picture is often justified, transparency would be improved if the report included discussion of where past or current programs have fallen short of expectations. This discussion would give the governments the opportunity to show how they are implementing an adaptive management approach – if they are indeed implementing such an approach – by assessing the effectiveness of actions and adjusting those actions to achieve the objectives of the GLWQA as outcomes and processes are better understood.

The PROP demonstrates that the Parties are implementing the principle of coordination with federal, state and provincial bodies. There is broad engagement by departments and agencies –listed in the report – that are contributing to the various Annex committees.

However, coordination beyond these bodies is less clear. Whereas some Annex committees (notably Annexes 2, Lakewide Management and 6, Aquatic Invasive Species) have broad and varied composition, others (for example Annexes 3, Chemicals of Mutual Concern, 8, Groundwater, and 10, Science) have predominantly, if not exclusively, government membership. The Annex 6 Sub-committee is most notable with respect to coordination in that it not only has a reasonably broad membership, but also works in close cooperation with the Great Lakes Panel on Aquatic Nuisance Species that predates the 2012 GLWQA and has its own broad membership. The Parties could perhaps demonstrate wider coordination and engagement if, as per Annex 3, details of the extended sub-committee were provided, either in the report or on binational.net.



In future rounds of reporting, the Parties could improve the PROP in content and delivery as a tool for public engagement, providing relatable case studies, pictures and informative graphics. For the purpose of public engagement, the PROP should be released publicly and promoted by both governments at least three weeks prior to the Great Lakes Public Forum. The report should then be used at the Forum as a context for the various presentations. Release of the SOGL report, in coordination with the PROP, prior to the Forum would further help public engagement.

In conclusion, the IJC finds the PROP to be a clear, readable catalogue of actions and the IJC recognizes the challenge of delivering the report on time. Overall, the PROP in itself represents a large step forward in accountability under the GLWQA. Accountability could be further improved over time with better, short-term objective setting. The report would also benefit from a more critical evaluation of the effectiveness of programs and measures by the Parties themselves, a greater demonstration of coordination outside of federal, state and provincial agencies, and greater focus on the PROP as a public engagement tool.



"I grew up on the lake and I have a lot of memories of how the lakes changed. I wouldn't have swum in it as a kid, we never really imagined it as a place where you'd go to have fun and jump in the water. I left Canada to study for about 10 years, and one of the striking things for me coming back was just getting in the lake and seeing how much things had improved. I swam the classic Marilyn Bell route, we started in Niagara-on-the-Lake on a beautiful evening, swam into the sunset, and arrived at Toronto the next day at Marilyn Bell park. I find myself now, I'll be driving somewhere or taking the bus and I'll find myself just staring at the lake, and remembering things, the sensations, the smells, the tastes, the sounds, and it's oddly captivating, because when you're doing [the open water swim] it's exhausting, like I will never ever do this again, but now as you think back, that sort of visceral connection with the water was important for me. I hope for everyone else the lakes have that kind of importance and we can find a way to remind them how important they are."

Loren King, Lake Ontario, Ontario

© Dmitry Naumov

2B.

A SUMMARY OF PUBLIC INPUT ON THE PROGRESS REPORT OF THE PARTIES



The Parties commit in the Agreement to “providing information and opportunities for the public to participate in activities that contribute to the achievement of the objectives” and to incorporating public opinion and advice and working with the public and others to accomplish its goals. The IJC strongly believes that public engagement is the foundation of good public policy and governance, and that achieving the Agreement’s purpose and goals will only happen if all sectors of the Great Lakes community are involved.

Because of this belief and its own Agreement commitments to consult on a regular basis with the public and to increase awareness of the inherent value of the lakes, the IJC intends at this time to conduct a series of active, open public engagement activities to capture input on the PROP and this TAP.

The input received from an online democracy platform, Participate IJC, ongoing input through our newsletters, social media and website, and a series of public meetings around the basin in March 2017 to obtain comment on this report and the Parties Report on Progress will be provided in the final version of this report.



WHAT IS PARTICIPATEIJC?

Throughout the IJC's review of progress under the Great Lakes Water Quality Agreement, you're invited to participate in the conversation by visiting our **online democracy platform** called ParticipateIJC. The sharing platform includes valuable information about the Agreement, the governments' report on progress that documents actions taken domestically and binationally in the support of the Agreement, as well as videos from the governments' Great Lakes Public Forum last October in Toronto and our own public meetings there and in Milwaukee.

More importantly, ParticipateIJC includes a variety of discussion forums and the opportunity for you to contribute your own comments and stories. You can talk with others across the basin about the successes and challenges facing the lakes, and read new information as we hold a series of public meetings in March 2017 within the Great Lakes basin to get input on this assessment report. You can find a complete list of locations, dates and times at www.ijc.org.

We're excited to provide this website as part of ongoing engagement with all of you about the Great Lakes. Join the conversation at www.ParticipateIJC.org and subscribe to our monthly newsletter, Great Lakes Connection, at www.ijc.org, or follow us on Facebook ([internationaljointcommission](https://www.facebook.com/internationaljointcommission)), on twitter ([@ijcsharedwaters](https://twitter.com/ijcsharedwaters)) and Instagram ([ijcsharedwaters](https://www.instagram.com/ijcsharedwaters)).



At this time, the IJC can provide several key messages from the public comment session at the Great Lakes Public Forum, and at the two public meetings in Toronto and Milwaukee. You can view the three sessions and read the summary reports at [ParticipateIJC](#).

Several major issues were addressed repeatedly at the Forum public comment session, across geographic and demographic groups:

- the need for enhanced public engagement by governments, which was identified as low, process-oriented, underfunded, and often missing the voices of those communities where the least Agreement progress has occurred
- greater involvement of indigenous communities in all aspects of Agreement processes and organizations
- improved funding, coordination, and regulations for integrated watershed management to protect nearshore habitats and wetlands
- an expedited, improved process to identify, monitor and implement regulations and action plans for chemicals of mutual concern
- the need to consider radionuclides and radioactive nuclear waste from energy production as a chemical of mutual concern, and take action to prevent their storage in the basin

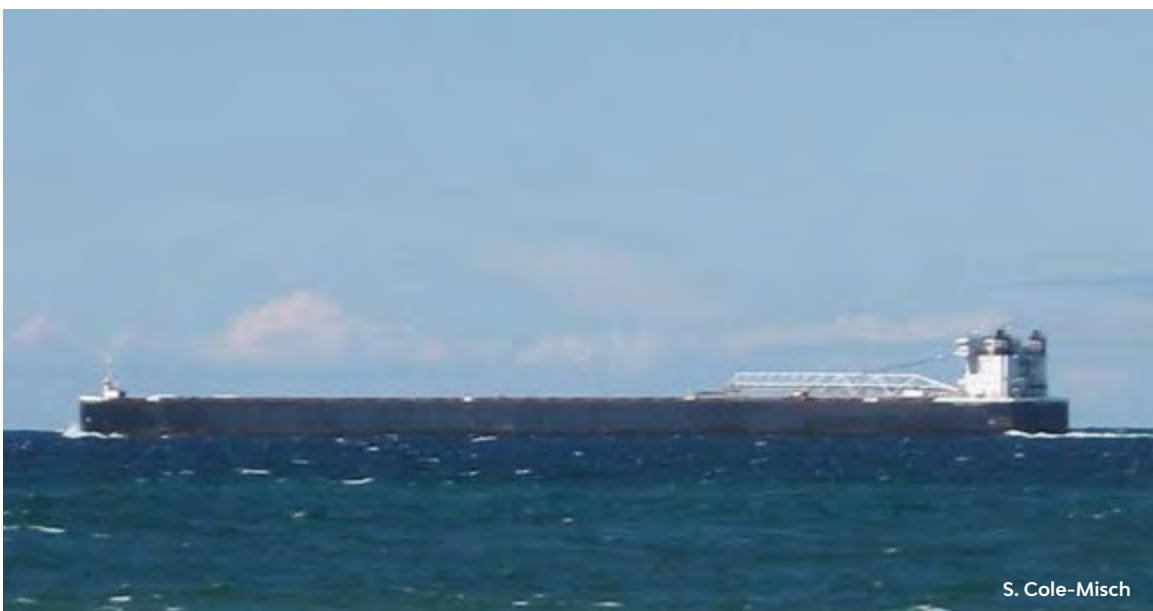
- a lack of specifics in the governments' progress report on timeframes, locations for actions, and implementation funding for nutrient management. Recommendations included focusing solutions in proportion to identified nutrient pollution sources, using innovative solutions, and using existing regulations to spur action
- the need to develop adaptation actions as a result of climate change, with heightened binational commitment to research and action.

At the evening public meeting at Toronto's City Hall, participants focused on local and regional efforts to restore the collective Toronto watershed and Lake Ontario. After presentations by five local experts in the areas of waterfront restoration, the Toronto area Remedial Action Plan (RAP), wastewater treatment and combined sewer overflows, toxic contaminants, and fish habitat, attendees divided into small groups to discuss findings and recommendations for these topics.

- Regional efforts to develop the Great Lakes Waterfront Trail to bring residents back to the lake were highlighted as a major success story.
- Progress under the RAP was also celebrated, although additional resources are needed to complete the identified remedial actions, science priorities and effective community and stakeholder engagement.

- Green infrastructure was listed as a priority, as was education and outreach to improve awareness of combined sewer overflows and their impact on the lake's nearshore region and recreational uses.
- Participants recommended that outfall pipes be extended to prevent sewer overflows from contaminating beaches and other areas where residents can enjoy recreation and valuable fish habitat.
- The unregulated and unmonitored use of road salt (and its derivatives) in parking lots by private operators, which accounts for 60% of the road salt spread in Ontario, is resulting in significant runoff of salt into waterways, affecting fish habitat.
- To engage urban populations, indigenous peoples, youth and others not traditionally engaged in Great Lakes issues and the Forum in particular, there is a need to reach out to and visit these communities, establish trust and credibility, and have members of the communities assist in promoting the relevance of the issues to their lives.

Two weeks after the Forum, in Milwaukee, Wisconsin, the IJC heard citizen perspectives on the western side of the basin about the state of the Great Lakes, and learned about successes and challenges in that city's watershed and Lake Michigan. Citizens joined with IJC, scientists and community experts at the University of Wisconsin-Milwaukee's School of Freshwater Sciences to hear presentations on local programs to develop green infrastructure, the Milwaukee Metropolitan Sewerage District's 2035 Vision to respond to a growing community and the effects of climate change, the city's Water Centric Cities Initiative for sustainable growth, citizen-based water monitoring, nutrient reduction, and the status of the state's waters. In small group discussions, participants discussed these topics further and developed a series of findings and recommendations for action on a local and Great Lakes-wide basis. These points and those raised at the Toronto meeting have direct relevance to progress under the Agreement.



S. Cole-Misch

- Green infrastructure was characterized as cost effective and providing unique, successful options to communities to manage water resources. Innovative financing solutions are needed to implement it on a broad scale, including public-private partnerships, and barriers removed from health and safety regulations to promote its use.
- Participants also agreed that the model for watercentric cities is promising, which allows for a decentralized infrastructure, requires good stewardship of water resources, and blends economic development with sustainability.
- Water quality monitoring in the Great Lakes was found to be data rich but information poor, with major gaps in coordination between local/state monitoring and that completed at the regional, federal and binational scale.
- Wisconsin and possibly all Great Lakes states and provinces were seen as at a critical tipping point for water: while there is a phenomenal increase in research and capacity, there is less ability to take decisions and actions due to cuts in state/provincial budgets and lack of long-sighted vision. Citizens aren't always aware of everything that goes into providing clean water, and societal economic stresses may prevent them from visiting and enjoying the lakes. Participants said this is essential so citizens are touched by and connected to the lakes, and thus a renewed effort is needed for Great Lakes literacy and appreciation.
- A basinwide climate change resiliency strategy that includes environmental literacy elements was considered a key priority for the Great Lakes.

“We spend our extended summers on Georgian Bay, which we’ve been doing for 38 years, and I know for a lot of people that’s not very long, because I’ve met all kinds of people who have been there for generations, but for me it feels like a significant part of time. My kids were one and three when we started going there, and they now have kids of their own, so it’s pretty special to have our grandkids grow up there. It’s been the one constant in our lives. We’ve always had a place where we always come together. After enjoying Georgian Bay for so long and having it be such a meaningful part of our lives, I’m now in a position to give back and make sure Georgian Bay is still there for our kids’ kids’ kids.”

Anne Randell, Georgian Bay, Ontario



E. Perschbacher

3.

ASSESSMENT OF PROGRESS TOWARD GENERAL OBJECTIVES

The GLWQA requires the IJC's Triennial Report to include "an assessment of the extent to which programs and other measures are achieving the general and specific objectives of the Agreement." This chapter assesses selected programs and measures in the context of their contribution to achieving the GLWQA's General Objectives and

considering the SOGL report information presented at the Great Lakes Public Forum. Additional assessment of and background detail regarding programs and measures related to general objectives are presented in the staff developed technical appendix report.



Dean Pennala - Fotolia

1. DRINKING WATER

GENERAL OBJECTIVE 1:

The Waters of the Great Lakes should be a source of safe, high-quality drinking water.

Draft SOGL Indicator (as presented at Great Lakes Public Forum)

Treated Drinking Water

- Ontario: source water and treated drinking water: status good, trend unchanging
- United States: treated drinking water: status good, trend unchanging

Overview:

Treatment technologies and care on the part of public drinking water system operators helps deliver clean, safe treated water an overwhelming majority of the time. However, the rare occasions when drinking water provision is compromised – such as the microcystin contamination affecting Toledo and Pelee Island – can have tragic consequences for the health and livelihood of those impacted. The prevention of further compromises of Great Lakes drinking water systems requires continued vigilance, foresight and investment and needs to be of utmost importance in implementation of the GLWQA.

The absence of a SOGL indicator for US source water quality is a significant gap in ensuring the safety of drinking water and in the assessment of progress against this

objective by the IJC. Protecting source water for drinking water supplies, rather than simply treating water after it is withdrawn, is consistent with the prevention approach in the GLWQA and an important part of source-to-tap protection. Additionally, the absence of an annex in the GLWQA focused on this and the other two human health objectives may impede progress towards their attainment.

Background:

The Great Lakes and their connecting river systems are a source of drinking water to over 40 million Canadians and Americans. However, these waters are susceptible to contamination from a variety of sources. As a result, the protection of these source waters is an important first step in the provision of safe drinking water. Protecting drinking water requires a comprehensive, “multi-barrier” approach, including source water protection, appropriate treatment, and distribution system maintenance and monitoring.

The Great Lakes region has experienced several drinking water contamination incidents in recent years. In 2014 “do not drink” advisories were issued by Toledo, OH and Pelee Island, ON in response to unsafe levels of microcystin, a toxin emanating from blue-green algae, in the treated water. In 2015, an emergency in Flint, MI resulted from elevated levels of lead leached from distribution pipes because of a failure to apply anti-corrosion control. Even though the City of Flint’s water was not drawn from the Great Lakes at the time of the incident, these cases serve as a reminder of the importance of safe drinking water in the

region and the decline in public confidence that results from even a few exceptions to the generally high quality of water that people in the basin expect when they turn on their tap. In addition, they may offer lessons that can lead to improvements in the protection and delivery of safe drinking water.

Assessment:

The quality of treated drinking water from the Great Lakes in both Canada and the United States is excellent, achieving health-based standards the overwhelming majority of the time.

US reporting characterizes the quality of drinking water after treatment. But the General Objective describes source water – that is, water quality *prior* to treatment. Source water quality is reported only on the Canadian/Ontario side of the border. There is no national US database for information on the quality of source water used as a public drinking water supply. This creates a gap in assessing progress towards meeting the source water General Objective.

In 2014, the IJC recommended to the Parties human health indicators to assess progress under the GLWQA. The two indicators for source water, *chemical integrity* and *biological hazard index*, provide for a cross-section of compounds potentially hazardous to human health monitored at source water intakes for drinking water treatment plants. The report, produced by the IJC's Health Professionals Advisory Board (HPAB), underscored the importance of having the Great Lakes as a source of clean drinking water.

Source water and treated drinking water monitoring are both important. However, consideration of source water allows for a more direct connection between the biological, chemical and physical integrity of the Great Lakes and risks to human health, and is more consistent with the source water objective. Ontario uses this approach. Source water parameters already reported by Ontario are not reported by the United States at source water intakes.

Although human health is a vital concern for the public, no Annex in the GLWQA specifically supports the achievement of the three General Objectives associated with human health – drinking water, swimming and recreational use, and fish and wildlife consumption. Review of the PROP shows that drinking water is only discussed in the context of nutrients, where US federal, Ohio and Ontario provincial actions related to actions addressing microcystins and harmful algal blooms are reported. The 2012 GLWQA highlights the connection of the quality of the waters of the Great Lakes to health, particularly the need to restore nearshore waters given that they are a major source of drinking water. A greater focus on the health objectives would enhance efforts by the Parties to achieve the General Objectives associated with human health.

Under Annex 1 (Areas of Concern or AOCs), progress has been made in removing the beneficial use impairment (BUI), *restrictions on drinking water consumption, or taste and odour problems*. (AOCs are geographic areas designated by the Parties where significant impairment of beneficial uses has occurred as a result of human activities at the local level.

BUIs are changes in the chemical, physical or biological integrity of the Great Lakes system sufficient to cause restrictions on uses.) Of the 43 AOCs designated by the Parties, ten at one time had a BUI associated with restrictions on drinking water consumption. To date, the Parties have removed this BUI at seven AOCs, with two of the remaining AOCs expected to restore the BUI within the next two to three years.

A key component in the delivery of safe drinking water is the development and implementation of source water protection plans (SWPPs). The requirement for the development and implementation of SWPPs varies between Ontario, where it is mandated, and the US states, where it is voluntary. The *Ontario Clean Water Act* requires the development of watershed-based SWPPs as a first step in a multi-barrier approach to protecting existing and future sources of drinking water.

The US *Safe Drinking Water Act* includes provisions intended to protect the nation's drinking water at all sources to reduce water treatment costs and risks to public health. The Act required that by 2003, each state develop a Source Water Assessment Program (SWAP) to assess the susceptibility of public drinking water supplies to contamination. Although the Act requires states to develop a source water *assessment* program, it does not require them to develop a source water *protection* program. The Ontario approach offers an extra measure of protection.

Agreement Objectives commit the Parties to assuring the waters of the Great Lakes are a source of safe, high-quality drinking water,

allow for swimming and consumption of fish and wildlife unrestricted by concerns due to harmful pollutants. Therefore providing and maintaining infrastructure adequate to meet these objectives is one of the governments' most basic – and expensive responsibilities. Both Parties have partnered with provincial, state and municipal governments in supporting essential infrastructure for drinking and waste water treatment systems.

However, infrastructure investments will continue to place considerable demands on public budgets, and planning for future needs is essential. Assessing and ensuring the adequacy of existing infrastructure to meet the objectives of the Agreement for at least one generation into the future, and assessing anticipated costs required to provide this infrastructure, requires continual attention from governments.

Conclusion:

Federal, state, provincial and local governments have done an outstanding job, providing safe drinking water almost all of the time everywhere in the basin. Protecting source water for drinking water supplies – where it is not already mandated -- would help reduce costs of treating water after it is withdrawn and benefit those drinking water supplies drawn directly from the lakes. This is also consistent with the prevention approach in the GLWQA. SOGL reporting should cover source waters in the United States, not Canada alone, and increased binational collaboration on all human health issues would help improve reporting and progress.

2. SWIMMING AND RECREATIONAL USE

GENERAL OBJECTIVE 2:

The Waters of the Great Lakes should allow for swimming and other recreational use, unrestricted by environmental quality concerns.

Draft SOGL Indicator:

Beach Advisories

- Status United States: good;
- Canada: fair; trend unchanging

Overview:

Public Great Lakes beaches are open and safe for swimming during 96 percent of the season in the United States and 78 percent of the season in Ontario. However, analysis of trends is made difficult because monitoring and criteria that support beach closing decisions vary across jurisdictions. The absence of an annex in the GLWQA focused on this and the other two human health objectives may impede progress towards their attainment. With recreation being the prime way that people identify with the Great Lakes, maintaining and improving healthy, recreational opportunities is key to engaging the public in the protection of the Great Lakes.

Background:

The coastal beaches and waters of the Great Lakes are a source of recreation to 40 million people in the United States and Canada. Coastal and in-lake recreation in the Great Lakes has many benefits. But swimming, boating and beach use also have the potential to affect human health adversely through exposure to biological hazards, such as bacteria or viruses, found in the water. Targeted epidemiological studies have shown a number of adverse health effects (including gastrointestinal and respiratory infections) to be associated with fecally-polluted recreational water. These effects can result in a significant burden of disease and economic loss.

Assessment:

Determining the extent to which programs and measures are achieving the recreational use General Objective is complicated by the lack of a specific corresponding annex that directly supports assessing progress towards the objective. Numerous activities associated with the GLWQA: indirectly monitor and protect recreational water quality; rely on assessment of recreational water quality during decision-making (for example, AOC beneficial use impairments before delisting); and consider recreational water quality when developing management action plans (LAMPs). Monitoring to support SOGL reporting falls under Annex 10 (Science), which would include human health indicators. However, this level of indirect attention is insufficient considering the importance of recreational water quality to the Great Lakes public.

As the PROP is organized around annex-by-annex reporting, there is little attention to swimming or the use of Great Lakes waters for recreation in the document. The discussion of swimming and recreational water quality that does occur is relative to the nutrients annex and relates to Ohio, Pennsylvania and US federal actions to monitor and manage harmful algal blooms in recreational waters. Canadian action on an AOC mentions improved recreational waters as a byproduct of AOC clean up.

Improved government coordination around beach and recreational water issues could speed progress towards achieving the objective. A Swimming and Recreational Use Objective Committee – or a committee organized around all three human health-related objectives under the GLWQA – could report on progress and examine emerging issues related to recreational water quality. The formation of the Traditional Ecological Knowledge Task Team under Annex 10 (Science) also serves as an example of a centralized binational approach by the Parties to take additional perspectives on board in their GLWQA activities.

SOGL reporting by the Parties on recreational waters includes an indicator addressing the number of beach closures in both countries. Great Lakes recreational waters have consistently been reported as exceeding the recreational water quality criteria of the US Environmental Protection Agency (USEPA) at the highest rate in the United States. Great Lakes beach closures are determined by First Nation/ Tribes, states, provinces and local governments.

Monitoring and criteria that support beach closing decisions vary across jurisdictions, adding to the complexity of interpreting trends in beach closures.

In 2014, the IJC recommended two indicators for recreational water. The first, *Risk of Illness from Great Lakes Beaches*, calls for continued measuring of the levels of *E. coli* levels in Great Lakes recreational waters. The second indicator, *Identified Risks at Great Lakes Beaches*, would include two measures: one supporting an assessment of the sources of contamination for Great Lakes beaches; and one to show how many beaches are adhering to best practices by using a beach survey tool.

The *US Beaches Environmental Assessment and Coastal Health Act* places a strong emphasis on bacterial monitoring for recreational waters. It requires all coastal states, including Great Lakes states, to develop programs for effective water quality monitoring and public notification at coastal recreational beaches. All eight states in the Great Lakes basin have signed onto the Act, including Wisconsin for Lake Superior, where previously there was no bacterial monitoring. These programs generally are implemented through state health or natural resources departments. Local and state health departments in the United States have experienced major budget and staff reductions since 2008, which present challenges to meeting their public health responsibilities. Moreover, funding for the Act historically has been tenuous and continued Congressional support is by no means certain.

In Ontario, the Safe Drinking Water Program requires Boards of Health to conduct surveillance of public beaches and assess factors and emerging trends related to illnesses and injuries. Ontario Public Health Standards recreational water monitoring protocols are based on authority from the Ontario's *Health Protection and Promotion Act*. This approach presents challenges for the health units, in that beach monitoring represents only one portion of a wide-ranging mandate for public health, while funding is limited.

Ongoing work by the USEPA and the US Geological Survey (USGS) holds promise for predicting real-time water quality conditions and increasing the accuracy of beach closure notifications. These programs are particularly valuable given that the

current lag time in availability of *E. coli* data can be up to 24 hours and the recognition that beach water quality can change quickly.

Conclusion:

Beaches are open and safe for recreational use the majority of the time in both countries. However, Great Lakes governments at all levels must strive to further improve safety. Additionally, the degree of attention being paid to recreational waters in the implementation of the GLWQA is insufficient considering the importance of lake recreation to the Great Lakes public. Harmonized measures and adoption of indicators recommended by the IJC are steps that could help improve reporting and help protect beaches.



3. CONSUMPTION OF FISH AND WILDLIFE

GENERAL OBJECTIVE 3:

The Waters of the Great Lakes should allow for human consumption of fish and wildlife unrestricted by concerns due to harmful pollutants.

Draft SOGL Indicator (Contaminants in Edible Fish):

- *Contaminants in edible fish*: status fair, trend improving or unchanging

Overview:

The IJC is pleased that the Parties' efforts since the 1970s have resulted in steep declines in legacy chemicals in commonly consumed Great Lakes fish. However, the current measurement of contaminant levels in whole fish (as opposed to the edible portion of fish) is not optimal for evaluating human health risk from consuming Great Lakes fish. To fully evaluate achievement of the objective, data collection and a sub-indicator also would be needed for consumption of wildlife. The absence in the GLWQA of a health annex or other focus on this and the other two human health objectives may impede progress towards their attainment.

Background:

Many people in the Great Lakes basin consume Great Lakes fish. But legacy toxic substances and emerging contaminants have triggered health advisories recommending limited human consumption of some species in some locations. Fish consumption advisories exist for some fish in each of the Great Lakes. These advisories vary across the region and are most notable for long-lived top predators and fish that have more fat, such as walleye and lake trout. Polychlorinated biphenyls (PCBs) are responsible for the majority of advisories, followed by mercury and dioxins. Health advisories related to Great Lakes fish consumption are of greatest concern for those who consume large amounts of Great Lakes fish, such as indigenous communities, anglers and their families and some Asian communities and those who are most vulnerable to the impact of toxic substances, such as women of child-bearing age and children.

Assessment:

Under the GLWQA, reporting on fish consumption has typically been based on a Contaminants in Whole Fish indicator. However, this indicator is not well suited for providing a picture of human health risk. Bones and organs are not typically consumed, nor is use of this indicator consistent with food preparation guidelines that advocate removal of skin and fat, the areas containing the highest levels of some contaminants. Levels of contaminants in the consumable portion of fish are a more appropriate human health indicator.

Additionally, while the number and location of sampling sites used to measure the indicator are appropriate for assessment of ecological health, they are not appropriate for determining human health risks because they are not directly related to the location of human populations consuming Great Lakes fish. Further, the majority of non-commercial anglers are catching nearshore, not offshore fish, and concentrations may vary widely between the two locations.

Differences in collection, analysis, and reporting of data also pose challenges in developing a Great Lakes basinwide indicator for fish consumption. A common set of fish species, chemicals and standardized methods are needed for comprehensive SOGL reporting.

Advisories for the Canadian Great Lakes vary by lake and are related primarily to PCB levels and secondarily to dioxins/furans and mercury levels. Ontario has also developed a comprehensive fish consumption advisory. The USEPA has published general guidance for fish consumption based on contaminant concentrations.

In 2014, the IJC recommended standardized methods to assess contaminant levels in the edible portions of fish and use it as an indicator, *Contaminant Levels in Great Lakes Edible Fish Species*. Fish indicator refinement would not necessarily involve new monitoring, as Tribes/First Nations and Métis, many states and Ontario already collect contaminant data on the concentrations in the edible portions of these fish species. But a significant effort would be needed to standardize and incorporate these



existing data streams into the SOGL process. The IJC supports binational methods and standards for determining the safety of Great Lakes fish consumption.

At the Great Lakes Public Forum, the Parties noted their intention to shift in approach to the Contaminants in Edible Fish indicator. Using this indicator, the Parties would report on contaminant data in edible fish portions based on existing monitoring programs and data from national, state/provincial and Tribes/First Nations and Métis.

Both countries maintain long-running programs to examine levels of chemicals in Great Lakes fish commonly consumed by humans, and there are multiple drivers for monitoring contaminants in fish and wildlife in both countries. In particular, Environment and Climate Change Canada (ECCC) supports the National Fish Contaminants Monitoring and Surveillance Program,

coordinating with USEPA's Great Lakes Fish Monitoring and Surveillance Program to screen for legacy and emerging contaminants across multiple fish species, which are included in binational reporting for the Great Lakes.

The only discussion of fish consumption in the PROP relates to the potential for exposure to persistent and bioaccumulative chemicals through fish consumption. No actions directly related to fish consumption are listed.

Although this objective notes that the waters of the Great Lakes should allow for human consumption of wildlife unrestricted by concerns due to harmful pollutants, the PROP does not mention programs related to wildlife consumption. As well, SOGL reporting does not connect human health with wildlife consumed from the waters of the Great Lakes. Information regarding the

widespread consumption of Great Lakes wildlife is limited and the level and spatial distribution of consumption patterns may not justify binational activities. Some US states have active health advisories for certain game species of waterfowl and snapping turtles due to concerns over levels of contamination by mercury and organic chemicals such as PCBs.

Conclusion:

Great Lakes fish are safe to eat provided that consumers follow guidelines in state and provincial advisories. However, concern persists about the human health impact of contaminants in fish consumed by subsistence anglers and women of child-bearing age. Some contaminants remain at levels of concern and improvements in data collection and reporting would help in discerning trends and communicating risks.



© Vasily Merkushev - Fotolia

4. POLLUTANTS

GENERAL OBJECTIVE 4:

The Waters of the Great Lakes should be free from pollutants in quantities or concentrations that could be harmful to human health, wildlife, or aquatic organisms, through direct exposure or indirect exposure through the food chain.

Draft SOGL Indicator

- *Chemicals in Great Lakes herring gull eggs:* status good, trend improving
- *Toxic chemical concentrations in open water:* status good, trend unchanging

Overview:

The development of procedures and processes for the nomination and scientific review of CMCs was a positive step, but identification of such chemicals and development of binational strategies to control them are well behind schedule. Further, the sheer number of potential CMCs argues for streamlining of the CMCs process.

Background:

The Great Lakes are uniquely vulnerable to chemical contamination, especially by chemicals such as PCBs and DDT that build up (bioaccumulate) in the food web and break down slowly in the environment. The Great Lakes have a large surface area and flush slowly, which means many chemicals collect in fish, wildlife and sediment and decline only gradually once controls are put in place.

Historically, intense industrial activity in the Great Lakes region and long-range atmospheric transport and deposition of chemicals from out-of-basin sources have contributed to chemical pollution of the Great Lakes. In addition to harming aquatic life, certain chemicals pose human health risks, largely through consumption of contaminated fish.

Assessment:

While levels of legacy toxic chemicals such as PCBs and dioxins are generally declining or unchanged in herring gull eggs across the Great Lakes (Figure 1), levels of several new and emerging toxic chemicals, such as the fire retardants dechlorane plus and hexabromocyclododecane, appear to be increasing. These pollutants could represent future stressors to the Great Lakes ecosystem. Mercury levels in some species of Great Lakes fish are stable or increasing but still well below levels of the 1970s.

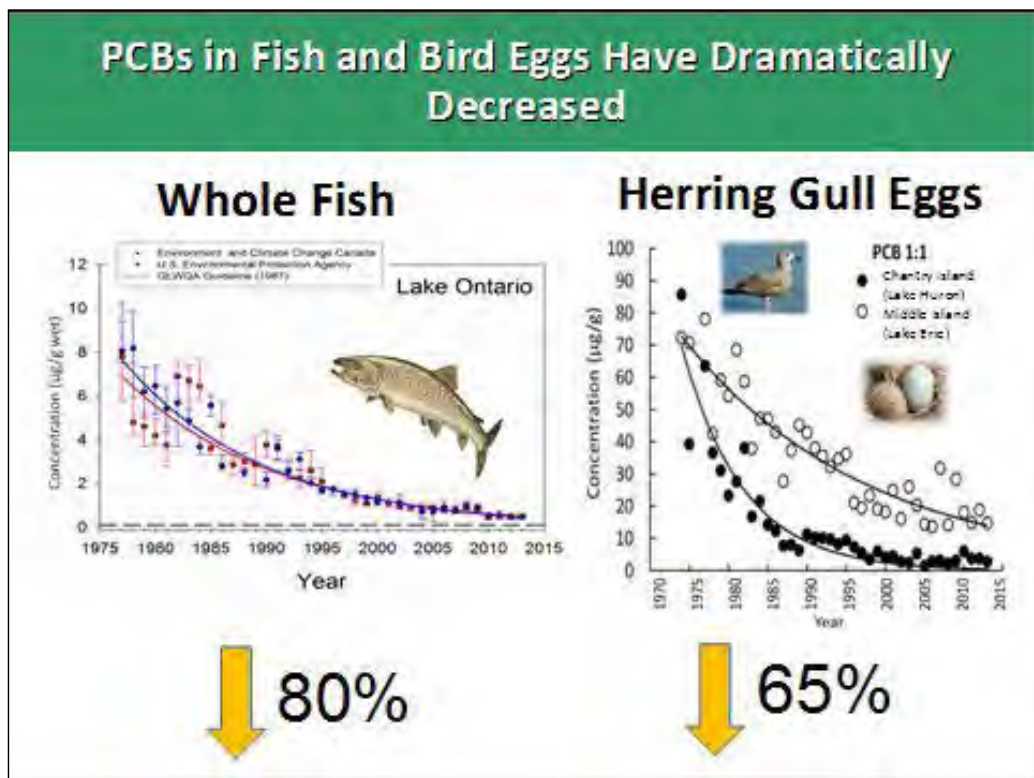


Figure 1. Levels of PCBs have declined in herring gull eggs and fish (Source: Draft State of the Great Lakes Report as presented at the Great Lakes Public Forum)

By developing a binational process and designating the first set of CMCs under the GLWQA, the Parties met their basic commitments under Annex 3. However, they have fallen well behind schedule in targeting CMCs for action through the development of binational strategies.

Although the Parties are to be commended for developing procedures and processes for the identification of CMCs, the IJC is concerned about a lack of resources to support Annex 3 efforts, the need for improved efforts to engage stakeholders and members of the public, and the need for a full commitment to making the work of the Annex as transparent as possible.

A particular concern is the pace at which the Parties are implementing the work plan for designating CMCs and developing binational strategies to address them. The Parties just designated the first set of eight CMCs under the GLWQA in May 2016 and have not yet completed pilot binational strategies for the first two of the identified CMCs. In addition, the binational strategies development process is not transparent to the public. The process should engage interested external stakeholders on a consistent and timely basis.

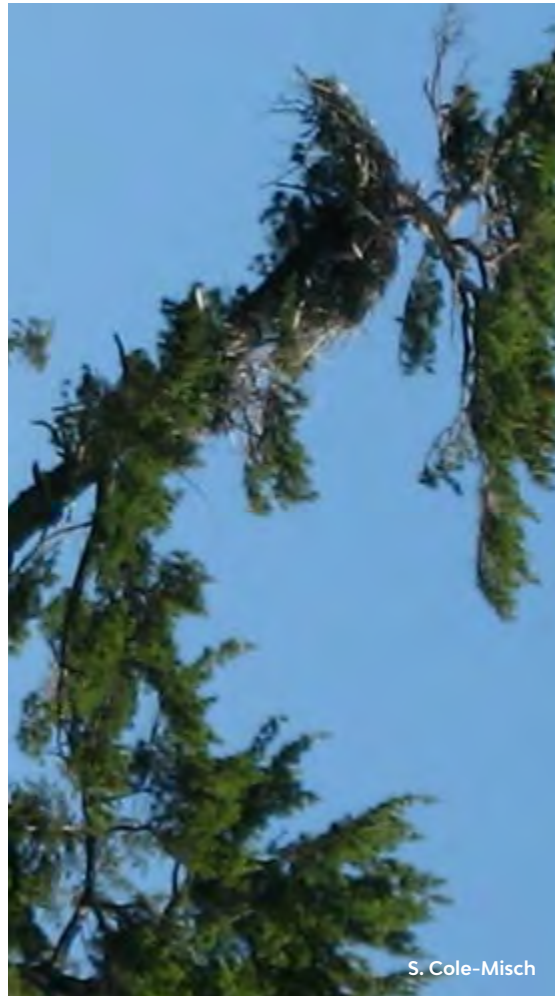
The IJC, through its Water Quality Board (WQB), undertook work on polybrominated diphenyl ethers (PBDEs), a family of chemicals used as fire retardants. PBDEs are among the first CMCs designated by the Parties. The IJC and WQB work applies directly to the efforts of the Chemicals of Mutual Concern Annex Sub-committee to develop binational strategies. IJC recommendations related to specific provisions identified in the GLWQA are offered that, while specific to PBDEs, can be adapted for other CMCs and their binational strategies.

In particular, an effective approach to managing or preventing toxic chemicals in the environment would be action by responsible governments (federal, provincial and state) to develop and implement Extended Producer Responsibility (EPR) programs throughout the basin. EPR is a policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle. EPR programs provide incentives to producers to incorporate environmental considerations in the design of their products.

Lessons learned from past programs and initiatives related to virtual elimination and zero discharge, such as the Great Lakes Binational Toxics Strategy and Lake Superior Zero Discharge Demonstration Program, could be incorporated into the binational strategies developed for CMCs and used as a basis for discussion on the path towards achieving the purpose of Annex 3.

Conclusion:

Expediting the process of selecting CMCs and developing binational strategies for their control are among the most important improvements needed to meet GLWQA objectives. Progress in reducing levels of legacy chemicals is encouraging but emerging contaminants are of concern.



S. Cole-Misch

5. WETLANDS AND OTHER HABITATS

GENERAL OBJECTIVE 5:

The Waters of the Great Lakes should support healthy and productive wetlands and other habitats to sustain resilient populations of native species.

Draft SOGL Indicator:

- *Coastal wetlands*: status fair, trend improving
- *Aquatic native species*: status fair, trend unchanging

Overview:

The Parties have made important progress in addressing the objective for wetlands and other habitats and implementing the Habitat and Species Annex. Building on many years of experience, the Parties have made considerable effort to assess the status and trends of the health of the Great Lakes related to this objective and prepare useful SOGL information. The development of binational habitat conservation strategies is a significant contribution towards the achievement of the objective. Wetland conditions can be improved and support for existing binational, domestic and local habitat programs and new initiatives should be further strengthened.

The overall trend of the food web sub-indicators varies, with some improving and others deteriorating. The bottom food-web component sub-indicators (phytoplankton and Diporeia) show a deteriorating trend; lake sturgeon populations are improving in all five lakes.

Background:

The Great Lakes consist of more than 121,000 hectares (300,000 acres) of coastal wetlands, 23,000 km³ (5,500 mile³) water volume, 246,000 km² (95,000 mile²) water surface area, and 16,000 km (10,000 mile) of shoreline. These features provide critically important habitats for native insects, reptiles, amphibians, fish, waterfowl, water birds, mammals and plants. Coastal wetlands also play an essential role in maintaining the health of the Great Lakes aquatic ecosystems in improving water quality by filtering pollutants and sediment and storing and cycling nutrients and organic material from land into the aquatic food web. Although healthy wetlands have always provided essential functions to support thriving plant and animal communities, their value has not always been understood and appreciated.

Other habitats (such as non-wetland shoreline ecosystems, and coastal tributaries) and habitat features such as connectivity to Great Lakes tributaries, coastal shoreline characteristics, lake substrates composition, water current movement and energy, and water quality and quantity are also critically important to aquatic life, ecosystem function and human uses of the Great Lakes.

Assessment:

The Parties' lakewide habitat and species protection and restoration conservation strategies have been important achievements in support of the objective for wetlands and other habitats. In addition, the Parties have developed a consistent basinwide approach for the survey of Great Lakes habitat and measurement of net habitat gain.

To comprehensively measure coastal wetlands and the food web, the Parties selected 16 sub-indicators. As a result, data collection and management is a key challenge to strengthening future assessments of progress towards this GLWQA objective. Weaknesses in the current approach are associated with: a reliance on short-term monitoring programs, which are vulnerable to being discontinued; a lack of standardized assessment methods among authors; a lack of continuity and transparency in data collection; and a lack of coordination among various individuals and agencies responsible for data collection.

The basin-wide approach to surveying Great Lakes habitat and measuring net habitat gain developed by the Parties has many strengths. However, it could be strengthened through: the application of standardized and consistent methods and criteria for spatial unit delineation and classification; standardized and consistent chemical and biological data collection over time; and an effective data management system and coordination mechanism to facilitate data sharing among partner agencies.

In addition to their own direct work towards this objective, the Parties have facilitated a range of binational collaborative partnerships and programs in support of the GLWQA objectives and the Habitat and Species Annex along with domestic and local collaborative programs. These partnerships have engaged federal, state and provincial, Tribal, First Nation, municipal, watershed management agencies and non-government organizations. New opportunities are emerging to promote and support new binational collaborative actions to reduce the loss of native species and habitat, recover populations of native species at risk, and restore degraded habitat.

The recent concurrence of the Parties with the IJC's Plan 2014 for the regulation of flows and levels through the Moses-Saunders dam at Cornwall, ON and Messina, NY will help restore the diversity and health of the remaining coastal wetlands on Lake Ontario and the upper St. Lawrence River. These wetlands represent over 20 percent of the existing coastal wetlands covered by the GLWQA.

Conclusion:

The Parties have done commendable work in developing habitat measurements and collaborating with a variety of actors in developing habitat conservation strategies. Further improvements in data collection and management could strengthen reporting and assessment of this objective.

6. NUTRIENTS

GENERAL OBJECTIVE 6:

The Waters of the Great Lakes should be free from nutrients that directly or indirectly enter the water as a result of human activity, in amounts that promote growth of algae and cyanobacteria that interfere with aquatic ecosystem health, or human use of the ecosystem.

Draft SOGL Indicator (Nutrients in Lakes):

Nutrients in Lakes

Status fair, trend deteriorating

Overview:

With the exception of Lake Superior, all Great Lakes are experiencing significant water quality issues related to nutrients. Open lake nutrient concentrations are below target and likely deteriorating in Lakes Michigan, Huron and Ontario, the probable cause being changes in the food web caused by non-native species. This is undermining valuable fish populations that depend on a stable food web. Due to excess phosphorus runoff from both agricultural and urban lands, nutrient concentrations are above target levels in the western and central basins of Lake Erie, fueling record harmful and nuisance algal blooms. Excess nutrients also undermine water quality in the Green Bay, WI and Saginaw Bay, MI areas.

The Parties have made commendable efforts to develop phosphorus loading targets and to begin developing plans to reduce harmful algal blooms (HABs) in western Lake Erie. Attainment of ambitious phosphorus loading reduction targets of 40 percent is unlikely without the addition of enforceable standards to supplement voluntary stewardship.

Background:

Phosphorus is the growth-limiting nutrient in the Great Lakes, as is the case in most freshwater systems. Limits on phosphorus in detergents and improved wastewater treatment helped make nutrient management a success story under the 1972 and 1978 iterations of the GLWQA. Total phosphorus loads and the occurrence of algal blooms declined, particularly in Lake Erie. Since the mid-1990s, however, nuisance and HABs in western Lake Erie have proliferated. Excess phosphorus, especially the highly bioavailable soluble reactive fraction, has led to a recurrence of severe HABs in western Lake Erie.

Assessment:

The Parties have met the timetable they set in the GLWQA for establishing phosphorus loading reduction targets for Lake Erie and are on track to meet the 2018 deadline for domestic action plans. However, the plans are unlikely to be sufficiently rigorous to deliver the loading target reductions.

Over the past ten to 15 years, governments at all levels have focused on incentive-based and voluntary programs to reduce nutrient

loadings in the western basin of Lake Erie. These voluntary programs include funding and support for implementation of best management practices on agricultural lands, the leading source of bioavailable phosphorus in the western Lake Erie basin. But frequent HABs in the last ten years suggest that the voluntary programs are not sufficient in achieving target loadings set by the Parties in 2016.

The PROP provides specificity regarding US on-the-ground activities, especially on agricultural lands and expected phosphorus

loading reductions. However, comparable detail is not provided for Canadian programs. The report also provides little discussion of declining nutrient levels in the open waters of most of the lakes and no plans are provided to address the issue. The high nearshore nutrient levels and offshore low nutrient problem may be due to the abundance of Zebra and Quagga mussels, which may help retain nutrients in the nearshore (Figure 2). The low offshore levels impact the availability of energy in the food web and ultimately affect fish abundance.

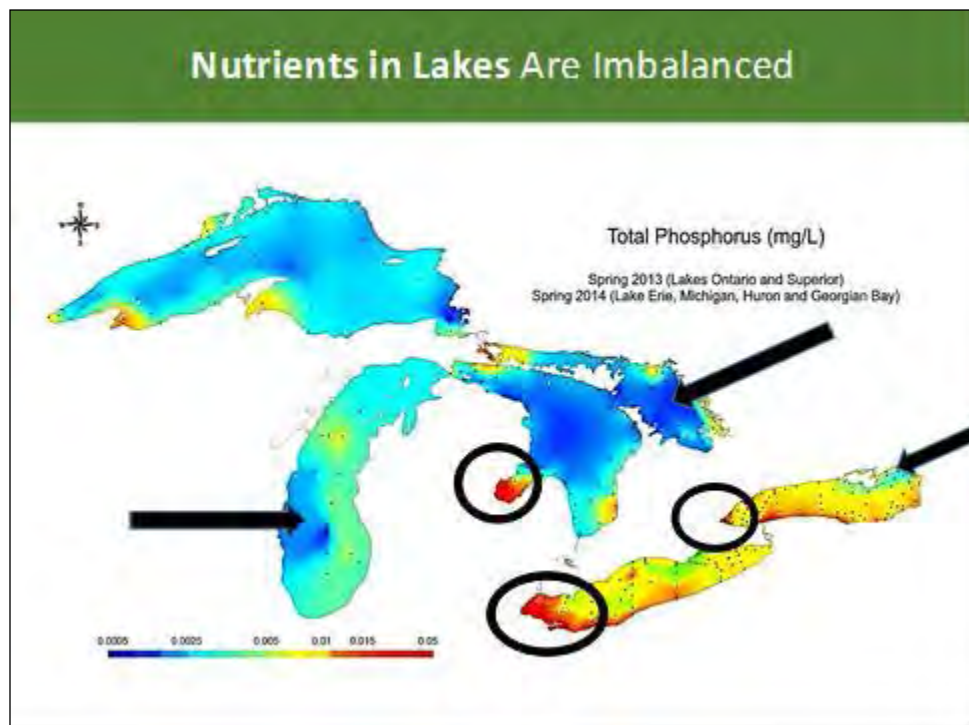


Figure 2: Imbalanced nutrient levels

Some areas are nutrient-rich (eutrophic) while others are nutrient-poor (oligotrophic). Some imbalance always existed, but the imbalance has been exacerbated recently.

Source: Draft SOGL as presented at the Great Lakes Public Forum

A major source of nutrient inputs to the western Lake Erie basin is concentrated animal feeding operations (CAFOs). These are livestock confinement facilities that house large quantities of animals, generating significant quantities of animal waste. Ohio legislation to curb the placement of animal waste on frozen, snow-covered or saturated ground is a positive step towards reducing nutrient runoff from CAFOs as well as conventional farm operations. Ontario's Nutrient Management Act, 2002, also prevents application of nutrients to agricultural land when the soil is snow-covered or frozen.

In northwestern Ohio, only five percent of Lake Erie's original approximately 125,000 hectares (307,000 acres) of wetlands remain, and similar patterns exist throughout the rest of the western basin of the lake. The draining of coastal wetlands and most of the approximately 300,000-hectare (736,000-acre) Great Black Swamp in the tributary watershed "eliminated most of the capacity to prevent pollutants and sediments generated in the upland portions of the watershed from entering the lake," according to the Ohio Department of Natural Resources. Achieving the Lake Erie phosphorus loading targets will require substantial wetland restoration and construction, given the proven success of wetlands in capturing and filtering pollutants.

While making commendable efforts to fulfill their commitment under the GLWQA with respect to monitoring and modeling of phosphorus and other nutrients in the Great Lakes and their tributaries and connecting rivers, the Parties could enhance modeling with the measurement of nutrients at critical locations and specific times of the year.

Conclusion:

Excess phosphorus loadings to the western Lake Erie basin remain a critical problem. The Parties are meeting GLWQA deadlines for targets and domestic action plans, but a greater sense of urgency and inclusion of regulatory protections in domestic action plans are needed. Another problem requiring attention is the nutrient-poor (oligotrophic) conditions in the offshore of most lakes, which are affecting fish abundance and fisheries.



7. INVASIVE SPECIES

GENERAL OBJECTIVE 7:

The Waters of the Great Lakes should be free from the introduction and spread of aquatic invasive species and free from the introduction and spread of terrestrial invasive species that adversely impact the quality of the Waters of the Great Lakes.

Draft SOGL Indicator:

Invasive Species

Status: poor, trend deteriorating

Overview:

The Parties have made significant progress in prevention, risk assessment, early detection and response planning for invasive species. Canada and the United States committed extensive resources to the task, established aquatic invasive species (AIS) as a priority in the 2012 GLWQA, created the AIS Annex sub-committee and took action to meet the priorities for science and time-bound commitments established in the Agreement. Progress in these areas has been accompanied by setbacks with the spread of several AIS and terrestrial invasive species documented in the draft SOGL presented by the Parties at the 2016 Great Lakes Public Forum.

The Parties have implemented vigorous, joint enforcement of requirements to exchange ballast and to flush empty ballast tanks with salt water prior to allowing sea going ships to enter the Great Lakes. These requirements have proven successful in stopping the introduction of AIS to the Great Lakes from ballast water discharges since 2006.

Background:

More than 180 aquatic non-native species have become established in the Great Lakes due to human activities over the past 175 years. Most aquatic non-native species, such as Rainbow trout and Coho Salmon, do not cause problems; however, about a quarter of the non-natives in the Great Lakes are considered invasive because they negatively impact the ecosystem, the economy, or human health.

AIS are among the toughest challenges facing the Great Lakes basin. They not only out-compete native species, but exacerbate the spread of chemical contaminants and nutrients in the Great Lakes ecosystem, as well.



The IJC has been reporting on the topic and providing a forum for binational collaboration on AIS issues for over 28 years, witnessing the basin-wide impacts of Sea Lamprey, Zebra and Quagga Mussels (*Dreissenids*) and other high-impact AIS.

Assessment:

Progress the Parties have made to date in large part has resulted from leveraging the existing, extensive network of federal, state, provincial, and local government agencies and non-governmental organizations with a depth of AIS-related experience. The need for effective multi-organizational coordination cannot be overstated. A 2012 study commissioned by the IJC found that in just a small portion of the Great Lakes basin, there were 100 Canadian and US public and non-governmental organizations involved in some way with AIS response. Close cooperation with the Great Lakes Panel on Aquatic Nuisance Species (ANS Panel) was a key element in harmonizing national and binational efforts through a network developed over the past 25 years by the panel². The Parties' efforts and funding have resulted in an impressive list of accomplishments over the past several years.

The rate of discovery of new non-native aquatic species in the Great Lakes has declined sharply from an average of one new species discovered every eight months, with over 70 percent attributed to ballast water discharges, to no new discoveries attributed to ballast water discharges since 2006. With the possible exception of a zooplankton species *Thermocyclops crassus*, no additional introductions from other pathways have resulted in establishment of a non-native species since 2006.³

This decline in new introductions can be attributed to the fact that both governments have mature AIS prevention programs that are institutionalized in domestic legislation and regulations. The Parties have instituted the most stringent ballast water management regulations in the world, taking into account the international ballast water discharge standard issued by the International Maritime Organization. These regulations require all ships entering the Great Lakes St. Lawrence Seaway from outside the Exclusive Economic Zone (a zone extending out up to 200 nautical miles from the territorial sea) to conduct ballast water exchange or flushing. Both governments have coordinated enforcement programs to achieve nearly 100 percent compliance.

² The Great Lakes Aquatic Nuisance Species (ANS) Panel was created as a regional advisory panel for the U.S. ANS Task Force by the *Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990*. The Great Lakes ANS Panel has binational representation, with members representing U.S. and Canadian federal agencies, the eight Great Lakes states and the provinces of Ontario and Québec, non-governmental organizations, local communities, tribal authorities, commercial interests, and the academic community.

³ On November 1, 2016 the USEPA's Great Lakes National Program Office confirmed the presence of a previously unreported non-native invertebrate zooplankton species *Thermocyclops crassus* in the western basin of Lake Erie. The NOAA Great Lakes Aquatic Nonindigenous Species Information System (GLANSIS) database has recently been updated to reflect this discovery. The species may have been present for some time but was only recently detected in 2014 samples. *Thermocyclops crassus* has been found elsewhere in North America and is not considered an invasive species because it does not appear to cause harm to the ecosystem, the economy, or human health.

The IJC supports the joint efforts of the two governments to strictly enforce ballast water exchange and flushing requirements for vessels entering the Great Lakes through the St. Lawrence Seaway. Measures called for by Canadian, USEPA and state regulators, to require a strict enforcement regime of mandatory ballast water exchange and flushing, in addition to ballast water discharge treatment, would be a significant added measure of safety.

Even though the rate of new invasions has slowed, the AIS situation is deteriorating because of the spread of previously established invasive species. For example, *Dreissenids* have increased in abundance over time and spread across all of the Great Lakes, with the exception of Lake Superior.

To address the spread of AIS, the regulation of ballast water discharges from “Lakers”, ships that remain within the Great Lakes, is being considered by Transport Canada as well as several states, though Lakers currently are exempt from US Coast Guard requirements. The two federal governments have agreed to seek consistency and compatibility between US and Canadian ballast water requirements in the 2017-2019 priorities for science and action, and this should provide a path towards compromise and harmonious joint implementation for both Lakers and seagoing vessels.

The waters of the Great Lakes also can be impacted by the introduction and spread of terrestrial species. Terrestrial invasive species can cause an array of ecosystem impacts, including deforestation leading to increased sediment, chemical and nutrient loading to

the Great Lakes. Sub-indicators associated with terrestrial invasive species include the common reed (*Phragmites*), Asian longhorned beetle, emerald ash borer, garlic mustard and purple loosestrife. The poor status and deteriorating trends associated with the spread of previously established terrestrial invasive species and AIS has overshadowed progress made in prevention of new AIS, resulting in an overall SOGL status of poor and deteriorating.

Significant investments also have been made in public outreach and education to address the spread of AIS by activities such as recreational boats, aquariums, commercial and internet trade.

The establishment of a first-ever AIS warning system and the use of environmental DNA (e-DNA) for monitoring and detection has shown innovation by the Parties and has significantly improved regarding scope, frequency and number of target species.





The application of new technology such as pheromones, chemical controls, acoustic, carbon dioxide and electrical barriers shows great potential to improve eradication and control of AIS. However, much more progress needs to be made to field test, perfect and implement new control tools.

The use of the information-sharing tools, the NOAA Non-indigenous Aquatic Species database, and the Early Detection & Distribution Mapping System have significantly improved the understanding of AIS impacts and have helped inform management actions.

There has been significant progress in the control of Asian Carp. The Great Lakes Mississippi River Interbasin Study and Chicago Area Waterways Study have identified options for preventing the migration of Asian carp through canals and other interbasin connections. The construction of a physical barrier

to eliminate the risk of AIS movement through Eagle Marsh to the headwaters of the Maumee River and Lake Erie is a significant accomplishment, as well. Much progress can be credited to US Great Lakes Restoration Initiative grants, but there is little sustained base program funding for binational AIS monitoring, control and technology development. Addressing the issue of funding is also critically important for actions related to control and eradication of AIS.

With few exceptions, existing AIS prevention and control programs have been funded and new collaborative efforts are focusing resources on specific vectors of AIS movement and on particular high-risk species. Efforts to manage the discharge of ballast water, stop the spread of Asian carps, *Dreissenids*, *Phragmites* and halt illicit trade of AIS on the internet are models of multi-jurisdictional collaboration and innovation.

The level of effort and funds spent on Asian carp control are well-justified by the fact that programs have curtailed their spread and the extent to which the response procedures and control technology developed for Asian carps may be applied to the eradication and control of many other species.

Over the past 25 years, the ANS Panel has become a mainstay for binational, regional collaboration on policy, research and operational protocols to stop the establishment and spread of AIS. The panel has binational representation, with members representing US and Canadian federal agencies, the eight Great Lakes states and the provinces of Ontario and Québec, non-governmental organizations, local communities, First Nations and tribal authorities, commercial interests, and the academic community. The Panel has never been fully funded despite taking on new challenges and providing important support for the AIS Annex Sub-committee.

Developing effective control measures is critically important. The Parties' 2017-2019 priorities for science include: determining the feasibility and effectiveness of AIS eradication and containment methods; developing technology and methods to achieve effective barriers that prevent the migration of AIS, while allowing the movement of beneficial species; and evaluating and enhancing AIS early detection technologies and methods. Sharing the results of this work among members of binational collaboratives established by the Great Lakes ANS Panel and the Annex 6 Sub-committee could accelerate progress in this area.

Conclusion:

The success of rigorously enforced binational requirements for ballast water exchange and saltwater flushing in preventing the introduction of aquatic invasive species to the Great Lakes is heartening. Moving from a grant-driven system to sustained program funding for binational AIS monitoring, control and technology development would strengthen long-term planning and protections. The impact of terrestrial invasive species spread on Great Lakes water quality is of concern.

8. GROUNDWATER

Draft SOGL Indicator:

Groundwater Quality

Status: fair, trend undetermined

GENERAL OBJECTIVE 8:

The Waters of the Great Lakes should be free from the harmful impact of contaminated groundwater.

Overall:

The Parties have made excellent progress, completing a comprehensive report on groundwater science under the GLWQA and undertaking work on a groundwater quality indicator for future SOGL reporting.

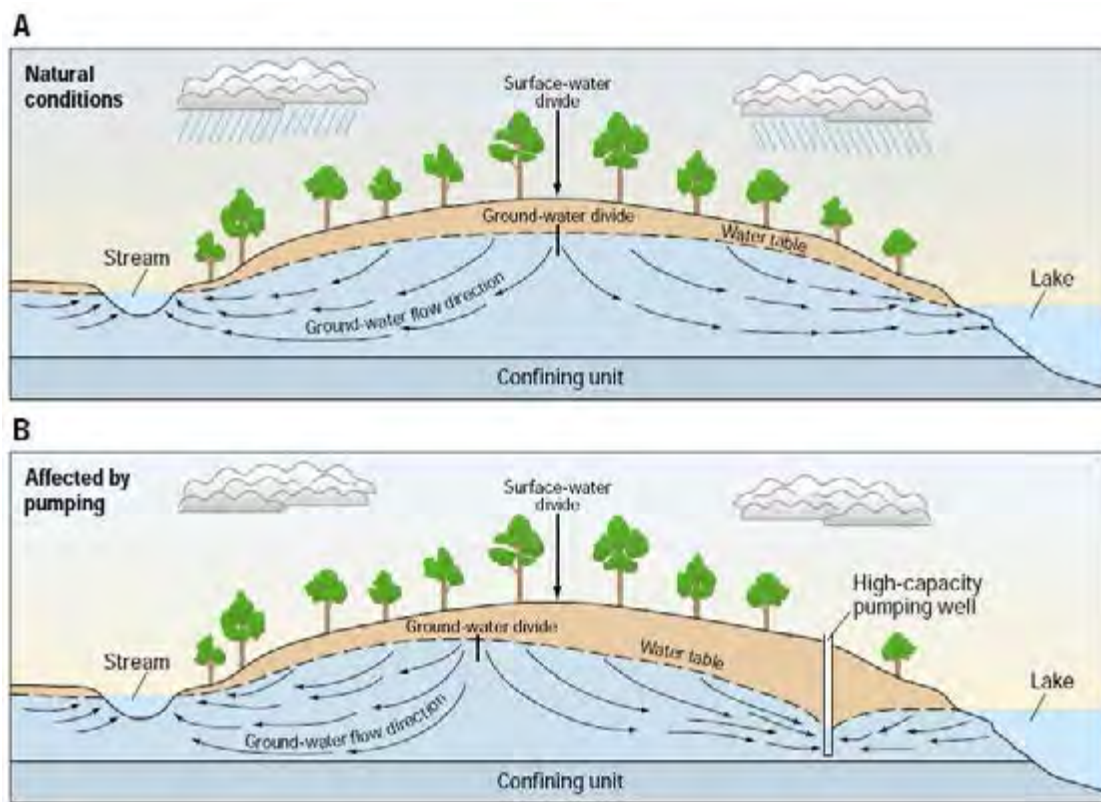


Figure 3 – Generalized Groundwater - Surface Water Interactions (A) under natural conditions and (B) affected by pumping (Source: USGS, 2000)

Background:

Groundwater in the Great Lakes basin is a critical part of the region's water resources. Groundwater and surface waters are inextricably linked in terms of both quality and quantity (Figure 3). Reductions in groundwater quantity, due to over-pumping for example, can reduce base flow to streams, negatively affecting surface waters and degrading groundwater dependent habitats and ecosystems. The Great Lakes also can be affected by contaminants in groundwater from leaking underground storage tanks and many other sources. If groundwater contaminant levels are higher than surface waters, then groundwater contamination also can degrade surface water quality if contaminants are ultimately discharged to receiving waters. Sometimes, groundwater transported to surface waters can be of higher quality than the receiving waters, enhancing surface water quality.

The 2012 GLWQA includes an updated Groundwater Annex that recognizes the interconnection between groundwater and the waters of the Great Lakes and that preventing groundwater contamination is critical in protecting the physical, chemical and biological integrity of the Great Lakes. The annex seeks to support the achievement of the groundwater General Objective by promoting the coordination of groundwater science and management actions.

Assessment:

The Parties established five binational priorities for science and action for groundwater for 2014-2016. Three of these



five priorities were accomplished with the release of the report on *Groundwater Science Relevant to the Great Lakes Water Quality Agreement: A Status Report* (May 2016), which examines threats and stresses to groundwater quality as well as the impacts of groundwater quantity and flows on the lakes.

The Parties' groundwater report identifies eight over-arching priority science needs, including improved groundwater research and monitoring to better understand and manage groundwater quality and subsequently its impacts on surface waters of the Great Lakes as well as groundwater quantity and its interactions with surface waters. Three of these priority science needs are reflected in the draft 2017-2019 Binational Priorities for Science and Action for groundwater. It is not clear when (or how) the remaining priority science needs will be addressed.

The priority science needs identified in the governments' Groundwater Science report are consistent with previous recommendations made in recent IJC and IJC Board reports. In general, the reports all identify the need for improved groundwater research and monitoring to better understand and manage groundwater quality and subsequently its impacts on surface waters of the Great Lakes. This includes groundwater quantity and its connection to surface waters, which is not well understood.

The status of groundwater quality in the Great Lakes basin is currently undergoing assessment through the development of a groundwater quality indicator under the 2016 SOGL reporting. The anticipated groundwater indicator is expected to more appropriately report progress towards the achievement of the groundwater General Objective by reporting on the quality of shallow groundwater in the basin, specifically the contaminants chloride and nitrate. Future reporting of this indicator is expected to expand the number of parameters to be analyzed and the Parties are encouraged to consider the parameters identified under the IJC's proposed ecosystem indicator for groundwater.

The impacts of withdrawals on groundwater quality, and ultimately the lakes, are increasingly important. The Great Lakes states and provinces should fully factor the adverse ecological and water quality impacts of groundwater withdrawals into both water use permitting procedures and decisions regarding consumptive use.

Conclusion:

The Parties have worked diligently to close scientific gaps in the understanding of connections between groundwater and Great Lakes water quality.

9. OTHER MATERIALS, SUBSTANCES AND CONDITIONS

GENERAL OBJECTIVE 9:

The Waters of the Great Lakes should be free from other substances, materials or conditions that may negatively impact the chemical, physical or biological integrity of the Waters of the Great Lakes.

Several topics are included in this analysis, including AOCs (Annex 1), lakewide management (Annex 2), climate change impacts (Annex 9), the Cooperative Science and Monitoring Initiative (CSMI) (part of Annex 10) and microplastics.



Areas of Concern

In the United States, 62 of 255 BUIs have been removed and four out of 26 AOCs delisted. In Canada, 65 of 146 BUIs have been removed, three AOCs delisted and two AOCs designated in recovery of 12 exclusively in Canadian waters. None of the five binational AOCs have been delisted.

Approximately one-third of the annual \$300 million US Great Lakes Restoration Initiative funding has been directed towards AOC cleanup. Canada has made significant recent investments at Hamilton Harbour AOC (\$139 million for sediment remediation and \$484 million for wastewater treatment infrastructure) and Port Hope Harbour AOC (\$1.28 billion for contaminated sediment remediation). Although base funding for AOC remediation through Canada's Great Lakes Action Plan has remained constant, investment in remediation activities also can occur through other programs, such as the Investing in Green Infrastructure program announced in the Canadian Budget 2016. Increased investments by the Government of Canada in Canadian AOCs could further accelerate progress towards AOC remediation. The Remediating Contaminated Sediments indicator in the 2011 State of the Lakes Ecosystem report notes an increasing trend in remediation between 1997-2010, which is encouraging and reflects implementation of projects that were planned and permitted earlier in various RAP processes.

Interaction among and between the numerous communities of practice associated with AOCs – including science and monitoring, project implementation and community engagement – would benefit

from technical transfer and coordination opportunities at a binational level. Unlike all the other GLWQA annexes, no committee structure exists for the AOC Annex.

For the five binational AOCs, two parallel domestic processes are in place, and progress towards completion of management actions is generally uneven between those domestic processes. This is inconsistent with the ecosystem approach principle included in the GLWQA. There is limited formal and contemporary guidance to inform BUI removals and delisting in binational AOCs.

In its initial assessment of issues related to ‘life after delisting,’ the IJC found that several challenges exist for communities transitioning beyond delisting. These challenges include a loss of momentum following delisting due to the loss of a tangible reason to organize, diffuse sources of funding for stewardship projects with uneven eligibility requirements, and less

frequent environmental monitoring than existed prior to delisting, which in turn makes it more difficult to detect backsliding of environmental conditions. Additional support to public advisory councils would improve the likelihood that these local councils could successfully transition to other activities after the AOC is delisted.

Lakewide Management

The IJC lauds the Parties for elevating the prominence of lakewide management in the GLWQA. The 2012 GLWQA Protocol includes lakewide management as a stand-alone annex, and assigns ambitious programs and measures to that annex. In 2015, the Parties released for comment the draft Lake Superior LAMP, the first LAMP issued under the current GLWQA. The LAMP was revised following a period of public input, and the final Lake Superior LAMP was issued in September 2016.



Concurrent with LAMP preparation, implementation of priority actions in all lakes is ongoing. Projects focused on nutrient reduction, invasive species control and habitat restoration have received particular attention in both Canada and the U.S. Although these projects involve a diversity of partners and stakeholders, it is notable that nearly four years after the 2012 Protocol came into effect, the LAMP partnerships have only recently begun to develop their approach to engaging the public and affected communities.

In accordance with their Annex 2 commitments in the GLWQA, the Parties released a draft Integrated Nearshore Framework for review in March 2016 and a final framework in September 2016. Completion of the framework was the result of substantial efforts by the Parties and other partners. The guiding principles included in the draft report are appropriate and comprehensive. Restoration and protection of sections of the coastline identified in the framework will require the allocation of adequate resources.

Cooperative Science and Monitoring

The development of LAMP management activities relies heavily on science information developed through the CSMI. The CSMI coordinates binational priority science and research activities in the Great Lakes basin with an emphasis on enhanced monitoring and research field activities, which are conducted on the basis of one lake per year on a five-year rotating cycle. Such coordination reduces monitoring costs and improves data collection efforts.

The CSMI is intended to complement ongoing monitoring conducted by the Parties in coordination with state/provincial agencies and others for various environmental components, including nearshore and offshore water quality, sediment quality and fish tissue contaminant concentrations. The CSMI focuses primarily on the lakes proper with limited focus on their associated connecting river systems. Given that these systems can act as sources of stressors to the downstream lake and/or modify in-lake processes, the binational lake partnerships and Annex 10 Cooperative Science and Monitoring Task Team should fully include the connecting river systems in the CSMI cycle.

The CSMI has significantly improved coordination among federal science agencies and some progress has been made coordinating involvement with state/provincial agencies. The encouraging progress made by the CSMI towards research and monitoring coordination could be built upon in other areas, including academic partner involvement. Reporting also could be improved through greater consolidation and more timeliness.

The year 2016 marks the ten-year anniversary of the CSMI's expansion to include research coordination. Two cycles of the CSMI have occurred since then. Therefore, it is an opportune time to review the program and assess its success and the extent to which it has provided new data and information otherwise lacking or absent. As part of any review, the Parties should consider the need for adequate and dedicated funding for monitoring and

research completed through the CSMI, given that understanding the lakes is critical to managing them well.

Climate Change

Annex 9 of the GLWQA commits the Parties “to coordinating efforts to identify, quantify, understand, and predict the climate change impacts on the quality of the Waters of the Great Lakes,” and to “sharing

information that Great Lakes resource managers need to proactively address these impacts.” Five items included in the Parties 2014-2016 binational priorities for science and action correspond to Annex 9 commitments, including compiling existing knowledge on Great Lakes climate change. At the Great Lakes Public Forum, the Parties reported on climate change in the Great Lakes and presented its impact on ice cover (Figure 4).

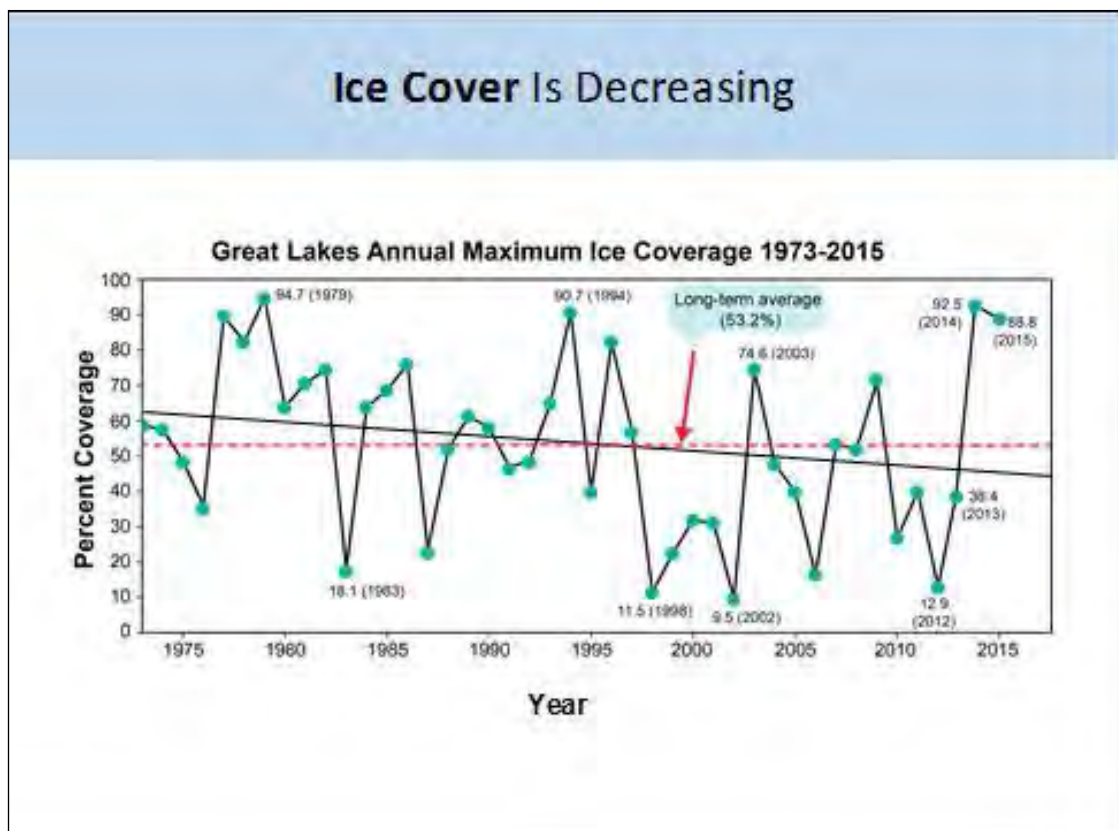


Figure 4. Ice coverage of the Great Lakes fluctuates from year to year but there is a downward trend over the past 40 years, possibly due to global climate change. Source: Draft SOGL as presented at the Great Lakes Public Forum

Perhaps the most important action taken by the Parties was publication of the *State of Climate Change Science in the Great Lakes Basin Report* in October 2015, which will support Annex 9 commitments. The report captures available science on impacts of climate change in the Great Lakes basin and inventories the climate change assessment methods applied in the region. The report is paired with a companion database with summaries of more than 250 recent climate change studies.

The PROP also identifies a significant number of domestic actions taken in fulfillment of the GLWQA's commitments on climate change. For example, Canada is developing regional climate change models for the Great Lakes – St. Lawrence River system. Fisheries and Oceans Canada, Hydro-Quebec, Centre of Water Expertise of Quebec, OURANOS and ECCC are conducting a coordinated evaluation of the impacts of climate change on the levels and flows of the St. Lawrence River from 1961-2100.

The Parties have satisfactorily addressed the science commitments made in Annex 9, cooperating successfully on numerous measurement and communications projects and meeting timelines. However, the Parties have not implemented some of the program commitments in Annex 9, especially “using their domestic programs to address climate change impacts to achieve the objectives of this Agreement.”

The IJC's Great Lakes WQB undertook a review of government policies associated with climate change resiliency in the region. Key recommendations were that Canadian

and US governments demonstrate global leadership by jointly developing a binational approach to climate change adaptation and resilience in the Great Lakes and that a vulnerability assessment be conducted.

Microplastics

Numerous studies have documented the presence of plastic debris, such as plastic bags, bottles, boxes, fibers, microbeads, and cigarette butts, in marine and fresh waters, including the Great Lakes. This larger plastic debris can degrade into smaller particles. Particles that are smaller than 5-mm in diameter are known as microplastics. There are several categories of microplastics, including preproduction plastic pellets and flakes, microfibers, breakdown materials from larger plastics and microbeads. Microbeads, the most well-known of these categories, are small plastic beads that are added as an abrasive to personal care products, including cosmetics, face washes, toothpastes, deodorants, hair coloring, shaving creams and sunscreens.



A. Voglesong



These smaller plastic particles, the microplastics, are of particular concern. They can be easily ingested by aquatic organisms, leading to a range of potential impacts including physiological effects, toxicological effects from adsorbed chemicals, and the trophic-transfer of plastics and toxins along the food web, potentially to humans.


No annex or specific provision of any annex in the GLWQA explicitly addresses microplastics. However, one of the principles and approaches outlined in the GLWQA, the *precautionary approach*, does have implications for addressing the issue. The GLWQA defines precaution as set forth

in the Rio Declaration on Environment and Development: “Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.” The potential impacts of microplastics on the Great Lakes ecosystem are significant enough to warrant action at the earliest possible opportunity.

The Parties have undertaken a number of activities related to marine debris, including researching, understanding and developing program and policy options to deal with microplastics.

In December 2015, the Microbeads-Free Waters Act became law in the United States. It prohibits soaps, body washes, toothpaste and other personal care products from containing the traditional plastic or biodegradable plastic beads as of July 1, 2017. The law also prohibits the sale of products containing microbeads as of July 1, 2019. In November 2016, the Canadian government announced a ban on the manufacture and sale of shower gels, toothpaste and facial scrubs containing microbeads. The prohibition of the manufacture of these products is to come into effect January 1, 2018, with the prohibition on their sale beginning July 1, 2019.

The US and Canadian governments are to be commended for the great strides they have made addressing the issue of microbeads. However, microbeads are a subset of the much broader issue of microplastics, which is a more complex problem requiring more complex policy responses.

A close-up photograph of a person's hands holding a fishing rod with a cork handle and a silver reel. The person is wearing a red jacket and a blue long-sleeved shirt. The background is a blurred view of Lake Superior with green reeds in the foreground. The text is overlaid on the upper left portion of the image.

“I have fished the Isle Royale waters of Lake Superior since 1939. We had great sport fishing for lake trout until the lamprey predation peaked in the late 1950s and into the 1960s. Now thanks to eradication by the United States and Canada, fishing is as good as it was before the lamprey arrived.”

Grant Merritt, Lake Superior, Minnesota

CONSIDERATION OF MOST RECENT SOGL REPORT: INFORMING THE PUBLIC ABOUT GREAT LAKES STATUS AND TRENDS

1. 2016 DRAFT STATE OF THE GREAT LAKES REPORT

The Agreement requires the IJC’s triennial assessment to include “consideration of the most recent State of the Lakes Report.” Because the Parties had not released the 2016 State of the Great Lakes Report at the time this draft report was prepared, this draft assessment does not include an overall appraisal of the state of the Great Lakes. Indicator data used in the assessment of progress toward the objectives is based primarily on information presented by the Parties at the Great Lakes Public Forum (GLPF) in October 2016. It is expected that the 2016 SOGL report will be released before this report is issued in final form and IJC looks forward to being able to include consideration of all of the 2016 data and analysis in our final report.

Although the SOGL report is not yet available, the Parties, at the Great Lakes Public Forum and through other venues such as GLEC, have listed the indicators that they intend to use in the SOGL 2016 reporting. The remainder of this chapter discusses the challenges of reporting on the Great Lakes and communicating status and trends with the public. It reviews why indicators are used and approaches for communicating with the public. The chapter also sets out gaps in the proposed suite of SOGL 2016 indicators and possible improvements for future SOGL reporting.



Background

Assessing and reporting on the condition of a large-scale regional ecosystem such as the Great Lakes basin is challenging, and communicating the findings to the public can be equally demanding. Under the 2012 GLWQA, the IJC has provided advice and recommendations to the Parties regarding a set of indicators and a report that: clearly communicates with the public the progress made by the Parties towards the nine General Objectives under the GLWQA; and answers the key question: *are the Great Lakes getting better or worse?*

Using indicators to describe status and trends

Indicators are needed to describe the condition of the environment in the same manner as indicators are used to describe human health (*e.g.*, blood pressure) and economic conditions (*e.g.*, Dow Jones Index). Communicating scientific information is a challenge and ecological information adds another level of complexity, because by its very nature ecology reflects the interaction of a multitude of organisms with each other and their environment. The staff technical appendix report describes some of the challenges communicating scientific information and examples used by other environmental assessment programs to overcome these challenges.

Process to select SOGL indicators

In its 16th Biennial Report to the Parties, issued in 2013, the IJC recommended that the Parties' report on the SOGL should use a smaller set of indicators logically connected to the GLWQA objectives, and that the indicators should have plain language descriptions and be presented in a format readily understood by the public. In 2014, the IJC followed this work with recommendations to the Parties on specific ecosystem indicators and human health for SOGL reporting. The Parties presented their plan for their 2016 SOGL report at the Great Lakes Public Forum. The plan adopts the IJC's recommendation to reorganize reporting into nine indicators (with various metrics or sub-indicators) that are linked to the GLWQA's General Objectives. The plan includes a large number of the indicators and metrics recommended by the IJC.

Sub-indicators and metrics for trend analysis

It is a challenge to summarize succinctly the status and trends of the several metrics or sub-indicators that are included in an indicator, especially for a large spatial scale such as the Great Lakes. Various techniques to quantitatively or qualitatively express the sub-indicators as a score or categorical ranking are discussed in the staff technical appendix. The IJC understands the Parties have an effective plan to address this challenge in the upcoming 2016 SOGL report.

Science Advisory Board and Great Lakes Vital Signs

Considering the need to communicate key aspects of Great Lakes status and trends more clearly and concisely, the IJC's Science Advisory Board (SAB) developed a process for selecting a smaller set of indicators and metrics that can tell meaningful and compelling stories to the public. The SAB selected the eight indicators and metrics deemed readily communicable to the public. The SAB recommended that this process be repeated on a regular basis as lake conditions, public interest and data availability change over time, perhaps every six to nine years, and that for the next triennial report the process be applied to human health indicators.

Based on the SAB report on communication indicators, the IJC identified eight sub-indicators, termed Great Lakes Vital Signs, that should be presented to the public in the manner presented in the staff technical appendix report.

- persistent bioaccumulative toxics in whole fish;
- mercury and atrazine concentrations in water;
- lake trout / lake whitefish abundance (walleye for Lake Erie);
- HABs in western Lake Erie, Saginaw Bay, and Green Bay using remote sensing pictures and the Lake Erie Severity Index (presented at the Great Lakes Public Forum);
- concentrations of dissolved reactive phosphorus in the nearshore and offshore;
- sea lamprey abundance;
- maximum ice cover; and
- long-term water variability.

2. IMPROVING INDICATORS

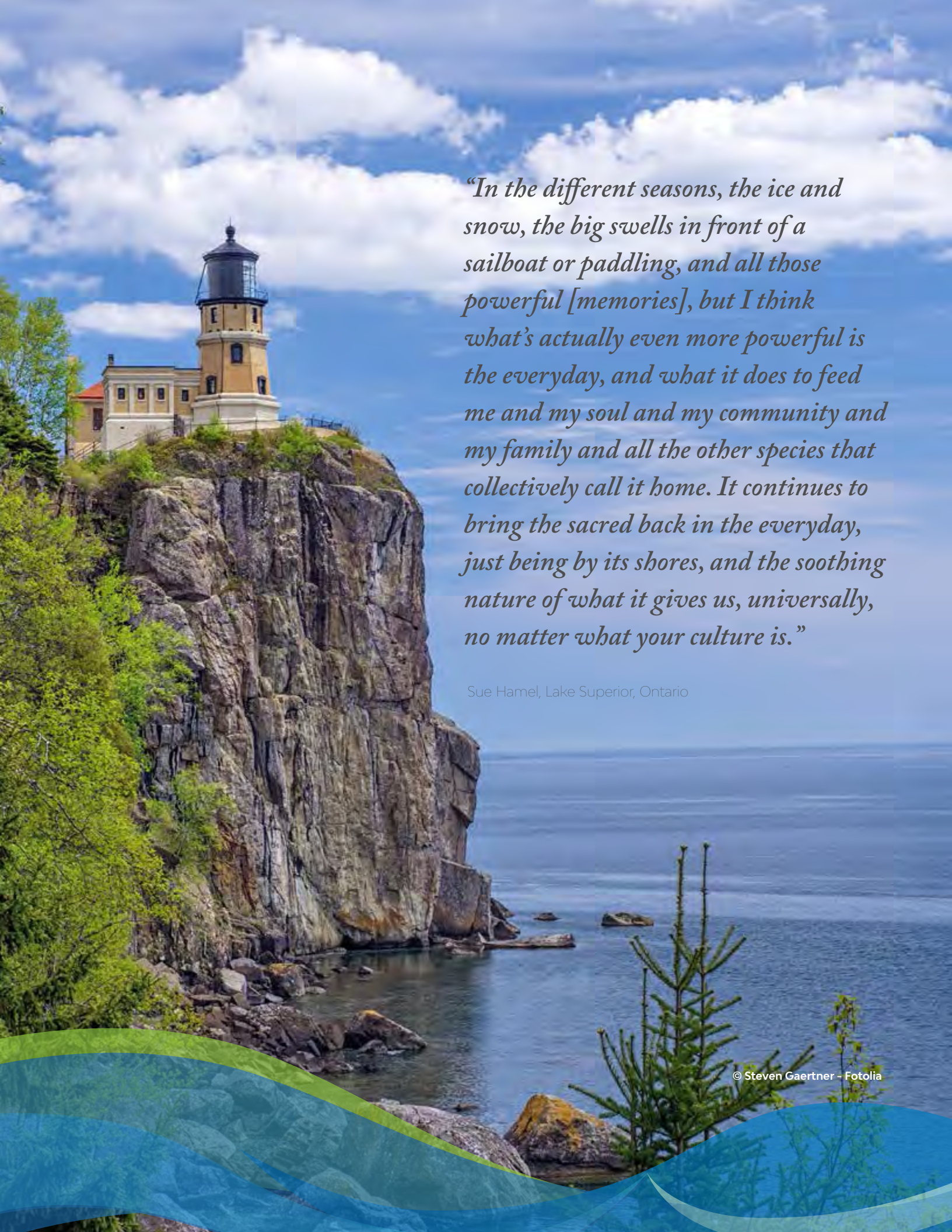
1. Indicator gaps

The IJC has undertaken efforts to identify improvements and refinements to Great Lakes indicators themselves. In consultation with Great Lakes regional indicator experts who are familiar with Agreement objectives, IJC believes the sub-indicators that the Parties have proposed for use in SOGL 2016 generally represent the nine Agreement General Objectives well. However, the report produced by the IJC's Research Coordinating Committee in 2016 showed that improvements could be made in several areas.

2. Indicator Reporting Improvements

The Parties have done an outstanding job selecting a small set of indicators and corresponding sub-indicators. The Parties need to standardize data collection and assessment methods to increase consistency in assessing long-term trends and detecting changes in lake health status. There is reasonable data coverage for a status assessment for the majority of the sub-indicators in the draft 2016 SOGL report. There are insufficient data for detecting trends for coastal wetlands and composition and HABs.

Several sub-indicators recommended by the IJC, that are critically important for the assessment of progress under the Agreement are not expected to be included in SOGL 2016. These include illness risk at beaches and the source of risks at beaches, tributary total phosphorus and soluble reactive phosphorus loadings, and nearshore total phosphorus and soluble reactive phosphorus concentrations and several others.

A photograph of a lighthouse situated on a high, rocky cliff. The lighthouse is a multi-story structure with a white base and a yellow upper section, topped with a black lantern room. To the left of the lighthouse is a smaller building with a red roof. The cliff is rugged and grey, with some green vegetation growing on its top and left side. The lake is a deep blue, and the sky is bright blue with scattered white clouds. In the foreground, there are some green trees and a blue and green wavy graphic at the bottom.

“In the different seasons, the ice and snow, the big swells in front of a sailboat or paddling, and all those powerful [memories], but I think what’s actually even more powerful is the everyday, and what it does to feed me and my soul and my community and my family and all the other species that collectively call it home. It continues to bring the sacred back in the everyday, just being by its shores, and the soothing nature of what it gives us, universally, no matter what your culture is.”

Sue Hamel, Lake Superior, Ontario

KEY FINDINGS AND QUESTIONS FOR CONSULTATION

The GLWQA authorizes the IJC to include in the Triennial Assessment of Progress “other advice and recommendations, as appropriate.” Believing strongly in public engagement – along with science – as guiding principles of Great Lakes governance, the IJC offers brief background information, findings, and discussion questions in this concluding chapter, with the intent of seeking input from the public during the consultation process.

The material is organized into themes to facilitate dialogue. Members of the public are encouraged to bring additional matters to the IJC’s attention. Following the consultation period, the IJC will take into account what it has learned from the public as it prepares formal recommendations to the Parties in the final version of this Assessment of Progress report.

In this first assessment of progress under the 2012 GLWQA, it is important to stress the many accomplishments of the Parties and other governments. However, in some instances progress has been slow. In other instances, the Parties have not fully embraced the GLWQA principles in their implementation actions. This section presents findings related to these matters and asks consultation questions. Responses from the public consultation will help the IJC refine these findings and make recommendations to governments in the final report.

1. NEW GLWQA, NEW MOMENTUM

The Great Lakes are a precious resource shared by two great nations. Though each nation can work individually on the restoration and maintenance of the Great Lakes, they best make progress when they work with each other and with their states, provinces and other orders of government. In a review of the 1987 GLWQA, conducted in 2006, the IJC found that the old GLWQA was no longer an important driver for programs and actions in the Great Lakes.



E. Perschbacher

The 2012 GLWQA has addressed many of the gaps, deficiencies and issues associated with the old Agreement and provided new approaches and commitments across a much greater range of issues. More binational attention than ever before is being given to Great Lakes aquatic invasive species, habitats and species and climate change, with full GLWQA Annexes dedicated to these areas. This is in addition to Annexes on topics like pollutants and nutrients that remain of high importance to the lakes and the communities on their shores. Review of the PROP shows the extensive binational, interagency and intergovernmental cooperation on all of the issues addressed in the GLWQA. No two countries in the world equal this cooperative effort.

FINDING: The 2012 GLWQA galvanized new energies, activity and binational cooperation over a larger span of issues than were being actively addressed under previous versions of the Agreement. The Parties are to be commended for authoring the new GLWQA, for giving it momentum and – for harmonizing implementation activities amongst not just two countries, but eight states and two provinces. The Commission salutes the Parties for this accomplishment.

Has the 2012 GLWQA affected you?

What was the most notable achievement of governments in the first three years of Agreement implementation?

What advice should the IJC give the Parties about how binational cooperation on Great Lakes issues can be maintained and expanded?

2. ESTABLISHING PROCESSES AND MEETING DEADLINES

In this first triennial cycle of GLWQA implementation, the Parties devoted considerable effort to institutionalizing processes and procedures and meeting deadlines for initial GLWQA commitments.



© Brian Lasenby - Fotolia

For example, the Parties successfully met deadlines for developing priorities for science and action, proposing a nearshore framework, and setting targets for Lake Erie phosphorus target reduction. The implementation of the first reporting cycle under the Agreement shows notable progress on accountability. Although the presentation and content of the PROP could be improved in future rounds of reporting, the fact that it exists and was produced on time is praiseworthy. Work under the Agreement is conducted through binational Annex Committees and task teams under the leadership of the Great Lakes Executive Committee (GLEC). This organizational structure is significant and should pay dividends in future work cycles.

FINDING: The Parties have made considerable progress institutionalizing processes and procedures and meeting deadlines for initial Agreement commitments and are to be congratulated for having established in only three years mechanisms by which the new Agreement can be implemented.

How do you benefit or could you benefit from these processes and procedures?

What principles and approaches from the GLWQA could be better institutionalized in the next work cycle?

What new deadlines should be set for work in the next triennial cycle(s)?

3. PROTECTING HUMAN HEALTH

In the Preamble to the 2012 GLWQA, the Parties acknowledge “the close connection between [the] quality of the Waters of the Great Lakes and the environment and human health, as well as the need to address the risks to human health posed by environmental degradation.” The first three general objectives of the GLWQA – drinking water, recreational water and consumption of fish and game – are closely linked to human health. They are of paramount importance to the people of the Great Lakes basin. However, gaps in the measurement and reporting of key indicators for assessing progress toward human health objectives and a lack of reporting specific to programs in support of these objectives make it difficult to assess progress on these topics.

Whereas the other General Objectives of the GLWQA have associated annexes and annex committees to manage initiatives related to those objectives, there are no GLWQA annexes or implementation committees devoted exclusively to these three human health objectives. This absence may hinder the mobilization of resources needed to support progress toward attainment of the objectives. It is appropriate, therefore, to develop processes that will efficiently harness energies of governments and non-governmental entities alike to pursue attainment of the human health objectives.

FINDING: *The Parties have not demonstrated sufficient progress toward the achievement of the human health objectives in their implementation of the GLWQA. Greater binational focus is required for the achievement of the GLWQA's drinkability, swimmability and fishability objectives.*

Do you agree with this finding regarding lack of demonstrated progress toward achievement of the human health objectives and the need for greater binational focus?

What advice should the IJC give the Parties on how to increase the binational focus on human health?

What issues should the Parties address as a priority under an increased binational focus on human health?



4. MOVING FROM PROCESS TO PROGRESS: POLLUTANTS

This draft assessment report shows progress to be slow on the challenge of addressing pollutants in the Great Lakes. In the first three years of implementation of the GLWQA, only eight CMCs have been identified. No strategies for the binational management of CMCs have been developed. Effectively dealing with chemicals of concern will require a different approach, involving additional resources and accountability for meeting deadlines. The strategy framework developed by the Great Lakes Water Quality Board and endorsed by IJC for control of PBDEs has value for all CMC strategies. In particular, the recommendation for extending a producer's responsibility for a product to the post-consumer stage of the product's life cycle can contribute significantly to reduction of chemical risks to the Great Lakes and human health.

FINDING: *There has been little progress in the identification of CMCs and no publicly available progress in the development and implementation of binational strategies to address them.*

Do you agree with this finding regarding the progress on CMCs?

How can the Parties improve their processes to designate CMCs and develop binational strategies for their control and/or elimination or generally increase their progress toward achieving the pollutants objective?



5. MOVING FROM PROCESS TO PROGRESS: NUTRIENTS

The IJC commends the participative approach developed by the Parties for the development of nutrient targets. However, the poor condition of Lake Erie warrants swifter action designed to achieve the targets, including domestic action plans with enforceable standards. The IJC has done significant work on nutrients in Lake Erie and has most recently presented a wide range of findings and recommendations in its 2014 report, *A Balanced Diet for Lake Erie*, which could serve as the basis for a comprehensive and urgent response by the Parties.

The IJC reiterates the advice in its 2014 report that to achieve steep reductions in phosphorus loadings and harmful algal

blooms in Lake Erie the Parties should:

1. enact regulatory protections to limit phosphorus runoff from agricultural sources;
2. coordinate reduction of phosphorus loadings across state boundaries with USEPA oversight; and
3. place greater emphasis on natural buffers, wetland construction and restoration to reduce phosphorus runoff.

FINDING: *The water quality of western and central Lake Erie is unacceptable. New mandatory protections should supplement voluntary initiatives to reduce phosphorus loadings.*

Do you agree with this finding regarding the progress on nutrients?

What are other steps could the Parties take to remedy degraded water quality in western and central Lake Erie?

Are there other actions the Parties should take to address nutrients in the Great Lakes?

6. HALTING AQUATIC INVASIVE SPECIES (AIS)

Prevention of new invasive species, both aquatic and terrestrial, is a major focus of the 2012 GLWQA. Both the Canadian and US governments have taken action to control the many pathways of AIS introduction. These pathways include aquarium releases, live food fish trade, water garden trade,

live bait release, internet trade, recreational boating transport, physical connections between watersheds, and commercial shipping. New legislation to prohibit trade and transport of AIS, and public outreach and education programs to encourage people to not release pets into the wild, to properly dispose of bait, and to inspect, drain, clean and dry recreational boats have increased awareness and compliance. There has been great success on prevention of new introductions of AIS via the commercial shipping vector.

Despite this success in stopping AIS introduction, the status of the invasive species indicator is poor and the trend deteriorating. This is due to setbacks with the spread of several AIS and terrestrial invasive species and the impact that this spread has had on the Great Lakes.

The need for further binational collaboration on measures to control spread becomes apparent when comparing US and Canadian efforts to control invasive aquatic plants. While many chemical control agents are approved for use in the United States only one is approved for use in Canada. Similarly, binational AIS control efforts lack a shared or integrated approach to the safe and environmentally responsible use of all types of chemical, physical and biological control measures among jurisdictions. A possible solution would be for the Parties to find common ground on the safe and environmentally responsible use of all types of these measures. This would include harmonizing permitting and regulations, removing administrative barriers, adopting integrated hazard assessment and implementing critical path controls.

Binational efforts to combat AIS lack the important elements of certainty and long-term planning facilitated by uninterrupted program funding. A possible solution would be for the Parties to provide for a long-term strategic approach to combatting AIS by moving from a grant-driven system to a sustained program funding model for binational AIS monitoring, prevention, control and technology development.

FINDING: There has been significant progress in preventing the introduction of AIS to the Great Lakes. The spread of previously introduced invasive species is a major concern. Further progress on AIS prevention and control could be enhanced by improving long term program funding mechanisms, reaching agreements on permitting the use of all types of control measures across jurisdictions and requiring ballast water exchange and flushing in addition to discharge treatment.

Do you agree with this finding of successes and gaps in the Parties' progress toward the achievement of this objective?

How could the Parties better harmonize permitting, remove administrative barriers and adopt an integrated approach to AIS management?

Are there other ways the Parties could improve their binational approach to invasive species?

7. ADDRESSING AREAS OF CONCERN

The first work cycle of the 2012 GLWQA has been a time of great progress for Areas of Concern. First designated almost 30 years ago in the 1987 GLWQA, progress in delisting has not always been evident. Of the 62 BUIs eliminated to-date in the United States, half were eliminated between 2013 and 2016. In Canada, almost 20% of the 65 BUIs eliminated to date were eliminated in the work cycle. This progress is a result of significant new government investment. On the US side, roughly one third of the annual \$300 million US Great Lakes Restoration Initiative funding has been directed towards AOC cleanup. Three US AOCs have been delisted in this work cycle, for a total of four delisted US AOCs.



This compares to the total-to-date of 3 Canadian AOCs delisted and 2 AOCs in recovery. In Canada, the federal, provincial (Ontario) and municipal governments have invested almost \$562 million in upgrades to municipal wastewater treatment plants in a number of AOCs. Canadian governments are also making significant investments in sediment remediation in Hamilton Harbour (\$139 million) and Port Hope Harbour (\$1.28 billion) AOCs. Partially as a result, 3 Canadian AOCs have been delisted and 2 AOC designated in Recovery. Although base funding for AOC remediation in Canada through the Great Lakes Action Plan has remained constant, investment in remediation activities can also occur through other programs, such as the Investing in Green Infrastructure program announced in the Canadian Budget 2016. The Parties are also prioritizing this work with ambitious plans for further BUI removal and site delistings in the next work cycle.

FINDING: The Parties have shown significant progress in addressing water quality contamination at Areas of Concern.

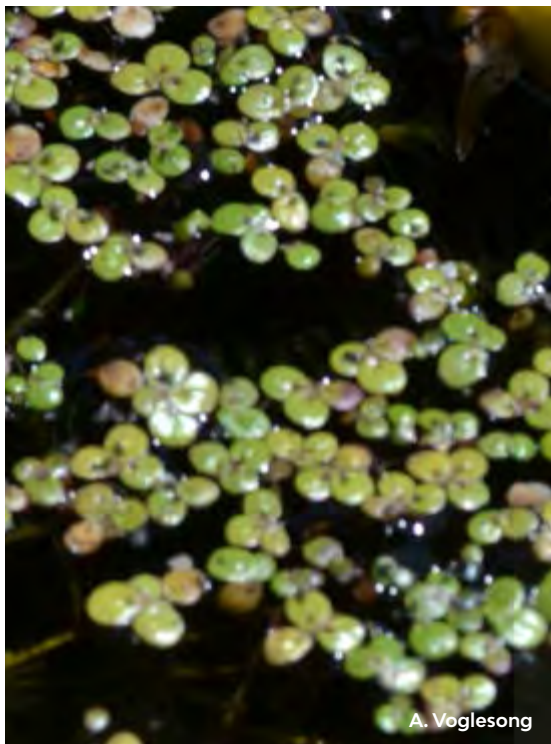
Do you agree with this finding on progress in restoring AOCs?

What should the Parties learn from progress in AOC restoration?

How can this progress on AOCs be maintained or improved?

8. COPING WITH CLIMATE CHANGE

A changing climate is already influencing Great Lakes water quality. Further climatic change is already built into the future, thanks to inexorably rising carbon dioxide concentrations in the atmosphere. A wide variety of water quality-related impacts will occur, ranging from more favorable conditions for algae and bacteria to increased polluted runoff from intense spring storms. Such dramatic change poses significant challenges to governments at all levels and to communities across the basin. As one example, an increase in extreme rainfall events will tax the sewage systems of Great Lakes cities. Preventing or limiting harm to the environment and to these communities will require planning.



The GLWQA charges the Parties to take into account climate change impacts on the integrity of the waters of the Great Lakes and to consider climate change impacts in the implementation of the Agreement. It further charges the Parties, in cooperation and consultation with state and provincial governments, Tribal Governments, First Nations, Métis, municipal governments, watershed management agencies, other local agencies, and the public, to use their domestic programs to address climate change impacts to achieve the objectives of the GLWQA. This focus on addressing climate change impacts under the GLWQA complements work, outside of the Agreement, to address other aspects of climate change, such as mitigation.

The Great Lakes WQB, the primary advisor to the IJC under the GLWQA, has observed that many Great Lakes communities as well as state/provincial and federal agencies are engaging in some aspects of climate change adaptation planning and implementation. However, there is no Great Lakes basin-wide perspective, approach or strategy.

The WQB advises the Parties to “demonstrate global leadership by jointly developing, in cooperation with other government jurisdictions and organizations in the Great Lakes basin, a Binational Approach to Climate Change Adaptation and Resilience in the Great Lakes. Such an approach would include a shared vision, coordinated action, and creation of a network to share science, information and knowledge, including Métis, First Nations and Tribal traditional ecological knowledge, if offered.”

The WQB also recommends investments in research, information sharing and knowledge management to carry out a Vulnerability Assessment, to engage stakeholders and rights holders, and to identify priorities for responsive actions in the Great Lakes region. The assessment should include due consideration of the vulnerabilities to the chemical, physical and biological integrity of the Great Lakes in the context of water quality, and the related potential vulnerabilities for Great Lakes coastal communities, commerce and public health at small enough geographic scales that can be of material use to communities and local decision makers. The IJC supports this advice.

FINDING: Climate change has been altering Great Lakes water quality and levels and further forecast changes will have detrimental impacts.

Do you support the WQB's recommendation that the Parties, working cooperatively with others, demonstrate global leadership in the development of a binational approach to climate change adaptation and resilience for the Great Lakes and also that a vulnerability assessment should be conducted?

What additional actions should Great Lakes governments and communities take to better adapt to and improve resiliency in the face of climate change impacts?

9. ENGAGING THE PUBLIC

Under the GLWQA, the Parties agree to be guided by principles and approaches that include engagement, which is defined as “incorporating Public opinion and advice, as appropriate and providing information and opportunities for the Public to participate in activities that contribute to the achievement of the objectives of this Agreement.”

As noted throughout this assessment report, the Parties have set an ambitious pace in undertaking implementation of many commitments under the GLWQA. In some cases, however, they have not fully incorporated robust public engagement into their activities.

For example, the Parties are not showing sufficient urgency in confirming their approach to public engagement and related activities for Annex 2, Lakewide Management. LAMP partnerships took more than three years to begin establishing their outreach and engagement work groups – after disbanding the existing committees.

The Progress Report of the Parties was intended, in part, to serve as a vehicle for public engagement. The 2016 PROP had only limited value for public engagement, however. It was made public too close to the Great Lakes Public Forum to generate significant dialogue. The report was not mentioned at the Forum and was not marketed by the Parties to the general public, either through traditional or social media opportunities.

The Public Forum provided an opportunity for the Parties to encourage the public to learn about Great Lakes issues, and to include citizens from all sectors of society in the GLWQA process. This opportunity was not fully utilized. An attitude of greater inclusiveness would garner immediate results and reflect the essential role the public plays in achieving the GLWQA's goals and objectives.

Another public engagement issue, identified in the public meetings held to date, is the absence of a strong connection between GLWQA processes and many affected communities. The workshops and conferences, public meetings and outreach efforts of the IJC and the Parties frequently have not been successful in engaging some urban, minority and indigenous populations in the Great Lakes basin. Therefore, the issues important to these groups may not be heard or understood.

Looking to the future, the IJC and the Parties should reach beyond the limits and audiences typically recognized and consider including environmental justice as a priority. Reaching out to non-traditional populations and stakeholders could provide lessons on how to incorporate science and how to predict and prevent the next urban water crisis. At a minimum, hearing new voices and meaningfully engaging people historically outside of outreach efforts will enrich everyone in better understanding the problems in the basin.

FINDING: The Parties have not sufficiently engaged with the public in their implementation of the GLWQA to date. This gap is notable in the development and implementation of LAMPs, where more effective engagement of non-government organizations, indigenous peoples, minorities and other constituencies could meaningfully improve these plans and enhance actions to improve lake conditions. Engagement with communities that rely on Great Lakes fish consumption for subsistence is of particular importance.

How would you like to be engaged with the Parties on Great Lakes issues?

Do you agree with the finding that the Parties have not demonstrated sufficient public engagement in their implementation of the GLWQA to date?

How could the Parties improve their public engagement performance?

How should the Parties seek to incorporate the concepts of fair treatment and meaningful involvement of all populations, including First Nations, Tribes, Métis and minorities, in their public engagement activities?

10. IMPROVING GREAT LAKES REPORTING

Assessing and communicating progress on the restoration and maintenance of the Great Lakes requires scientific measurement of key parameters of ecosystem and human health. In recent years, the IJC and its Boards have provided considerable advice to the Parties on indicators for inclusion in SOGL reporting. The IJC is pleased that the Parties have accepted much of this advice, particularly on the indicators to use for SOGL reporting. However, potential further improvements could be made.

Possible enhancements include:

- Reporting on status and trends in source water in both countries, not Canada alone
- Reporting on contaminant levels in edible portions of fish
- Additional reporting on *e-coli* levels at Great Lakes beaches to support the beach closure indicator
- Reporting on Vital Signs, a small group of key measures of chemical biological and physical indicators (listed in Chapter 4) that most clearly and concisely communicate progress under the GLWQA and would help to improve understanding of the health of the lakes by the public and decision makers.

FINDING: *The Parties have significantly improved the selection of indicators to support the assessment of progress toward the achievement of GLWQA objectives. Reporting could be further enhanced with improved binational coordination and focus on key Vital Signs.*

Do you agree with this finding on Great Lakes indicators?

What additional improvements could be made in Great Lakes reporting?





CONCLUSION

The 2012 GLWQA was a landmark in cooperative efforts to protect the Great Lakes. Its objectives, guiding principles and Annex elements have stimulated new scientific, programmatic and advocacy efforts on the part of the Parties and the broader Great Lakes community. In doing so, they have renewed the reputation of the GLWQA as a globally significant framework for protecting and restoring shared freshwater resources.

A cooperative framework for freshwater ecosystem management is only as good as the human will to carry it out. The IJC is heartened by the dedication of so many constituencies and public servants to work that will guard the Great Lakes.

It is worth underscoring that governments have made significant progress on many seemingly intractable Great Lakes problems, from remediating AOCs to slowing the introduction of AIS to a near standstill. These are impressive accomplishments.

As it has always been, the future of the Great Lakes is fraught with uncertainty. Climate change in particular poses vexing new challenges. But the 45 years that have elapsed since the signing of the initial GLWQA demonstrate that the people of the basin will work valiantly in defense of these precious waters and the life that depends on it.

In that spirit, the IJC offers this assessment of progress, and its admiration of and support to all who value the Great Lakes.

LIST OF ACRONYMS, FIGURES AND GLOSSARY

LIST OF ACRONYMS

The following is a list of common acronyms used in the report:

AIS	Aquatic invasive species	IJC	International Joint Commission
AOC	Area of concern	LAMP	Lakewide action management plan
BUI	Beneficial use impairment	PBDEs	Polybrominated diphenyl ethers
CAFO	Confined animal feeding operation	PCBs	Polychlorinated biphenyls
CMC	Chemicals of mutual concern	PROP	Progress Report of the Parties
CSMI	Cooperative Science and Monitoring Initiative	RAP	Remedial action plan
ECCC	Environment and Climate Change Canada	SAB	Great Lakes Science Advisory Board
GLWQA	Great Lakes Water Quality Agreement	SOGL	State of the Great Lakes
HABs	Harmful algal blooms	USEPA	Environmental Protection Agency
HPAB	Health Professionals Advisory Board	USGS	United States Geological Survey
		WQB	Great Lakes Water Quality Board

LIST OF FIGURES

- FIGURE 1.** Levels of PCBs have declined in herring gull eggs and fish
- FIGURE 2.** Imbalanced nutrient levels
- FIGURE 3.** Generalized Groundwater - Surface Water Interactions (A) under natural conditions and (B) affected by pumping
- FIGURE 4.** Ice coverage of the Great Lakes fluctuates from year to year but there is a downward trend over the past 40 years, possibly due to global climate change.

GLOSSARY

ADAPTIVE MANAGEMENT –

A planning process that can provide a structured, iterative approach for improving actions through long-term monitoring, modelling and assessment. Through adaptive management, decisions can be reviewed, adjusted and revised as new information and knowledge becomes available or as conditions change.

AQUATIC INVASIVE SPECIES (AIS) –

As defined in the Great Lakes Water Quality Agreement, AIS refers to any non-indigenous species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that threatens or may threaten the diversity or abundance of aquatic native species, or the ecological stability, and thus water quality, or water quality of infested waters, or commercial, recreational, or other activities dependent on such waters.

ALGAE – Aquatic organisms that survive through photosynthesis; they can range in size from microscopic organisms to large seaweed and giant kelp.

ALGAL BLOOMS – An excessive and relatively rapid growth of algae on or near the surface of water. It can occur naturally as the result of a change in water temperature and current or as a result of an excess of nutrients in the water.

AREA OF CONCERN (AOC) –

A geographic area designated by the Parties under the Great Lakes Water Quality Agreement where water quality and ecosystem health have been severely degraded by human activities at the local level.

BASIN – The region or area of which the surface waters and groundwater ultimately drain into a particular course or body of water.

BENEFICIAL USES – Uses and benefits of Great Lakes water quality and ecosystem resources, as identified in the Great Lakes Water Quality Agreement. They include fish and wildlife health and habitat, drinking water, and recreation.

BENEFICIAL USE IMPAIRMENT (BUI) – Under the Great Lakes Water Quality Agreement, a BUI is a reduction in the chemical, physical or biological integrity of the waters of the Great Lakes sufficient to cause any of 14 identified outcomes (impairments). These outcomes include: restrictions on the human consumption of fish and wildlife; eutrophication or undesirable algae; restrictions on drinking water consumption; and beach closings.

BOUNDARY WATERS TREATY OF 1909 – The agreement between the United States and Canada that established principles and mechanisms for the resolution of disputes related to boundary waters shared by the two countries. The International Joint Commission was created as a result of this treaty.

CHEMICALS OF MUTUAL CONCERN – Under the Great Lakes Water Quality Agreement, the Parties agree to mutually determine those chemicals originating from anthropogenic sources that are potentially harmful to human health or the environment and to take cooperative and coordinated measures to reduce the release of these chemicals.

CLIMATE CHANGE – A change of climate that is attributed directly or indirectly to human activity, that alters the composition of the global atmosphere, and which is in addition to natural climate variability observed over comparable time periods.

ECOSYSTEM – A biological community in interaction with its physical environment, and including the transfer and circulation of matter and energy.

ENVIRONMENT – Air, land or water; plant and animal life including humans; and the social, economic, cultural, physical, biological and other conditions that may act on an organism or community to influence its development or existence.

GENERAL OBJECTIVES – As defined in the Great Lakes Water Quality Agreement, General Objectives refer to the broad descriptions of water quality conditions consistent with the protection of the level of environmental quality which the Parties desire to secure and which provide a basis for overall water management guidance. The Agreement identifies nine categories of General Objectives.

GREAT LAKES WATER QUALITY AGREEMENT – The Agreement expresses the commitment of Canada and the United States to restore and maintain the chemical, physical and biological integrity of the Great Lakes basin ecosystem. The most recent protocol amending the original 1978 Agreement was signed in 2012.

HARMFUL ALGAL BLOOMS

(HABS) – HABs result from the proliferation of blue-green algae (including cyanobacteria) in environmentally stressed systems, where conditions favor opportunistic growth of one or more noxious species, displacing more benign ones. The blooms are considered harmful because excessive growth can harm ecosystems and produce poisons (or toxins) that can cause illness in humans, domestic pets and wildlife.

INDICATOR – A numerical value that helps provide insight into the state of the environment or human health. Environmental indicators are developed based on quantitative measurements or statistics of environmental conditions that are tracked over time. They can be developed and used at a variety of geographic scales, from local to regional to national levels.

INTERNATIONAL JOINT COMMISSION (IJC)

– International independent agency formed in 1909 by the United States and Canada under the Boundary Waters Treaty to prevent and resolve boundary waters disputes between the two countries. The IJC makes decisions on applications for projects such as dams in boundary waters, issues Orders of Approval and regulates the operations of many of those projects. It also has a permanent reference under the Great Lakes Water Quality Agreement to help the two national governments restore and maintain the chemical, physical, and biological integrity of those waters.

LAKEWIDE MANAGEMENT ACTION PLAN (LAMP)

– Under the Great Lakes Water Quality Agreement, a LAMP is an action plan for cooperatively restoring and protecting the ecosystem of a Great Lake. LAMPs are developed and implemented in consultation with US state governments and the Ontario provincial governments, and may include participation from local government agencies. LAMPs are in place for Lakes Superior, Michigan, Erie and Ontario.

MICROPLASTICS – Plastic particles that are smaller than 5-mm in diameter, such as preproduction plastic pellets and flakes, microfibers, breakdown materials from larger plastics and microbeads. Microbeads, the most well-known of these categories, are small plastic beads that are added as an abrasive to personal care products, including cosmetics, toothpastes, deodorants, shaving creams and sunscreens. Microplastics can be ingested by aquatic organisms, leading to a range of potential impacts including the trophic-transfer of plastics and toxins along the food web, potentially to humans.

NEARSHORE – The marginal zone of a lake consisting of two areas: the coastal margin, that is, the shoreline, wetlands and very shallow open-waters extending some distance from the shoreline; and the nearshore open-water area where the water still is shallower and warmer than in the open waters.

NUTRIENT – A food or any nourishing substance assimilated by an organism and required for growth, repair, and normal metabolism. For example, phosphorus and nitrogen are nutrients for algae.

PARTIES – The parties or signatories to the Great Lakes Water Quality Agreement. That is, the Governments of Canada and the United States.

PHOSPHORUS – An element used in a wide range of agricultural, industrial and domestic products; a key nutrient limiting the amount of phytoplankton and attached algae in the Great Lakes.

PROGRESS REPORT OF THE PARTIES (PROP) – Under the Great Lakes Water Quality Agreement, the Parties agree to prepare a triennial progress report documenting actions taken domestically and binationally in support of the Agreement. The government production of the PROP and the IJC review of it is a key government accountability feature under the Agreement.

PUBLIC INFORMATION AND ENGAGEMENT – A proactive, coordinated process of informing the public throughout the course of a study and providing opportunities to interested individuals and organizations to make their views known and to review and comment on preliminary findings.

REMEDIAL ACTION PLAN (RAP) – Under the Great Lakes Water Quality Agreement, plans designed to restore beneficial uses that have become impaired due to local conditions at Areas of Concern. Developed and implemented in cooperation with state and provincial governments, RAPs include: an identification of BUIs and causes; criteria for restoring beneficial uses, established in consultation with the local community; and remedial measures to be taken.

STATE OF GREAT LAKES REPORTING (SOGLR) – A process in which the governments of Canada and the United States regularly report on progress towards achieving the overall purpose of the Great Lakes Water Quality Agreement through reporting on ecosystem conditions and trends. A key component of SOGLR is the State of the Lakes Ecosystem Conferences, hosted by the US Environmental Protection Agency and Environment and Climate Change Canada on behalf of the two countries. These conferences are a culmination of scientific information gathered from a wide variety of sources and engage a variety of organizations. The conferences: report on the state of the Great Lakes ecosystem and the major factors impacting it; provide a forum for exchange of this information among Great Lakes decision-makers; and provide information to people in all levels of government, corporate, and not-for-profit sectors.

~ FIRST TRIENNIAL ASSESSMENT OF PROGRESS ON ~

GREAT LAKES WATER QUALITY

DRAFT REPORT FOR PURPOSES OF PUBLIC CONSULTATION

